Regional differences in systolic active stress profiles in the normal beating heart - A modelling approach based on echocardiographic data

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Regional differences in active stress (S_A) development in normal hearts have been reported in isolated muscle experiments under physiological loading conditions, by subtracting the passive stress (S_P) from the total stress(S_T) measured. We previously developed a mechanical model based on m-mode imaging data to calculate global active stress (S_A) in normal beating hearts. In the current study this model was improved by using B-mode grayscale data to allow regional estimation of S_A.

Methods: In 10 closed chest pigs a micro-manometer tipped catheter was placed in the left ventricle (LV) to measure pressure (LVP). B-mode grayscale data (GE Vivid 7, 2.5 MHz, 80 fps) were recorded in a short axis view. On the B-mode image, using a new tool in prototype software (GE EchoPAC 2D Strain), points along the mid-wall were selected and then tracked automatically. The displacement vectors of these points were used to make a kinematic model of the LV based on conservation of myocardial volume. S_T was calculated from the Laplace equation using the local curvature and LVP. Material parameters for the stress/strain relation were estimated during diastole, when it was assumed that S_A was zero, and then used to calculate S_P during systole. S_A was calculated and by subtracting S_P from S_T. Statistics were performed using ANOVA and a post hoc Fishers test.

Results: S_A was found to be significantly higher in the posterior wall(34.5±0.21 kPa) than in the anterior wall(27.2±0.16 kPa) or septum(27.7±0.15). Circumferential strain(C_E) was greatest in the A(-0.146±0.006), lower in the S(-0.14±0.005) and significantly lower in the P(-0.117±0.007).

Conclusion: Estimation of regional S_A is possible in normal beating hearts using B-mode imaging data combined with simple mechanical modeling.

Isovolumic contraction velocity is a potential measurement of left ventricular state of contractility a simultaneous pulsed Doppler tissue imaging and cardiac catheterization study

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Background: Echocardiographic techniques have not so far been feasible to provide a good estimation of myocardial contractility in humans. Longitudinal myocardial motion during the isovolumic contraction (IVC) phase, measured by tissue Doppler imaging (TDI), has recently in experimental models been shown to determine the state of myocardial contractility. The aim of the present clinical study was therefore to investigate the relationship between left ventricular (LV) isovolumic contraction velocities (IVCv) and LV state of contractility.

Methods: Cardiac catheterization and TDI were simultaneously performed in 18 consecutive patients with different cardiac diseases (13 were males, mean age 55±12 years). The peak positive IVCv was measured at basal levels of the lateral, septal, anterior and posterior walls. From cardiac catheterization, the first derivative of LV pressure (dP/dt max) was measured.

Results: Peak IVCv was obtainable in 83-89% of the four wall segments. A linear relationship was found between IVCv and dP/dt max at the septal (r=0.70, p<0.01), the anterior (r=0.63, p<0.05) and the posterior (r=0.83, p<0.001) segments of the LV.

Conclusion: IVCv is an easily obtainable non-invasive parameter, which correlates with the invasive measurement of LV state of contractility. Furthermore, it seems that there are regional differences in wall motion during IVCv when TDI is used to determine state of contractility.
134 Load-dependence of Doppler-derived ejection intraventricular pressure gradients
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Ejection intraventricular pressure gradients are caused directly by the active force of the contracting myocardium. We have previously validated a new method based on digital processing of color-Doppler M-mode (CDMM) images, for the measurement of the ejection intraventricular pressure difference (EIVPD) between the LV apex and the outflow tract. Recently, we have demonstrated that Doppler-derived EIVPDs provide quantitative and reproducible indices of contractility (peak EIVPD and peak inertial EIVPD) that closely correlate with invasive indices based on the pressure-volume relationship. This study was designed to assess the load-dependence of these new non-invasive indices of contractility.

Methods: Simultaneous color-Doppler M-mode (CDMM) recordings of LV outflow (5-chamber apical view) and pressure-volume data (pressure-conductance dual-field catheters) were obtained in five close-chest mini-pigs (50-65 kg) undergoing inotropic pharmacological interventions (esmolol and dobutamine). The consecutive beats obtained during 10 seconds of caval and aortic occlusions were analyzed. Total EIVPD curves and their inertial and convective components were obtained using custom software. The first time derivative of pressure (dP/dtmax), stroke volume (SV) and ejection fraction (EF) were calculated for exactly the same beats processed non-invasively. The change from pre-occlusion values (average of 237 beats) markedly decreased end-diastolic volume (-40%), and end-diastolic LV pressure (-90%), without increasing heart rate. During this acute preload manipulation, dP/dtmax, EF, and SV changed significantly, whereas peak EIVPD remained constant and the active stress profile during systole (Fig1 left). Duration of systole was defined from the onset of Q-wave till aortic valve closure (min dPdt-20 ms).

Results: During DI, SV increased at every stage (b:20.3±0.58 20 μg:37.6±1.5), while during AP SV remained constant. At rest, SV peaked at about 1/3 of systole (Fig1). For similar heart rates, systole shortened more with DI then with AP. With DI, time to peak SV remained unmodified during the entire occlusion period (-7%, p<0.001). However, the peak inertial component of EIVPD remained unmodified during the entire occlusion period (-7%, p<0.05). Conclusions: Doppler-derived EIVPDs are relatively load-independent at these new non-invasive indices of contractility.

135 Timing of maximal active stress development. A comparison between isotropic and chronotropic alterations
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Recently, we proposed a model-based approach to estimate myocardial active stress (S_A), making use of Myocardial Velocity Imaging and left ventricular pressure (LVP) data. Peak S_A has been shown to correlate with maximal dP/dt. Moreover, since the S_A profile is estimated during the complete cycle, it is possible to study timing of peak S_A.

Aim: to assess changes in timing of peak S_A during chronotropic (right atrial pacing (AP)) and inotropic (dobutamine infusion (DI)) challenges.

Methods: In 10 pigs, heart rate was modulated by AP (120-180 bpm) and contractility by DI (5-20 μg/kg/min). At each stage M-mode RF-data (PowerVision6000, Toshiba) was acquired in a SAX view at mid level, simultaneously with LVP data (Millar). The mechanical model is based on an ellipsoid geometry, constructed from the echocardiographic data. The balance of forces between the elastic stress (non-linear stress-strain relation), the cavity pressure and the S_A is solved throughout the cycle. This yields the elasticity parameters (measured during diastole, where S_A=0) and the active stress profile during systole (Fig1 left). Duration of systole was defined from the onset of Q-wave till aortic valve closure (min dPdt-20 ms).

Results: During DI, S_A increased at every stage (b:20.3±0.58 20 μg:37.6±1.5), while during AP S_A remained constant. At rest, S_A peaked at about 1/3 of systole (Fig1). For similar heart rates, systole shortened more with DI then with AP. With DI, time to peak S_A (t_S_A) shortened according to systole duration, such that peak S_A occurred at 1/3 of systole for all stages. On the contrary, with AP t_S_A remained constant, making the force development occur relatively later in systole.

Conclusions: DI and AP induce different changes in the t_S_A.

136 Diagnostic implications of right ventricular systolic dysfunction in patients with dilated cardiomyopathy
M. Elnoamany. Shebin elkom, Egypt

Objectives: To investigate the role of right ventricular (RV) systolic dysfunction in idiopathic dilated cardiomyopathy (IDC) versus (vs.) ischemic cardiomyopathy (ICM).

Background: Unlike left ventricular (LV) function, right ventricular (RV) function has not been widely studied in ischemic patients. Evidence for the role of RV function is emerging in patients with heart failure of different etiologies.

Methods: The study included a series of 102 patients with (LV) systolic dysfunction (Ejection Fraction (EF)<45%) of either non ischemic (n=49, IDC group) or ischemic (n=53, ICM group) & 20 healthy volunteers as a control group. RV systolic function was assessed by pulsed - wave Doppler tissue imaging (PWDTI) of tricuspid annular systolic motion, EF of both RV & LV were estimated by Simpson’s rule. Coronary angiography was performed to rule in or out coronary artery disease.

Results: Patients with IDC and ICM had comparable LV EF (36.7±7.2% vs. 39±6.6%, p=0.01) and pulmonary systolic pressures (38.1±5.7 mmHg, Vs. 35.8±7.5 mmHg, p=0.08). Tricuspid annular systolic velocity (TASV) (by PWDTI) & RV EF were significantly lower in IDC compared to ICM (10.6±1.2 vs. 12.7±1.4, p=0.001) & (34.1±4.1 vs. 47.6±7.5, p=0.001) respectively. The prevalence of RV dysfunction & EF concordance was significantly higher in the IDC group compared with ICM group (67.4% vs. 17%, p<0.001) & (85.7 vs. 15.1, p<0.001) respectively. Reduced RV EF & low TASV were powerful independent predictors of IDC compared with ICM (odds ratio 0.78 & 11.47, 95% confidence interval 0.72-0.85 & 3.93-33.53 respectively, p<0.001 for each). The correlation between TASV & RV EF was stronger in the IDC group compared with the ICM group (r=0.87, p<0.001 & r=0.69, p<0.001) respectively.

Conclusions: In the presence of LV dysfunction, the combination of low TASV & reduced RV EF is a powerful marker for IDC compared with ICM, independent of pulmonary hypertension, LV EF. These findings support the concept that IDC is frequently characterized by a biventricular affection and that the presence of RV dysfunction represents a distinguishing feature of this disease.
Left ventricular isovolumic tissue motion by Doppler echocardiography is refound in impedance volume measurements

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During the isovolumic phases when both valves of the left ventricle (LV) are closed the LV is regarded as having no volume changes. Previously LV volume changes measured during the isovolumic phases have been disregarded as artifacts.

**Aims:** To study the relation between myocardial motion and LV volume with respect to the isovolumic phases.

**Methods:** The motion of the septal basal wall was calculated from tissue Doppler velocities acquired using a GE Vingmed Vivid 7. LV volumes were measured with a Baan impedance catheter. The two measurements were performed simultaneously in 8 open chest pigs. One to nine images with good quality from each pig were selected, a total number of 50 measurements. The results of the two measurement methods were plotted against each other and analyzed by linear regression and analysis of covariance (ANCova).

**Results and discussion:** Average $r^2$ for the different pigs varies from 0.58 to 0.88 with a mean of 0.75. ANCOVA showed that the slope of the regression line varied substantially from pig to pig while it was similar from measurement to measurement within each pig. In the figures we can see how the curves follow each other through the isovolumic phases, where the ventricular volume is believed to be constant. The figure to the right spans one heart beat from R-peak to R-peak of the ECG. Since the volume changes seen in the ventricle during isovolumic events which previously have been disregarded as artifacts are also found in the tissue velocities, it may be time to review the myocardial motion during the isovolumic phases.

**Conclusions:** There is a high correlation between the LV volume and the myocardial motion. Changes during the isovolumic phases are seen in both volume and motion measurements.

### Table

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Conclusion: BMSC infusion in post MI pts results in a statistically significant increase of PSySR at rest and during low dose dobutamine. Maximum systolic strain and ejection time strain tend to increase; this increase though reaches statistical significance only after dobutamine infusion.
140 Echocardiographic assessment of left ventricular recovery during mechanical unloading to predict stability of cardiac function after weaning from left ventricular assist devices

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Lasting recovery of cardiac function during left ventricular assist device (LVAD) support can occur in some patients with idiopathic dilated cardiomyopathy (DCM). Thus, thirty-three patients with DCM have been weaned in our department since 1995. In these patients, before LVAD implantation, the LV enddiastolic diameter (LVEDD) was 75.8 mm and the LV ejection fraction (LVEF) 15.5%. After LVAD implantation, echocardiographic evaluation of the LV during repeated "off pump" trials was the cornerstone for weaning decisions. The aim of this study was to assess retrospectively the predictive value of our echocardiographic data for long-term stability of cardiac function after LVAD removal.

Methods: Echocardiographic data obtained during the final "off pump" trial before LVAD explantation were used to calculate the predictive value of certain parameters for long-term (> 3 years) stable cardiac function. These data were: LVEDD, relative wall thickness, short/long axis ratio, stroke volume, LVEF, systolic wall stress, left ventricular systolic radial and longitudinal wall motion peak velocity (Sm) at the basal posterior and lateral wall (measured by pulsed-wave tissue Doppler) and diastolic transmitral flow pattern.

Results: The positive predictive value of echocardiographic parameters alone appeared insufficient to predict lasting recovery, but inclusion of the history of heart failure (HF) in the calculations allows accurate prediction of long-term stability of cardiac function after weaning from LVADs. Thus, normal LVEDD (<55 mm) associated with LVEF<45% at weaning, together with a history of <5 years, appeared already highly predictive of good long-term cardiac function (positive predictive value 92.3%). On the contrary, "off pump" LVEDD >55 mm and/or LVEF<45% are predictive for recurrence of HF during the first 3 years after LVAD removal (negative predictive values 84.6-88.9%). The relative wall thickness, short/long axis ratio, and Sm also appeared helpful for weaning decisions. Thus, both short/long axis ratio >0.7 and Sm values >8 cm/s appeared highly predictive for early recurrence of heart failure after weaning.

Conclusions: Echocardiographic data obtained during "off-pump" trials are reliable for detection of LV recovery sufficient for long-term optimal cardiac function after weaning. Simple parameters like LVEDD and LVEF are already predictive if history of HF is also considered. Additional parameters such as short/long axis ratio and Sm can further improve the predictive value of echocardiographic data.

141 Tendency to pseudonormalization at high filling pressures is a major limitation for the Tei index in evaluating the severity of left ventricular dysfunction

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The potential advantages provided by the combination of systolic and diastolic parameters makes the Tei index attractive, but also controversial. Usually this index is prolonged during left ventricular (LV) systolic dysfunction, but the influence of diastolic dysfunction is unclear. The aim of our study was to validate the Tei index for the evaluation of LV dysfunction severity, in relation to the severity of systolic and/or diastolic dysfunction.

Methods: To evaluate the systolic dysfunction associated with various degrees of diastolic dysfunction by the Tei index, the isovolumetric contraction and relaxation time (IVCT and IVRT) and ejection time were measured by continuous wave Doppler in 80 patients accepted for heart transplantation (HTx) because of advanced dilated cardiomyopathy (DCM). To evaluate the diastolic dysfunction by the Tei index, the same Doppler measurements were performed in 174 HTx patients with isolated diastolic LV dysfunction (LVEF >55%).

Results: Although the Tei index was prolonged (0.69 ± 0.16) in DCM patients, there was no significant correlation between LVEF and Tei index. Due to the shorter IVRT (P < 0.001) during end-stage heart failure (NYHA IV) than in NYHA II-III patients (60.4 ± 12 vs. 114.3 ± 19.8 ms), the Tei index was lower in NYHA IV patients (P < 0.001) in comparison to NYHA II-III patients (0.56 ± 0.10 vs. 0.75 ± 0.15), although the LVEF was lower (P < 0.001) in NYHA IV than in NYHA II-III patients (17.7 ± 5% vs. 27 ± 6%). In HTx patients, due to initially prolonged IVRT, the Tei index was higher before (p < 0.01) than after the first post-HTx year (0.54 ± 0.08 vs. 0.45 ± 0.08). The Tei index was also lower (P < 0.05) in patients with, than in those without coronary artery bypass graft surgery (CABG), although those with CABG showed lower (P < 0.001) systolic wall motion velocities (12.5 ± 2 vs. 9.4 ± 1.9 cm/s) and peak oxygen uptake. The shorter IVRT and lower Tei index in patients with post-HTx times >1 year (with or without CABG) appeared related to higher amounts of fibrosis (P < 0.01) after the 1st post-HTx year. For both DCM and HTx patients there was a significant correlation between IVRT and Tei index (P < 0.001; r = 0.71 and r = 0.72) and also between LV enddiastolic pressure and Tei index (P < 0.001; r = 0.69 and r = 0.74, respectively).

Conclusions: The shortening of the IVRT due to the elevation of filling pressures in both severe systolic (i.e. DCM) and isolated diastolic dysfunction (post-HTx) lowers the Tei index (pseudonormalization tendency) and thus, especially in severe cases, this index becomes useless or even misleading.
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Diagnostic implications of right ventricular systolic dysfunction in patients with dilated cardiomyopathy
M. Elnoamany, Shebin elkom, Egypt

Objectives: To investigate the role of right ventricular (RV) systolic dysfunction in idiopathic dilated cardiomyopathy (IDC) versus (vs.) ischemic cardiomyopathy (ICM).

Background: Unlike left ventricular (LV) function, right ventricular (RV) function has not been widely studied in ischemic patients. Evidence for the role of RV function is emerging in patients with heart failure of different etiologies.

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Results: Patients with IDC and ICM had comparable LV EF (36.7%±7.2% vs. 39%±6.6, p=0.1) and pulmonary systolic pressures (38.1±5.7 mmHg vs. 35.8±7.5 mmHg, p=0.08). TASV (by PWTDI) & RV EF were significantly lower in IDC compared to ICM (10.6±1.2 vs. 12.7±1.4, p=0.001) & (34.1±4.1 vs. 47.6±7.5, p=0.001) respectively. The prevalence of RV dysfunction & EF concordance was significantly higher in the IDC group compared with ICM group (67.4% vs. 17%, p=0.001) & (85.7 vs. 15.1%, p=0.001) respectively. Reduced RV EF & low TASV were powerful independent predictors of IDC compared with ICM (odds ratio=0.786 & 11.47, 95% confidence interval 0.72-0.85 & 3.93-33.53 respectively, p=0.001 for each). The correlation between TASV & RV EF was stronger in the IDC group compared with the ICM group (r=0.87, p=0.001 & r=0.69, p=0.001 respectively).

Conclusions: In the presence of LV dysfunction, the combination of low TASV & reduced RV EF is a powerful marker for IDC compared with ICM, independent of pulmonary hypertension. LV EF, these findings support the concept that IDC is frequently characterized by a biventricular affection and that the presence of RV dysfunction represents a distinguishing feature of this disease.

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Correlations of right ventricular function parameters with functional capacity and N-terminal pro brain natriuretic peptide in idiopathic dilated cardiomyopathy

Purpose: Both peak VO2 and BNP are useful for risk stratification in patients with congestive heart failure (CHF). We assessed the hypothesis that standard and tissue Doppler (TDI) echocardiographic parameters of left (LV) and right (RV) ventricular function could correlate with cardiopulmonary exercise derived functional parameters and to N-terminal pro brain natriuretic peptide (NT-proBNP) in patients with idiopathic dilated cardiomyopathy (DCM).

Methods: Fifteen patients (10 M, mean age: 50+/−15 years) with stable DCM referred for peak VO2 study also had complete Echo and NT-proBNP test (ECLA technique). Peak VO2, anaerobic threshold and VE/VO2 slope were calculated during cardiopulmonary exercise. Standard 2D and Doppler echocardiography was performed and myocardial performance indexes of LV (LV MPI) and RV (RV MPI) were calculated as the sum of isovolumetric contraction time and relaxation time divided by the ejection time. TDI was used to measure systolic (Sm) and diastolic (Em and Am) velocities in the basal portion of the interventricular septum (sep) and of the left (LV) and right (RV) ventricular free walls. Ratio of mitral E to sep Em was calculated. Correlations were obtained by Pearson test. p<0.05 was considered significant.

Results: Peak VO2 was correlated with cardiac output (r=0.606, p=0.05) and with sep Am (r=0.621, p=0.01). VE/VO2 slope was correlated with RV MPI (r=0.577, p=0.04). NT-proBNP was correlated with mitral E (r=0.593, p=0.02) and A wave (r=0.819, p=0.000), mitral deceleration time (r=0.613, p=0.03), sep Am (r=0.700, p=0.004), E/Em (r=0.639, p=0.01), RV MPI (r=0.753, p=0.003) and RV Sm (r=0.538, p=0.04). LV tissue Doppler parameters showed no significant correlations with NT-proBNP and functional exercise parameters. NT-proBNP did not correlate with functional parameters.

Conclusion: RV MPI, a global marker of RV function, showed significant correlations with both VE/VO2 slope and NT-proBNP. Furthermore, LV filling and RV systolic function parameters derived from standard and tissue Doppler were also interestingly correlated with NT-proBNP. This emphasizes the importance of Doppler-derived parameters of RV function in the routine evaluation of patients with DCM. In another hand, LV filling parameters and sep Am also exhibited significant correlations with functional and/or biological markers of CHF, probably witnessing the prognostic role of both LV diastolic and atrial function.

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Cardiac inotropic reserve is related to myocardial adrenergic innervation and predicts outcome in patients with non-ischemic dilated cardiomyopathy
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Background: Evaluation of myocardial contractile reserve in patients with dilated cardiomyopathy has been proposed to provide additive useful information for the risk stratification of these patients. Non-invasive scintigraphy with 123-I-Metaiodobenzylguanidine (MIBG) was developed to visualize cardiac sympathetic innervation. Decreased cardiac MIBG uptake has been found in patients with heart failure and have been proposed that predicts mortality in those patients. A direct head to head comparison between those two different methods in patients with NIDC remains unclear.

We assessed the relationship between cardiac inotropic reserve and myocardial sympathetic innervation and their prognostic value in patients with non-ischemic dilated cardiomyopathy (NIDC).

Methods: Low dose Dobutamine stress echocardiography (LDDE) and radiotracer studies with MIBG provided quantitative assessment of left ventricular (LV) wall motion and cardiac sympathetic innervation, were performed in 38 patients with NIDC and LVEF<40%. Patients were followed and cardiac events (cardiac death, transplantation or hospitalizations) were recorded.

Results: During the follow-up (26.3 months, range 6.9 to 53.5 months) cardiac events were recorded in 11 (28.9%) patients (5 dead, 1 cardiac transplantation). The 2 year survival was 93.84%, the 3 year was 84.2%. The average annual cardiac death rate was 6.8%.

Wall Motion Score Index (WMSI) changes (d) at LDDE correlated with early (r=0.56, p=0.001) and late (r=0.55, p=0.001) MIBG. Patients with lower dWMSI have significantly increased risk for cardiac events, as compared to those with higher dWMSI (log-rank p=0.024). More specifically, 8 of the 19 patients with dWMSI<30% (median dWMSI) experienced cardiac events as opposed to 3 of the 19 patients with dWMSI≥30%.

Early and late MIBG uptake univariately were also significantly related with the time to cardiac events (log-rank p=0.01 and p=0.003, respectively). Cox proportional hazard regression showed that among dWMSI, early and late MIBG, dWMSI was the sole independently significant prognostic risk factor for cardiac events (χ2=7.57, b=−0.87, p=0.006). We estimate from the model that for each 1% unit increase in dWMSI the cardiac hazard decreases by a little more than 8% (95% confidence interval 2 -15%).

Conclusion: Cardiac inotropic reserve is associated with cardiac adrenergic innervation both predicting cardiac events in patients with NIDC. However dWMSI at Dobutamine seems to be more predictive than MIBG in the assessment of patients with NIDC.
Assessment of systolic and diastolic functions of left ventricle in patients with primary dilated cardiomyopathy (PDCM) before and after posterior semicircular reductive annuloplasty

V. Torbica, M. Kovac, D. Zecевич, N. Radovanovic. Institute of Cardiovascular Diseases, Sremska Kamenica, Serbia and Montenegro

Introduction: Patients with primary dilated cardiomyopathy (PDCM) present signs of alterations in geometry and left ventricle contractility, dilatation of mitral and tricuspid annulus, remodeling of fibrous skeleton of the heart basis and consecutive mitral (MR) and tricuspid (TR) regurgitation.

Purpose: The aim of the study was the assessment of systolic and diastolic functions of left ventricle in patients with PDCM before and after reductive annuloplasty of double mitral and tricuspid orifices (RADO).

Material and methods: The study consisted of 20 patients both gender with PDCM (mean age 31.4, mean EF 26.4%, NYHA III-IV, mean MR 3.7±0.1). Two dimensional multiplane transesophageal echo (TEE) was performed using omniplane 6.0 MHz probe on echocardiogram GE Vivid 7. To evaluate the systolic function, we measured: ejection fraction (EF), cardiac output (CO), sphericity index (SI), index of annular dilation (IAD), mitral annular area (MAA).

To assess the diastolic function, we measured: enddiastolic volume (EDV), Doppler tissue imaging (DTI) for mitral annulus velocities (ratio E'/A').

Results: Table 1. Before and after posterior semicircular reductive annuloplasty

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<thead>
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<th>Result</th>
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<th>p</th>
<th>Postoperative</th>
<th>Control group</th>
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<td>MAA (cm²)</td>
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<td>6.2±0.98</td>
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<td>LVIDd (cm)</td>
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<td>EDV (ml)</td>
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<td>26.8±6.3</td>
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<td>LVIDs (cm)</td>
<td>11.6±2.9</td>
<td>&lt;0.001</td>
<td></td>
<td>6.2±0.98</td>
<td>&lt;0.001</td>
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<tr>
<td>SI (%)</td>
<td>78.0±11.0</td>
<td>&lt;0.001</td>
<td></td>
<td>48.98±7.84</td>
<td>&lt;0.001</td>
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<td>MAA (cm²)</td>
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<td>&lt;0.001</td>
<td></td>
<td>6.2±0.62</td>
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<tr>
<td>TAA (cm²)</td>
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<td>&lt;0.001</td>
<td></td>
<td>7.77±0.81</td>
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<tr>
<td>EDV (ml)</td>
<td>268.0±79.0</td>
<td>&lt;0.001</td>
<td></td>
<td>218.0±78.0</td>
<td>&lt;0.001</td>
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Conclusion: RADO procedure reduces significantly MAA, IAD, Si and TAA.

Abstracts
Abstracts

150 Can global myocardial index evaluate ventricular desynchronization in patients with dilated cardiomyopathy? A Time-movement and Tissue Doppler imaging timing study
D. Cozma, S. Pescariu, A. Ionac, D. Ligezan, C. Moros, A. Dragulescu, F. Golda, S.T.I. Dragulescu. Instituto of Cardiovascular Medicine, Timisoara, Romania

Global myocardial index (GMI) is a sensitive indicator of overall cardiac function.

Aim of study: To assess the relation between GMI and currently used echocardiographic parameters of ventricular desynchronization in order to predict the value in the assessment the severity of systolic asynchrony for biventricular pacing indication.

Methods: 47 patients (pts) aged 58.3±18.3 years with dilated cardiomyopathy (DCM) were analyzed. The following parameters were measured: QRS duration (QRSd); septal (S), posterior (P), lateral (L) and posteroseptal (PL) wall delays, as the time from QRS onset to maximal wall contraction, and the derived parameters: left ventricular mechanical delays (LVD) as the time interval from maximal contraction between interventricular septum and posterior (LVDp), lateral (LVDl) and posterolateral wall (LVDpl), using para-sternal, 4 chamber view and subcostal incidence both in time-movement and Tissue Doppler imaging (TDI). TDI measurements were performed using both color and pulsed TDI (from QRS onset to the end of S wave for each wall).

Results: 32 pts presented QRSd>120 ms; evidence of significant left ventricular desynchronization with at least one LVD>70 ms was found in 37 pts (7 pts with QRSd>120 ms); in this group GMI was significantly higher than in the rest of the pts (1.19±0.27 vs 0.74±0.17, p=0.0001). LVD was significantly higher in QRSd>120 ms pts (p=0.0001 in each LVDp,L). The simple regression analysis demonstrated a statistically significant linear correlation between GMI and maximal LVD in each patient (r=0.53, p=0.0001). Using a GMI>0.87 (and QRSd>120 ms) as cut-point, left ventricular desynchronization can be detected with a sensitivity of 94% (81%) and specificity of 70% (80%); positive predictive value was 92% (93%), and negative predictive value was 77% (53%). A trend towards correlation was found between GMI and QRSd (r=-0.31). There was no correlation between QRSd and timing echocardiographic parameters (r<0.3 each).

Conclusion: Regional ventricular delayed activation results in an uncoordinated and prolonged ventricular contraction with lengthening of the isovolumetric contraction and relaxation time and decrease of the time available for filling and ejection. GMI explore all these parameters and may be considered a global indicator of ventricular desynchronization.

151 Diagnostic implications of right ventricular systolic dysfunction in patients with dilated cardiomyopathy
M. Elnoamany, Shebin el kom, Egypt

Objectives: To investigate the role of right ventricular (RV) systolic dysfunction in idiopathic dilated cardiomyopathy (IDC) versus (vs.) ischemic cardiomyopathy (ICM).

Background: Unlike left ventricular (LV) function, right ventricular (RV) function has not been widely studied in ischemic patients. Evidence for the role of RV function is emerging in patients with heart failure of different etiologies.

Methods: The study included a series of 102 patients with (LV) systolic dysfunction (Ejection Fraction [EF]<45%) of either non ischemic (n=49, IDC group) or ischemic (n=53, ICM group) & 20 healthy volunteers as a control group. Systolic function of RV was assessed by pulsed wave Doppler tissue imaging (PWDTI) of tricuspid annular systolic function. Ejection Fraction of both RV & LV were estimated by Simpson’s rule. Coronary angiography was performed for to rule in or out coronary artery disease.

Results: Patients with IDC and ICM had comparable LV EF (36.7%±7.2% vs. 39%±6.6%, p=0.1) and pulmonary systolic pressures (38.1±5.7 mmHg; Vs. 35.8±7.5 mmHg, p=0.08). Tricuspid annular systolic velocity (TASV) (by PWDTI) & RV EF were significantly lower in IDC compared to ICM (10.6±1.2 vs. 12.7±1.4, p=0.001) & (34.1±4.1 vs. 47.6±7.5, p=0.001) respectively. The prevalence of RV dysfunction & EF concordance was significantly higher in the IDC group compared with ICM group (67.4% vs. 17%, p=0.001) & (65.7% vs. 15.1, p=0.001) respectively. Reduced RV EF & low TASV were powerful independent predictors of IDC compared with ICM (odds ratio=0.78 & 11.47, 95% confidence interval 0.72-0.85 & 3.93-33.53 respectively, p=0.001 for each). The correlation between TASV & RV EF was stronger in the IDC group compared with the ICM group (r=0.87, p=0.001 & r=0.69, p=0.001 respectively).

Conclusions: In the presence of LV dysfunction, the combination of low TASV & reduced RV EF is a powerful marker for IDC compared with ICM, independent of pulmonary hypertension, LV EF. These findings support the concept that IDC is frequently characterized by a biventricular affection and that the presence of RV dysfunction represents a distinguishing feature of this disease.

153 Discrete subvalvular aortic stenosis as a diagnostic pitfall in hypertrophic obstructive cardiomyopathy referred for catheter interventional therapy: invasive and echocardiographic investigations
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Generally, diagnosis of hypertrophic obstructive cardiomyopathy (HOCM) with subaortic obstruction and dynamic pressure gradient across the left ventricular outflow tract (LVOT) is made by non invasive diagnostic procedures with great certainty by employing transthoracic (TTE) and/or transoesophageal echocardiography (TEE). However, in pts with asymmetric septal hypertrophy additional discrete subvalvular membrane may be a potential pitfall in the diagnosis of HOCM. The exclusion of discrete subvalvular aortic stenosis (DSAS) is of special importance in pts referred for catheter interventional therapy (TASH). To date, systematic investigations concerning DSAS in symptomatic pts referred for TASH of HOCM are lacking.

Methods: We investigated in a systematic study 350 consecutive symptomatic (functional class 3 or 4 according to NYHA) pts with HOCM who were referred for TASH. In all pts TTE and bicycle exercise Doppler echocardiography were performed. Additionally multiplane TEE and colour-coded tissue Doppler echocardiography were performed in the majority of pts.

Results: In 9 of these pts DSAS (age 48 years, range 16 to 63 years; functional class 3 according to NYHA) comorbic with HOCM was diagnosed (2.5%). TTE revealed pronounced asymmetrical septal hypertrophy (mean septal diameter 20 mm; posterior wall 13 mm) mimicking HOCM. 8 of these pts belonged to the membranous type of DSAS; in one pt a tunnel-like form of DSAS was present. Diagnosis of DSAS was made in 4 pts by TTE, in 3 pts by TEE and in 2 pts by the combination of TEE and left ventricular angiography. In most pts TEE evaluation was of crucial importance with demonstration of a typical subvalvular membrane (8 pts) which was situated a few millimeters below the aortic valve. A SAM-like motion was demonstrated in all pts. In contrast to pts with HOCM, there was only a disproportionately lesser degree of SAM in relation to the LVOT gradient (LVOT gradient 106 mmHg). Doppler echocardiography revealed an early peaking LVOT velocity profile in contrast to most pts with HOCM who showed a late peaking LVOT velocity profile. In all pts with DSAS a pronounced intraoperative finding was present.

Conclusion: The frequency of DSAS in symptomatic pts referred for TASH of HOCM is unexpectedly high. Especially in pts in whom TTE evaluation is of insufficient quality, the use of TEE with careful evaluation of the small poststenotic subvalvular area in HOCM is of importance in diagnosing DSAS. This is of significant prior to catheter interventional therapy, because in pts with DSAS surgical treatment is mandatory.
154 Alcohol septal ablation for hypertrophic obstructive cardiomyopathy: relation between alcohol dose and early echocardiographic changes

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Background: Relation between dose of alcohol injected during procedure and the early hemodynamic and morphologic changes has not been determined up to now.

Methods: Forty-two patients have been randomized into two groups according to the amount of alcohol used during procedure (group A: 21 pts., 13 women, age 53 (30-75), alcohol amount <2 ml and group B: 21 pts., 12 women, age 53 (24-68), alcohol amount >2 ml). Transthoracic echocardiography was used to determine the hemodynamic and morphologic changes. Patients were examined at baseline, immediately after procedure, and 3-5 days, 3 weeks, and 3 months thereafter.

Results: At baseline, both groups of patients matched in all clinical and echocardiographic data. The dose of alcohol injected was 2.8±0.6 and 1.5±0.4 ml (p<0.001) with subsequent peak of CK-MB 3.7±2.42 and 2.33±0.85 U/L (p=0.03) in group A and B, respectively. In both groups of patients, there was a significant decrease in symptoms (p<0.001), LVOG (p<0.001), septum thickness (p<0.001) and left ventricular (LV) ejection fraction (p=0.05). Also, LV diameter dilated slightly in both groups (p<0.05). However, there were no significant differences in the time course of both hemodynamic (LVOG) and morphologic (remodeling of LV and interventricular septum) changes.

Conclusion: Alcohol septal ablation for drug-refractory hypertrophic obstructive cardiomyopathy is associated with symptoms improvement, LV remodeling and LVOG reduction. In the early postprocedural period, the time course of changes is not related to use of low (1-2 ml) or standard (≥2 ml) dose of alcohol.

155 Relationship between B-type natriuretic peptide levels, conventional Doppler and tissue Doppler echocardiographic parameters in patients with hypertrophic cardiomyopathy

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Preload-independent pulsed tissue Doppler echocardiography (TDI) and conventional pulsed Doppler echocardiography were used to assess the global left ventricular diastolic function in patients with hypertrophic cardiomyopathy (HCM). Levels of B-type natriuretic peptide (BNP) could be elevated in patients with isolated left ventricular diastolic dysfunction. The correlation between BNP levels and the parameters measured by conventional echocardiography and TDI is unclear in this patients group.

Patients: 32 consecutive patients with HCM (21 male, 11 female, mean age 47±14 years) were studied. Inclusion criteria were: normal sinus rhythm; ejection fraction >50%; absence of moderate to severe mitral regurgitation or artificial mitral valve.

Methods: In addition to the conventional transmural flow patterns (E, A, E/A, deceleration time, isovolumic relaxation time) myocardial early (Ea) and late diastolic (Aa) velocities were measured at the lateral and septal border of the mitral annulus by ATL HDI 5000 ultrasound system. Ea/Aa and E/Ea ratios were calculated. NT-pro-BNP levels were measured by Roche-Elecsys test (immunoassay).

Results: Mean BNP level was 543±845 pg/ml. BNP levels negatively correlated with lateral Aa values (r=−0.59, p<0.001). No significant relationship was observed between BNP levels and other echocardiographic parameters. By stepwise multiple linear regression analysis the only significant predictor of BNP was lateral Aa value, too (r=−0.467, p<0.05).

Conclusion: Significant correlation was found between BNP levels and a single TDI parameter characterizing left atrial systolic function, but there was no significant correlation between BNP levels and global left ventricular diastolic function characterized by either conventional echocardiographic or TDI parameters.

156 Alcohol septal ablation for hypertrophic obstructive cardiomyopathy improves myocardial performance

J. Veselka, S. Prochazkova, R. Duchonova, P. Cervinka1, D. Tesar1, University Hospital Motol, Prague 5, Czech Republic, 1Masaryk Hospital, Usti n. Labem, Czech Republic, 2University Hospital Motol, Prague 5, Czech Republic

Background: Alcohol septal ablation (PTSMA) improves outflow gradient, left ventricular (LV) diastolic function and symptoms in patients with hypertrophic obstructive cardiomyopathy (HOCM). Index of myocardial performance - Tei index (TI) is a readily evaluated parameter reflecting both systolic and diastolic left ventricular function.

Methods: Twenty-five consecutive patients (mean age 54±14 years) with symptomatic HOCM underwent PTSMA procedure. Clinical and echocardiographic data were collected at baseline, six and 12 months after PTSMA. TI was assessed as a sum of isovolumic contractile (ICT) and relaxation (IRT) times divided by LV ejection time (LVET). Time intervals were obtained with Doppler echocardiography.

Results: Twelve-month survival was 96%. Measured time intervals are summarized in Table. LV remodeling was determined by LV dimension increase from 46.6±10.8 to 47.5±11.6 mm and basal septal thickness reduction from 22.4±7.1 to 15.3±5.3 mm. LV ejection fraction decreased from 78.7±8.7 to 73.6±11% and maximal outflow gradient decreased from 69.4±4 to 15±11 mmHg. All changes were statistically significant (p<0.01). Symptomatic improvement was characterized by relief of dyspnea (2.5±0.7 versus 1.4±0.6 NYHA class; p<0.01) and angina pectoris (2.6±0.9 versus 0.7±0.7 CCS class; p<0.01).

Conclusions: PTSMA is an effective method of therapy for HOCM. Shortening of TI suggests the improvement of LV myocardial performance in the mid-term follow-up.

Abstracts

157 Left ventricle outflow tract pressure gradient in patients with hypertrophic cardiomyopathy and mitral SAM: echocardiography is superior to invasive measurements

W. Plazak, P. Pieniazek, P. Podolec, T. Przewlocki, W. Tracz. John Paul II Hospital, Krakow, Poland

Objective and aim: Hypertrophic obstructive cardiomyopathy (HOCM) leads to increase of left ventricle outflow tract (LVOT) pressure gradient due to muscle hypertrophy and systolic anterior motion (SAM) of mitral leaflets. The disagreements between invasive measurements and echocardiographic assessment results are frequent. We show that the insertion of catheter into left ventricle may significantly reduce LVOT gradient due to SAM reduction.

Material and methods: Two HOCM patients: female aged 60 and male aged 35 were examined. In both cases high rest LVOT gradient was found with intensive SAM narrowing LVOT. Echocardiographic assessment was performed continuously during invasive measurements.

Results: The thickness of interventricular septum in examined patients was 22 mm and 25 mm. Before 6F Multipurpose catheter insertion into the ventricle significant LVOT narrowing was observed (the distance between septum and mitral leaflet in apical 4 chamber view 2 mm in both cases) with high LVOT pressure gradient (142 mmHg and 97 mmHg, respectively). After insertion of the catheter the intensity of SAM was significantly decreased in both cases: the mitral leaflets leaned on the catheter. LVOT was widened to 7 and 9 mm, respectively. The pressure gradients dropped to 34 mmHg and 22 mmHg, respectively. The scheme of this phenomenon is shown in the figure. Reproducibility was confirmed by insertion the catheter 3 times during each procedure with the same effect. After pulling out of the catheter the gradients increased up gradually with pre-procedural values 5 minutes after pulling out.

Conclusions: The LVOT pressure gradient measured in patients with intensive SAM invasively may be artificially underestimated. In such cases continuous echocardiographic assessment may be necessary.

Abstracts

158 Improvement of the TI during follow up

Parameter | Baseline | Six months | Twelve months
--- | --- | --- | ---
ICT, ms | 74±20 | 49±13* | 48±11*
IRT, ms | 146±25 | 119±12* | 117±9*
LVET, ms | 330±42 | 300±15* | 298±13*
TI | 0.67±0.11 | 0.56±0.07* | 0.55±0.06*

*p<0.01 between baseline and 6 or 12 month follow-up.

159 Insertion of the catheter decreases SAM

Image 308x80 to 470x229

Insertion of the catheter decreases SAM
158 Do we need ultrasound contrast or MRI in all patients with suspected apical hypertrophic cardiomyopathy?: A study on three patients

R. Couto, M.J. Andrade1, M. Trabulo1, M. Canada1, R. Ribeiras1, C. Reis1, R. Gouveia1, R. Seabra-Gomes1. Hospital de Santa Cruz, Oeiras, Portugal, 2Hospital de Santa Cruz, Camanxide, Portugal

Background: Poor or inadequate visualization of the apical endocardium has been pointed out as a diagnostic limitation of 2D echocardiography for the diagnosis of apical hypertrophic cardiomyopathy (HCM). Recent image modalities, such as the use of an ultrasound contrast or MRI have been proposed as the solution to surpass this limitation and to aid in the diagnosis of this rare entity.

Objectives: 1) To compare the information provided by "clean" 2D echo (top-end equipment with harmonics), 2D echo plus ultrasound contrast and MRI for the diagnosis of apical HCM. 2) To evaluate if and what do we really gain from adding these new image modalities to the diagnostic work-up.

Methods: We studied three patients (P), all women, aged 41, 43 and 72, referred to our echo laboratory with clinical and electrocardiographic suspicion of apical MCH. All three underwent "normal" 2D-echo, i.v. ultrasound contrast for endocardium delineation and MRI.

Results: In all of them 2D-echo was able to confirm the presence of hypertrophied myocardium confined to the apical level. In two P, other abnormal findings related to the mitral valve apparatus were elicited: an extra papillary muscle (PM) and a discrete "systolic anterior movement" (SAM) of the chordae tendineas in one, and an anterior displacement of the anterolateral PM in the other. The use of i.v. ultrasound contrast reproduced the beautiful pathognomonic "ace of spades" configuration of the left ventricle (LV), similar to that obtained from LV ventriculography, without adding any extra information concerning location and extent of the hypertrophy. It did, however, "blur" the images on the subvalvular mitral apparatus.

MRI information reinforced the already established diagnosis, and the obtained images were comparable to those seen in the contrast echo, though omitted part of the abnormalities of the valvular apparatus.

Conclusion: Nowadays, top-end 2D – echo equipment provides the correct diagnosis of apical HCM. A high degree index of suspicion along with experienced hands and eyes are critical for the recognition of the condition. Contrast echo may be an invaluable tool only for the exceptional patient with bad acoustic "window". MRI, proclaimed as the "gold standard", and experience, even with the aid of ultrasound contrast, are not able to surpass this limitation.

159 Premature systolic contraction by pulsed Doppler tissue imaging analysis in hypertrophic obstructive cardiomyopathy


Background: The clinical utility of the pulsed Doppler tissue imaging (DTI) technique has not been fully investigated especially in cases with different forms of left ventricular (LV) cardiomyopathies.

Purpose: The aim of our study was to evaluate by pulsed DTI, a sample population (n = 22 pts) with the clinical and echocardiographic-Doppler diagnosis of hypertrophic obstructive cardiomyopathy (HOCM group), with significant LV outflow tract obstruction and intracavitary gradients (ICG>4.1 mmHg) as inclusion criteria, with a mean age of 47±10 years, 64% male gender.

Methods: This group of pts were submitted to color and pulsed DTI study and compared with an aged matched population of 30 normal subjects (N group). Using a transthoracic echocardiographic-Doppler apical approach and the 16 segmental LV model recommended by the ASE, all cases were submitted to a pulsed DTI analysis in order to evaluate the systolic (s') pattern, time intervals (ms) and velocities (Vel-cm/s) of the DTI systolic s' contraction wave. In each case and in each one of the LV myocardial wall segments, we measured several time interval parameters, including the isovolumic contraction time (IC), total s' duration (TS), the time interval from the end of diastole to peak systole contraction (DP), acceleration (AS) and deceleration (DS) phases of the DTI s' positive inward contraction wave. Also, the mean and peak Vel of the s' contraction wave were calculated. Other LV morphological parameters were also evaluated, including its end systolic (ESD-ESV), enddiastolic (EDD-EDV) and stroke (EKD-EKV) diameters (mm) and volumes (ml), and derived LV ejection fraction (LVEF%), global LV mass (LVM-g) and LVM index (LVMi-g/m²).

Results: A total number of 352 LV myocardial wall segments were evaluated in the HOCM group and 480 in the N group, and 96.8% (n=341) and 98% (n=470) were considered as adequate for analysis, respectively. A majority of the LV myocardial wall segments among the HOCM group revealed a premature s' peak (n = 191; 56% vs 3%; p<0.001), with a reduced IC (25±8 vs 57±11 ms; p=0.02), DP (127±22 vs 171±29 ms; p=0.01) and AS (97±15 vs 143±19 ms; p<0.01). In the comparison between N and HOCM groups, other pulsed DTI s' variables were not significant.

Conclusions: The pulsed DTI assessment of HCM patients revealed an abnormal pattern of the s' contraction wave of LV wall motion, characterised by a premature peak associated with a reduced isovolumic contraction and acceleration time intervals, findings that could be observed in the majority of patients and LV myocardial wall segments, but especially at the LV basal level.

160 Left atrial area and emptying in hypertrophic cardiomyopathy - Automatic borderline detection study

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Purpose: Left ventricular diastolic dysfunction plays an important role in the pathogenesis of symptoms in patients with hypertrophic cardiomyopathy (HCM). Theoretically abnormal LV filling should lead to left atrium (LA) enlargement with its abnormal emptying.

Methods: Our study was performed in 28 pts with hypertrophic cardiomyopathy (mean interventricular thickness 2.4±0.73cm, mean posterior wall thickness 1.2±0.42cm and mean LV wall thickness measured at 10 segments 1.93±0.37cm) and 38 healthy volunteers. Transmitral Doppler flow parameters (peakE, peakA, tdecE, peak E/peak A) did not differ in both groups. We used 2D echocardiographic automatic borderline detection method to assess the following LA areas during its emptying: maximal LA area (LAmax), area before active atrial contraction - P wave on ECG(LA-P) and minimal LA area after atrial contraction (LAmin). We also calculated total LA emptying fraction (%LAEF), absolute area changes during LA early emptying (dLA-AE) and atrial contraction (dLA-AC). 11 pts had mitral regurgitation. The mitral regurgitation fraction was calculated as the ratio of the area of mitral regurgitation to LA area.

Results: Significantly larger LAmax (24.5±12.7 vs 19.22±9 cm², p<0.05), LA-A-P (17.4±4.1 vs 15.0±2.9 cm², p>0.05) and LAmin (14.1±3.6 vs 11.9±3.2 cm², p<0.02) were found in HCM compared to C. The total LA emptying fraction %LAEF (37.3±8.7 vs 31.4±12.8%, NS), dLA-AE (5.1±2.1 vs 5.2±1.8 cm², NS) and dLA-AC (3.5±1.5 vs 3.1±2.4 cm², NS) were similar in both groups. The regurgitation fraction observed in HCM was 2.7-31.1%. No significant correlation were found between mitral regurgitation fraction and LA areas as well as LA emptying parameters in HCM.

Conclusion: LV hypertrophy in hypertrophic cardiomyopathy leads to LA enlargement but not changes in its emptying. We found larger the following LA areas: maximal area, area before atrial contraction and minimal area and greater LA area change during active emptying. Total LA emptying fraction, area change during early emptying and active emptying were similar in both groups. No correlation existed between mitral regurgitation fraction and LA size and emptying parameters. Because of small group of pts with mitral regurgitation further study are needed.
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Relation of longitudinal strain rate/strain with coronary flow velocity in patients with hypertrophic cardiomyopathy
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The aim of study was to test the hypotheses that blood flow velocity recorded in the left anterior descending (LAD) and circumflex (CX) coronary arteries using transthoracic echocardiography and second harmonic echo modality correlates with longitudinal Strain Rate (SR) and Strain (S) in patients with hypertrophic cardiomyopathy.

Methods: Sixteen pts (14 men and two women, mean age 28.2±14.0 years) with asymmetric hypertrophic non-obstructive cardiomyopathy underwent doppler tissue imaging and high frequency transthoracic Doppler echocardiographic assessment of LAD and CX using “VIVID 7”. Longitudinal myocardial velocities, SR and S were postprocessed (EchoPac PC) from basal, mid, and apical segments using apical views. The coronary flow velocity in LAD and CX coronary arteries was obtained in all pts. All pts had angiographically normal coronary arteries. Thickness of each segment in diastolic was assessed in all patients with hypertrophic cardiomyopathy using Anatomical M-mode. The results were compared with 14 normal participants (10 men and 4 women, mean age 36.1±10.4 years) who had no evidence of cardiac disease.

Results: Longitudinal SR and S were decreased in basal and mid segments of left ventricle in pts with hypertrophic cardiomyopathy compared with normal participants. Thickness of the segment didn’t correlate with longitudinal SR and S of this segment both in pts and normal participants. Diastolic peak flow velocity (Vmax), mean flow velocity (Vmn) in LAD and CX coronary arteries were significantly reduced in pts with hypertrophic cardiomyopathy compared with normal participants (LAD: Vmax 28.2±10.2 cm/s vs 48.0±10.4 cm/s; Vmn 24.2±4.2 cm/s vs 32.1±8.4 cm/s p=0.05 respectively; CX: Vmax 27.0±6.2 cm/s vs 42.5±4.2 cm/s; Vmn 15.0±4.2 cm/s vs 27.7±9.0 cm/s p=0.05 respectively). Reversal pattern of systolic blood flow velocity in distal segment of LAD coronary artery was found in three pts (mean age 17.0±8.3 years) with severe anterior wall (28.2±1.2 mm) and septal hypertrophy (32.3±2.1 mm). Longitudinal SR and S of segment related to LAD or CX coronary arteries correlated with diastolic velocity flow (LAD: Vmax r=-0.56 -0.76; Vmn r= -0.63-0.72; CX: Vmax r=-0.65 -0.78; Vmn r=-0.46 -0.56 p<0.05 respectively).

Conclusion: Longitudinal SR and S correlate with coronary flow velocity in LAD and CX coronary arteries in pts with hypertrophic cardiomyopathy.

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Long term progression of systolic and diastolic dysfunction in hypertrophic cardiomyopathy: a Doppler echocardiography study
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Background: Hypertrophic cardiomyopathy (HCM) is typically characterized by left ventricular hypertrophy and diastolic dysfunction; systolic function is usually preserved. At Doppler echocardiography, the usual diastolic abnormality reported in HCM is an abnormal relaxation pattern. Restrictive filling pattern (RFP), as well as the progression of diastolic and systolic dysfunction during long term follow-up, has never been extensively evaluated in HCM.
Aim: To evaluate the frequency of the systolic and diastolic left ventricular dysfunction in HCM by Doppler echocardiography and their progression during follow-up.

Methods and results: From March 1993 to February 2001 we enrolled in our study 87 pts with HCM (56 M (64%), 31 F (36%), mean age 45±19 years). At enrolment and during follow-up, all subjects underwent clinical examination and Doppler echocardiographic examination. At baseline study, mean NYHA class was 2±0.4. Fourteen pts (16%) had CHF and six pts (7%) had a systolic dysfunction (mean EF 35±6%). An abnormal relaxation filling pattern (E/A ratio <1) was observed in 18 pts (21%) and RFP (EDT>120 ms or E/A<2 if EDT<150 ms) was detected in 11 patients (12.6%). Fifteen pts (17.2%) had a significant intraventricular gradient (PG mean 95±44 mmHg). Eleven pts (12.6%) had significant mitral regurgitation (MR, >1+). During a mean follow-up of 96±54 months, in 9 pts (10.3%) there was a worsening NYHA class and 18 pts (20.6%) developed CHF. New systolic dysfunction developed in 7 pts (8%), whereas it worsened in 2 cases (2.3%). Twelve pts (13.8%) developed RFP. Significant intraventricular gradient disappeared in 11 cases (12.6%), while it appeared in 4 pts (4.6%). Significant MR developed in 14 pts (16%), and it worsened in 1. Twenty-one pts (24%) died for sudden death or for refractory HF, and 4 (4%) were transplanted.

Conclusions: In HCM an evolution towards systolic and diastolic dysfunctional is frequently documented at echo-Doppler during long term follow-up. Its clinical and prognostic relevance is presently unknown. Additional extensive clinical studies are required. Genotype and phenotype correlations could help to clarify and identify pattern of progression of the disease.

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N terminal pro brain natriuretic peptide elevation in hypertrophic cardiomyopathy: clinical importance and relevance with echocardiographic parameters
Purpose: In cardiac disease, both N terminal proBNP (NTproBNP) and BNP levels increase, but NTproBNP levels exceeds that for BNP, which suggests that it may be the more specific marker. The relation between NTproBNP levels and left ventricular hypertrophy (LVH) is not clear, yet. In our study, we aimed to demonstrate the clinical importance of NTproBNP elevation and its relevance with echocardiographic parameters in patients with hypertrophic cardiomyopathy (HCM).

Methods: The study population consisted of 50 HCM patients with normal systolic left ventricular function. Plasma concentrations of NTproBNP were measured at rest following echocardiographic examination. The patient population is divided into 2 groups according to median NTproBNP plasma level (80 pmol/l).

Results: Comparison was made in respect of demographic, clinical, and echocardiographic parameters. Echocardiographic data that has statistical significance is demonstrated in Table-I. After stepwise logistic regression analysis, LV Mass (p<0.01), LA (p<0.05) and LVOT mean gradient (p<0.05) were found to be independent predictors of median NTproBNP plasma level.

Conclusions: In HCM patients, increasing levels of LVH and left ventricular outflow tract mean gradient (LVOTmg) results in higher levels of plasma NTproBNP. Sudden death in first degree relatives was also more common in higher NTproBNP levels. In conclusion, NTproBNP plasma level seems to be a sensitive parameter in the follow up and risk stratification of HCM patients.

Table I
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<th>Parameters</th>
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<tr>
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<td>NTproBNP&lt;80, n=25</td>
<td>NTproBNP&gt;80, n=25</td>
</tr>
<tr>
<td>LA (cm)</td>
<td>4.04±0.7</td>
<td>4.74±0.7</td>
</tr>
<tr>
<td>LVM (g)</td>
<td>398±163</td>
<td>573±303</td>
</tr>
<tr>
<td>SSD (cm)</td>
<td>2.3±0.44</td>
<td>2.7±0.7</td>
</tr>
<tr>
<td>LVOTmg (mmHg)</td>
<td>13.6±21</td>
<td>27.7±39</td>
</tr>
<tr>
<td>SD, n, (%)</td>
<td>3.12(%)</td>
<td>9.38(%)</td>
</tr>
<tr>
<td>LA-left atrial diameter, LVH-left ventricular mass, SSD-septum diastolic diameter, LVOTmg-left ventricular outflow tract mean gradient, SD=sudden death history in first degree relatives.</td>
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</table>
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Intracardiac echocardiography guidance during percutaneous transluminal septal myocardial ablation in patients with obstructive hypertrophic cardiomyopathy

C. Pedone, M. Vijayakumar1, E. Biagini1, N. De Jong1, P.W. Serruys1, F.J. Ten Cate1, Ballarini Hospital, Bologna, Italy, 1Thoraxcenter Erasmus MC, Rotterdam, Netherlands

Background: Percutaneous transluminal myocardial septal ablation (PTSDA) recently emerged as an alternative to myectomy for hypertrophic obstructive cardiomyopathy (HOCM) patients with drug-refractory symptoms. The potential role of intracardiac echocardiography (ICE) in guiding PTSDA has never been tested.

Methods: Nine consecutive HOCM patients (age range 47 to 75 years, 4 men) underwent PTSDA under intracardiac echo (ICE) guidance (AcuNav 6-7 MHz phased-array transducer interfaced with Cypress, Acuson). The catheter tip was placed toward right side of the interventricular septum providing a long axis view of the left ventricle. Images were obtained continuously during the procedures and acquired at baseline, after contrast (Leovist, Schering, Berlin) and ethanol injection into the target septal branch. Peri-procedural clinical data were collected.

Results: PTSDA was effective to reduce left ventricle outflow tract gradient from 75 ± 30 to 5 ± 9 mmHg (p < 0.001). None of the patients had haemodynamic compromise or significant arrhythmias during the procedure; one patients developed complete heart block requiring permanent dual chamber pacing. There were no ICE related complications. After contrast injection risk area visualized in all the patients and it guided the choice of the target septal branch. After the ethanol delivery an hypeerechoic, sharply demarked triangular area appeared (ablated area) within septum as result of local interaction of contrast microbubble with injected ethanol. Mean ablated planimetrized area was 1.9 ± 0.7 cm² (0.6-2.6).

Conclusions: In this initial experience ICE monitoring during PTSDA was safe and provided high quality and continuous imaging of the treated segment of the septum during the whole procedure. ICE may be considered as complete guiding tool during PTSDA.

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Degree of left ventricular hypertrophy reflects impairment of regional left ventricular diastolic function in patients with hypertrophic cardiomyopathy

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Purpose: It is already known that patients with hypertrophic cardiomyopathy (HCM) exhibit regional diastolic dysfunction in the hypertrophied interventricular septum (IVS), as well as in the non-hypertrophied lateral wall compared to normal patients or to patients with other types of hypertrophy. However the relation concerning the regional diastolic dysfunction and the thickness of IVS is not a consistent finding in the studies involving patients with HCM, whether regional diastolic function is estimated at the level of the septal side of mitral annulus or at the hypertrophied mid segment of IVS. Aim of this study was to investigate this relation with the use of tissue doppler echocardiography (TDE).

Methods: Thirty two (32) patients (25 men and 7 women) with HCM and asymmetrical hypertrophy of the interventricular septum, aged 58±14 years, were enrolled in this study. Fourteen (14) of them had left ventricle outflow tract obstruction at rest (eight patients), or latent (six patients). All patients were in sinus rhythm and exclusion criteria were hypertension, coronary artery and valvular disease, bundle branch block (BBB) or permanent pacemaker. All patients underwent a TDE study at the mid-segment of the hypertrophied IVS from the apical four chambers view. We particularly measured the following variables: 1) Regional early (e) and late (a) diastolic velocities 2) Regional isovolumic relaxation time (IVRT) and 3) Deceleration time of the e wave at the mid segment of IVS. Statistical analysis of our data was performed using Spearman’s correlation coefficient.

Results: We observed an inverse relationship between thickness of IVS and e velocities (r = -0.487, p = 0.005). No statistically significant relation was found between the other regional diastolic indexes and IVS thickness.

Conclusions: In patients with HCM, thickness of IVS is well correlated to the impairment of left ventricular regional diastolic relaxation. We could say that the degree of diastolic asynchrony of the thick IVS in HCM depends on its dimensions.

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The presence of mitral L wave in patients with hypertrophic cardiomyopathy indicates advanced diastolic dysfunction


Background: The prominent mid-diastolic filling wave, which has been described as an L wave, is not infrequently encountered in patients with hypertrophic cardiomyopathy (HCM). However, the significance of L wave has not been explored previously in patients with HCM. The purpose of this study was to explore possible mechanisms and clinical implications of L wave in patients with HCM using Doppler tissue imaging (DTI) and proBNP.

Methods and results: Fifty-five patients with HCM (41 male, 14 female; mean age, 57 ± 10 years) were studied. Mitral L wave was defined when mitral flow is triphasic, including mid-diastolic flow velocity of at least 0.2 m/s, and sinus rhythm. Peak velocity of E, L, and A, and deceleration time (DT) of the E wave velocity were measured. Diastolic mitral annular velocities were measured at the septal corner of the mitral annulus by DTI from the apical 4-chamber view. ProBNP was measured at the time of echocardiogram using Elecsys proBNP, a quantitative electrochemiluminescence immunoassay. Patients were classified into 2 groups: group 1 (n = 16) included those with mitral L wave and group 2 (n = 39) included those without mitral L wave. The heart rate was significantly lower in patients with group 1 (54 ± 6 vs 62 ± 10, p = 0.001). Group 1 patients had significantly higher E/A (1.6 ± 0.2 vs 1.2 ± 0.6, p = 0.03), peak of L wave velocity (10.7 ± 4.8 vs 7.7 ± 4.7 cm/s, p = 0.001) and left ventricular pressure (mmHg) provoked 262 ± 52 vs 158 ± 136 (p = 0.001) and proBNP was also significantly higher in group 1 (1442 ± 361 vs 593 ± 95 pg/ml, p = 0.02).

Conclusion: The presence of L wave in patients with HCM is associated with higher E/A, shorter DT, elevated proBNP and enlarged left atrium indicating advanced diastolic dysfunction with elevated filling pressures. This unique mitral inflow velocity pattern should be helpful in identifying the patients with advanced diastolic dysfunction and increased LV filling pressures in patients with HCM.
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The incremental prognostic significance of restrictive filling pattern in hypertrophic cardiomyopathy: a Doppler echocardiographic study
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Background: Hypertrophic cardiomyopathy (HCM) is characterized by left ventricular diastolic dysfunction and preserved systolic function. Whether an abnormal relaxation pattern is the typical diastolic abnormality at Doppler echocardiography, restrictive filling pattern (RFP) has never been extensively evaluated in patients with HCM.
Aim: The objectives of our study were to analyze the frequency and incremental prognostic significance of RFP in comparison with clinical evaluation in HCM.
Methods: In our study 87 patients with HCM were included (56 M (64%), 31 F (36%), age 45±19 years). All subjects underwent detailed clinical examination and Doppler echocardiographic study.
Results: At clinical evaluation mean duration of the disease was 92±105 months, 34 (39%) and 7 (8%) patients were in NYHA class II or III, respectively, and 14 (16%) had signs of CHF. At Doppler echocardiographic study 6 pts (7%) had systolic dysfunction (mean LVEF 35±6%), 18 (21%) had an abnormal relaxation pattern (E/A ratio <1), 11 (13%) showed a RFP (EDT≤120 ms or E/A≤2 if EDT≤150 ms), 15 (17%) had a significant intraventricular gradient (mean gradient 95±44 mmHg) and 11 (13%) had significant mitral regurgitation (MR ≥1+) (mean MR grade 1.3±0.7). During a mean follow-up of 96±54 months, twenty-one patients (24%) died for sudden death or for refractory heart failure, and 4 (5%) were transplanted. Duration of the disease and NYHA class were selected in a multivariate proportional hazard model as the only clinical predictors of death or transplant. In the clinical-echocardiographic model, in addition to duration of the disease and NYHA class, indexed left atrial diameter (HR 2.92, 95% CI: 1.02-7.34) were independently related to outcome. The AUC of ROC curves significantly improved from 0.77 of the clinical model to 0.87 of the clinical-echocardiographic model (p=0.048). A nomogram was derived from the model to quantify the risk of death or transplant at two, five, and 10 years of follow-up.
Conclusions: In this study, we demonstrated that the presence of RFP and increased left atrial dimension have an incremental prognostic value over clinical evaluation in predicting death or heart transplantation in patients with HCM. This model, that includes clinical and echocardiographic variables, showed the highest predictive value in identification of patients with HCM and poor outcome.

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Distribution and long-term significance of extreme echocardiographic values in hypertrophic cardiomyopathy: the Italian registry for HCM
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Background: The distribution of commonly used echocardiographic measurements have not been reported in hypertrophic cardiomyopathy (HCM). Based on the Italian Registry for HCM, we studied (1) the distribution of extreme values in predicting outcome. Materials and methods: We enrolled 1677 patients in 40 institutions. Of these, 1491 adult HCM patients, (mean age 47±17 years, men 61%, obstructive 19%), had ≥2 follow-up visit following initial echocardiographic evaluation (follow-up:9.4±7.4 years), represent the study group.
Results: Mean values and percentile distribution of LA size, LV end-diastolic diameter (LVEDD), maximal wall thickness (MWT), and the MWT/LVEDD ratio are in Table 1. Most patients had LA size greater than commonly accepted reference limits. Long-term, LA values >48 mm had a multivariate hazard ratio (HR) of 2.4 for all-cause mortality (p=0.0013) and 2.5 for cardiovascular death (p=0.0011). Smaller LA sizes were not predictive of an increased risk. Similar HR were obtained after excluding patients with atrial fibrillation, and in patients with and without obstruction. Extreme values of the other variables, including MWT, were not predictive of adverse outcome.
Conclusions: In a large HCM population, only extreme degrees of LA dilatation (≥48 mm) were predictive of adverse outcome. Disease-specific echocardiographic reference values are required for reliable risk assessment and design of prospective studies in HCM patients.

<table>
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<th>Table 1</th>
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<tr>
<td>LA (mm)</td>
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</tr>
<tr>
<td>Mean (SD)</td>
</tr>
<tr>
<td>25th percentile</td>
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<tr>
<td>50th percentile</td>
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<td>75th percentile</td>
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Tissue Doppler echocardiography in patients with hypertrophic obstructive septal deceleration of septal motion after catheter interventional therapy
G. Beer, O.A. Breithardt1, T. Lawrenz, J. Reinhardt, F. Lieder, H. Kuhn. Städtische Kliniken Bielefeld, Mitte, Bielefeld, Germany, 1Universitätsklinikum Aachen, Aachen, Germany
In pts with hypertrophic obstructive cardiomyopathy (HOCM), a new sign of left ventricular outflow tract (LVOT) obstruction, characterized by an abrupt mid-systolic septal deceleration notch (MSSD) in the basal septal longitudinal velocity trace, was reported using colour-coded tissue Doppler imaging (TDI). This characteristic pattern appears to provide a new insight into the mechanism of LVOT obstruction in HOCM.
Methods: We examined 20 consecutive pts with HOCM (age 52±18 years; 10 men, 10 women; septal wall 23±4 mm; SAM septal contact in 17/20 pts) and a resting gradient of more than 30 mmHg across the LVOT (82±46 mmHg assessed by CW-Doppler) by transthoracic echocardiography and bicycle Doppler echocardiography before and 1 week after catheter interventional therapy (TASH) of HOCM. In all pts septal longitudinal motion was assessed by colour-coded TDI (≥100 frames/s) at rest for the identification of MSSD. Timing of the MSSD notch was compared to timing of aortic valve closure by CW-Doppler to differentiate the MSSD notch from the isovolumetric velocity spike.

Results: A pathological septal longitudinal motion at rest with a characteristic biphasic systolic velocity pattern with an early (S1) and a late positive velocity peak, interrupted by an abrupt MSSD notch (defined as >25% relative or >1 cm/s absolute decrease from S1) was identified in all pts (100%) before TASH. After TASH peak LVOT gradient at rest was significantly (p<0.01) reduced (from 82±43 mmHg to 43±27 mmHg). In 10 pts both a gradient of more than 30 mmHg at rest and MSSD persisted. In 10 pts (50%) the septal longitudinal velocity trace was normalized after TASH. In 9 of these 10 pts (90%) obstruction (>30 mmHg) at rest was eliminated. Pts with persisting MSSD after TASH, compared to those without MSSD, had a significant (p<0.01) higher LVOT gradient at rest examined non-invasively by CW-Doppler (64±21 mmHg to 22±12 mmHg) and invasively (52±29 mmHg to 16±20 mmHg) immediately after TASH.
Conclusion: Disappearance of the MSSD notch in septal longitudinal motion correlates well with LVOT gradient reduction (in terms of post-TASH values at rest of <30 mmHg). MSSD obtained by colour-coded TDI seems to be a helpful new parameter for gradient characterization and to evaluate the efficacy of the catheter based therapy of HOCM.
Mid-systolic septal deceleration by colour-coded tissue Doppler echocardiography after catheter interventional therapy of hypertrophic obstruction cardiomyopathy: a new tool for therapy monitoring?

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In pts with hypertrophic obstructive cardiomyopathy (HOCM), a new sign of severe left ventricular outflow tract (LVOT) obstruction, characterized by an abrupt mid-systolic septal deceleration (MSSD) in the basal septal longitudinal velocity trace obtained by colour-coded tissue Doppler imaging (TDI), has been described (Z Kardiol 2003;92:1003-7). This new sign has been validated by acute postprocedural assessment after catheter interventional therapy (TASH) of HOCM; mid-term data are missing so far.

Methods: To evaluate this new diagnostic sign we performed serial colour-coded TDI investigation (up to 6 examinations per pt; up to 6 months after TASH) in 6 pts with HOCM (age 43 +/- 13 years; septal wall 25 +/- 3 mm) in the follow up of TASH. Septal longitudinal motion was assessed by colour-coded TDI (>100 frames/s) at rest for the identification of MSSD. Timing of the MSSD notch was compared to timing of aortic valve closure by CW-Doppler, to differentiate the MSSD notch from the isovolumetric velocity spike. A pathological septal longitudinal motion at rest was defined as a characteristic biphasic systolic velocity pattern with an early (S1) and a late positive velocity peak, interrupted by an abrupt MSSD notch (defined as >25% relative or >1 cm/s absolute decrease from S1). TDI was correlated to the LVOT gradients obtained by invasive investigation and CW-Doppler.

Results: TASH resulted immediately and after 6 months in a significant decrease of the gradient at rest (70 +/- 39 mmHg to 31 +/- 37 mmHg) and after provocation (149 +/- 70 mmHg to 71 +/- 29 mmHg). In 5 pts a MSSD was identified by TDI before TASH in the presence of a severe gradient at rest (81 +/- 34 mmHg). In 2/5 pts the MSSD disappeared after abolition of the resting gradient (15 and 7 mmHg) and there was no recovery of MSSD and resting gradient in the follow up examinations. In 3/5 pts the MSSD pattern was present after TASH and after 6 months follow up due to persistence of LVOT gradient at rest (>30 mmHg). 1 pt had pre-TASH no MSSD pattern at rest resulting from a small gradient at rest (20 mmHg) despite significant gradient after provocation.

Conclusion: In pts with HOCM a MSSD normalizes after TASH and in the mid-term follow up period after successful abolition of the LVOT gradient (>30 mmHg at rest). MSSD obtained by TDI may be helpful not only in monitoring the catheter interventional therapy and early postprocedural period of TASH but also during follow up. This holds especially true for challenging cases with concomitant mitral regurgitation and during provocation maneuvers.

Mid-systolic septal deceleration (MSSD) in patients with hypertrophic cardiomyopathy (HCM): diagnosis of left ventricular outflow tract obstruction by colour - coded tissue Doppler echocardiography

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The obstructive form of HCM (HOCM) is characterized by the presence of dynamic left ventricular outflow tract (LVOT) obstruction (>30 mmHg) at baseline or after provocation. Correct diagnosis of these pts is of crucial importance for prognostic and therapeutic reasons. Doppler evaluation of the LVOT gradient especially during provocation maneuvers remains technically challenging.

Methods: We studied 54 consecutive pts with HCM (age 50 +/- 17 years; septal wall >15 mm) to elucidate a recently described sign of LVOT obstruction, characterized by an abrupt MSSD in the basal septal longitudinal velocity trace. In all pts septal longitudinal motion was assessed by colour-coded tissue Doppler echocardiography (TDI) at rest (>100 frames/s). Additionally transthoracic and bicycle Doppler echocardiography were performed and pts were divided into 3 subgroups of 18 pts each. Group 1 consisted of pts with hypertrophic non obstructive cardiomyopathy (HNCM); group 2 consisted of pts with HOCM without gradient at rest (22 +/- 6 mmHg rest; 90 +/- 22 mmHg after provocation). The pts of group 3 with HOCM had a gradient at rest (81 +/- 36 mmHg) and after provocation (147 +/- 37 mmHg).

Results: A characteristic biphasic systolic velocity pattern with an early (S1) and a late positive velocity peak, interrupted by an abrupt MSSD notch (defined as >25% relative or >1 cm/s absolute decrease from S1) was seen in 20 of 54 pts (37%). MSSD was identified in none of the 18 pts of group 1, but in 3/18 pts (17%) of group 2 and in 17/18 pts (94%) of group 3. The presence of an MSSD identified severe LVOT obstruction (>30 mmHg at rest) with 95% sensitivity and 92% specificity. Doppler derived LVOT gradient was significantly higher in pts with MSSD compared to those without MSSD (rest: 75 +/- 34 mmHg vs 15 +/- 8 mmHg; after provocation (bicycle exercise): 138 +/- 39 mmHg vs 54 +/- 44 mmHg). In 1 pt with HOCM with a significant obstruction at rest, but no MSSD, the baseline gradient was in the borderline area (31 mmHg); the same holds true for the pts with MSSD without a LVOT gradient at rest.

Conclusion: The presence of a MSSD pattern in the TDI velocity trace at rest is strongly associated with severe LVOT obstruction. This is comparable to the spike and dome phenomenon in carotid pulse tracing and in the invasively recorded aortic pressure tracing. This MSSD notch-pattern may constitute a new diagnostic tool for gradient characterization in pts with HCM, especially in challenging cases with concomitant mitral regurgitation and during provocation maneuvers.

Diastolic left ventricular function is improved after septal ablation for hypertrophic obstructive cardiomyopathy

L. Faber, L. Weige, H. Seggewiss, D. Fassbender, H.K. Schmidt, D. Horstkotte. Heart Center North Rhine-Westphalia, Bad Oeynhausen, Germany; 1Leopoldina Hospital, Schweinfurt, Germany

Background and introduction: Diastolic left ventricular (LV) filling is impaired in patients (pts.) with hypertrophic obstructive cardiomyopathy (HOCM). We analyzed Doppler-echocardiographic (ED) markers of diastolic LV function in a cohort of 251 pts. (mean age: 53 +/- 15 years) who underwent a septal ablation procedure (PTSMA) and who had a complete follow-up over 12 months.

Results: NYHA functional class was improved from 2.9 +/- 0.4 to 1.5 +/- 0.7 at follow-up, parallel to a reduction of the outflow gradient (LVOTO) from 58 +/- 34 to 9 +/- 16 mmHg at rest, and 122 +/- 45 to 27 +/- 32 mmHg with provocation. On average, changes in LV filling pressure, LA size, and transmitial flow by ED (see table 1) were consistent with regression of a pseudonormal LV filling pattern. When comparing pts. with marked clinical improvement (group A: >3 NYHA classes and/or >20 watts on bicycle stress test) with those who had mild or no improvement (group B), group A pts. (n=125) had a more pronounced decrease in LA size (4 +/- 6 vs. 2 +/- 5 mm) and a slightly lower residual LVOTO during stress (22 +/- 29 vs. 31 +/- 33 mmHg; p=0.03, resp.). On univariate analysis, LA size reduction was the best single correlate of NYHA class improvement (r=0.42). Stepwise multiple regression analysis revealed reduction of LA size and prolongation of e wave deceleration time as the only predictors of a clinical improvement (r=0.5; p=0.02).

Conclusions: LA size and ED transmitial flow analysis are valuable noninvasive variables to assess the functional status of HCM pts. after LVOTO reduction. A good clinical response is associated with regression of a pseudonormal to a delayed-relaxation LV filling pattern.

Table 1

<table>
<thead>
<tr>
<th>LA size (mm)</th>
<th>baseline</th>
<th>follow-up</th>
<th>p value</th>
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<tr>
<td>48 +/- 7</td>
<td>45 +/- 7</td>
<td>&lt;0.0001</td>
<td></td>
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<tr>
<td>e/a ratio of transmitial flow</td>
<td>1.15 +/- 0.46</td>
<td>0.95 +/- 0.36</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>e wave deceleration time (ms)</td>
<td>277 +/- 90</td>
<td>338 +/- 119</td>
<td>&lt;0.02</td>
</tr>
<tr>
<td>LV enddiastolic pressure (mmHg)</td>
<td>25 +/- 8</td>
<td>19 +/- 7</td>
<td>&lt;0.0001</td>
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</table>
174 Concealed myocardial storage disease in patients with hypertrophic non obstructive cardiomyopathy (HNCM): invasive and echocardiographic investigations

G. Beer, N. Stoevesandt, C. Strunk - Müller, H. Kuhn, Städtische Kliniken Bielefeld, Mitte, Bielefeld, Germany

A correct diagnosis of pts with HNCM is of importance for prognostic and therapeutic reasons. Diagnostic pitfalls may arise from concealed cardiac storage disease. Systematic investigations concerning the frequency of concealed myocardial storage disease in pts with HNCM are still lacking.

Methods: We investigated for the first time 250 consecutive patients (154 male pts and 96 female pts; mean age 56 years, range 14 to 90 years) with HNCM (septal wall >15 mm). In all pts we performed right ventricular endomyocardial catheter biopsy (EMCB) to exclude concealed myocardial storage disease additional to the diagnostic left ventricular angiogram, coronary angiography and transthoracic echocardiography.

Results: In 28 of 250 pts (11%) the result of EMCB revealed concealed cardiac storage disease mimicking the clinical features and echocardiographic features of HNCM. Amyloid heart disease was diagnosed in 7 pts (3%). The echocardiographic features of these 7 pts consisted of severe, predominantly concentric left ventricular hypertrophy (septal wall 17 to 22 mm). In 2 pts regional contraction disorders and in 4 pts small pericardial effusion were present. In 21 pts (8%) there was evidence of cardiac Fabry disease on the basis of electron microscopic evaluation. Evaluation by electron microscopy revealed in these 21 pts lysosomal concentric lamellar structures with parallel orientation typical of Fabry disease. The clinical and echocardiographic features of these 21 pts were indistinguishable from the pts with HNCM. Echocardiography revealed asymmetry of systolic left ventricular function. This is the first report about the frequency and clinical/echocardiographic features of HNCM.

Conclusion: This is the first report about the frequency and clinical/echocardiographic features of concealed myocardial storage disease in a large group of consecutive pts with HNCM. The frequency of concealed myocardial storage disease mimicking the clinical features of HNCM is unexpectedly high. This especially holds true for cardiac Fabry disease (8%). Based on this results, invasive diagnostic procedures (coronary angiography and left ventricular angiography for the detection of apical hypertrophy) and additional EMCB to rule out or to prove concealed myocardial storage disease are mandatory additional to echocardiography for the correct diagnosis and management of symptomatic pts with HNCM and pronounced left ventricular hypertrophy. This is of clinical importance because enzyme replacement therapy of Fabry disease for the first time offers a specific therapeutic option in a subgroup of pts with HNCM.

Conclusions: Correlations between individual ED and HD measurements of LVOTO severity 2 days apart were low in this cohort of symptomatic HOCM pts. considered for PTSMA. However, a Valsalva-provoked ED gradient of >100 mmHg was highly predictive for a significant provoking obstruction as measured by HD, and may therefore serve for non-invasive screening prior to non-pharmacological treatment of LVOTO in HOCM.

175 Assessment of outflow gradients in symptomatic HOCM prior to septal ablation: correlation of Doppler and invasive measurements

L. Faber, D. Welge, H. Seggewiss, D. Fassbender, H.K. Schmidt, D. Horstkotte. Heart Center North Rhine-Westphalia, Bad Oeynhausen, Germany, 1 Leopoldina Hospital, Schwanenburg, Germany

Background and introduction: Severity of left ventricular outflow obstruction (LVOTO) in hypertrophic obstructive cardiomyopathy (HOCM) may be assessed both by echo-Doppler (ED) and hemodynamic (HD) measurements, and may show substantial spontaneous variability. In a cohort of 251 highly symptomatic HOCM patients (pts., mean NYHA class: 2.9±0.4, age 53±15 years) we tested the correlation of ED and HD measurements at baseline prior to a septal ablation procedure (PTSMA).

Results: All ED and HD measurements were taken during one hospital stay with ED 2±1 days prior to HD. By ED, 199 pts. (79%) had significant (>30 mmHg) resting LVOTO by HD 216 pts. (86%), and by both HD and ED measurements 181 pts. (72%). With provocation (ED: by a Valsalva maneuver, HD: by postextrasystolic augmentation), LVOTO was >100 mmHg by ED measurement in 164 pts. (66%), by HD in 208 pts. (83%); the two methods corresponded in 156 pts. (55%). The correlation between ED and HD measurements was low (r=0.51 at rest, r=0.39 under provocation; p<0.001 each). However, a Valsalva-provoked gradient of >100 mmHg by ED was predictive for a post-ES HD gradient of the same degree or higher in 95% (198 pts.), while a resting ED gradient of 30 mmHg predicted a significant post-ES HD gradient in 85% (177 pts.).

Conclusions: Correlations between individual ED and HD measurements of LVOTO severity 2 days apart were low in this cohort of symptomatic HOCM pts. considered for PTSMA. However, a Valsalva-provoked ED gradient of >100 mmHg was highly predictive for a significant provoking obstruction as measured by HD, and may therefore serve for non-invasive screening prior to non-pharmacological treatment of LVOTO in HOCM.

176 Tissue Doppler derived indices predict exercise capacity in patients with apical hypertrophic cardiomyopathy


Background: Apical hypertrophic cardiomyopathy (apHCM) is a unique form of hypertrophic cardiomyopathy, in which the hypertrophy of myocardium predominantly involves the apex of the left ventricle (LV). Although impaired LV diastolic function is a prominent feature of hypertrophic cardiomyopathy, diastolic function and its relation to exercise capacity in apHCM has not been explored previously. This study was sought to determine the relationship between diastolic annular velocities combined with conventional Doppler indices and exercise capacity in patients with ApHCM.

Methods: Twenty-nine patients with apHCM (24 male, mean age, 57±10) underwent supine bicycle exercise with simultaneous respiratory gas analysis and two-dimensional and Doppler echocardiographic study at the same time. The mitral inflow velocities were traced and the following variables were derived: peak velocity of early (E) and late (A) filling and deceleration time (DT) of E velocity. Early diastolic mitral annular velocity (E') was measured at septal corner of mitral annulus by Doppler tissue imaging (DTI) from apical 4-chamber view. ProBNP was measured at the time of echocardiogram using a quantitative electrochemiluminescence immunoassay.

Results: E/E' correlated inversely with maximal oxygen uptake (VO2max) (r²=0.22, p<0.01). There was significant positive correlation between E' and VO2max (r²=0.17, p=0.024). However, no correlation was found between conventional two-dimensional, Doppler indices, and proBNP and exercise duration (E, r²=0.03, p=0.4; E/A, r²=0.003, p=0.76; DT, r²=0.02, p=0.44; Left atrial volume index, r²=0.004, p=0.75; proBNP, r²=0.035, p=0.33). Of all the echo and clinical parameters assessed, E' had the best correlation with exercise capacity (r²=0.22) and was the strongest independent predictor of VO2max by multivariate analysis (p<0.01).

Conclusion: Conventional transmural inflow Doppler, two-dimensional echocardiographic measures and proBNP are limited in predicting exercise capacity in patients with apHCM. DTI-derived indices (E' E/E''), an estimate of myocardial relaxation and LV filling pressures, correlate with exercise capacity in patients with apHCM, suggesting that abnormal diastolic function is an important factor limiting exercise capacity.
178 Non compaction cardiomyopathy, family report


Isolated left ventricular non compaction cardiomyopathy (NC-CM) is a rare congenital disease, which is categorized as unclassified cardiomyopathy. It is caused by a deficiency of the cardiac morphogenesis resulting in hypertrophy of the involved walls. Usually the apex with a thin fibrous epicardial layer and a heavy, spongy trabeculated endocardial layer with deep intertrabecular recesses. The disease is characterized by heart failure, systolic and diastolic events and arrhythmias. The diagnosis of NC-CM is primarily based on echocardiography, but the extent of non compaction can be visualized accurately using cardiac MRI.

A family with 3 generations (9 members, 6 male, 3 female) was screened. Grandfather died in an unknown heart disease at the age of 49 and grandmother had no heart disease. Their two sons, the 53 and 47 year old brothers showed typical NC-CM depicted by both echocardiography and cardiac MRI. They have moderately decreased systolic heart function with ejection fractions of 44 (left ventricular mass (LVM): 210 g including 72 g of NC layer) and 47% (LVM: 168 g, including 34 g NC layer), respectively. The older brother has malignant ventricular arrhythmias, and the younger one was hospitalized earlier due to atrial fibrillation. Their wives have no heart disease. 3 men are in the younger generation, one with NC-CM (preserved left ventricular function, LVM: 179 g, NC: 39 g), and two without cardiomyopathy.

The aim of our report was to call attention to this rare and hardly known disease, to demonstrate its autosomal dominant heritage, to emphasize the role of both echocardiography and cardiac MRI in its characterization and to show that the development of heart failure in non compaction cardiomyopathy is probably age related.

179 Pitfalls in the diagnosis of left ventricular hypertrabeculation/noncompaction

C. Stoellberger, J. Finsterer1. Wien, Austria, 1 Wien, Austria

Background: Left ventricular hypertrabeculation/noncompaction (LVHT) is a rare cardiac abnormality of unknown etiology, characterized by >3 left ventricular trabeculations apically to the papillary muscles, visible in one echocardiographic image plane, and intertrabecular spaces perfused from the ventricular cavity, as visualized on colour Doppler imaging. LVHT occurs with or without other cardiac abnormalities and is frequently associated with heart failure and ECG abnormalities. LVHT is frequently associated with neuromuscular disorders. Because of its rarity, LVHT has been frequently overlooked. This study gives an overview about 1) LVHT patients, in whom LVHT was initially overlooked and 2) cardiac conditions which may lead to falsely diagnosed LVHT.

Methods and results: In 50 cases reported in the literature, LVHT has been overlooked and misdiagnosed as dilated (n=20), hypertrophic (n=14), or restrictive (n=2) cardiomyopathy, endocardial fibroelastosis (n=5), endomyocardial fibrosis (n=1), myocarditis (n=3), thrombus (n=2), localized left ventricular hypertrophy (n=1), left ventricular mass (n=1) or myocardial/periocardial disease (n=1). In 14 of the 50 cases LVHT was not diagnosed by transthoracic but by transesophageal echocardiography (n=1), cardiac computed tomography (n=2) ventriculography (n=2) cardiac magnetic resonance imaging (n=3) or pathoanatomically (n=6).

Cardiac abnormalities which may be falsely diagnosed as LVHT comprise false tendons, aberrant bands, thrombi, the apical type of hypertrophic cardiomyopathy, fibroma, oblitative processes of the left ventricular cardiac, intramyocardial hematoma, cardiac metastases and intramyocardial abscesses.

Conclusion: Echocardiographers should be more aware of LVHT and consider its differential diagnoses. Additional investigations should be applied when the echocardiographic image of the apical region is poor.

181 Evaluation of isolated ventricular non-compaction by second harmonic echocardiography and magnetic resonance imaging

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Isolated ventricular non compaction (IVNC) is a rare congenital cardiomyopathy due to the persistence of primary spongy myocardium during the early development of the heart. Various imaging technique have been used in the diagnosis of IVNC. Peculiar echocardiographic findings for diagnosis of IVNC were described by standard transthoracic echocardiography (TE). The aim of our study was to evaluate the accuracy of second harmonic echocardiography (HE) in detecting the spongy myocardium in comparison to magnetic resonance imaging (MR).

Material and methods: In this report we describe 7 adult patients initially diagnosed as affected by hypertrophic cardiomyopathy (2 cases), dilated cardiomyopathy (4 cases), cardiac tumor (1 case), in wich the presence of IVNC was suspected with standard TE. Diagnostic criteria during HE were considered: 1) presence of multiple prominent trabeculations of one or more ventricular segments, 2) deep intertrabecular spaces communicat- ing, at color Doppler, with the ventricular cavity, 3) non compacted endocar- dium/compacted epicardium thickness ratio >2. MR gradient echo was performed to demonstrate thickened ventricular segments and areas of the myocardium characterized by deep intertrabecular recesses.

Results: In the present series of cases MR was very sensitive to assess the persistence of spongy myocardium in 6/7 patients in the left ventricle and in 3/7 patients the biventricular involvement. HE clearly identified the regions of spongy myocardium in the corresponding 6 patients but in only 1 HE identified the biventricular malformations. One patient with MR and HE negative studies had an exaggerated apical trabeculation of right ventricle.

Discussion: The problems on the differential diagnosis with more frequently diagnosed conditions. In addition HE demonstrated impaired systolic function of the non compacted ventricle.

Conclusions: HE can be considered the first choice in the diagnosis of IVNC. MR has a potential in patients with poor quality HE imaging and in the evaluation of right ventricle.
Abstracts

182 Isolated noncompaction left ventricle. Evidence of reduced perfusion as assessed by myocardial contrast echocardiography
A.G. Almeida, G. Pereira 1, M.M. Pedro 1, C.N. David 1, P.N. Marques 1, E.I. Oliveira 1, L. Pereira 1, J.C. Cunha 1, Lisboa, Portugal, Hospital Santa Maria, Lisboa, Portugal

Objective: Isolated noncompaction left ventricle (INLV), an unclassified cardiomyopathy, is associated to an ominous prognosis due to arrhythmias, embolism and heart failure. We hypothesised that, in patients with INLV, abnormalities of myocardium perfusion could contribute to left ventricle (LV) dysfunction and aimed to analyse the influence of perfusion as assessed by myocardial contrast echocardiography (MCE).

Methods: 12 consecutive patients (pts), from 4 families (aged 22±57 years-old; 8 men) with INLV, were included. Diagnosis was established by 2D harmonic echocardiography and colour Doppler, according to accepted criteria (Jenni, 2001). The morphologic and perfusion assessment of LV was performed according to the ASE 16 segments model. LV dimensions, thickness and thickness and ejection fraction were obtained. For perfusion assessment, all were submitted to MCE, using an infusion of Sonovue® and real time perfusion imaging (PPI, MI 0.16-0.20) and systolic triggering replenishment with flash. Each patient was submitted to 2 perfusion studies: basal and after dipyridamole (0.56 mg/kg/min). Perfusion was evaluated in each of LV segments: a) quantitatively, using 3 degrees of perfusion: 1, normal; 2, heterogeneous/reduced; 3, absent; b) quantitatively, calculating coronary reserve (CR) from the ratio of maximal acoustic intensity in dipyridamole study to maximal intensity in basal one.

Results: 6 pts were in NYHA class I, 4 in II and 2 in III. All were in sinus rhythm. LV diastolic dimension was increased in 2 pts. Reduced/low normal ejection fraction (38-50%) was present in 6 pts (Group A) and was normal in the remaining (Group B). Noncompaction was identified in 26% of segments, at mid and apical segments of lateral, inferior and septal walls, which showed increased thickness (13-18 mm) and regional hypokinesia. Hypokinesia was also present in 11% of segments morphologically normal. In Group A, more segments were involved by noncompaction/hypokinesia in comparison with Group B (p=0.005). Perfusion assessment yielded: a) A type 2 or 3 qualitative pattern in the compacted layer of 74% of the involved segments by noncompaction and/or hypokinesia; b) Quantitative: CR was reduced in the compacted layer of abnormal segments in comparison with normal ones, 2.6±1.0 vs 1.7±0.8, p=0.001.

Conclusion: Pts with INLV have regional perfusion abnormalities of both, noncompaction and morphologically normal segments, as assessed by MCE. Hypoperfusion, which may be related to micro-vessels disarray, is a possible contributory mechanism for LV dysfunction.

183 Mitral valve repair in ischemic mitral regurgitation: comparison between ring and suture posterior annuloplasty
S. Castelvecchio, A. Tatu-Chitoiu, L. Menicanti, A. Miniati, M. Ranucci, M. Di Donato, San Donato Milanese Hospital, Milan, Italy

Background: Surgical management of ischemic mitral regurgitation (IMR) is still controversial. Aim of the present study was to compare ring(R) vs suture (S)annuloplasty in pts submitted to mitral repair for chronic IMR. Success of mitral repair was defined as absence or trivial MR and failure as the presence of grade 2+ or >MR, at post-operative echocardiographic examination.

Methods: between 1998 and 2001, 233 pts underwent mitral valve repair. We identified 57 pts with IMR, who had mid term post-operative echocardiogram (6.7±7.0 mo). 40 pts (age 65±8) had R and 17 pts (69±9 years) had R. Surgical technique was performed according to surgeon’s preference. MR was graded from 1+ to 4+. All pts had CABG; associate procedures were ventricular restoration (SVR) in S; atrial septal defect closure in one. A double-armed running suture bounding the posterior annulus was constructed from tricose to tricose and pulled over a 23 mm sizer. Posterior hemi-ring annuloplasty was made with standard technique. Table shows pre and post-operative echocardiographic data.

Results: Suture induces a significant reduction of LV volumes. Pulmonary pressure is significantly reduced with both techniques as well as the degree of MR. 72.5% of suture group (29/40) and 58.8% of ring group (10/18) had trivial or none MR at mid term echocardiographic examination (success) (p=0.36).

In conclusion, the type of mitral repair in these IMR patients is equally effective and both give good results in reducing the degree of MR and pulmonary pressure. Thus, suture can be considered a valid, faster and less expensive alternative to ring annuloplasty.

184 Does coronary artery bypass grafting correct moderate ischemic mitral regurgitation?
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The aim of the study was to assess coronary artery bypass grafting (CABG) impact on moderate ischemic mitral regurgitation (IMR) observed before surgery.

Materials and methods: We analyzed 204 patients (pts) (64 -111 years old, men-126, women- 78) with a history of Q-wave myocardial infarction (MI) during the last 12 months, qualified towards CABG. During transthoracic echocardiography (TTE) before CABG we found moderate MR in 50 (24%) pts (group I), and severe MR in 12 (6%) pts (group II). Two weeks after CABG TTE was performed for MR evaluation. TTE was performed using Philips Sonos 5500 and Hewlett-Packard 2500 equipment, and recorded on a magneto-optic disc and SVHS tape for future assessment by 2 independent cardiologists.

In case of 12 pts with severe IMR, CABG with mitral plasty was performed. Results: Analysis of IMR after CABG:
Group I - no IMR change 35 (70%), decreased IMR- 12, increased IMR- 3
Group II - no IMR change 0 (0%), decreased IMR- 12, increased IMR- 0

Conclusions: 1. CABG alone has no significant impact on the frequency and severity of moderate IMR
2. In case of the group with IMR, mainly pts with an history of antero-lateral MI were considered, the groups being similar when other echo parameters were concerned (LA, LVDD, EF, WMSI) before CABG.

Table 1 Echo data of pts with IMR before

<table>
<thead>
<tr>
<th></th>
<th>No change</th>
<th>Decrease IMR</th>
<th>Increase IMR</th>
<th>p</th>
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<tr>
<td>n</td>
<td>35</td>
<td>12</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MI antero-lateral</td>
<td>19</td>
<td>10</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>MI inferior</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td></td>
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<tr>
<td>LA (cm)</td>
<td>3.9+/−0.7</td>
<td>4.0+/−0.4</td>
<td>4.0+/−0.3</td>
<td>NS</td>
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<tr>
<td>LVDD (cm)</td>
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<td>5.5+/−0.5</td>
<td>5.6+/−0.7</td>
<td>NS</td>
</tr>
<tr>
<td>EF (%)</td>
<td>41+/−12</td>
<td>40+/−11</td>
<td>39+/−10</td>
<td>NS</td>
</tr>
<tr>
<td>WMSI</td>
<td>1.8+/−0.5</td>
<td>1.8+/−0.5</td>
<td>1.9+/−0.5</td>
<td>MS</td>
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</table>

Table 1 Suture vs Ring

<table>
<thead>
<tr>
<th></th>
<th>Suture</th>
<th>Ring</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Pre-op</td>
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<tr>
<td>Post-op</td>
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<tr>
<td>Pre-opS</td>
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<tr>
<td>Post-opR</td>
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</table>

Table 1 Echo data of pts with IMR before
Effects of surgical ventricular restoration in left and right ventricular systolic and diastolic function in patients with ischemic cardiomyopathy.

A. Tatu-Chitoiu, S. Castelvecchio, L. Menicanti, C. De Vincentis, A. San Donato Milanese Hospital, Milan, Italy

Background: Surgical ventricular restoration (SVR) is a continually improving and successful technique for restoring left ventricular (LV) size and function in patients with dilated ischemic cardiomyopathy.

Aim: To evaluate LV and right ventricular (RV) systolic and diastolic function in pts with depressed pump function undergoing SVR.

Patients: 24 patients (69.3±9.0 years/4 F) with previous anterior myocardial infarction and depressed ejection fraction (EF=0.35) represent the study group. All pts had transesophageal echocardiographic study before and after an average of 20.9 months from surgery. At post-operative echo we also evaluated systolic and diastolic myocardial velocities at the level of the lateral and septal mitral annulus and of the lateral tricuspid annulus. Two pts had pre-op moderate-severe MR (L or G).

Surgical procedure was conducted under total cardiac arrest. Complete coronary revascularization was first performed in all pts. Then the ventricle was incised and a patient-specific sizer shaper was inflated in the ventricle, based on BSA (90 m²/m²). The new apex was formed around the shaper which was removed prior to closing the ventricle. Four pts had also mitral repair.

Results: One pt still had grade 3+ MR after surgery. EF significantly increased from 32.8±3.5% to 42.8% (p=0.0021). E/A (as evaluated by Doppler trans-mitral flow) was 1.0±0.5 before and 1.3±0.8 after surgery (NS); IVRT went from 117±41 ms to 110±35 ms (NS). LV mean systolic velocities were 0.05±0.01 m/s (lateral wall and septum) and for RV 8.7±1.2 cm/s. EF increased from 35±8% to 41±14% before and after surgery (p=0.0014). Aa went from 35 ms to 89 ms after surgery. LV systolic velocities increased from 1.2±0.8 to 1.3±0.9 cm/s; RV diastolic velocities increased from 0.7±0.5 to 0.8±0.7 cm/s for interventricular septum and 0.7±0.5 to 0.7±0.4 for the RV. The ratio E/Ea was less than 6 in 5 pts, between 6-15 in 17 pts, and more than 15 in 2 pts.

Conclusions: in pts with pre-op ischemic cardiomyopathy and reduced ejection fraction SVR induces a late improvement in systolic function without a deterioration of diastolic function.

Echocardiographic evaluation on the effects of glucose-insulin-potassium infusion in patients with STEMI treated with thrombolytic therapy.


Background: Glucose insulin potassium (GIK) infusion improves systolic function in patients (pts) with chronic ischemic cardiomyopathy. Also, some studies showed the efficacy of GIK to improve regional myocardial perfusion and function mainly in segment to the recently infarcted area.

Objectives: The aim of this prospective, randomized, open label study was to assess the benefit of GIK infusion on systolic and diastolic function of pts with STEMI treated with thrombolytic therapy.

Methods: One hundred and twenty pts with STEMI, mean age 56.6±10.2 years, 81 males and 37 females, were randomized within 12 hours from the onset of symptoms (mean 1.8 h) to receive GIK infusion and thrombolytic therapy (GIK group, N=78) or thrombolytic therapy only (CON group, N=40). GIK infusion was not completed in two pts. GIK infusion consisted of 25% glucose, 50IU soluble Insulin per liter and 80 mmol KCl per liter at an infusion rate of 1 ml/kg/h, over 24 h. All other therapy was standard for AMI and same in both groups. The groups did not differ in age (GIK 56.6±10.6 vs. CON 56.7±9.7 years); in m/f ratio (GIK 52/26 vs. CON 29/31) and max values of CK (GIK 1559.8±1246.7 vs. CON 1605.5±1089.7 UI). Patents with unstable diabetes before admission were excluded. We assessed ejection fraction (EF), left ventricular end diastolic (LVEDV) and end systolic volumes (LVEVS), wall motion score index (WMSI), the relationship of pick velocity rapid filling and atrial filling (E/A) 10 days after and 6 months after treatments.

Results: In the GIK group WMSI was significantly lower compared with WMSI in CON group (WMSI: 1.22 vs. 1.32, p=0.046), 10 days after treatment. In the GIK group, only, EF was significantly improved in period of 6 months (GIK group: EF 48.4% vs. 51.71%; p=0.001 and CON group: EF 45.20% vs. 46.0%; p=0.580). Diastolic dysfunction was seen in 59.1% of pts in GIK group and 73.3% of pts in CON group (p=0.140), after 10 days and in 57.9% of pts in GIK group and 71.4% of pts in CON group (p=0.276), after 6 months.

Conclusions: Glucose-insulin-potassium infusion used as an adjunct to thrombolytic therapy in patients with STEMI could improve regional systolic function in early post-infarction period. Also, GIK infusion could increase global systolic function after 6 months of treatment. The effects of GIK on diastolic function after 10 days and after 6 months did not reach a statistical significance.

Magnetic resonance for the prediction of left ventricular wall motion recovery after reperfused acute myocardial infarction.

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Magnetic resonance (MR) with contrast administration may evaluate microvascular injury and fibrosis. We sought to determine whether first-pass (FP) and delayed contrast-enhancement (DCE) MR predicts recovery of LV function after acute myocardial infarction (AMI).

Methods: We included 38 patients (pts) (mean age 56±11 years) with AMI (anterior AMI in 28) submitted to percutaneous transluminal coronary angioplasty with stent implantation. FP and DCE with gadolinium were performed 27±20 days after AMI. 2-dimensional echocardiography (2-DE) was performed before discharge (7±4 days after AMI) and at follow-up (10±1 week) to measure wall motion score index (WMSI). A 17-segment LV model was used for MR whereas a 16-segment model was used for 2-DE.

Results: Follow-up 2-DE was available in 37 pts that were subdivided in 2 groups: Recovery (RG) (n=21) and no recovery group (NRG) (n=16). Peak creatine phosphokinase was higher in the NRG (p<0.05). No significant differences in other clinical, angiographic and 2-DE variables were found between groups at baseline. The WMSI improved from 1.4±0.3 to 1.1±0.2 (p<0.001) in the RG, and was unchanged from 1.5±0.4 to 1.6±0.3 (p=NS) in the NRG. The number of segments with FP defect was not different in both groups (1.5±2.4 vs. 2.9±3.0) whereas the number of segments with DCE was lower in the RG (2.6±2.9 vs. 4.5±2.3, p<0.05). The transmural extension of DCE was 32±38% in the RG and 61±33% in the NRG (p<0.05). The DCE score (n of segments with DCE x transmural extension/100) was lower in the RG (1.7±2.4 vs. 3.4±2.6, p<0.05). A DCE score <1.5 was the more accurate MR index to predict LV recovery with positive predictive value of 78% and negative predictive value of 67% (AUC=0.72; CI95%:0.55-0.89, p<0.05).

Conclusion: DCE by MR has a moderate predictive value for recovery of LV function after reperfused AMI.
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Intra-coronary autologous bone marrow transplantation is safe and may improve hibernation and ischemia in patients with ischemic cardiomyopathy

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Objectives: To evaluate the safety and efficacy of intra-coronary autologous bone marrow (BM) transplantation in patients with ischemic cardiomyopathy without revascularization option.

Methods: 6 patients with ischemic cardiomyopathy, NYHA class III-IV, without revascularization options, ejection fraction (EF)<35%, with significant hibernation or ischemia in at least 2 myocardial segments on dobutamine stress echo underwent intra-coronary autologous BM transplantation. All the patients underwent 4 months follow up clinical evaluation and DSE.

Results: One patient developed post procedure hypotension and troponin I increase. At 4 months follow-up NYHA class improved from 3.5±0.5 to 2.3±1.0 (p<0.04), and resting EF improved from 25±7 to 28±8%, P=0.055. We observed mild improvement in resting wall motion score (WMS) in the segments with hibernation in baseline DSE (2.3±0.5 to 2.0±0.6, p=0.03) and improvement in high-dose dobutamine WMS in segments showing significant ischemia at baseline DSE (2.5±0.5 to 2.0±0.6, p=0.001).

Conclusions: In patients with severe ischemic cardiomyopathy, mild intra-coronary autologous BM transplantation is feasible, safe and may improve hibernation and ischemia.

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Echocardiographic assessment of the left ventricular global wall motion score in patients with acute myocardial infarction and primary PTCA: two different designs and their relation to reperfusion

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Background: The evolution of the left ventricular wall motion disturbances assessed by echocardiography often serves as a reference when angiographic and other reperfusion indices are evaluated in the setting of acute myocardial infarction (AMI) treated by primary PTCA.

Objective: To compare two different designs used for patient group definition when the 16 segment global wall motion score index (GWMI) is used for estimation of reperfusion indices: 1: absolute cutoff value of the final GWMI; 2: determination of the reversibility of left ventricular dysfunction.

Methods: Fifty six consecutive patients with AMI and successful PTCA<12 h (stents implanted in 93%, all LAD infarcts stented) are included. Three reperfusion indices were determined within 1 h after the procedure: ST segment resolution (ST res), corrected TIMI frame count (cTFC), myocardial blush grade (MBG). Echocardiography was performed initially within 48 h and finally (>2 months). Patients were divided in 2 groups according to the value of the final GWMI (GWMIit): Gr. Ia, n=17, significant LV dysfunction, GWMIit>=1.5; Gr. Ib, n=39, nonsignificant LV dysfunction, GWMIit<1.5. The same 56 patients were divided again according to the difference of the initial and the final GWMI (dGWMI) in other two groups: Gr. Ib n=12, irreversible LV dysfunction, dGWMIit<0.15; Gr. Ib n=44, left ventricular recovery, dGWMIit>=0.15.

Conclusion: The patients with irreversible LV dysfunction represent a uniform group with severe impairment of repersfusion. The absolut cutoff value design does not allow the seggregation of patients with such a homogeneous reperfusion profile but reveals the advantage of MBG and ST res over cTFC.

Reperfusion indices and patient groups

<table>
<thead>
<tr>
<th>Gr</th>
<th>n</th>
<th>ST res</th>
<th>cTFC</th>
<th>MBG</th>
<th>p</th>
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<tbody>
<tr>
<td>Ia</td>
<td>17</td>
<td>0.8</td>
<td>1.0</td>
<td>0.8</td>
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<tr>
<td>Ia</td>
<td>39</td>
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<td>0.00</td>
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<td>Ib</td>
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</table>

Gr - group, n - number, ST res - ST resolution, cTFC - corrected TIMI frame count, MBG - myocardial blush grade.

Conclusion: Plasma cortisol levels in early phase of AMI is correlated with the echocardiographic parameters of LV function through 3 months. Also plasma GH level is correlated with LVEDV and LVESV values of the first and the third months but not during the early phase of AMI. YLGF-1 is not related to echocardiographic parameters of LV function in early and late phases of AMI.
193 Left ventricular apical ballooning syndrome in a caucasian population: echocardiographic presentation and evolution and response to stress echocardiography

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IRCCS Policlinico S. Matteo, Pavia, Italy

Background: Left ventricular apical balloon syndrome (LVABS) is an acute coronary syndrome (ACS) characterized by chest pain, ST-T segment abnormalities similar to acute myocardial infarction with increase of cardiac enzymes and reversible balloon-like wall motion abnormalities (WMA) of LV apex in the absence of significant coronary disease, which was mainly observed in Japanese population.

Aim of the study: To describe acute and follow-up (FU) echocardiography (E) findings and response to provocative stress echocardiography (SE) of LVABS in a caucasian population and to evaluate possible pathogenetic mechanisms.

Methods: From January 2002 to April 2004 11 pts, all women, aged 59 - 83 years, admitted for an ACS fulfilled the diagnostic criteria for LVABS. All underwent coronary angiography and acute and FU E; dobutamine (DOB) SE was carried out in 7/11 pts to identify dynamic LV obstruction and ergonovine (ERG)SE in 6/11 pts to provoke coronary artery spasm; myocardial contrast (MC) E was performed in DOB SE using real time pulse inversion power Doppler to assess regional myocardial perfusion.

Results: In the acute phase all pts showed akinesia or dyskinesia with dilatation of LV apex; LV ejection fraction was 49 ± 11% and LV end-diastolic volume (EDV) 100 ± 50 ml; 5 pts showed anterior ST elevation, 5 negative anterior T waves and 1 no significant ST-T changes. Acute MCE showed a fixed apical perfusion defect in 2 pts and a slow reflowl of the apex during wash-in phase in 1 pt and 2 pts, a FU MCSE showed an improvement of perfusion defect. Low-dose DOB SE induced midventricular obstruction (peak gradient 120 mmHg) with severe mitral regurgitation and ST-depression in 1 pt, mild (38 mmHg) midventricular gradient in 1 pt and was negative in the other 5; ERG SE was negative in all 6 pts. At FU E, 9/11 pts (who had a FU < 3 months) showed complete recovery of apical WMA and 2 pts who were studied 1 month after the acute phase) a partial recovery; LV ejection fraction increased to 66 ± 4% and LV EDV decreased to 93 ± 20 ml. During FU no pt died or had recurrence of symptoms.

Conclusions: 1) In LVABS serial E shows a recovery of apical WMA and of LV function and demonstrates that WMA are caused by post-ischemic myocardial stunning; 2) Although the mechanisms of LVABS remain elusive, coronary vasoconstriction is ruled out by negative ERG SE, while midventricular obstruction elicited by sympathetic stimulation may play a role in some cases; 3) Short and medium-term prognosis of pts with LVABS seems to be good.

194 Left atrial ischemia: a determinant of diastolic function in acute myocardial infarction?

12 de Octubre, Madrid, Spain

Background: Diastolic function, considering transmural and pulmonary vein (PV) flow patterns assessed by Doppler Echocardiography, has an important prognostic value in patients after acute myocardial infarction (AMI). On the other hand, induced left atrial (LA) ischemia in patients with coronary artery disease affects LA function.

Objectives: The aim of this study was to assess the influence of LA ischemia in diastolic and LA function after AMI.

Methods: 97 patients admitted with AMI who underwent coronary angiography were included in this study. LA ischemia was considered when the origin of the atrial branch was distal to the culprit lesion (n = 10). Doppler Echocardiography was performed within the first week after AMI, assessing transmural and PV flow patterns and LA function.

Results: There were no significant differences in clinical variables and left ventricular systolic function between the two groups. Echocardiographic data are shown in the table.

Conclusions: PV flow, but not transmural flow pattern and LA function, is altered by LA ischemia. In patients after AMI the presence of left atrial ischemia has to be considered in the assessment of left ventricular diastolic function.

195 Ventricular diastolic dysfunction marker: Doppler parameters as markers of coronary artery disease in hypertensive patients

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A. Kartalis, C. Stefanadis1, I. Kallikazaros.
Hippokration Hospital, Athens, Greece, 1 Athens University, Athens, Greece

Left ventricular(LV)diastolic dysfunction is an early finding in patients with arterial hypertension, while coronary artery disease (CAD) deteriorates left ventricular relaxation. The combination of these two common diseases may aggravate left ventricular diastolic function even more.

Methods: We examined 94 consecutive patients with uncomplicated essential hypertension (63 males and 31 females, mean age 61.3 ± 9.9 years) who underwent diagnostic coronary angiography. All patients presented with typical anginal pain. Patients with diabetes mellitus or history of myocardial infarction or CAD invasive procedures were excluded from the study. All the patients underwent a complete echocardiographic study (2D,Doppler echocardiography, and Doppler tissue imaging) within 24 hours of cardiac catheterization. Significant obstructive CAD (stenosis > 60% of lumen diameter) was demonstrated in 53 patients. All patients were either on ACE-I, b-blockers or calcium antagonists for hypertension treatment. There were no significant differences between the tow groups concerning treatment.

Results: On echocardiographic Doppler examination, significant differences appeared between the two groups(with CAD, without CAD) in the bellow parameters. The deceleration time (DT) of E wave was measured as 31.5 ± 0.63 vs 23.7 ± 0.47 ms (p = 0.0001). The average of late mitral annulus velocities in 4C and 2C apical views(Ama) was found 11.88 ± 2.85 vs 10.42 ± 2.27 p < 0.01.

Conclusions: Increased LV diastolic doppler values , as DT of E,IVRT and Ama are indicative of CAD coexistence in hypertensive patients.

196 Serum copper level after myocardial infarction: relation to echocardiographic parameters

A. Fazinezhad, A.L.I. Eshraghi1, Shahid rajaei hospital, Tehran, Iran (Islamic Republic of), 1Gaem Hospital, Mashhad, Iran (Islamic Republic of)

Background: According to several studies, serum copper level increases after acute myocardial infarction(AMI). Some of these studies have suggested that this increase is of prognostic value.

Materials and methods: 45 patients with first episode of AMI were chosen (21 females and 24 males).

Sampling of patients sera were performed in 5th day after AMI and echocardiography performed in the same day. Serum copper level determined using atomic absorption spectrometry (with perkin-Elmer 3030). Parameters of systolic and diastolic performance of LV determined (

Echocardiographic data

<table>
<thead>
<tr>
<th>LA ischemia</th>
<th>Not LA ischemia</th>
</tr>
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<tbody>
<tr>
<td>n=10</td>
<td>n=87</td>
</tr>
<tr>
<td>LA SV</td>
<td>55.9 ± 23.7</td>
</tr>
<tr>
<td>LA DV</td>
<td>32.0 ± 17.3</td>
</tr>
<tr>
<td>E velocity</td>
<td>45.5 ± 14.5</td>
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<tr>
<td>A velocity</td>
<td>70.8 ± 17.3</td>
</tr>
<tr>
<td>D velocity</td>
<td>68.9 ± 26.7</td>
</tr>
<tr>
<td>E/A velocity</td>
<td>1.1 ± 0.5</td>
</tr>
<tr>
<td>S integral</td>
<td>61.9 ± 4.7</td>
</tr>
<tr>
<td>D velocity</td>
<td>53.3 ± 18.4</td>
</tr>
<tr>
<td>S integral</td>
<td>16.3 ± 3.7</td>
</tr>
<tr>
<td>D integral</td>
<td>12.1 ± 4.6</td>
</tr>
<tr>
<td>Dif Dur Ami-Apv</td>
<td>0.6 ± 0.05</td>
</tr>
</tbody>
</table>

Conclusions: Serum copper level increases significantly after AMI. There were no significant relationship between serum copper increasing and echocardiographically determined parameters of impaired LV relaxation and systolic function after acute myocardial infarction.

Key words: Acute myocardial infarction, copper, echoardiography, LV diastolic function, LV systolic function.
197  
Effect of carvedilol on left ventricular systolic and diastolic functions in patients with acute coronary syndrome with ST segment elevation  
B.A. Alyavi, A.L. Alyavi, V.Y.U. Golosokskova¹, M.M. Yakubov. Tashkent, Uzbekistan, ¹Tashkent, Uzbekistan  
The PURPOSE of our investigation was to evaluate effects of carvedilol on left ventricular (LV) systolic and diastolic functions in patients suffered from acute coronary syndrome (ACS) with ST segment elevation.  
Methods: We have examined 21 patients suffered from ACS with ST segment elevation. Initial electrocardiography, echocardiography and Doppler-echocardiography were performed in all patients enrolled in our study. LV end diastolic volume (EDV), LV ejection fraction (EF), and LV stroke volume (SV) were assessed as well as isovolumetric relaxation time (IVRT), LV PE/PA, and LV deceleration time (DT). All patients were given therapy with carvedilol at the average dose of 12.5-25 mg/day. Standard therapy included nitrates, heparin, aspirin, and ACF inhibitors. All investigations were repeated on 3rd and 7th day of the treatment.  
Results: Patients with ACS had LV systolic dysfunction and dilatation, LV ischemic changes or not.  
Methods: Patients with ACS had LV systolic dysfunction and dilatation, LV ischemic changes or not.  
Results: Patients with ACS had LV systolic dysfunction and dilatation, LV ischemic changes or not.  
Conclusion: Therapy with carvedilol resulted in LV systolic function improvement by the 7th day of the disease in patients suffered from ACS with ST segment elevation. The first insignificant effects appeared by the 3rd day of the treatment. The improving concerns mostly LV EF and SV, but it was not significantly connected with the LV EDV decreasing. Improving in diastolic function was mostly connected with PE/PA increasing, which was achieved by the 3rd day of the treatment.  

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Cases of subendocardial myocardial tears in patients with acute myocardial infarction  
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The most serious complication of myocardial infarction is ruptured myocardium. We observed 8 cases of incomplete myocardial rupture - subendocardial tears.  
Purpose: The purpose of the present study is to examine the patients with subendocardial myocardial tears after acute myocardial infarction (AMI).  
Methods: Using high resolution ultrasound we detected subendocardial tears in 8 patients of 1250 patients with AMI (0.65%) admitted in CCU from 1999 to 2003.  
Results: Subendocardial tears were detected from 2 to 10 days after myocardial infarction. The profundity of tears was from 2 to 5 mm, width of these defects was 3-5 mm at diastole. Location of tears was: interventricular septum - 5 patients, apex - 2 patients, posterior wall - 1 patient. In 2 cases the total myocardial rupture developed during acute period of AMI (in one case - free wall rupture with tamponade, in another case - interventricular septum defect), and these 2 patients died. After 1 year follow up period 6 remained patients were alive. After 1 year in the place of tears in all 6 cases we observed small aneurism, in 2 cases with thrombus formations. No pseudoaneurism were detected.  
Conclusion: Subendocardial tears are a rare complication of acute myocardial infarction. If a total myocardial rupture has not occurred in acute period, subsequently aneurism would develop in the place of tear.  

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Matrix metalloproteinase changes during dobutamine stress echocardiography; evidence for relationship with the outcome of the test  
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Introduction: Matrix metalloproteinase-9 (MMP-9) and MMP-2 are increased in peripheral blood in acute coronary syndromes. It is unknown whether MMP activation occurs after moderate ischemia provocation in chronic stable coronary artery disease (CAD). We investigated whether blood levels of MMP-2, MMP-9 are affected in patients (pts) with stable CAD during dobutamine stress echocardiography (DSE) whether it produces ischemic changes or not.  
Patients-methods: 40 pts with stable CAD were studied: age 58±12 years, ejection fraction (EF) 41±12%, with follow up post DSE 66±13 months. Antecubital vein samples were obtained at rest (R), and 30 min after DSE (REC) for MMP-2 and MMP-9 plasma levels (pg/ml). Regional wall motion abnormalities (RWMA) score using conventional 16-segments model was estimated at R and at peak Dobutamine (Dob).  
Results: 1. Pts with EF<55% (n=14) had increased MMP-2 compared to those with EF>55%, both at R and REC (197±69/208±68 vs 160±27/165±27, p=0.008 /0.022 respectively). MMP-2 at R and REC were related with score-Dob: (r=0.31, p=0.05 and r=0.42, p=0.008 respectively). MMP-9 at R had inverse relationship to score-R (r=−0.30, p=0.06).  
2. MMP-9 at R was related with the % of akinetic segments with viability detected per patient (r=−0.41, p=0.05). Pts with a biphasic response during DSE had higher MMP-9 at R (110±102 vs 85±62) and at REC (245±216 vs 82±35, both p<0.03). In contrast, there were no changes post DSE for MMP-2 regardless of ischemic response.  
3. Pts who died or decompensated to NYHA III/IV during follow up (n=12) had higher MMP-2 both at R and REC (199±70/206±67 vs 161±33/171±37, p=0.039 /0.05 respectively).  
Conclusion: 1. Ischemia provoked during DSE in chronic stable CAD induces changes in MMP-9 which are detectable in peripheral blood and are related to a biphasic response and to the presence of viable myocardium. Increased MMP-9 at rest is also related to the presence of viable myocardium 2. MMP-2 does not change post DSE ischemia. MMP-2 levels are related to the extent of induced RWMA during DSE. Increased MMP-2 is related with low EF and ominous long term cardiac prognosis, verifying its more constant pattern of expression than MMP-9.
200 Dynamic changes of matrix metalloproteinases during dobutamine stress echocardiography: evidence for relationship with inflammation indices

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Despite the established role of matrix metalloproteinase-9 (MMP-9) and MMP-2 in acute coronary syndromes, their changes after moderate ischemia in chronic stable coronary artery disease (CAD) have not been yet studied.

1. To investigate the dynamic changes of MMP-2, MMP-9 post dobutamine stress echocardiography (DSE).
2. To interrogate potential relationships to inflammation mediators during DSE.

Methods:
40 pts with stable CAD were studied aged 58 ± 12 years, with ejection fraction (EF) 41 ± 12%.

Blood samples were obtained at rest (R), 30 min after DSE (REC) for MMP-2 and MMP-9 plasma levels (pg/ml).

Interleukin-6 (IL-6) and tumor necrosis factor (TNFa) were also estimated at R. REC and peak DSE (P). C-reactive protein (CRP) was estimated at R.

Results:
1. Both MMP-2 and MMP-9 increased post DSE: (R/REC: estimated at R, REC and peak DSE (P). C-reactive protein (CRP) was estimated at R, REC and peak DSE (P). C-reactive protein (CRP) was estimated at R.
2. MMP-9 at REC was related with IL-6 at R, P and REC (r = 0.36, p = 0.024, r = 0.31, p = 0.056, r = 0.052 respectively).

3. MMP-2 and MMP-9 had no relationship either at R or REC.

4. MMP-2 was not related, reflecting a more constant pattern of expression.
5. MMP-2 changes are greater than MMP-9 ones. MMP-9 and MMP-2 increases in both MMP-2 and MMP-9 plasma levels.

MMP-9 changes are not related to the inflammation indices.

Conclusion: 1. DSE performed in pts with chronic stable CAD induces increases in both MMP-2 and MMP-9 plasma levels.
2. MMP-2 changes are greater than MMP-9 changes. MMP-9 and MMP-2 changes are unrelated.
3. MMP-9 is related to an increased baseline inflammatory status as well as to the extent of dynamic changes of cytokines induced by DSE, while MMP-2 was not related, reflecting a more constant pattern of expression.

201 Mental stress facilitates development of myocardial ischemia during exercise stress test

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Introduction: Mental stress (MS) test commonly provokes symptomatic or silent myocardial ischemia in patients with coronary artery disease (CAD), by a significant sympathetic response that differs in certain respects from the sympathetic response of physical stress.

Objective: The aims of this study were twofold: 1) to investigate the occurrence of myocardial ischemia during MS echocardiography test; 2) to test the hypothesis that MS may facilitate the development of myocardial ischemia during exercise stress test.

Methods: Study population included 49 pts (36 male, 13 female, mean age 52 ± 8 years) with angiographically confirmed CAD (26 pts multivessel CAD) and previous positive exercise stress echocardiography test (Ex).

All laboratory sessions began at noon, and the pts were studied off antianginal therapy. Anginal status, 12-lead ECG, hemodynamic parameters and echocardiography for new wall motion abnormalities were continuously monitored. MS protocol consisted of rest phase (15 min), mental task phase (5 min; subtract 75 serially from a 4-digit number) and simulated public speech task (10-15 min; describing their personal faults and shortcomings).

After MS, in all pts Ex echo stress test (Ex), according to submaximal Bruce treadmill protocol, was performed.

Results: MS was successfully performed in all pts. During MS, chest pain occurred in 6/46 pts (13%), ischemic ECG changes developed in 3/46 pts (7%; p = NS vs. angina) and new or worsening of wall motion abnormalities developed in 29/46 pts (54%; p < 0.01 vs. angina and ExG). Rate-pressure product increased significantly at MS in comparison to rest (17,470 ± 4,700 vs. 9,880 ± 2,600; p < 0.05). Ex echo after MS was also positive in all pts. However, time-to-ischemia at Ex after MS was significantly shorter than of Ex alone (5.2 ± 2.6 vs. 7.7 ± 2.2; p < 0.05). In addition, peak-rate-pressure produce was significantly lower at Ex after MS than that of Ex alone (24,500 ± 3,310 vs. 26,800 ± 4,100; p < 0.01).

Conclusion: Mental stress test triggers supersilent myocardial ischemia in significant number of pts with CAD. In addition, mental stress facilitates development of myocardial ischemia in the settings of physical exercise.

202 Ischemic cascade by real time myocardial contrast echocardiography during dobutamine stress echocardiography

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Our purpose was to assess the ischemic cascade by real time myocardial contrast echocardiography (RT-MCE) during positive diagnostic dobutamine stress echocardiographic (DSE) studies in single vessel left anterior descending (LAD) coronary artery disease. DSE was performed with RT-MCE in a group of 24 pts without basal wall motion abnormalities, single vessel LAD coronary disease and positive test. We applied the classical DSE protocol with 5 µg/kg/min dobutamine dose increase every 3 min stage, till myocardial ischemia criteria were achieved. MCE perfusion was assessed with a continuous infusion of the ultrasound agent SonoVue (Bracco, Italy). Myocardial blood flow (MBF) was estimated by RT-MCE and quantitative analysis using the Yabko 2.7 (Univ. Virginia, USA) software. In each segment of the LAD territory, septal, anterior and apical left ventricular (LV) walls, by RT-MCE we calculated A, a (and A.a) (MBF). In each DSE stage, we analysed 144 LV myocardial wall segments from basal (B), low dose (stage I), 30 lg/kg/min (stage II), high dose (stage III) and recovery (R), corresponding to a total number of 720 wall segments. Myocardial ischemia was considered when new regional wall motion abnormalities were detected or a 30% MBF drop was obtained, when compared to B stage. MBF variation was observed in stages II and III in 63% and 75% of pts, while regional LV wall motion abnormalities could be seen only in 33% and 50% of pts in stages II and III, respectively. Statistical analysis revealed a /2 values of 21 and 28 (p < 0.005) for these MBF stages II and III changes.

Conclusions: Our study showed the clinical applicability of quantitative analysis of myocardial perfusion during DSE, with significant reduction of MBF preceding the onset of regional LV wall motion abnormalities.
203 Stress echocardiography in the recognition of pulmonary hypertension in patients with collagen-vascular systemic diseases

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Introduction: Patients (pts) suffering from collagen-vascular diseases (CVD) (scleroderma (SD), antiphospholipid antibody syndrome (AAS), systemic lupus erythematosus (SLE) and CREST syndrome) develop, in about 15% to 20% of cases, pulmonary hypertension (PH), which reduces pt quality of life and vital prognosis. PH screening using echocardiography carries some limitations, mainly in the initial stages when PH appears only during effort. In spite of the technical difficulties when using the method, stress echocardiography (SE) has been advocated by PH experts as the method to use in PH screening.

Purpose: To use treadmill SE in the recognition and evaluation of PH in a population of pts with CVD.

Methods: We studied a group of 10 pts with CVD (Group A), nine women mean aged 44.4 years. Five of the pts suffered from SD, four from SLE and one from AAS. In the control group (Group B) we studied pts with similar demographic characteristics who had been referred to SE because of suspected coronary artery disease, but whose SE result was negative for myocardial ischemia. All patients underwent echocardiogram at rest in left lateral decubitus (LLD) including measurement of the pressure gradient between the right ventricle and the right atrium (RV/RAg) in pts with tricuspid regurgitation. The RV/RAg was then evaluated in the standing position (SP). During treadmill stress testing the RV/RAg was evaluated in pts with tricuspid regurgitation. For analysis purpose, the RV/RAg was calculated and registered at peak workload. We also evaluated stress testing duration, arrhythmias occurrence and left ventricular regional contractility.

Results: All pts right cavities’ size was within the normal range. Left ventricular size was also normal in all pts studied and no pt had contractility anomalies. One pt from Group A had slight left atrium dilatation and another pt, whom we excluded from the analysis, had non-rheumatic mitral stenosis. From the nine pts left in Group A, 4 (44%) developed high RV/RAg reflecting PH during exercise (40,43,70,75 mmHg), while only two pts in group B developed high RV/RAg (36 e 45 mmHg).

Conclusions: 1. Pts suffering from CVD and with normal resting echocardiogram developed severe pulmonary hypertension during exercise. 2. The results of this study emphasise the need for using SE in the early screening of PH in CVD pts and underscore the need for longterm follow-up of these pts with the purpose of clarifying the clinical implications of the results of our study.

204 Low risk of dangerous arrhythmia during dobutamine and dipyridamole stress echocardiography - A single centre study

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Pharmacological stress echocardiography (SE) is an established diagnostic and prognostic method in patients with ischemic heart disease. A potential significant complication of pharmacological stress tests is, however, a provocation of dangerous arrhythmia. The aim of the study was to assess the prevalence, types and consequences of arrhythmia occurring during SE.

Materials and methods: We performed a retrospective study of records of SE performed in Department of Cardiology between 1995 and 2003. We followed the data of 899 patients (pts) (240 women/659 men, aged 52±5 years). Dobutamine SE was performed in 735 pts (82%) and dipyridamole SE in a group of 164 pts (18%). Atropine was administered additionally to achieve submaximal heart rate in a group of 746 pts (83%).

Results: During SE there was more arrhythmic complications during dobutamine rather than dipyridamole administration significantly (see table). Serious arrhythmia was rare including one case of sustained ventricular tachycardia (VT, 0.14%) and two of paroxysmal of atrial fibrillation (0.27%) in dobutamine test. Non-sustained ventricular tachycardia occurred in 7 pts (0.78%) - including 6 from dobutamine group and 1 from dipyridamole group. Complex forms of ventricular ectopy (bigeminy and trigeminy) were induced in 52 pts (5.78%) - 48 in dobutamine SE and 4 in dipyridamole SE.

All arrhythmias were mild and withdrew spontaneously or after beta-adreno-lytic administration before the termination of the study. There was no relationship between atrophone use, age and sex. All cases of VT occurred in patients with significant coronary disease.

Conclusions: 1. The risk of dangerous arrhythmia during either dobutamine SE or dipyridamole SE is small, related to test-induced ischemia and similar in both groups. 2. Dobutamine induces ventricular arrhythmia more often than dipyridamole (p=0.048).

205 Conventional dobutamine stress echocardiography versus tissue Doppler imaging before and after coronary revascularization

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Background: Dobutamine stress echocardiography (DSE) is an established technique for detection of myocardial ischemia by visual assessment. Tissue Doppler Imaging (TDI) is a newer echocardiographic modality that allows quantitative assessment of myocardial wall motion. Aim of the study was to compare both techniques in patients with known coronary artery disease (> 50% diameter stenosis by angiography) before and 4 weeks after coronary artery revascularization.

Methods: Peak DSE was performed in 60 patients employing a standard protocol (16-segment model) using harmonic imaging. TDI was recorded simultaneously for each segment from the apical window. Conventional and TDI DSE were analyzed by two separate reviewers blinded to each other and the result of coronary angiography. A positive DSE test was defined as new or worsening regional wall motion or a decrease in E' velocity > 2 cm/s in at least 2 segments.

Results: Before revascularization, overall sensitivity for the detection of coronary artery disease was 93 % for TDI, 90% for conventional, and 98% for combined conventional and TDI DSE. The association of segmental abnormalities with a specific coronary artery is listed below. After revascularization, E' velocity increased for all segments from 11.1±1.8 to 13.4±1.3 (P<0.001).

Conclusions: TDI is highly sensitive for the detection of coronary artery disease in the LAD, conventional DSE is highly sensitive for the detection of coronary artery disease in the RCX and RCA. TDI DSE is a suitable modality to document resolution of inducible myocardial ischemia after coronary revascularization.

Table:

<table>
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<tr>
<th>Technique</th>
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<th>Negative predictive value</th>
<th>Risk ratio</th>
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</table>
206 Quantity of viable myocardium is associated with localization and extension of coronary atherosclerosis in patients with previous myocardial infarction

O.O. Nemchyha, M.I. Lutay, A.V. Tszhy, V.V. Bugaenko, O. Nemchyha1. Strazheshko Institute of Cardiology, Kiev, Ukraine, 2Kiev, Ukraine

Dobutamine stress echocardiography (DSE) is useful tool for detection of viable myocardium.

The aim of this study was to establish the correlation between quantity of viable myocardium among dysfunctional segments (SEG) of left ventricle (LV) and localization as well as extension of atherosclerotic lesions in coronary arteries.

Methods: Forty consecutive patients (mean age 52±8 years, 3 females) with the history of Q-myocardial infarction (Q-MI) and rest wall motion abnormalities underwent DSE. Those SEG of LV, which were dysfunctional at rest, but have shown an improvement of ≥1 grade of regional wall motion score during low dose dobutamine infusion (up to 10 μg/kg/min), were considered as viable. Patients were divided on two groups according to the quantity of viable myocardial SEG. Group A (n=22) consisted of patients with more than 50% of viable SEG among all dysfunctional SEG, while Group B (n=18) had 50% and less of viable SEG among all dysfunctional SEG. All patients underwent coronary angiography within 7 days. Significant coronary artery stenosis (>70% of lumen narrowing in one or more major coronary arteries) was detected in all patients. Analysis was provided according to the number of damaged major arteries and localization of significant atherosclerotic plaque.

Results: There was no significant difference between group A and B with regards to the presence of 2-vessel coronary disease (36.4% of patients vs 23.3%, respectively, p>0.05) or localization of atherosclerotic plaque in the left anterior descending artery (72.7% of patients vs 88.9%, respectively, p>0.05) as well as in left circumflex artery (72.7% of patients vs 55.5%, respectively, p>0.05). Statistically significant differences were revealed between group A and B in occurrence of 1-vessel disease (22.7% of patients vs 55.5%, respectively, p<0.05) and 3-vessel disease (40.9% of patients vs 11.2%, respectively, p<0.05), as well as significant stenosis of right coronary artery was detected in group A in 54.5% of patients versus 11.1% in group B (p<0.05).

Conclusions: Patients after Q-MI with wall motion abnormalities at rest has different quantity of viable myocardium detected by low-dose DSE according to the number of damaged coronary arteries and localization of atherosclerotic plaque.

207 Accuracy of dobutamine stress echocardiography and plasma cardiac troponin T for the detection of severe coronary disease in end stage disease

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Ischaemic heart disease is the leading cause of mortality and morbidity in patients with end-stage renal disease (ESRD) and after renal transplantation. However, the optimal non-invasive test for coronary artery disease diagnosis in this population has yet to be established. Plasma cardiac troponin T (cTnT) is persistently elevated in a proportion of ESRD patients vs 11.2%, respectively, p<0.05) and 3-vessel disease (36.4% of patients vs 88.9%, respectively, p<0.05). Statistically significant differences were revealed between group A and B in occurrence of 1-vessel disease (22.7% of patients vs 55.5%, respectively, p<0.05) and 3-vessel disease (40.9% of patients vs 11.2%, respectively, p<0.05), as well as significant stenosis of right coronary artery was detected in group A in 54.5% of patients versus 11.1% in group B (p<0.05).

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Conclusions: Patients after Q-MI with wall motion abnormalities at rest has different quantity of viable myocardium detected by low-dose DSE according to the number of damaged coronary arteries and localization of atherosclerotic plaque.

208 Relation between QT dispersion and tissue Doppler myocardial velocities in patients with myocardial infarction treated with primary angioplasty

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Increased QT dispersion (QTD) reflecting electrical inhomogeneity of myocardium is associated with high incidence of ventricular arrhythmias. The exact dependencies of QTD on left ventricular (LV) performance has not yet been well recognized.

Aim: To investigate the relation between QTD and LV myocardial velocities evaluated by tissue Doppler imaging (TDI) in patients (pts) with myocardial infarction (MI) treated with primary angioplasty.

Material and methods: Each of 38 pts aged 58.9±/−/9.6 underwent on the 7th day after MI echocardiographic study including TDI and evaluation of QTd calculated as a difference between the longest and shortest QT interval from the 12-leads ECG. The values of QTd>50 ms were considered as normal. The analysis of TDI curves comprised the following parameters expressed as their mean values from the six basal and the mid segments of LV: peak systolic velocity (Sm), peak early (Em) and late diastolic velocity (Am), isolovulation relaxation time (IRTm), peak velocity during isolovulation contraction (ICV) and isolovulation relaxation (IRV) and acceleration during isolovulation contraction (ICCA).

Results: Pts with increased QTD demonstrated greater negative IRV and greater ICA than those with normal QTd. No significant differences between both groups were shown for other echo parameters. Significant correlations between QTD and IRV were found out both for mid (r=−0.60; p<0.005) and basal segments (r=−0.38; p<0.05). In multivariate analysis including age, gender, drug assignment, infarct site, all TDI parameters, LV ejection fraction, intraventricular septum and posterior wall thickness, LV end-diastolic dimension, LV mass index and wall motion score index IRV was the only independent predictor of increased QTD.

Conclusion: In pts with MI treated with primary angioplasty QTD is related to myocardial velocities during isolovulation relaxation; higher negative IRVs reflecting greater lengthening of cardiomyocytes during isolovulation relaxation are accompanied by greater QTD.

Table 1

<table>
<thead>
<tr>
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<th>normal QTD</th>
<th>increased QTD</th>
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<tr>
<td>basal IRV (cm/s)</td>
<td>0.01−/−/−0.05</td>
<td>0.78−/−/0.98</td>
<td>0.01</td>
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<tr>
<td>basal ICA [m/s²]</td>
<td>1.14−/−/0.49</td>
<td>1.61−/−/0.75</td>
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<td>mid IRV [m/s]</td>
<td>0.24−/−/1.02</td>
<td>1.08−/−/1.19</td>
<td>0.01</td>
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<tr>
<td>mid ICA [m/s²]</td>
<td>0.84−/−/0.26</td>
<td>1.22−/−/0.48</td>
<td>0.01</td>
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</table>
Successful revascularization results in a redistribution of myocardial longitudinal deformation

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Background: Quantitative analysis of regional myocardial deformation is possible using strain (S) and strain rate (SR) imaging. Functional recovery after therapy might thus be assessed by monitoring the regional change in myocardial deformation.

Aim: To monitor regional changes in longitudinal myocardial function after successful revascularization in patients with single vessel coronary artery disease.

Methods: We prospectively enrolled 10 patients with angina pectoris having single vessel coronary artery disease (> 70%) treated with PTCA. Myocardial Velocity Imaging data sets were taken one day before and six weeks after the procedure using a GE Vivid 7. Data were acquired for all myocardial walls at high frame rate (> 180 Hz) and analysed using dedicated software (SPEQLE) to extract end-systolic strain in an 18-segment model. The change in longitudinal deformation (i.e. functional improvement) was correlated against longitudinal function pre-revascularization using linear regression and expressed as a Pearson’s correlation coefficient.

Results: A good correlation (r = 0.65; p<0.001) was found between the functional improvement after revascularization and the severity of dysfunction before revascularization (PIQ3).

Conclusion: While dysfunctional segments improve systolic function after PTCA, segments with high end-systolic deformation (above normal) before revascularization reduce systolic function after revascularization. Most likely, this is due to a compensatory mechanism where normal segments compensate for the reduced function in adjacent ischemic segments.

Is tissue velocity imaging superior to myocardial contrast echocardiography with power Doppler harmonic imaging during adenosine stress?

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The aim of the present study was to evaluate prospectively the feasibility and efficacy of a combined stress protocol using tissue velocity imaging (TVI) and myocardial contrast echocardiography (MCE). In 40 patients (pts) with exertional angina vasodilator stress was performed with adenosine (140 μg kg-1 min-1). In all pts coronary angiography was performed within one week after stress testing. In TVI recordings regional systolic longitudinal shortening was recorded at stress and during hyperemia. Abnormal function was defined as a value below the regional cut-off-values. MCE with triggered Power Doppler harmonic imaging (PDHI) was performed using bolus injections of 0.3ml Optison. Time intensity curves were analyzed according to a protocol previously evaluated for flow limiting stenoses at rest. Systolic velocities did not increase and/or postsystolic shortening was observed only in 10% of normally perfused territories. Decrease in Doppler intensities were observed only in 40% of the patients with significant coronary artery stenosis during hyperemia; whereas abnormal PDHI response was found only in 5-10% of normally perfused territories.

Conclusions: It is able to perform an combination of PDHI and TVI in a clinical scenario. Complete PDHI and TVI data sets of all left ventricular segments could be analyzed. The present study, however, demonstrates a higher sensitivity of TVI in comparison to MCE to detect significant coronary artery stenosis during adenosine stress if an i.v. bolus administration of contrast is used.

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Post-systolic shortening indicates absence of viability. New insights from the direct comparison of tissue Doppler imaging and late enhancement contrast MRI

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Background: Post-systolic shortening (PPS) refers to shortening occurring after aortic valve closure (AVC). Recently, PPS has been proposed as a sign of residual myocardial viability in patients with chronic LV ischemic dysfunction. To verify this, we compared the time from maximum systolic strain to AVC (Ts-max), by tissue Doppler imaging (TDI), with infarct transmurality by contrast-enhanced MR (CE-MR).

Methods: 6 coronary patients (65±7 years), with an ejection fraction of 34±4%, underwent TDI and CE-MR for the measurements of systolic strain and infarct transmurality, respectively. Ts-max was computed off line from apical Color TDI sequences and expressed in relation to AVC. Infarct transmurality by CE-MR (% of wall thickness) was categorized in 3 groups of increasing severity (<25%, 26-50%, >50%). All analyses were performed using the 16-segment ASE model.

Results: 76/128 segments (59%) were dysfunctional by TDI. Ts-max measurement was possible in 98.5% segments. In dysfunctional segments with <25% transmural necrosis (26/76), Ts-max occurred before AVC in 65% (17/26), whereas it occurred after mitral valve opening (MVO) in 75% (15/20) of the segments with >50% transmural necrosis. Strain values were significantly lower in segments whose Ts-max occurred after MVO than in those in which Ts-max occurred before AVC [11±6% vs 6±6%, p=0.0001]. Normalized Ts-max was also closely correlated to CE-MR% (r=0.75, p<0.0001).

Conclusion: In patients with chronic LV ischemic dysfunction, PSS is mainly seen in non viable segments by CE-MR. It therefore most likely reflects passive wall movements and should therefore not be considered as indicative of myocardial viability.
Detection of construction errors in ex-vivo coronary artery anastomoses by 13 MHz epicardial ultrasound: comparison to angiography


Objective: In CAGB, intra-operative detection of suboptimal coronary anastomoses allows revision before chest closure. We evaluated epicardial 13 MHz ultrasound as a means to detect three different coronary anastomosis construction errors and compared it to the gold standard angiography.

Methods: In total, 48 internal mammary artery to coronary artery anastomoses were constructed correctly (n=24) or incorrectly (n=24) with one technical error: suture cross-over, purse string or deep toe stitch (n=8 each), on ex-vivo pressure perfused porcine (24 anastomoses) and human hearts (24 anastomoses). Two blinded observers scored the anastomoses using epicardial ultrasound. Angiograms were made in at least 2 different oblique projections and scored by two other blinded observers. Angioscopy and cast construction errors with higher sensitivity and specificity than angiography.

Results: All anastomoses were accurately scored as correct or incorrect within 79 s (14-256) (median with range) by both observers using ultrasound (sensitivity 1.00, specificity 1.00, kappa 1.00). In 3 anastomoses, unintended irregularities were detected. Presence of plaque or calcifications was no confounding factor for ultrasound scoring. By angiography anastomoses were accurately scored with a sensitivity of 0.75 and specificity of 0.81 (p<0.001, vs. ultrasound) and kappa of 0.54. The suture cross-over could not be seen by angiography (see Figure). Angioscopy and cast confirmed ultrasound findings and did not reveal other irregularities.

Conclusions: Ex vivo, epicardial 13 MHz ultrasound allowed rapid and accurate evaluation of coronary anastomoses and detected technical construction errors with higher sensitivity and specificity than angiography.

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212 Detection of construction errors in ex-vivo coronary artery anastomoses by 13 MHz epicardial ultrasound: comparison to angiography

213 Does Athens QRS score contain more prognostic information about coronary artery disease severity than classical ST segment depression: stress echocardiographic study?


Background: Athens QRS score is shown to be a new index of myocardial ischemia even in the absence of significant ST segment changes, but its relation to stress echocardiography test results still remained unknown.

Objectives: To determine, the prognostic significance of Athens QRS score in assessment of functional significance of coronary stenosis as judged from exercise stress echocardiography results.

Methods: Exercise (EX) stress echocardiography (maximal Bruce protocol) and coronary arteriography (analysed by quantitative arteriography) were performed in 88 pts (74 male; 51±9 years; 28 with previous myocardial infarction, 60 with angina pectoris; CAD (equal or more than 50% diameter stenosis) present in 73 pts: 49 one-, 24 multi-vessel CAD). We correlated the Athens QRS score with the degree of coronary artery stenosis size accepted as over 50%.

Results: Athens QRS score was decreased as the number of stenosed coronary arteries increased; the score was unrelated to stress-induced ST segment changes didn't show the strong relation (P>0.05). Univariate regression analysis showed significant correlation between Athens score (p=0.0001) and Ex results (p=0.0004) with the number of diseased coronary vessels, while ST segment changes didn't show the strong relation (P=0.08). However, in multivariable regression analysis Athens score (p=0.0001) and Ex echocardiographic score (p=0.0002) were both significant predictors of the CAD severity described by the number of affected vessels.

Conclusion: Athens score is excellent predictor of stress induced myocardial dysfunction adding more prognostic information to CAD assessment than simple ST segment changes. Echo which contains the information about location and potential distribution of lesions should also be considered when prognostic estimates are made.

214 Echocardiographic stress test in patients with permanent pacing as a method in diagnosing of ischaemic heart disease with concomitant left ventricular hypertrophy

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 Aim: The aim of this study was to assess the utility and safety of echocardiographic stress test (EST) in non-invasive diagnosis of ischemic heart disease in patients with implanted pacemaker, left ventricle hypertrophy, and receiving B-blockers therapy.

Method: EST was performed in 40 patients with pacemaker (mean age 60±10 years, from 43 to 77) with pacemaker. Using external programming system heart rate was accelerated by 10 beats in every minute till reaching maximal heart rate. The examination was conducted only in patients with physiological stimulation of right atrium by AAI mode. Angiographically significant coronary artery stenosis size was accepted as over 50% artery diameter. Mean duration time of performed examination was 215±4.8 min. No adverse events were observed during stress echocardiography. Test visualization was good in every case. Heart rate at rest and at maximal stimulation were respectively 69±8 and 132±13 per minute (p<0.01), and systolic blood pressure 140±13 and 142±13 mmHg. In 10 (25%) patients the result was positive, in 24 (60%) negative, and in 6 (15%) non-diagnostic. Non-diagnostic result of the test was due to pacemaker limitations (1 person), and not achieving Wenckebach point (5 persons). Test specificity was 95%, sensitivity – 68%. Significant occlusion in coronary angiography were observed in 41% patients (including 1-vessel disease – 12.5%). In left ventricle hypertrophy group (n=19), the EST sensitivity was 88% and specificity 86% (without significant differences with non-hypertrophy group). The group with B-blockers medication (n=14) the observed sensitivity was 86% and specificity 100%.

Conclusions: EST is a safe, short-lasting examination with good quality of echo visualization. This method seems to be of important value in diagnosing the ischaemic heart disease in the patients with pacemaker, left ventricle hypertrophy and obligatory B-blockers medication.

215 Relationship between function of the left ventricular long axis and BNP serum levels during dobutamine stress echocardiography

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Introduction: The effect of myocardial ischemia on serum levels of brain natriuretic peptide (BNP) remains not fully elucidated. BNP is released by endocardial cells, following stimulation of special receptors by wall stress. The aim of this study was to investigate any relationship between serum levels of BNP and indices of function of the left ventricular long axis, during dobutamine stress echocardiography (DSE) induced ischemia.

Methods: We studied 71 patients (pts) (52 males, aged 55.05±14 years) who underwent a DSE study for myocardial detection ischemia. The protocol of the study included dobutamine administration in 3-minute stages of incremental dosages 10 to 50 mcg/kg/min, with atropine if needed. We applied pulsed tissue doppler imaging (TDI) from apical views to measure velocities of the basal segments of the mitral annulus. We assessed the following TDI indices at baseline and at the end of the 2nd stage of DSE study (20 mcg/kg/min), separately in each segment and then we calculated the averages: peak velocity of S wave (peak S) (cm/sec), time to peak S (peakS) (ms), deceleration time of E wave (deceE) (ms), isovolumic contraction time (IVCT) (ms), and isovolumic relaxation time (IVRT) (ms). Blood sampling took place before and 1 hour following DSE study in order to assess pro BNP serum levels with an ELISA (pg/ml).

Results: DSE studies detected myocardial ischemia in 32 (45.1%) pts, whereas BNP serum levels were normal (~80 pg/ml) in 40 (56.3%) pts and remained normal after the DSE study. BNP serum levels were not statistically different before and after DSE study (p=0.38). BNP serum levels were also not statistically different between pts with and without DSE induced ischemia before (p=0.1) and after the study (p=0.17). Baseline serum levels of BNP were negatively correlated to peak S at baseline (r=−0.39 p=0.02) and at the end of 2nd stage (r=−0.46 p=0.03), and positively correlated to IVCT at baseline (r=−0.37 p=0.03) at the end of the 2nd stage (r=0.56 p=0.006). Post DSE study serum levels of BNP were also negatively correlated to peak S at baseline (r=−0.39 p=0.02) and at the end of the 2nd stage (r=−0.46 p=0.03), and positively correlated to IVCT at baseline (r=−0.4 p=0.02) at the end of the 2nd stage (r=−0.58 p=0.004).

Multivariate regression analysis revealed that IVCT and diabetes mellitus were independent predictors of BNP serum levels both pre and post DSE study.

Conclusions: IVCT of long axis of mitral annulus predicts BNP levels independent of presence of myocardial ischemia.
Intracardiac calcification is a marker of atherosclerosis

Background: Myocardial jeopardy score (JS) is shown to be a potent predictor of stress induced myocardial ischemia containing the information about amount of myocardium at risk, but integrated evaluation of myocardial status and stenosis severity has remained unexploited.

Objectives: To determine, in the same group of patients, the predictive value of modified myocardial jeopardy score (MJS) in assessment of functional significance of coronary stenosis as judged from dobutamine-atro- pine (DobAtro), diprydamole-atropine (DipAtro) and exercise (Ex) stress echo results.

Methods: DobAtro (up to 40 µg/kg/min i.v. Dob with addition of 1 mg of atro- pine), DipAtro (up to 0.84 mg/kg Dip with addition of 1 mg of atro- pine), Ex (Bruce) and coronary arteriography (analysed by quantitative arteriogra- phy) were performed in 166 pts (133 male: 51:10 years). Of them, 81 pts had previous myocardial infarction (CAD present in 68 pts: 51 one-, 17 multi-vessel CAD). Myocardial jeopardy score is calculated for each vessel as a sum of all significant lesions represented as a product of: (1) myocardial kinetic status (1 for akinetic, 1.5 for hypokinetic, and 2 for each normoki- netic myocardial segment subserved by the vessel with equal or more than 50% diameter stenosis), (2) diameter stenosis of significantly stenosed coronary vessel (scored from 2-5), and (3) weighting flow factor for particular stenosis.

Results: Among demographic and angiographic variables (particular coro- nary artery, stenosis localization, number of diseased vessels and myocar- dial jeopardy score) only MJS and number of diseased vessels were significant univariate predictors of DobAtro, DipAtro and Ex results (p<0.0001 for all). However, in multivariable logistic regression analysis only MJS contains all prognostic information of stress echo results (p<0.0000) for all tests.

Conclusion: Myocardial jeopardy score as an excellent predictor of stress induced myocardial ischemia confirms the need for assessment both stenosis severity and myocardial status (ischemic potential) in patients with previous myocardial infarction.

Chronicotrop effects predeed inotropic changes during very low dose Beta-1 stimulation in patients with poor left ventricular function due to ischaemia: a myocardial velocity imaging study

Background: Myocardial velocity imaging (MI) allows sensitive assessment of regional myocardial function in isch- aemia, therefore we investigated the effect of very low dose DSE using velocity (V), strain rate (SR) and strain (S) imaging in patients with ischae- mic LV dysfunction.

Methods: 22 patients (20 men; age 61±10 years) with multivessel coronary disease (34% 2-vessel, 64% 3-vessel) and poor LV (mean EF 31±8% on blood pool) and preserved though reduced regional myocardial perfusion, underwent graded DSE (0-10 µg/kg/min using standard views, with digital storage and off-line analysis with 'tracking' of the region of interest throughout systole and diastole (5 mm regions used for SR comparisons) (Echopac TVI, SPEQUE (Leuven)). MI of V, SR and 5 parameters (scar and non perfused segments were excluded) were used to detect functional significance of the coronary stenosis.

Results: Heart rate increased at 5 and 10 µg/kg/min by 4 and 23% respec- tively (p<0.05 v rest) and double product increased by 7 and 24% (p<0.05 v rest). Systolic blood pressure remained constant throughout the dobuta- mine infusion (p≈ns v rest for all doses), with diastolic pressure falling at doses above 10 µg/kg/min (p<0.05 v rest). Mean segmental systolic (S) and SR remained unchanged at 2.5 and 5 µg/kg/min (p≈ns) but increased at 10 µg/kg/min (Vs 4.5 v 0.4, p=0.05 v rest; Ss increased only up to 10µg/kg/min and fell at peak (6.1 v 0.7, p<0.0005 v rest)). SRs increased at doses above 10 µg/kg/min. Similar changes occurred at 10 µg/kg/min in mid segments (Vs 3.2 v 0.4, 1.9 v 0.2 cm²/s; Ss 0.9 v 0.0 v 0.47 v 0.05 v rest); Ss showed a similar response, p≈ns v rest at 10 µg/kg/min). Apical segments had (p≈ns) differences.

Conclusions: In patients with poor LV function, the effects of Beta-1 stimulation induce a chronotrophic effect with modest but highly significant correlation with the extent of coronary disease (number of vessels diseased), r=0.4, p=0.0001 and r=0.4, p=0.0003 respectively. Neither WMSI at peak nor DWMSI showed any correlation with coronary calcium score r=0.0437, p=0.0469. Conclusions: Stress induced ischemia on echocardiography is not re- lated to the presence of non obstructive atherosclerotic disease. Our find- ings validate the use of stress echocardiography as a sensitive means of evaluating myocardial jeopardy in patients with ischaemia, indicating the presence of non obstructive atherosclerotic disease. We also observed that non obstructive atherosclerotic disease is related to the presence of non obstructive atherosclerotic disease. Our find- ings validate the use of stress echocardiography as a sensitive means of evaluating myocardial jeopardy in patients with ischaemia, indicating the presence of non obstructive atherosclerotic disease. We also observed that non obstructive atherosclerotic disease is related to the presence of non obstructive atherosclerotic disease. Our find- ings validate the use of stress echocardiography as a sensitive means of evaluating myocardial jeopardy in patients with ischaemia, indicating the presence of non obstructive atherosclerotic disease.
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220 Long axis function response to dobutamine stress in women with chest pain and normal coronary angiography

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Background: Non invasive diagnosis of women with CP and normal coronary angiography is challenging. The aim of this study was to investigate the comparative behavior of long axis function response to dobutamine stress echocardiography (DSE) in women with CP and normal coronary angiograms to those with angiographic evidence of obstructive CAD.

Methods: From 100 female patients recruited with CP suggestive of ischemic etiology and subjected to coronary angiography, only 42 patients had intact global LV systolic function (EF% >50%) and completed DSE protocol. Patients were classified into two groups according to the angiographic results. Group I: included 22 patients having normal coronaries (mean age 47.6 years) and group II: 20 patients having obstructive CAD (mean age 48.6 years). They were compared to 20 age matched healthy females as a control group. The amplitude of systolic long axis excursion was measured at rest using M-mode cursor at four sites of mitral valve ring. Then, they were repeated during low dose (10 mcg/kg/min) and peak dose (40 mcg/kg/min) of dobutamine infusion.

Results: In-group I and control, the global LV EF% significantly increased from rest to peak stress with 8.8% and 8.6% respectively. In group II, they were repeated during low dose (10 mcg/kg/min) and peak dose (40 mcg/kg/min) of dobutamine infusion. The % of LAS from rest to peak stress, it had 67% sensitivity, 80% specificity, 88% positive predictive value and 70% accuracy in the prediction of normal coronary angiogram in women with chest pain.

Conclusion: Long axis function provides a promising, quantitative adjunct to DSE for evaluation of women with intermediate probability of CAD. The incremental increase in long axis excursion during DSE may predict normal coronary angiogram.

Keywords: Long axis function – Dobutamine stress- chest pain.

221 Cardiac resynchronization acutely reduces dynamic functional mitral regurgitation in heart failure: a study using quantitative Doppler exercise echocardiography

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Background: Dynamic mitral regurgitation (MR) is frequent in heart failure patients and conveys adverse prognosis. The effects of cardiac resynchronization therapy (CRT) on dynamic MR and its determinants have never been examined. We sought to quantify the effects CRT on exercise-induced changes in the degree of functional MR in patients with left ventricular dysfunction (LVD) and the prediction of CRT response.

Methods: Seventeen heart failure patients with MR who received CRT underwent quantitative exercise echocardiography 44±11 days after implantation. The effective regurgitant orifice (ERO) of MR was quantitatively assessed by Doppler methods.

Results: During exercise, ERO increased in all patients with CRT OFF from 24±11 mm² (range: 11-44 mm²) to 39±13 mm² (range: 16-66 mm²), (p<0.001, in mode ON, ERO increased in 15 patients from 12±7 mm² (range: 3-24 mm²) to 20±6 mm² (range: 8-33 mm²) (p=0.0015) and decreased in the remaining 2. The increase in ERO was lower during CRT ON (p=0.0008). In mode OFF but not ON, changes in ERO were related to the percentage of increase in LV dp/dt (r=-0.82). Conversely, in mode ON but not OFF, changes in ERO were directly related to changes in systolic tenting area (r=-0.73).

Conclusions: CRT significantly reduces MR severity during exercise and its dynamic component. The determinants of exercise-induced changes in MR differ in a synchronous and resynthesised LV: inadequate mitral closing force and altered valve geometry, respectively.

222 Exercise echocardiography with addition of atropine

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Background: One of the determinants of the sensitivity of exercise echocardiography (EE) is maximal achieved heart rate (HR). Recent reports have suggested the possibility of adding atropine (AT) at the end of the exercise to reach maximal heart rate. We show our experience with the use of AT-EE in selected patients (pts).

Methods: From January 2003 to January 2004 we performed 797 treadmill EE studies. After excluding the presence of glaucoma, severe obstructive pulmonary disease and obstructive uropathy an intravenous line was inserted in 40(4%) of them (86-11, 30 males) to added AT if a submaximal HR was not achieved. Reasons to include the pts in the AT-EE protocol were severe lower lungs ischemia in 8, beta-blocking agents interact the day of the test or the day before with rest HR>60 bpm in 12, previous exercise testing inconclusive because of less than submaximal achieved HR in 5, lower extremities arthropathy in 4, and global disability in 11. Bruce protocol was used in 22, modified Bruce in 15 and Naughton in 3.

Results: AT was empirically administered when the HR was expected to be inferior to the age-predicted submaximal HR. In 6 pts AT was not given: because disability prevents treadmill exercise at the very beginning, in 1 because developed severe ischemia, and in 4 because of unexpected achievement of < 85% maximal HR. In the other 34 pts AT was administered to a dose of 0.25 to 2.0 mg (mean dose: 0.74±0.34 mg). Achieved Mets were 7.4. Reasons to interrupt the test were exhaustion in 24 pts, lower extremities ischemia in 9 and transient ventricular tachycardia in 1. There were no complications in all but this patient that developed ventricular tachycardia at peak exercise, coincident with severe dyspnea on the territory of a severe right coronary artery stenosis. AT was given when the mean HR was 105±12 bpm (range 85-128 bpm). The HR increase after AT was 26±9 bpm (range 2-47 bpm). Maximal HR was achieved with AT in 4 pts, submaximal in 23, and inferior to submaximal (< 85% of the age-predicted maximal HR) in 7 pts. EE showed abnormal results in 19 pts and normal in 15. Angiography was performed in 12 pts with ischemia, showing CAD in 11 (1 vessel CAD in 5 and multivessel CAD in 6); in 1 patient with necrosis (1-vessel CAD), and in 2 pts with normal result (no CAD).

Conclusion: We did not see unsafe effects of AT except a possible induction or facilitation of ventricular tachycardia in 1 patient. Conclusive tests are achieved in most of the patients with low probability of reaching submaximal HR when an atropine-EE protocol is used.

223 Quantitative strain response to dobutamine best identifies inducible ischemia at a segmental level

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Background: Post-systolic strain (PSS) measured by ultrasonic strain rate imaging (SRI) during dobutamine stress echocardiography (DSE) has been described as an accurate marker for the detection of inducible ischemia. However, these studies have been limited to describe the presence of inducible ischemia at a patient level.

Aim: To define the SRI parameter that can best identify inducible ischemia at a segmental level.

Methods: We prospectively enrolled 10 patients with angina pectoris and vessel disease >70% treated with PCI. Every patient underwent DSE (max dose 20 mcg/kg/min) one day prior PCI. At the same instance Myocardial Velocity Imaging data sets were acquired (GE Vivid7, >180 Hz) in apical views and analysed (in an 18-segment model) using dedicated software (SPEQ2). The following longitudinal SRI parameters were studied: peak systolic strain (SPSmax), end systolic strain (S es), peak systolic strain (S max) and PSS at baseline, peak dose and their response to DSE (peak-baseline). All myocardial segments were assigned to the presumed perfusion territory using coronary angiography by a blinded reader. Segments with a perfusing coronary with >70% stenosis were defined as inducible ischemia. ROC curves for the detection of inducible ischemia were made for all SRI parameters using the strain rate data as a reference.

Results: In this study population S max response during DSE was the best predictor of inducible ischemia at a segmental level. Segments that decreased in S max by more than 1% with dobutamine infusion showed inducible ischemia with specificity 89% and sensitivity 76% (AUC 0.81) (FIG1).

Conclusion: This study shows that SRI during DSE can accurately detect segments with abnormal flow reserve based on the response of S max to dobutamine.

Response to dobutamine (ROC analysis)

1. Figure
Regional systolic and diastolic myocardial strain demonstrates a base to apex gradient and biphasic response to dobutamine in ischaemic heart failure - A measure of load dependent contractility?

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Regional myocardial velocities (v) assessed by myocardial velocity imaging (MVI) have a base to apex gradient are influenced by function and tethering from neighbouring segments. Myocardial strain rate (SR) and strain (S) measure regional deformation and are comparatively unaffected by tethering and therefore are more uniform throughout the myocardium thereby making them more useful for diagnosis in patients with poor ventricular (LV) function or previous infarction. We investigated the dose response of SR and S during dobutamine stress (DSE) in such patients.

Methods: 22 patients (20 men; age 61 ± 10 years) with multivessel coronary disease (34% 2-vessel, 64% 3-vessel) and poor LV function (mean EF 22%) at rest (Vs 2.7 ± 0.8/min for basal segments only). Early (e) diastolic strain (Se) behaved similarly with a base-apex gradient at rest (Se 8.4 ± 0.9, 6.2 ± 0.7, and 3.5 ± 0.6 %) and increased up to 10 μg/kg/min (Se 9.9 ± 1.1, 7.8 ± 0.8, and 4.5 ± 0.8 %) then reduced in all segments at peak dobutamine whilst maintaining its base-apex gradient (Se 6.1 ± 0.7, 5.7 ± 0.6, and 2.9 ± 0.6 %; p < 0.05 v 10 μg/kg/min for basal segments only). Early (e) diastolic strain (Se) behaved similarly with a base-apex gradient at rest (Se 8.7 ± 0.7, 6.6 ± 0.6, and 3.2 ± 0.6 %), increasing up to 10 μg/kg/min (10.2 ± 0.9, 7.8 ± 0.6, and 4.9 ± 0.6 %), then fell at peak dobutamine (6.6 ± 0.5 %; p < 0.05 v 10 μg/kg/min for basal segments only). Early (e) diastolic strain (Se) behaved similarly with a base-apex gradient at rest (Se 8.7 ± 0.7, 6.6 ± 0.6, and 3.2 ± 0.6 %), increasing up to 10 μg/kg/min (10.2 ± 0.9, 7.8 ± 0.6, and 4.9 ± 0.6 %), then fell at peak dobutamine (6.6 ± 0.5 %; p < 0.05 v 10 μg/kg/min for basal segments only).

Conclusions: This may be used as an objective marker of the normal contractile reserve, relatively independent of the increase in HR and afterload. This could offer possibilities to differentiate regional ischemic changes due to tx vasculopathy in these patients.

225 Strain rate imaging during dobutamine stress echocardiography quantifies the regional contractile reserve after heart transplantation


Purpose: The interpretation of a dobutamine stress echocardiography (DSE) is subjective and strongly dependent on the experience of the reader. Strain rate imaging (SRl) has proven to be useful for quantifying regional myocardial function during DSE. This study investigates the clinical applicability of SRl during DSE in transplant (tx) patients and to analyze the normal regional myocardial response to DSE.

Methods: A DSE study (max 20μg/kg/min) performed in 15 tx patients, all of whom had a normal coronary angiography. Gray-scale and color myocardial Doppler data were acquired at each stage. Longitudinal strain (S) and strain rate (SR) were processed from regional myocardial velocities. Peak systolic velocity (Vmax), SR (SRmax) and S (Smax) were analyzed for eighteen segments.

Results: The visually assessed wall motion score index was normal in all patients. Heart rate (HR) and systolic blood pressure (SBP) were augmented from 76 ± 8/min, 138 ± 10 mmHg to 127 ± 8/min, 155 ± 19 mmHg. There was a significant increase in Vmax and SRmax in each segment with incremental doses. However, Smax did not increase after 10μg and showed a moderate correlation with SBP (r = -0.46, p < 0.05). Although the increase in Vmax was significantly correlated with HR (r = 0.50, p < 0.05), the increase in regional SRmax was independent from HR and SBP (r = 0.15, r = 0.20, p = NS)

Table 1

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Low dose</th>
<th>Peak dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>method 1 SRS 1/s</td>
<td>-1.15(0.31)</td>
<td>-1.63(0.45)</td>
<td>-2.07(0.66)</td>
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<tr>
<td>method 2 SRS 1/s</td>
<td>-1.47(0.54)</td>
<td>-1.96(0.65)</td>
<td>-2.68(1.03)</td>
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<tr>
<td>Strain rate imaging parameters for all methods during dobutamine stress echocardiography</td>
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</tbody>
</table>
Abstracts

227 Strain rate echocardiography at low dose dobutamine identifies segments with inducible ischemia

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Background: As previously shown, strain rate imaging (SRI) can be more sensitive for the detection of pathology than standard echo. During dobutamine stress echocardiography (DSE) it might thus detect segmental inducible ischemia at a lower dobutamine dose than the standard DSE protocol.

Aim: To define whether SRI during DSE can detect inducible ischemia at lower levels of dobutamine infusion.

Methods: 10 patients with angina pectoris and vessel disease >70% treated with PCI were prospectively enrolled. All patients underwent DSE at low dose infusion rates (10 and 20 mcg/kg/min) one day prior PCI during Myocardial Velocity Imaging (GE Vivid7; 180 Hz). All standard apical views were acquired and analysed (18-segment model) using dedicated software (SPEQLE) to extract the response of maximal longitudinal systolic velocity to dobutamine (Smax; sensitivity 76%; specificity 89%).

Results: At peak dose, segmental inducible ischemia could be accurately identified as the segments with a negative Smax response to dobutamine infusion (sensitivity 76%; specificity 89%).

Conclusion: The response of Smax to dobutamine can detect inducible ischemia at low dobutamine dose (20 mcg/kg/min). However, the infusion response of Smax cannot be decreased further as segments with inducible ischemia based on Smax response were constructed using the angiography data as a reference for the different dobutamine levels.

228 Left atrial size as a powerful predictor of cardiovascular mortality in coronary artery disease

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Background: Left atrial (LA) volume has been evaluated as an indicator of diastolic left ventricular function and predicts mortality after acute myocardial infarction. We aimed at investigating whether left atrial size determined by transplantors–echocardiography provides superior information compared to other echocardiographic variables and cardiovascular risk factors with regard to future cardiovascular mortality in patients with coronary artery disease (CAD).

Methods: In 625 consecutive patients with angiographically documented CAD LA longitudinal diameters at endstesole were determined in addition to left ventricular systolic and diastolic dimensions such as left ventricular enddiastolic (ESV) and enddiastolic (EDV) volume index. Measurements were corrected for body surface area. The population was divided according to LA size of 2.5 cm/m². During a follow-up of 3.9 years (maximum: 5.4 years) 60 cardiovascular (CV) deaths were registered.

Results: In the event group mean atrial size was significantly higher than in the control group (Mean: 5.2±5.9 vs. 3.9±1.2; p<0.0001). Patients with enlarged atrium (LA>2.5 cm/m²) had a 2.3-fold increase in risk of future CV events (Chi-Square: 0.017). Atrial dimensions correlated well with enddiastolic and endystolic volume indices (Correlation coefficients: EDVI -0.29, EDVI -0.32). All of them showed a similar increase in risk as in case of enlarged atrium (LA>2.5 cm/m²) 2.3-fold (p=0.017). In multivariate analyses including classical risk factors (p=0.015), LVD, LVSII and left ventricular ejection fraction (p<0.001) and various markers of inflammation (high-sensitivity-CRP, il-6, il-18, TNF-alfa; p<0.0001) LA remained an independent predictor of future CV mortality.

Conclusion: This prospective study demonstrates that increasing dimensions of the left atrium are strongly and independently associated with future cardiovascular mortality. Echocardiographic left atrial size as easily available variable may thus support CAD risk stratification and serve as therapeutic guidance.

229 Effects of changes in the Tei index on outcome in patients with complicated acute myocardial infarction

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Background: Early improvement in left ventricular (LV) systolic and diastolic function after acute type MI (AMI) is associated with improvement in outcome. The Tei index of combined systolic and diastolic function is a powerful predictor of outcome after AMI, however little is known regarding the importance of changes in the Tei index after AMI.

Methods: 225 patients 50 years of age or older with documented AMI and heart failure and/or LV dysfunction who were enrolled in the Optimal Trial in Myocardial Infarction with Angiotensin II Antagonist Losartan (OPTIMAAL) trial were studied. Echocardiography was performed at randomization and after 3 months, echocardiograms were analyzed blinded at core-laboratory for changes in wall motion score index (WMSI), E-wave deceleration time, and Tei index defined as the sum of isovolumic relaxation and contraction times divided by ejection time. Primary endpoint was a composite endpoint of death, hospitalisation for heart failure and new nonfatal AMI.

Results: Baseline Tei index was 0.60±0.14, after 3 months of follow-up Tei index had decreased to 0.55±0.14. In 145 (64%) patients the Tei index decreased in the remaining 80 patients (36%) the index remained unchanged or increased. During follow-up of 28±13 months 23 patients (10%) died, 25 (11%) were rehospitalized for heart failure, and 37 patients (16%) sustained a new non-fatal AMI. The event rate was significantly higher in patients with an increase of the Tei index during follow-up (26±80, versus 25±120, p<0.009). Furthermore, a reduction of 0.1 in the Tei index was associated with an unadjusted risk reduction of 0.75 (0.62-0.91), p=0.022. In a multivariate Cox analysis with adjustment for age, gender, Killip class, infarct location and use of beta-blocker, baseline Tei index, restrictive filling pattern, a reduction of the Tei index of 0.1 was associated with a risk reduction of 0.89 (0.66-0.99), p<0.05. Also baseline Tei index (relative risk 1.34 (1.12-1.61), p=0.001), and E-wave deceleration time <140 ms (relative risk 2.45 (1.40-4.26), p=0.002) were independent predictors of the composite endpoint.

Conclusion: An improvement in overall LV function assessed with the Tei index suggests reduced risk of major complications after AMI, this effect remained significant after adjustment for conventional risk factors.

230 Correlation of myocardial performance index with left ventricular dilatation and mortality in acute myocardial infarction

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Background: The Tei index is an echocardiographic index of combined systolic and diastolic function, calculated as isovolumic relaxation time plus isovolumic contraction time divided by ejection time. We evaluated the correlation of Tei index with left ventricular dilatation and mortality in patients with AMI.

Methods: Seventyseven patients (58 men,19 women) with a mean age 53±12 years who had presented with an AMI in our clinic between June 2001 and February 2002 were compared with a control group of 88 healthy subjects (63 men, 25 women) with a mean age 55±6 years. Echocardiographic evaluation was carried out within 24 hours and the third month of AMI. Echocardiographic evaluation was done using a 3.5 MHz probe with pulse wave Doppler recordings by the adult cardiac mode of Acuson C 256.

Results: 13 patients died during the follow-up period of 3 months. Tei index was significantly higher in the patients who died compared with those who survived (0.70±0.1 vs. 0.61±0.1; p=0.014). The 22 patients who had heart failure after AMI had a Tei index <0.60 whereas the remaining 19 had a Tei index >0.60. Patients were divided into two groups according to their Tei index. Patients with >0.60 Tei index had significantly higher endystolic and enddiastolic volumes compared with patients <0.60 Tei index (p<0.001 and p<0.001, respectively). Within 3 months: patients with >0.60 Tei index had significantly lower endystolic volumes (p=0.011), whereas their enddiastolic volumes did not change significantly (p=0.19).

Conclusion: Tei index is an important indicator of mortality and left ventricular dysfunction after AMI. Patients with a higher Tei index has a prognostic implication of greater left ventricular dilatation and remodeling.
Echocardiography vs. radionuclide angiography in the assessment of left ventricular systolic function following acute myocardial infarction: relation to five-year mortality

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Background: Although there is a good correlation between LV ejection fraction (EF) determined by two-dimensional echocardiography (ECHO) and equilibrium radionuclide ventriculography (RNV) in patients following acute myocardial infarction (MI), it is not clear whether assessment of LV function by different techniques may carry different long-term prognostic information.

Aim: This study sought to investigate relation of LV systolic function assessed by ECHO and RNV on five-year mortality in patients following acute MI.

Methods: We have prospectively evaluated 115 consecutive patients (86 males, mean age 55±9 years) with first acute MI who underwent ECHO and RNV during first 6 weeks after MI. Simpson biplane formula was used for LVEF calculation by ECHO. RNV was performed in the left anterior oblique view using small field-of-view gamma camera equipped with a low-energy, all purpose collimator. The data were spatially and temporally smoothed, and LVEF was determined using commercially available software. Patients were followed for cardiac mortality during five years after index MI.

Results: Mean LVEF by ECHO was 48.6±10.7%, and by RNV 48.4±12.9%. There was good correlation (r=0.81, p<0.001), but only moderate agreement (+15.6, -14.7%) between these methods. During follow-up, cardiac death occurred in 15 patients, non-cardiac death in 3, and 7 patients were lost to follow-up. Kaplan-Meier curves, constructed using traditional 40% cut-off point, demonstrated that RNV can somewhat better separate cardiac survivors from non-survivors than ECHO (log rank 10.42, p=0.001, and log rank 7.68, p=0.005, respectively). ROC analysis showed that areas under the curves for prediction of five-year cardiac death were 0.68 and 0.65 (p=0.23) for RNV and ECHO, respectively. Additionally, ECHO has low sensitivity (42.9%) but high specificity (95.5%) for prediction of cardiac mortality, whereas RNV has acceptable sensitivity (66.7%) but low specificity (50.5%). Most interestingly, ROC analysis identified LVEF of ~<33% by ECHO and ~<51% by RNV as the best cut-off points for prediction of cardiac mortality.

Conclusions: Assessment of LV systolic function by either ECHO or RNV provides similar long-term prognostic information. It appears that values of LVEF obtained by these methods should not be used interchangeably and that cut-off values should be set for each method separately.

Wall motion score index and ejection fraction for risk stratification following acute myocardial infarction

J.E. Moller, G.S. Hillis, J.K. Oh, G.S. Reeder, B. Gersh, P.A. Pellikka. Mayo Clinic, Rochester, United States of America, 1 Mayo Clinic, Rochester, United States of America

Background: The prognostic importance of regional systolic function using wall motion score index (WMSI) compared with global function using left ventricular ejection fraction (LVEF) has not been assessed in large populations after AMI. We therefore sought to compare the prognostic value of LVEF and WMSI after acute myocardial infarction (AMI).

Methods: 2 dimensional echocardiography with assessment of WMSI and LVEF were performed on 767 patients with definite AMI at a median of 1 day (interquartile range, 0-2 days) after hospital admission. In addition anterior and inferior infarct zone WMSI was assessed. Patients were followed for a median of 19 (interquartile range, 12 to 28) months. Cox proportional hazards models were constructed for the primary study end-point (all-cause mortality), and for secondary end-point (hospitalization for congestive heart failure).

Results: A close correlation between LVEF and WMSI was found (r= -0.87, p<0.00001). The correlation between LVEF and anterior infarct zone -WMSI was -0.78, p<0.0001, whereas for inferior infarct zone -WMSI was -0.61, p<0.0001. During follow-up, 168 patients died, and 54 were hospitalized for congestive heart failure. The unadjusted mortality rate increased exponentially with decreasing LVEF, but was linear with increasing WMSI. On univariate analysis, both LVEF (p<0.0001) and WMSI (p<0.0001) were powerful predictors of all cause mortality. In a forward conditional Cox model, WMSI proved to be an independent predictor of death (hazard ratio 1.17 per 0.2 unit increase; 95% Confidence interval (CI) 1.09 -1.22; p<0.0001). When WMSI was included in the model, LVEF did not provide additional prognostic information (p=0.26). In addition, the overall power of a model of clinical variables and WMSI was significantly greater (p<0.01) than a model of clinical variables and LVEF. In a stratified analysis WMSI and LVEF seem to possess the same prognostic power in ST segment elevation AMI (p=0.77), whereas WMSI was LVEF superior in non ST segment elevation AMI, p<0.001. WMSI also proved to be an independent predictor of hospitalization for congestive heart failure (hazard ratio 1.21 per 0.2 unit increase; 95% CI 1.07 -1.37; p=0.002), whereas LVEF was not (p=0.56).

Conclusion: Both LVEF and WMSI provide powerful prognostic information after AMI; however, predictive power of WMSI is greater especially in non ST segment elevation AMI.

Importance of wall motion abnormality in acute coronary syndrome without persistent ST elevation

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Aim: Wall motion abnormalities in acute coronary syndrome (ACS) associated with ST elevation is common. The significance of new resting wall motion abnormality in patients without persistent ST elevation is not fully investigated. The aim of this study was to assess the importance of wall motion abnormality in ACS without persistent ST elevation.

Patients and methods: 50 consecutive patients (18 female, mean age 67; 32 male, mean age 61) with ACS without persistent ST elevation admitted to CCU were studied. Venous blood samples for determination of Troponin-I levels were obtained immediately and 6 hours after admission using AxSyB Troponin-I assay in all patients. 12 lead ECG during chest pain and ten minutes after were obtained. All patients underwent complete resting 2D-echocardiographic examination. Coronary angiography was performed in all pts within 24 hours.

Results: 17 pts (34%) had wall motion abnormality, 2 pts out of 17 pts (12%) were 15 of out 33 pts Troponin-I positive (45%) (p<0.001). 4 of 13 pts with no ECG change during chest pain (31%) and 13 out of 37 with significant ECG change during angina (35%) had wall motion abnormalities (p=0.05). The localization of ST changes and wall motion abnormalities were identical. Significant coronary stenosis was demonstrated in all patients. 26 pts had single vessel, 14 pts had two-vessel and 10 pts had triple vessel disease. PCI were performed in 47 cases. 15 interventions out of 17 patients with wall motion abnormalities were performed in vessels supplying hypo- or akinetic territory.

Conclusion: Resting wall motion abnormalities are often in Troponin-I positive patients with acute coronary syndrome without persistent ST elevation. Detection of wall motion abnormality may help to select the culprit lesion in cases of multivessel disease.
234 Effects of surgical ventricular restoration on determinants of functional mitral regurgitation in anterior myocardial infarction with depressed left ventricular function

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Background: Surgical ventricular restoration (SVR) is a continuously improving and successful technique for restoring left ventricular (LV) size and function in patients with dilated ischemic cardiomyopathy.

Aim: To evaluate the effect of SVR without mitral repair on functional MR in pts with depressed pump function.

Patients: 60 patients (65 +/- 10 years/11 F) with previous anterior myocardial infarction were selected from 190 pts underwent SVR if they had EF <= 35% and no associate mitral procedure.

Echo measures were done in triplicate. MR was graded from 0 to 4 in a semiquantitative way. Forty-nine pts had mild to moderate MR (10 grade 2+ or greater).

Surgical procedure was conducted under total cardiac arrest. Complete coronary revascularization was first performed in all pts. Then the ventricle was incised and a patient-specific sizer shaper was inflated in the ventricle, based on BSA (60 m²/m²). The new apex was formed around the shaper which was removed prior to closing the ventricle.

Results: End diastolic and end systolic volume increased from 214 +/- 66 to 138 +/- 41 and 51.57 +/- 59 to 30.26 ml (p < 0.0001), respectively; EF improved from 27.8 to 37.7% (p < 0.010).

Only 3 pts still had grade 2+ MR after surgery. Geometric measures are reported in the table 1.

Conclusions: SVR induces a improvement in pump function in pts with pre-op ischemic cardiomyopathy and reduced ejection fraction. Determinants of functional MR improve significantly, thus leading to an improved mitral functioning. Further experience is needed to establish whether SVR without mitral repair in mild to moderate ischemic MR may prevent late occurrence or recurrence and impact the prognosis of these patients.

Table 1

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<tr>
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<th>Pre-op</th>
<th>Post-op</th>
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<tr>
<td>Mitral annulus (cm²)</td>
<td>32 +/- 7</td>
<td>31 +/- 8</td>
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</tr>
<tr>
<td>Tenting area D (cm²)</td>
<td>3.3 +/- 1.2</td>
<td>2.6 +/- 1.1</td>
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</tr>
<tr>
<td>Tenting area S (cm²)</td>
<td>2.3 +/- 0.9</td>
<td>1.8 +/- 0.8</td>
<td>0.05</td>
</tr>
<tr>
<td>Papillary Distance D(cm)</td>
<td>3.2 +/- 1.1</td>
<td>2.8 +/- 1.2</td>
<td>0.028</td>
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<tr>
<td>Papillary Distance S(cm)</td>
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<td>1.9 +/- 1.1</td>
<td>0.05</td>
</tr>
<tr>
<td>Short axis (m)</td>
<td>5.4 +/- 1.1</td>
<td>4.8 +/- 1</td>
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<tr>
<td>Degree of MR</td>
<td>1.2 +/- 1</td>
<td>0.7 +/- 0.6</td>
<td>0.0058</td>
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</tbody>
</table>

235 Left ventricular ejection fraction and volumes as predictors of clinical endpoints after coronary artery bypass grafting - 10 years' follow-up

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Introduction: As assessment of individual risk for potential clinical cardiovascular endpoints in patients who underwent coronary artery bypass grafting remains a subject of debates, we focused on post-op left ventricular volumes (LVVs) and ejection fraction (LVEF) as possible predictors.

Methods and results: 120 consecutive patients hospitalized for coronary artery disease to be treated with CABG at our Institute were determined LVEF and LVVs (telesystolic and telediastolic) early post-op. Over a 10-years follow up period, we analyzed recurrence of angina, acute myocardial infarction and other clinical cardiovascular events requiring in-hospital treatment and investi-gation. Other therapeutic appearance correlated with disturbance of the echo parameters we studied.

Results: The mean age was 59.6 ± 6.4 years (range 41 - 71 years), with male in majority (82%) and more than a half (61%) with a myocardial infarction prior to CABG. Post-op, mild and moderate LVEF reduction was observed in 41% of patients, while 24% of patients had increased both LVV. New coronary events occurred in 31 patient who developed angina (37.2%), 11 patients had a new myocardial infarction (13.2%), congestive heart failure was present in 12 patients (14.4%), while 32 patients died (38.4%). Reduced LVEF and increased LVVs haven’t been proven predictive of new coronary events, but they have a predictive value for congestive heart failure and mortality.

Conclusion: Reduced left ventricular ejection fraction and increased left ventricular volumes early after coronary artery bypass grafting had no influence on appearance of new coronary events, but did predict development of congestive heart failure and mortality.

236 CABG alone in patients with ischemic cardiomyopathy and mitral incompetence: left ventricular function at late follow up

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Background: The issues regarding the appropriate management of pts with ischemic mitral regurgitation (MR) and advanced left ventricular (LV) dysfunction are controversial and limited. The study was undertaken to evaluate late postoperative dynamics of ischemic MR, LV dimensions and function in pts with ischemic cardiomyopathy (ICM) and mild to moderate MR who underwent CABG alone.

Materials and methods: 199 pts with available 1-year follow-up data were retrospectively included into the study, among them 73 pts with ICM (LV ejection fraction (EF) < 50%) and 126 pts with ICM and moderate MR, who underwent isolated CABG (gr.1), 66 pts with ICM and none or mild MR, who underwent isolated CABG (gr.2) and 60 pts with ICM and moderate MR, who underwent CABG combined with mitral valve repair (MV) (gr.3).

In 3gr. MR repair consisted of annuloplasty combined with valvuloplasty in 29 (48.3%) pts and isolated annuloplasty in the remaining. Echocardiographic investigation included: 1) quantification of MR, 2) evaluation of LV dimensions and function and 3) pulmonary artery pressure preoperatively, within 10-14th day and 1 year after surgery. MR was graded by color Doppler mapping using the measurement of regurgitant jet area, size of the proximal jet area and effective regurgitant orifice.

Results: At late follow up severity of MR did not differ from the preoperative in 1gr. (2.1 ± 0.5 vs 1.97 ± 0.8), increased and significantly differed from the preoperative values in 2gr. (0.76 ± 0.43 vs 1.44 ± 0.77, p < 0.05), but was significantly lower in 3gr. (2.8 ± 0.5 vs 1.6 ± 0.7, p < 0.05). At late follow up in 1gr. LVEF end systolic volume index (ESVI) had tendency to increase, end diastolic volume index (EDVI) increased from 69.6 ± 22.6 to 79.6 ± 23.2 ml/m². EF increased from 27.9 ± 5.9 to 31.3 ± 9.4%, pulmonary artery pressure (PAP) increased from 31.9 ± 7.0 to 39.5 ± 17.4 mmHg. In 2gr. - LV volumes had tendency to increase with EF in 3gr. LVEF ESVI decreased markedly from 54.6 ± 16.9 to 47.1 ± 21.7 ml/m². EDVI had tendency to decrease. EF increased from 28.9 ± 8.6 to 36.5 ± 11.3%, PAP decreased from 35.5 ± 6.0 to 32.8 ± 8.3 mmHg.

Conclusions: Isolated CABG in pts with ICM and mild to moderate MR is insufficient in reducing MR. In pts with ICM and none or mild MR does not effectively prevent progression of LV dysfunction.

237 Clinical and prognostic significance of ischemic mitral regurgitation after acute myocardial infarction

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Aim of the study: our purpose was to assess the impact of the occurrence of ischemic mitral regurgitation after an acute myocardial infarction on the evolution of these patients during hospitalization.

Material and methods: We prospectively studied 985 consecutive patients enrolled in the acute myocardial infarction (AMI) registry of the Department of Cardiology of our Institute, between 1998-2003. The mean age of the pts was 60.52 ± 11.82 years old with a large preponderence of the male sex (73.2%). The data was prospectively added in a database, for all patients: demographical characteristics, clinical, and echocardiographic data and coronary angiograms. All pts were unsedated for the transesophageal echocardiography. Mitral regurgitation was assessed with a 4 graded scalae. We defined MR grade 3 and 4 as severe drug and grade 1 and 2 as mild drug. We used the Ross, the Malaysian and the Cardiacアウトフレームの設定を確認してください。
Long term prognostic value of real-time myocardial microcirculation assessment in patients with non ST elevation myocardial infarction


The recently developed non-invasive imaging techniques are associated with the iv administration of myocardial contrast echocardiographic (MCE) agents to assess left ventricular (LV) myocardial perfusion in real time (RT-MCE). Our aim was to apply RT-MCE of the LV, during the early phase with the iv administration of a 2nd generation ultrasound MCE agent, Sonovue (Bracco, Rovi SA, Italy), at 3rd day post AMI. We performed 2D imaging acquisition in grey scale, with a multifrequency 3v2c probe and second harmonic H4.0 (within 72 hours from the chest pain onset) with mitral regurgitation (Vmax 3 m/s). Our aim was to apply RT-MCE of the LV, during the early phase with the iv administration of myocardial contrast echocardiographic (MCE) agents to assess left ventricular (LV) myocardial perfusion in real time (RT-MCE). Our aim was to apply RT-MCE of the LV, during the early phase with the iv administration of myocardial contrast echocardiographic (MCE) agents to assess left ventricular (LV) myocardial perfusion in real time (RT-MCE).

The aim of the study was to evaluate the clinical usefulness of doppler parameters dP/dt and dP/dt in patients with acute coronary syndrome - 3-month follow-up I. Graczak, W. Braksator, A. Mamcarz, K. Sadkowska, M. Dluzniewski. 1/ Division of Medical University, Warsaw, Poland.

Aim: To verify whether age affects the prognostic value of stress echo in different clinical situations. The study population was divided into 3 different risk groups: low risk group: dP/dt >1.5; moderate risk group: dP/dt between 1.00 and 1.5; high risk group: dP/dt <1.00.

Results: Follow-up was 3 months. 7 patients died. In 10 pts no cardiac events were observed. In 31 pts at least one cardiac event was observed (VF/VT, shock, pulmonary oedema, asystolia, conduction disorders, exacerbation of heart failure, recurrence). In the remaining 14 pts full data are not available.

Conclusions: 1/ dP/dt and –dP/dt are strong prognostic factors of death and cardiac events in patients with ACS.

2/ Fast identification of high risk patients is possible thanks to evaluation of dP/dt and –dP/dt.

Risk groups

<table>
<thead>
<tr>
<th>Group I (high risk)</th>
<th>p</th>
<th>Group II (moderate risk)</th>
<th>p</th>
<th>Group III (low risk)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>23.5%</td>
<td>0.005</td>
<td>11.7%</td>
<td>0.005</td>
<td>5%</td>
</tr>
<tr>
<td>Cardiac events</td>
<td>63.4%</td>
<td>0.002</td>
<td>46.2%</td>
<td>0.003</td>
<td>14.3%</td>
</tr>
</tbody>
</table>

Age-dependence of the prognostic value of inducible ischemia in diabetes mellitus

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Aim: To verify whether age affects the prognostic value of stress echo in different clinical situations. The study population was divided into 3 different risk groups: low risk group: dP/dt >1.5; moderate risk group: dP/dt between 1.00 and 1.5; high risk group: dP/dt <1.00.

Results: Ischemia at stress echo (new or worsening of preexisting wall motion abnormality) was assessed in 2040 (37%) cases. During a mean follow-up of 42 months, 411 (8%) patients died. Additionally 1606 (29%) patients underwent coronary revascularization and were censored. Among 13 clinical and echo covariates, resting wall motion score index, ischemia at stress echo, and age independently predicted mortality. Four groups of patients were considered: D under 65 yy (n=366), ND under 65 yy (n=2938), D over 65 yy (n=381), and ND over 65 yy (n=1769).

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Conclusions: Prognostic value of inducible ischemia is age-dependent in D but not in ND.

Assessment of doppler parameters dP/dt and –dP/dt in patients with acute coronary syndrome - 3-month follow-up I. Graczak, W. Braksator, A. Mamcarz, K. Sadkowska, M. Dluzniewski. 1/ Division of Medical University, Warsaw, Poland. 2/ II Division of Medical University, Warsaw, Poland.

Introduction: Doppler parameters dP/dt and –dP/dt are indicators of left ventricle (LV) function. dP/dt reflects LV systolic function and –dP/dt diastolic function. They do not depend much on preload, afterload, heart rate and the rhythm. These indexes are used mainly in assessment of patients with heart failure.

The aim of the study was to evaluate the clinical usefulness of doppler parameters dP/dt and –dP/dt in identification of high risk patients in the group of patients with ACS.

Material and methods: 55 patients (33 female, 22 male, mean age – 69 years) hospitalized because of ACS with or without ST segment elevation (within 72 hours from the chest pain onset) with mitral regurgitation (Vmax > 3 m/s) evaluated by CW-Doppler were enrolled into the study. The patients were not qualified to PCI. In all the patients echocardiography was performed, besides standard parameters defining systolic and diastolic function of left ventricle (EF, WMSI, E/A, DT etc) dP/dt and –dP/dt were evaluated. Endpoints parameters were cardiac death and major cardiac events during 3 months of follow up. The patients were divided into 3 groups: 1/ high risk group: dP/dt <700 and –dP/dt <500; moderate risk group: dP/dt between 700-1000 and –dP/dt between 500-700 and III low risk group: dP/dt >1000 and –dP/dt >700.
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7 year follow up after dobutamine stress echocardiography.
Impact of gender on survival
E. Biagini, V. Rizzello 1, A.F.L. Schinkel 1, B.J. Krenning 1, C. Pedone 1, J.R. Roelandt 1, J.J. Bax 2, D. Poldermans 3, S. Orsola, Bologna, Italy, 1Thoraxcenter Erasmus MC, Rotterdam, Netherlands, 2Leiden University Medical Center, Leiden, Netherlands

Purpose: The aim of this study was to investigate the effects of gender on long-term survival in patients undergoing dobutamine stress echocardiography (DSE).

Methods: We studied 2276 men and 1105 women who underwent DSE (up to 40 mg/kg/min) for the evaluation of known or suspected coronary artery disease (CAD). Follow-up events were cardiac mortality and nonfatal myocardial infarction (hard cardiac events). Multivariable Cox regression analysis was used to identify the independent predictors of follow-up events.

Results: DSE was normal in 687 (30%) and 483 (44%) women (p<0.0001). New wall motion abnormalities were present in 1194 (52%) men and in 416 (38%) women (p<0.0001). During a mean follow-up of 7–3.4 years, there were 894 (28%) deaths, of which 442 (13%) were attributed to cardiac causes. One hundred forty-five (4%) patients experienced nonfatal myocardial infarction during follow-up, with a higher incidence in men. The annual hard cardiac event rate in patients with a normal DSE was 2.5% in men and 1.2% in women (p<0.0001). Independent predictors of hard cardiac events in patients with a normal test were male gender (HR: 1.7 [1.1-2.8]), age (HR: 1.02 [1.01-1.04]), history of heart failure (HR: 3.4 [1.5-7.9]), previous myocardial infarction (HR: 1.7 [1.1-2.8]) and diabetes (HR: 2.4 [1.3-4.5]). Independent predictors of cardiac death and nonfatal myocardial infarction in patients with an abnormal DSE were age (HR: 1.03 [1.02-1.04]), history of heart failure (HR: 1.7 [1.3-2.1]), diabetes (HR: 1.4 [1.1-1.8]), heart rate at rest (HR: 2.8 [1.4-5.8]) and wall motion abnormalities (HR: 1.06 [1.04-1.09]) and ischemia (HR: 1.04 [1.02-1.07]).

Conclusion: DSE provides independent prognostic information in both men and women. In patients with normal DSE, gender is independently associated with cardiac events. The outcome of patients with abnormal DSE is not related to gender after adjusting for stress echocardiographic data. Therefore, women with abnormal DSE should be treated as aggressively as men.

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Long-term prognostic value of contractile reserve and ischemia during dobutamine stress echocardiography in patients with ischemic cardiomyopathy undergoing coronary revascularization
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Background: Contractile reserve (CR) and ischemia represent different features of myocardial viability. Aim of the present study was to evaluate the relative role of CR and ischemia in the prediction of long-term prognosis after revascularization.

Methods: Low-high dose dobutamine stress echocardiography (DSE) was performed before revascularization in 128 consecutive patients with ischemic cardiomyopathy. Cardiac events were evaluated during a 5 years follow-up. Clinical, angiographic and echocardiographic data were analysed to identify predictors of cardiac death and composite cardiac events.

Results: Univariable predictors of cardiac deaths were the presence of multi-vessel diseases (HR 0.21), baseline LVEF (HR 0.90), the wall motion score index (WMSI) at rest (HR 4.02), low-dose (HR 7.01) and peak DSE (HR 4.62), the extent of scar tissue (HR 1.39) and the presence of CR in at least 25% of dysfunctional segments (HR 0.34). The best multivariable model to predict cardiac death included the presence of multi-vessel disease, the WMSI at low-dose DSE and the presence of CR in at least 25% of severely dysfunctional segments (Chi-square 43.96, HR 9.62 CI 3.99-23.14, p<0.0001). Inclusion of ischemia to the model did not provide any additional predictive value. During the 5 years follow-up, cardiac death occurred less frequently in patients with CR (10%) as compared to patients without CR (29%). Figure 1. Similarly, composite cardiac events occurred in 24% and 39% of patients, respectively (p=0.04).

Conclusion: The findings in the present study showed that in patients with ischemic cardiomyopathy the extent of CR was a strong predictor of long-term prognosis. Conversely, ischemia did not add significantly in the prediction of outcome after revascularization.

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Long-term survival of patients with chest pain syndrome and angiographically normal or near normal coronary arteries: the additional prognostic value of dipyridamole stress echocardiography
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Background: Patients with normal coronary arteries have a heterogeneous prognosis.

Aim: To assess whether stress echo positivity identifies a prognostically less benign subset.

Methods: From the Institute of Clinical Physiology data bank, we selected 487 patients (259 males; 56±10 years) with angiographically non-significant (<50% visually assessed) stenosis in any major vessel and preserved left ventricular function (Ejection Fraction >45%), who underwent pharmacologic stress echocardiography with either high dose dipyridamole (n=457) or high dose dobutamine (n=30) (DET). All patients were followed-up for a median of 86 (range 1 to 219) months.

Results: Mean wall motion score index at rest was 1.1±0.2. DET positivity for regional dysfunction occurred in 44 (9%). Coronary arteries were smooth in 391, and with mild (0-20%) or moderate (20-40%) irregularities in 60 and 32 patients respectively. The total mortality was 39% (8%). Kaplan-Meier survival estimates showed a significant better outcome for those patients with negative DET compared to those with positive DET (Fig). At multivariate analysis, age (HR=1.04, CI 95%=1.0-1.08), irregularity on coronary arteriogram (HR=2.5, CI 95%=1.3-4.7), smoking habit (HR=2.0, CI 95%=1.02-3.9), diabetes (HR=3.0, CI 95%=1.1-7.8) and wall motion score index at peak stress (HR=4.8 CI 95%=1.8-13.0) were independent predictors of all cause death.

Conclusions: DET adds incremental value to the prognostic stratification achieved with clinical and angiographic data in patients with normal or near normal coronary arteries.
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Long-term prognostic value of exercise stress echocardiography in patients with known or suspected coronary artery disease

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Benevento, Naples, Italy, 1 Ospedale Vincenzo Monaldi, Naples, Italy, 2 Second University of Naples, Naples, Italy

Objectives: The purpose of our study was to assess the prognostic significance of cardiac events of exercise stress echocardiography (ESE), and the ESE additional role compared to other traditional clinical and rest echo variables, in a population of patients with proven or suspected coronary artery disease (CAD).

Methods and results: Clinical status and long-term outcome were assessed in 507 patients, for a mean period of 46 months (range 4-60). ESE was performed for diagnosis of suspected CAD in 226 patients (44.5%), and for risk stratification in 281 patients (56.5%). Patients underwent ESE by bicycle ergometer in supine position using a standard protocol. In baseline conditions, the mean value of WMSI was 1.22±0.36, and the mean left ventricular ejection fraction (EF) was 58.5±10.9%. The stressecho was positive for ischemia in 179 patients (35.8%), while the ECG was suggestive for ischemia in 130 patients (25.8%). During the test only 83 patients (16.3%) experienced angina. At peak effort, the mean WMSI was 1.38±0.46, and EF was 62.3±9.8%. 76 patients failed to reach the endpoint target rate. Cardiac-related death and non-fatal myocardial infarction were considered hard events. During the follow-up period there were 56 hard events (11.1%), including 33 death (6.5%) and 23 acute non-fatal myocardial infarction (4.6%). The other cardiac events were: angina pectoris in 26 patients (5.1%), heart failure in 13 (2.6%), PTCA in 61 (12%), CABG in 17 (3.4%). By stepwise multivariable model, using Cox regression analysis in the overall population previous myocardial infarction (p<0.01), peak WMSI (p<0.001), positive ESE for ischemia (p<0.001) and submaximal exercise test (p<0.01) were the only independent predictors of cardiac death. In addition, peak WMSI (p<0.001), positive ESE for ischemia (p<0.001), cigarette smoking (p=0.01) and angina during the test (p<0.01) were the only independent predictors of hard events. By Kaplan-Meier life-table procedure, the mean survival time was 57.8 vs. 48.6 months (in patients with negative vs. positive ESE for ischemia, respectively; Log Rank: 13.1; p<0.00001).

Conclusions: Exercise stress echo yields prognostic information for risk stratification of patients with known or suspected CAD. The combined evaluation of clinical and different ESE variables, such as peak WMSI and exercise capacity, can further select patients at greatest risk of cardiac hard events in the overall population.

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Prognosis of patients with akinesis becoming dyskinesis during dobutamine stress echocardiography

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Background: Akinesis becoming dyskinesis at high-dose dobutamine stress echocardiography (DSE) has been disregarded as a marker of myocardial ischemia. The impact of this pattern during the follow-up of pts with coronary artery disease has not been studied yet.

Objectives: To assess the long-term outcome of pts who developed dyskinesis during high-dose DSE in > then 1 left ventricular akinetic segment.

Methods: 731 patients (age 62±15 years, 86% men) underwent DSE and were followed for a mean period of 5±2.7 years. End-points during follow-up were all causes of mortality and hard cardiac events (cardiac death+non-fatal myocardial infarction [MI]+heart failure).

Results: 480 pts (66%) had a history of old MI. Dyskinesis at peak stress developed in 61 pts (8%). Ischemia at DSE was detected in 682 pts (93%). During follow-up, 243 pts (33%) developed hard cardiac events: in particular 50% and 44% were respectively the percentage of pts with and without dyskinesis at peak stress (P<0.03). 226 pts (31%) died of various causes (cardiac death in 172 pts). The annualised hard cardiac event rate was 11% in pts who developed dyskinesis at peak stress and 6% in pts who did not develop dyskinesis (p<0.03). See figure attached. There was no significant difference between the two subgroups of pts when the endpoint was total mortality.

None of the clinical or stress test data were predictive of cardiac events.

Conclusions: Pts who developed dyskinesis at peak stress had a worse outcome compared to pts who did not develop dyskinesis at peak stress.
Abstracts

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Long-term prediction of mortality in the elderly by dobutamine stress echocardiography

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Purpose: Dobutamine stress echocardiography (DSE) was shown to provide incremental prognostic information. However, its role in the prediction of mortality in the elderly is not well defined. The aim of this study was to assess the value of DSE in the prediction of mortality and cardiac hard events during long-term follow-up in patients older than 65 years.

Methods: We studied 1434 patients (mean age 72 ± 3 years) who underwent DSE for evaluation of coronary artery disease. Follow-up events were total mortality and hard cardiac events (cardiac mortality and nonfatal myocardial infarction). Multivariable Cox regression analysis was used to identify the independent predictors of follow-up events.

Results: Ischemia was detected in 675 (47%) patients. Five hundred-six patients (35%) had a normal study and 253 (18%) fixed wall motion abnormalities. During a mean follow-up of 6.5 years, 532 (37%) deaths occurred, of which 249 (17%) were due to cardiac causes. A nonfatal myocardial infarction occurred in 45 (3%) patients. Independent predictors of all cause mortality in a multivariate analysis model were age (HR:1.06 [1.05-1.08]), male gender (HR:1.5 [1.2-1.8]), hypertension (HR:1.2 [1.1-1.4]), smoking (HR:1.3 [1.1-1.6]), diabetes (HR:1.4 [1.1-1.8]), wall motion abnormalities (HR:1.07 [1.06-1.09]), and ischemia (HR:1.3 [1.1-1.6]). Independent predictors of hard cardiac events were age (HR:1.07 [1.05-1.09]), male gender (HR:1.3 [1.1-1.7]), smoking (HR:1.3 [1.1-1.6]), diabetes (HR:1.6 [1.2-2.2]), wall motion abnormalities (HR:1.13 [1.12-1.16]), and ischemia (HR:2.1 [1.5-2.8]).

Conclusions: DSE provides independent prognostic information to predict all cause mortality and hard cardiac events in elderly patients.

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Regional ischemia and global left ventricular isovolumetric reserve by dobutamine stress echo are both strongly related to long term prognosis in LBBB

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Introduction: LBBB is related to ominous prognosis in heart failure (HF). Dobutamine stress echo (DSE) investigates both the presence of ischemia as well as left ventricular (LV) inotropic reserve. We assessed long term prognostic contribution of DSE in pts with LBBB.

Methods: 98 pts with LBBB were referred for DSE for either exclusion of coronary disease.

Results: During follow up 38 pts had cardiac events (Group EV). 21 pts had HF decompensation (NYHA III/IV) and 17 pts had cardiac death (group D). Group D had had lower EF rest (25% vs 39%, p=0.001), increased LV enddiastolic diameter (LVDd) (7.4±1 vs 5.9±1, p=0.001), lower EF post DSE (EFdob) (0.36±0.12 vs 0.54±0.17, p=0.002), lower % of EFdob vs 45% (33% vs 74%, p=0.01), prolonged QRS (153±24 vs 142±22, p=0.07) and greater incidence of QRS >140 ms (0.3% vs 1.4%, p=0.04). The same were found for Group EV with the exception of QRS.

Conclusion: Low cardiac event rates in patients with negative SE may warrant further evaluation for the assessment of coronary disease.

Baseline Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>56±14</td>
<td>49±11</td>
<td>56±12</td>
<td>50±25</td>
<td>0.05</td>
</tr>
<tr>
<td>Females</td>
<td>52%</td>
<td>37%</td>
<td>60%</td>
<td>46%</td>
<td>0.03</td>
</tr>
<tr>
<td>African Americans</td>
<td>9.7%</td>
<td>3.7%</td>
<td>11.9%</td>
<td>28.2%</td>
<td>0.001</td>
</tr>
<tr>
<td>Beta-Blocker Use</td>
<td>33.0%</td>
<td>11.8%</td>
<td>8.8%</td>
<td>3.7%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>MACE</td>
<td>10.8%</td>
<td>14.8%</td>
<td>6.4%</td>
<td>4.5%</td>
<td>0.029</td>
</tr>
</tbody>
</table>


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Prognostic value of negative stress echocardiography in the setting of submaximal heart rate or workload response: a practical problem with important implications

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Background: Adequate stress level in exercise echocardiography (SE) is defined as maximal heart rate achieved (PMHR)=~85% predicted for age and double product (DP) =>/=25000. Given the lower sensitivity of SE compared to nuclear imaging, it is important to identify subgroups of patients among negative SE who may warrant further evaluation.

Hypothesis: We tested the hypothesis that patients with either inadequate heart rate response or submaximal double product but negative SE have a higher major adverse cardiac event (MACE) rate.

Methods: Retrospective study of consecutive patients who had a negative SE between January-December 1997. Patients were divided into 4 groups based on whether they achieved adequate PMHR and/or DP. Baseline demographics and SE variables were obtained through medical record review and the SE report. Patients were followed up for a median follow up duration of 73 months to identify MACE (death, myocardial infarction, coronary angioplasty, coronary artery bypass surgery and cerebrovascular accident).

Results: 636 patients fulfilled the inclusion criteria. After a median follow up of 73 months, there was an increased MACE rate among patients with inadequate stress level (p=0.029 for trend). The highest event rate was among patients with decreased chronotropic effect (group 2, p=0.018 group 2 vs. 4). This continued to be significant after adjusting for unequal variables between the groups (p=0.029, Adjusted OR 2.84, 95% CI 1.1-7.3)

Conclusion: In conclusion, low cardiac event rates in patients with negative SE cannot be extrapolated to patients with chronotropic incompetence or submaximal double product and negative SE. This subgroup (particularly those with chronotropic incompetence) may need further evaluation for the assessment of coronary disease.
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Prognostic value of noninvasive pacemaker stress echocardiography in patients with permanent pacemakers
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Purpose: Noninvasive pacemaker stress echocardiography (PASE) is simple, rapid, and safe and diagnostically efficient option for noninvasive diagnosis of coronary artery disease in the expanding population of patients with permanent pacemakers. We investigated the prognostic value of PASE in patients with permanent pacemakers and suspected coronary artery disease during prospective 2-year follow-up.

Methods: 83 patients (57 men, age 67.3±11.1 years) with permanent pacemakers underwent noninvasive PASE by external programming (10 bpm increment up to evidence of ischemia or target heart rate) to evaluate extent and severity of coronary artery disease. Wall motion score index (on a one to four scale; 16 segments model of the left ventricle) was calculated at baseline and peak stress. All patients were prospectively evaluated during mean follow-up 22±11 months. Both soft (coronary revascularization, unstable angina) and hard (myocardial infarction, cardiac death) end-points were analyzed. Survival curves were created using the Kaplan-Meier method.

Results: A positive result of PASE (wall motion score increase) was detected in 32 (38.6%) patients. During follow-up, there were 3 cardiac deaths, 2 myocardial infarctions, 10 coronary revascularizations (6 CABG, 4 PTCA), and 10 unstable angina. The overall event-free survival was 34.4% in the ischemic group and 94.1% in the nonischemic group (p<0.001) (Figure). In a multivariate analysis positive result of PASE was independently associated with increased risk of end points (hazard ratio 30.5; 95% confidence interval: 7.7 to 120.1; p<0.001).

Conclusions: Positive noninvasive pacemaker stress echocardiography in patients with suspected or known coronary artery disease is a strong prognostic factor for long term survival.

Survival Functions

Figure

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ST-segment resolution predicts clinical outcome and response to dobutamine test after primary PTCA
A. Tomaszuk-Kazberuk, W.J. Musial, S. Dobrzycki, University Hospital, Białystok, Poland

Aim: The purpose of this study was to assess clinical outcome and left ventricular (LV) contractility improvement in 6 month follow-up after successful primary PTCA, according to rapid ST-segment resolution. Usefulness of early DE (dobutamine echocardiography) in prediction of LV functional recovery in patients treated with primary PTCA was tested.

Methods: 110 consecutive patients with first acute myocardial infarction (AMI) after successful primary PTCA (TIMI 3 flow, stenosis<30%) were divided into 2 groups according to ST-segment resolution 1 hour after the procedure. The patients underwent clinical assessment and echocardiography (ejection fraction - EF and wall motion index - WMI) after primary PTCA, during dobutamine echocardiography (DE) on 4th day of hospitalization and after 3 and 6 months.

Results: In patients with ST-segment resolution (76 (69%)) LVEF increased significantly during 6 month follow-up (p=0.0001), changes found in the group without ST-segment resolution were insignificant (p=0.4). Early DE in patients with rapid ST-segment resolution revealed significant improvement in LV contractility measured by EF and WMI. Patients without ST-segment resolution had higher incidence of death (3/34 (9%) vs 0/76 (0%), p=0.0086), reinfarction (5/34 (14.7%) vs 2/76 (2.6%), p=0.28) and revascularization (4/34 (11.8%) vs 3/76 (3.9%) p=0.12). Combined end-point (death, reinfarction and revascularization) was significantly lower in patients with ST-segment resolution (p=0.03).

Conclusions: Rapid ST-segment resolution is associated with LV contractility recovery, better clinical outcome and prognosis after successful primary PTCA. Early DE after primary PTCA precisely predicts LV functional recovery. Patients with ST-segment resolution are likely to respond to early dobutamine test.

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Echocardiography vs inflammation: procalcitonin is related to ejection fraction and predicts risk in acute myocardial infarction treated with primary PTCA
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Introduction: Procalcitonin (PCT) is a novel marker of inflammation carrying prognostic information in neoplastic and inflammatory disease. The aim of the study was to assess the relationship of PCT with established risk markers and the prognostic significance in patients with myocardial infarction (MI) treated by primary PTCA.

Methods: 65 patients (45 males and 20 females) aged 61±9 years admitted to our Department with first ST-elevation MI and treated with primary PTCA. Beside the standard clinical and biochemical data, IL-1, IL-10, Fas ligand and MCP-1, CRP and BNP, serum concentrations of PCT were semiquantitated with immunochromatographic method; PCT level >0.5 ng/ml was considered positive (27 pts, 42%) and >2 ng/ml - significantly elevated (7 pts, 11%).

Results: Concentrations of PCT had no association with demographic, clinical, echocardiographic and biochemical markers with an exception of: left ventricular ejection fraction (ANOVA p=0.046, lower ejection fraction coexisting with higher PCT), serum concentrations of IL-1 and triglycerides (p=0.025, lower IL-1 and p=0.039 - lower triglycerides in patients with negative PCT) and Fas ligand (p=0.009).

The patients were followed-up for 1 year and 15 clinical events occurred, defined as death, reinfarction, ventricular fibrillation, need for repeat coronary angiography or angioplasty. (In survival analysis, there was a relationship of worse event-free survival and higher PCT concentrations (see graph, logrank test for trend p=0.047).

Conclusion: Positive PCT test is a novel risk marker indicative of worse event-free survival after first acute myocardial infarction treated with primary PTCA. PCT is related to abnormal left ventricular function. These findings warrant confirmation in larger studies.
Poster Session 2

2 December 2004, 14:00 to 18:00
Location: Poster Hall

343 Postoperative improvement of regional myocardial function in patients with severe aortic stenosis revealed by strain rate echocardiography

T. Poerner, B. Goebel, S. Jantscha, J.J. Kaden, T. Süselbeck, University Hospital of Mannheim, Mannheim, Germany

Purpose of the study was to determine the influence of pressure overload due to severe aortic stenosis (AS) on left ventricular (LV) regional myocardial function using strain rate echocardiography (SRE).

Methods: Thirty-nine patients (pt.) aged 51 ± 16 years with symptomatic pure AS underwent TDE before and 6 to 16 days after successful aortic valve replacement (AVR). Fifty matched subjects with normal coronary angiograms and LV function served as a control group. SRE measurements in a 16-segment LV model included: peak systolic (Vs) and diastolic (Ve) velocities, peak systolic strain rate (SR) and peak strain. While Vs and Ve were obtained in the basal segments, strain and SR were expressed as mean values between all LV segments.

Results: AS was associated with a marked LV long-axis dysfunction, even when ejection fraction (EF) was normal. EF worsened when the radial function was also impaired. All patients improved after AVR.

Conclusions: SRE is a useful tool to assess myocardial functional damage and disease progression in pt. with AS.

Echocardiographic data

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Controls</th>
<th>AS with EF&lt;50% (n=17)</th>
<th>AS with EF=50% (n=17)</th>
<th>AS with EF&gt;50% (n=22)</th>
<th>AS with EF&gt;50% (n=22)</th>
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</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>60±11</td>
<td>65±26</td>
<td>70±8</td>
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<td>EF (%)</td>
<td>69±9</td>
<td>39±9**</td>
<td>46±12**</td>
<td>64±7</td>
<td>60±13</td>
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<tr>
<td>LVED (mm)</td>
<td>48±6</td>
<td>57±6**</td>
<td>53±4***</td>
<td>47±8</td>
<td>43±7**</td>
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<tr>
<td>LVMI (g/m²)</td>
<td>98±17</td>
<td>225±62**</td>
<td>237±18*</td>
<td>198±72</td>
<td>191±65*</td>
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<tr>
<td>Aortic valve area (cm²)</td>
<td>2.1±0.6</td>
<td>0.75±0.30**</td>
<td>1.66±0.80**</td>
<td>0.52±0.32*</td>
<td>1.45±0.70**</td>
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<td>Mean PG (mmHg)</td>
<td>3±3</td>
<td>55±26**</td>
<td>15±5**</td>
<td>70±27</td>
<td>20±8**</td>
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<tr>
<td>Long-axis SR (1/s)</td>
<td>1.32±0.33</td>
<td>0.67±0.17**</td>
<td>0.87±0.30**</td>
<td>0.94±0.26**</td>
<td>1.09±0.25**</td>
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<tr>
<td>Long-axis strain (%)</td>
<td>18±4</td>
<td>9±3**</td>
<td>9±2**</td>
<td>14±4</td>
<td>13±3</td>
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<tr>
<td>Long-axis strain (%)</td>
<td>66±21</td>
<td>31±13**</td>
<td>43±30**</td>
<td>42±13</td>
<td>54±16**</td>
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<td>Vs (mm/s)</td>
<td>74±30</td>
<td>31±17**</td>
<td>42±40</td>
<td>46±18</td>
<td>53±20</td>
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<td>Ve (mm/s)</td>
<td>2.06±0.86</td>
<td>1.54±0.92**</td>
<td>1.67±1.02**</td>
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<td>Radial SR (1/s)</td>
<td>24±8</td>
<td>11±8**</td>
<td>13±8*</td>
<td>25±16</td>
<td>24±9</td>
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<tr>
<td>Radial strain (%)</td>
<td>32±11</td>
<td>17±7**</td>
<td>29±11**</td>
<td>26±9</td>
<td>43±11**</td>
</tr>
<tr>
<td>Radial Ve (mm/s)</td>
<td>52±25</td>
<td>31±17**</td>
<td>51±20</td>
<td>35±23</td>
<td>51±25**</td>
</tr>
</tbody>
</table>

LVED: LV enddiastolic diameter, LVMI: LV mass index, p<0.05: ** vs. baseline, * vs. controls, † vs. AS with normal EF.

344 Quantitative exercise echocardiographic assessment of asymptomatic aortic valve stenosis: prognostic implications

P. Lancellotti, F. Lebois, M. Simon1, C. Chauvel1, L. Pierard. University Hospital, Liège, Belgium, 1St Augustin, Bordeaux, France

Background: In patients (pts) with asymptomatic aortic valve stenosis, exercise testing may help to stratify the clinical risk. However, data are limited and the role of quantitative exercise echocardiography has never investigated.

Methods and results: Sixty-three consecutive pts with moderate to severe asymptomatic aortic stenosis who prospectively underwent quantitative echocardiographic measurements at rest and during semi-supine exercise test were followed up for 14 ± 6.5 months. Of these pts, 26 had an abnormal response to exercise (occurrence of >1 of the following findings: angina, dyspnea, >2 mm ST segment depression, fall or small (<20 mmHg) rise in blood pressure during the test) and 18 presented cardiac events during follow-up (symptoms 2, acute pulmonary edema 2, aortic valve replacement 11, cardiac death 3). In univariate analysis, patients who had cardiac events exhibited a much higher increase in both maximum (36 ± 15 vs 25 ± 14 mmHg, p=0.011) and mean (25 ± 13 vs 16 ± 10 mmHg, p=0.00011) transaortic pressure gradients, whereas left ventricular ejection fraction (63 ± 14 vs 69 ± 12%, p=0.0003) and heart rate (112 ± 21 vs 130 ± 20 bpm, p=0.0022) reached at peak stress were lower. Change in ejection fraction (-1.1 ± 7.7 vs 6.3 ± 5%, p=0.001), in aortic valve area (-0.02 ± 0.17 to 0.12 ± 0.6 cm², p=0.0065) and in heart rate (39 ± 15 vs 53 ± 21 bpm, p=0.0013) were also weaker. These patients experienced more frequently symptoms during exercise (14/18 vs 12/45, p=0.00068).

By logistic multivariate analysis, three independent predictors of cardiac events were selected stepwise: a larger increase in mean transaortic pressure gradient (p=0.011) during exercise, a lower change in heart rate (p=0.033) at peak exercise and the occurrence of symptoms during exercise (p=0.04).

Conclusions: Quantitative exercise echocardiography could be useful to identify a high-risk subset of patients with asymptomatic aortic valve stenosis and help for clinical decision making.
Echocardiographic determinants of abnormal response to exercise in asymptomatic aortic valve stenosis

P. Lancellotti, F. Lebois, M. Simon, C. Chauvel, L. Piérard. University Hospital, Liège, Belgium, 1st Augustin, Bordeaux, France

Background: Patients (pts) with asymptomatic aortic valve stenosis and abnormal hemodynamic responses to exercise testing are at increasing risk of cardiac events. Exercise-induced changes in Doppler echocardiographic parameters have never been investigated in this setting.

Methods and results: Thirty-six consecutive pts with moderate to severe asymptomatic aortic stenosis underwent quantitative echocardiographic measurements at rest and during semi-supine exercise test. Of these pts, 26 had an abnormal response to exercise which was defined as the occurrence of > 1 of the following findings: angina, dyspnea, ≥ 2 mm ST segment depression, fall or small (< 20 mmHg) rise in systemic blood pressure during the test. During exercise, transaortic pressure gradients (maximal: 56 ± 23 vs 84 ± 27 mmHg; mean: 32 ± 16 vs 50 ± 20 mmHg) and aortic valve area (0.98 ± 0.31 vs 1.06 ± 0.36 cm²) increased significantly (p = 0.001, respectively). In univariate analysis, patients with abnormal test exhibited a higher increase in both maximum (34 ± 15 vs 24 ± 14 mmHg, p = 0.001) and mean (25 ± 12 vs 15 ± 9 mmHg, p = 0.0011) transaortic pressure gradients and in aorti valve resistance (123 ± 118 vs 48 ± 105 dynes.s.cm⁻⁵, p = 0.023) whereas left ventricular ejection fraction (66 ± 13 vs 73 ± 7%, p = 0.02) reached at peak stress was lower. Change in ejection fraction was also weaker (0.6 ± 0.5% vs 0.0026% p < 0.001) in aorti valve resistance. In two independent determinants of abnormal exercise response were selected stepwise: a larger increase in mean transaortic pressure gradient (p = 0.012) during exercise and a lower change in ejection fraction (p = 0.02) at peak exercise.

Conclusions: Abnormal responses to exercise in asymptomatic aortic valve stenosis patients are mediated by a larger increase in mean transaortic pressure gradient and/or a limited contractile reserve characterized by an inadequate increase in ejection fraction at peak exercise.

Low gradient aortic stenosis: can dobutamine stress hemodynamics predict postoperative recovery of left ventricular function?(French multicenter registry on low gradient aortic stenosis).

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Objectives: The prognostic value of Dobutamine Stress Hemodynamics (DSH) in patients with low gradient aortic valve stenosis (AS) is well established. Among the survivors, an increase in left ventricular ejection fraction (LVEF) from rest before AVR and at follow up. Patients were divided into 2 groups according to the presence (Group I) or absence (Group II) of left ventricular contractile reserve (defined by an increase in stroke volume of >= 20% on DSH compared to baseline).

Results: Forty-four patients (69%) were in Group I and 20 (31%) in Group II. In the whole group, LVEF improved from 30% [25-33]% preoperatively to 47% [40-56]% after AVR (p < 0.0001). Improvement in LVEF > 10 EF Units occurred in 36 (82%) Group I-patients (from 30% [24-33]% to 45% [40-55%], p < 0.0001) and in 13 (65%) Group II-patients (from 32% [27-37%] to 50% [36-58%], p < 0.001). Mean EF improvement was similar in both groups (15% vs 18%, p = 0.88). By multivariate analysis, neither LV contractile reserve nor coronary artery disease or previous myocardial infarction were predictors of postoperative LVEF improvement. Only change in aortic valve area (p = 0.003) with dobutamine was related to LVEF improvement.

Conclusion: In patients with low gradient AS, improvement in LVEF after AVR occurs in most patients with contractile reserve. Furthermore, in patients without contractile reserve, despite a high operative mortality, LVEF improvement is relatively common after AVR.

Velocity peak count: a novel index for assessing the severity of aortic stenosis by 3D-Doppler

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Purpose: The severity of aortic stenosis as assessed in classical five-chamber view by conventional Doppler-method shows high interobserver variability. The purpose of this study was to develop a new observer independent Doppler tool which can also be used in transathoracic parasternal or transesophageal echocardiography.

Methods: Transesophageal 3-dimensional Doppler was performed in 40 patients (aortic stenosis n=20 and normal aortas n=20). Angle-correction was implemented into the EchoAnalyzer software developed at our institution. Three-dimensional flow profiles were generated 2 cm downstream of the aortic valves. A “peak” was defined as a region of flow velocity including values exceeding a given threshold. The velocity peak count within 3D-Doppler flow profiles in normal and stenotic aortic valves were compared to the pressure gradients obtained by cardiac catheterisation (mmHg).

Results: This new software proved very comfortable in daily clinical use. Normal flow profiles showed a maximum of six velocity peaks (mean 2.5±1.8), whereas in aortic stenosis the amount of peaks ranged from 11 to 27 (mean 19.9±5.6). The velocity peak count within 3D-Doppler flow profiles significantly correlated (r=0.95; p<0.001, y=0.3x+3) with invasive pressure gradients (range 0-80 mmHg, mean 25.9±29.6 mmHg). Results were reproducible by the same (mean difference of repeat measurements: 1.4±4.3; SEE=0.7) as well as different observers (mean difference: 1.3±7.7; SEE=1.2).

Conclusions: The novel index of velocity peak count within 3D-Doppler flow profiles is ideally suited for the assessment of turbulences and hence the severity of aortic stenosis.

Estimation of reverse myocardial remodeling in patient with aortic stenosis after aortic valve replacement by standard echocardiography and cardiac cycle depended variation of integrated backscatter

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Severity of systolic and diastolic dysfunction in patients with aortic stenosis could be associated with alterations in myocardial ultrasonic reflectivity detected by integrated backscatter analysis (CVIBS). The pressure overload in patients with aortic stenosis could cause an increase in intramyocardial fibrosis.

For IBS analysis two regions of interest were chosen in the parasternal long-axis view: mid septum and mid posterior wall. Full standard echocardiographic examination and IBS measurements were obtained before and 10 months after aortic valve replacement operation (AVR). Eleven patients (age 68±11 years, 8 male, 3 female) were enrolled into the study.

The magnitude of cyclic variation of IBS was significantly higher ten months after AVR than before. Table shows the effect of AVR on the echocardiographic parameters. The study demonstrates that AVR significantly increases CVIBS in both interventricular septum and posterior wall. The standard echocardiographic parameters suggest myocardial reverse remodeling and improvement of left ventricular performance. The analysis of IBS among patients with aortic stenosis may help us to understand reverse remodeling mechanisms in patients with aortic stenosis after AVR. However to estimate the usefulness of CVIBS as predictor of AS evolution and potential indicator for optional time aortic valve replacement further studies need to be undertaken.
Diastolic dysfunction in patients with aortic stenosis evolve late after aortic valve replacement


Background: Patients with aortic stenosis (AS) are known to have left ventricular (LV) hypertrophy and diastolic dysfunction. Normalization of myocardial structure and reversal of diastolic dysfunction has been shown in younger patients late after aortic valve replacement (AVR). In the present study the changes in LV mass (LVM), systolic and diastolic function two- and ten years after AVR for AS were evaluated in a representative group of patients.

Methods: Fifty-seven patients (66.6% of patients) and ten years after AVR for AS were examined with Doppler echocardiography preoperatively, two- and ten-years post-operatively. The diastolic function was evaluated by integrating mitral and pulmonary venous flow data. The normal limits were defined using a control group (n=71, age 18-83 years). Four different filling patterns were described: A=normal; B=mild diastolic dysfunction (impaired relaxation); C=moderate dysfunction (pseudonormal filling); D=severe dysfunction (restrictive filling).

Results: There was a significant reduction in LVM-index between the preoperative and two-year examination, 161 ± 39 vs. 114 ± 28 g/m² (p=0.0001), but no further reduction was found at ten-years follow-up, 119 ± 49 g/m². The LV ejection fraction increased from 57±13% preoperatively to 63±10% at two-years (p=0.009) while after ten years it was again 57±13% (p=0.0004). It took 18.9±7.8 and 10.7±10.8; 14.0±7.0 and 13.5±9.0; 33.6±6.3 and 38.5±5.8 respectively. The only parameter improved in both compared interval 28 and 52 yrs was EF. However there was a trend towards more rapid increase of TP-Vel in diabetic pts (0.13 ± 0.05 m²/s/yr) was observed in 29% of patients with diabetes mellitus, which was significantly more rapid than in non-diabetic patients (0.05 ± 0.05 m²/s/yr). This indicates nonreversible myocardial abnormalities at the time of operation and our data encourage earlier surgical intervention.

Conclusion: The present study shows a marked diastolic dysfunction evolving in elderly patients ten years after AVR for AS. This finding indicates irreversible myocardial abnormalities at the time of operation and our data encourage earlier surgical intervention.

Preoperative diastolic dysfunction and postoperative left ventricle hypertrophy reversibility in severe aortic stenosis

Y. Ivaniv. Lviv, Ukraine.

Background: Late prognosis after successful valve replacement in severe aortic stenosis (AS) depends on reversibility of LV myocardial hypertrophy. It remains unclear do favorable postoperative changes of LV myocardium affect bioprosthetic valve degeneration. These findings further underline the severity of diastolic dysfunction (DDF) type.

Materials and methods: 28 pts (mean age 62±6.7 years, 18 males) with isolated AS in sinus rhythm and valve area <1.0 m² (0.7±0.12 m²) and EF<40% (32±5.4%) have been selected. Peak systolic pressure gradient was 56±18.9 mmHg. Echocardiographic examination with comprehensive assessment of diastolic function using Doppler/mitral inflow characterization in combination with TDI parameters and colour M-mode LV flow propagation velocity has been performed before (-1.5 days) and 1 year after surgery.

Results: Impaired relaxation mitral inflow pattern (type of DDF) has been revealed in 5 pts; pseudonormal (IItype) in 12 and restrictive (III type) in 11 pts. When we compared the extent of LV hypertrophy regression and changes of functional indices 1 year after valve replacement it was revealed that in join I and II DDF types group LV myocardial mass index decreased from 168±14.3 to 130±12.7 g/m² (p<0.01), LV PW thickness from 14.0±0.4 to 11.0±0.6 mm (p=0.05) and LV EF increased from 30±5.2% to 52±6.0% (p<0.01) but in III DDF group these parameters did not change significantly: 188±8.8 and 172±10.8; 14.7±0.7 and 15±1.0; 33.6±3.3 and 38.5±5.8 respectively. The only parameter changed in both compared groups was mitral annulus systolic velocity (Sm) measured by PW TDI in join I and II DDF type group from 5.2±1.0 to 7.1±1.4 cm/s (p=0.01) and in III DDF type group from 5.1±1.3 to 6.6±0.9 (p=0.05). Diastolic index E/E’ improved only in join I-II DDF type group 1 year after surgery: from 13.6±4.4 to 9.2±3.1 (p<0.01), and remained unchanged in III DDF group type: 17.6±5.4 and 16.2±5.0.

Conclusion: At admission with severe AS and low LV EF showed LV diastolic function disorders and 39% of them had irreversible restrictive pattern. Successful valve replacement does not lead to LV hypertrophy regression and functional indexes improvement in late postoperative term if diastolic function was deeply impaired preoperatively. Significant positive changes develop in groups with less severe preoperative diastolic dysfunction.
354 Prognostic value of carotid intima-media thickness in detection of coronary artery disease in patients with calcific aortic valve stenosis

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Abstract: Aortic stenosis (AS) coexists with coronary artery disease (CAD) in at least 30% of patients. Patients with concomitant CAD may benefit from simultaneous coronary bypass grafting. The study aimed to evaluate prognostic value of carotid intima-media thickening (IMT) in patients with AS in assessing concomitant CAD.

Methods: Group I: 33 patients (61.0±8.2 years, 18M) with AS, and without CAD on angiograms. Group II: 34 patients (64.4±8.0 years, 25M) with AS and CAD confirmed angiographically. Control Group: 36 patients (61.2±4.9 years, 18M) with normal coronary arteries and no AS. Maximal IMT was assessed in all patients at both common carotid (CCA), bulb (BULB) and internal carotid (ICA) arteries, and expressed as a mean value.

Results: There were no differences among the respective groups with regard to age, gender, frequency of hypertension, diabetes and smoking habit, although CAD patients were more often hyperlipemic (p<0.038). IMT of CCA, BULB and ICA was significantly higher in patients with AS and CAD, compared to both Control Group and patients with AS only, and higher in AS patients compared to Controls. The multivariable stepwise regression analysis revealed that CAD (p<0.0001), calcific AS (p=0.0065), age (p<0.001), male gender (p=0.031), diabetes mellitus type II (p=0.023) and rheumatic fever (p=0.024) were independent factors strongly impacting IMT values. Patients with calcific AS had a 77.4% CAD probability, with sensitivity of 73.5% and specificity of 72.7% provided that IMT mean value was over 1.2 mm.

Conclusions: IMT thickness increases in patients with AS. The greatest IMT values are observed in patients with both AS and CAD. Patients with AS might be suspected of CAD when IMT value exceeds 1.2 mm.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th>Group I</th>
<th>Group II</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCA IMT</td>
<td>0.89±0.17</td>
<td>0.94±0.16</td>
<td>1.21±0.32</td>
</tr>
<tr>
<td>BULB IMT</td>
<td>1.18±0.23</td>
<td>1.42±0.50</td>
<td>1.72±0.43</td>
</tr>
<tr>
<td>ICA IMT</td>
<td>0.93±0.19</td>
<td>1.06±0.33</td>
<td>1.30±0.51</td>
</tr>
<tr>
<td>Mean IMT</td>
<td>1.01±0.17</td>
<td>1.13±0.26</td>
<td>1.38±0.32</td>
</tr>
</tbody>
</table>

Mean values of maximal IMT measured at the selected sites of carotid arteries (ANOVA).

355 Magnetic resonance imaging in the assessment of aortic valve area and LV function: comparison to TTE and TEE

P. Reant, S. Lalitte, V. Lebouffos, M. Berhouet, M. Montaudon, F. Laurent, R. Roudaut. Hopital Cardiologique Haut Leveque, PESSAC, France

Abstract: Assessment of the aortic valve area (AVA) is essential to appreciate the severity of aortic stenosis (AS) especially when left ventricular function is impaired. Transoesophageal echocardiography (TEE) demonstrates high accuracy in such assessment but remains semi-invasive and consequently unassessable for all patients. Conversely, Magnetic Resonance Imaging (MRI) showed promises in capability of AVA measurement with higher level of feasibility.

Objective: To evaluate whether MRI could be an alternative to TEE for absolute AVA measurement and of higher accuracy than transthoracic echocardiography (TEE) for relative AVA measurement.

Methods and results: 45 consecutive patients were investigated by TTE and TEE with relative (continuity equation) and absolute (planimetry) AVA measurement. MRI was performed subsequently on a 1.5 T Siemens system and allowed to measure AVA by planimetry on True-FISP sequence in the valvular plane. Ejection fraction assessed by TTE was 69±10% without significant difference with MRI (58±15%; p ns); mean trans-aortic gradient by TEE was 69±10 mmHg; relative AVA by TEE was 1.19±0.88 cm² whereas absolute AVA by TEE was 1.13±0.78 cm² ranging from 0.44 to 3.89 cm². No significant difference was observed between TEE and MRI (1.13±0.78 cm² vs 1.21±0.85 cm², p ns). Coefficient correlation for AVA was 0.94 between TEE and MRI (Figure). Inter-observer variability was similar between MRI and TEE.

Conclusion: MRI provides an accurate, non-invasive, well tolerated technique in the assessment of AVA and LV function. MRI should be considered as an interesting alternative for evaluation of patients with aortic stenosis.
357 Incidence of left atrial appendage thrombus and slow flow in patients with aortic stenosis

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**Background:** It is well known, that patients with mitral stenosis have a high incidence of left atrial appendage (LAA) thrombus seen with transoesophageal echocardiography (TEE). What is the frequency of thrombi in the more commonly seen patients with aortic stenosis?

**Methods:** We analysed the frequency of LAA thrombus and slow flow in 2964 consecutive TEE studies performed at our institution from January 2000 to December 2003. LAA thrombus was identified in 2D mode, LAA slow flow was defined with spontaneous LAA echo contrast or pulse wave flow less than 20 cm/sec.

**Results:** In 44 (1.5%) of all TEE patients a LAA thrombus was present and in 158 patients (5.3%) LAA slow flow was recognised. The thrombus group were slightly older than the entire TEE group (64.6 vs 63.2 years) and had a lower mean ejection fraction than the entire group (EF=47 vs 55%). The slow flow group had a mean age of 66 years and EF was 51%. The absolute and relative incidence of thrombi and slow flow for patients with mitral stenosis (MS) and insufficiency (MI), aortic stenosis (AS) and insufficiency (AI) is displayed in the table.

As expected mitral stenosis patients have the highest relative incidence of LAA thrombus and slow flow. Aortic stenosis is the second leading valve disease. The occurrence of thrombus and slow flow in patients with mitral stenosis (MS) and insufficiency (MI), aortic stenosis (AS) and insufficiency (AI) is displayed in the table.

**Conclusion:** Nowadays valve disease spectrum we see that the absolute number of LAA thrombus and slow flow in aortic stenosis patients exceeds the number of thrombi in mitral stenosis. Particularly the combination of aortic stenosis and reduced ejection fraction should raise suspicion for the existence of LAA thrombus and slow flow.

**Incidence of LAA Thrombus and Slow Flow**

<table>
<thead>
<tr>
<th>LAA thrombus patients (n)</th>
<th>moderate disease</th>
<th>severe disease</th>
<th>Slow flow patients (n)</th>
<th>moderate disease</th>
<th>severe disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS</td>
<td>1 (3.1%)</td>
<td>4 (14%)</td>
<td>MS</td>
<td>6 (19%)</td>
<td>6 (21%)</td>
</tr>
<tr>
<td>AS</td>
<td>1 (1.3%)</td>
<td>6 (25%)</td>
<td>AS</td>
<td>3 (4.0%)</td>
<td>16 (6.8%)</td>
</tr>
<tr>
<td>MI</td>
<td>4 (10.0%)</td>
<td>2 (8.0%)</td>
<td>MI</td>
<td>3 (8.4%)</td>
<td>7 (2.8%)</td>
</tr>
<tr>
<td>AI</td>
<td>2 (2.2%)</td>
<td>1 (1.0%)</td>
<td>AI</td>
<td>9 (5.0%)</td>
<td>3 (2.9%)</td>
</tr>
</tbody>
</table>

358 Left atrial spontaneous echo contrast and thrombus in aortic valve stenosis: a transesophageal echocardiographic study

E. Garbarz, J. Sylvain, B. Petillon, G. Lefevre, E. Nicollet, J. Berdaht, C. Atta, P.L. Michel, Hospital tenon, paris, France, 1Tenon hospital, Paris, France

**Background:** Left atrial spontaneous echo contrast (LA-SEC) detected by transesophageal echocardiography (TEE) is associated with thrombus formation and an increased risk of thromboembolism. LA-SEC is a frequent finding in patients with mitral valve disease but little is known its frequency in aortic valve stenosis (AS). We sought to determine the incidence and predictors of LA-SEC and thrombus in AS.

**Methods:** We prospectively performed a complete transthoracic and TEE echocardiographic follow-up of the 164 pts operated of Ross procedure at our Center between 1994 and 2003. We reviewed 27 pts (71% male, mean age 25 ± 13 years). Preoperatively, they all had aortic insufficiency (76% severe, 20% moderate) with bicuspid valve in 10 pts. Pulmonary autograft was used in all pts to replace the aortic root and 9 pts had an aortic wrapping. We measured ventricular, aortic and pulmonary dimensions, as well as the gradients and the regurgitant grade of both aortic and pulmonary valves. Aortic area was calculated with continuity equation.

**Results:** Average follow up was 28 ± 28 months. Functional status was excellent with 25 pts (93%) in NYHA class 1 and 2 in class II. Mean aortic area was 3.54 cm². Ascending aortic diameter was 41 ± 7 mm pre and 31 ± 3 mm post-operatively, p = 0.0001. The aortic ring went from 27 ± 5 mm to 33 ± 7 mm, p = 0.0018. Post-operative degree of aortic regurgitation was trivial in 17 and mild in 10. Echocardiographic data are reported in Table 1. No pt had moderate or severe pulmonary insufficiency. Maximal trans-pulmonary gradients after the intervention was 20.3 ± 16.4 mmHg and the mean gradient was 12.11 ± 10.3 mmHg. Two pts showed a maximal gradient of the homograft greater than 30 mmHg.

**Conclusions:** The aortic autograft has an excellent mid-term performance. A significant decrease in left ventricular diastolic and systolic diameters and volumes was observed as well as in aortic gradients. The valvular homograft area was normal.

<table>
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<th>Table 1</th>
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</table>

359 Bicuspid aortic valve in athletes: is valvular insufficiency an underestimated problem?

L.S. Stefani, G.G. Giorgio Galanti, B.C. Brunello Cappelli. University of Florence, Florence, Italy

**Background:** Bicuspid aortic valve is a common congenital cardiac disease and the complications are mainly considered to be stenosis and limited data are available in athletes. The physicians are mostly concerned with the valvaral and vascular complications characterizing the natural history of BAV, which may well be accelerated or worsened by athletic training.

**Object:** To evaluate the prevalence of bicuspid aortic valve in a large group of unselected, competitive asymptomatic athletes, and the prevalence and extent of associated complications, in comparison with those reported in community-based studies.

**Method:** In a 3-year period, 2273 consecutive competitive athletes (788 F and 1485 M) aged 8 to 60 years (average: 31±11.3 years) who represented 16 different sports were evaluated by Echocardiography (Echo). Echo measurements included aortic root dimensions at four levels: aortic annulus, Valsalva sinuses, sinotubular junction and proximal ascending aorta.

**Results:** BAV was diagnosed in 58 athletes, corresponding to a prevalence of 2.55%, significantly greater than that reported in population-based studies. BAV was normally functioning in only 9 athletes. Aortic regurgitation was detected in the other 49. It was mild in 14, moderate in 27 and moderate to severe in 8. Moderate aortic stenosis was documented in 2 athletes. Aortic root dimensions at all the measured levels were significantly larger in athletes with BAV than in those with tricuspid aortic valve. Aortic dilatation was not associated with age, body surface area, presence and extent of aortic regurgitation, or years of training.

15 BAV athletes were disqualified from competitive sport because of severe aortic regurgitation associated with left ventricular dilatation or aortic dilatation, independently of valvular function.

**Conclusions:** The results of this investigation highlight the high prevalence of BAV and of aortic valvular insufficiency in the athletic population. These data disagree with studies in the literature, which have strongly supported the close relationship between BAV and aortic stenosis. Our data also strongly support the implementation of pre-participation screening with echocardiography.
363 Ross procedure: clinical and echocardiographic mid-term assessment
Ross procedure (RP) is a valid and alternative in young adult patients with severely damaged aortic valves. Objective: To investigate mid-term evolution of pulmonary autograft (PA) and pulmonary homograft (PH) and possibly related factors. Patients and methods: All consecutive RP p in one single institution with more than 1 year follow up available. Transesophageal echocardiograms were performed at regular intervals with special interest in both PH an PA functions.
Results: 43 p were included, 34 were male, aged 42-9 years old, and median follow-up was 21 months. In the echo assessment of the PA, mild dilatation of the aortic root and aethiology of the valve lesion.
Conclusions: The effect of the diameter of the aortic root and the detection of an aortic regurgitation needs to be evaluated taking into account the body surface. The relationship is different depending on whether the valve is bicuspid or tricuspid.

364 Severe aortic stenosis and myocardial function: diagnostic and prognostic usefulness of ultrasonic integrated backscatter analysis
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Aim of present study is to assess myocardial reflectivity pattern in severe aortic valve stenosis, using Integrated Backscatter (IBS) analysis. Aortic Stenosis patients (AS) were carefully selected in Cardiac Department. 35 subjects (AS: valve orifice <1 cm²) were studied. All subjects of study performed: conventional 2D-Doppler echocardiography and IBS. Backscatter signal was sampled at septum and posterior wall level. AS were divided into two groups: sixteen patients who presented initial signs of congestive heart failure and a depressed left ventricular systolic function (DSF); ejection fraction (EF) (range: 35-50%) and nineteen totally asymptomatic patients with normal left ventricular systolic function (NSF) (EF>50%). Myocardial echo intensity (pericardium related) was significantly higher at septum and at posterior wall level in DSF than in NSF and in controls. IBS Variation, as expression of variation of the signal, appears significantly lower in AS with DSF than in NSF and in controls, both at septum and posterior wall level. DSF patients underwent aortic valve replacement and during surgery intervention a septal myocardial biopsy was made for evaluation of myocardial/fibrosis ratio. Abnormally increased echo intensity was detected in left ventricular pressure overload by severe aortic stenosis and correlated with increase of myocardial collagen content (operating biopsy). After one year after aortic valve replacement, we observed a significant reduction of left ventricular mass and only if pericardial indexed IBS value (reduction of interstitial fibrosis) decreased, it was possible to observe an improvement of EF and IBS Variation.

365 Left ventricular remodelling, wall stress, contractile state and symptoms in chronic degenerative mitral valve disease
M. Yusoff, J. Fallon, S.G. Ray, Wythenshawe Hospital, Manchester, United Kingdom
The aim of the study was to look at the relationship of left ventricular remodelling, wall stress, contractile state and symptoms in patients with degenerative mitral regurgitation.
We performed a detailed transthoracic echocardiogram on 40 patients with severe mitral regurgitation (regurgitant fraction >50) due to degenerative mitral valve disease and 30 controls. No patients were in heart failure requiring diuretics. Patient symptoms were classified by NYHA class. The end systolic and end-diastolic volumes, ejection fraction, sphericity index, end systolic wall stress/rate corrected velocity of circumferential shortening and the end-systolic wall stress/rate corrected velocity of fibre shortening was calculated. The left ventricular end-systolic volume (65 ml vs 46 ml), end-diastolic volume (184 ml vs 102 ml), ejection fraction (64 vs 54), sphericity index (0.51 vs 0.33) end systolic wall stress (70 vs 60) and rate corrected velocity of circumferential fiber shortening (0.95 vs 0.85) was significantly higher (p<0.001) in patients compared to controls. End-diastolic volume (p=0.007) and sphericity index (p<0.001) correlated with NYHA class. Left ventricular end systolic wall stress/rate corrected velocity of circumferential fiber shortening (a pre-load independent measure of contractile state) did not differ between patients and controls or between the different NYHA subsets in the patient group. In this group of patients with severe mitral regurgitation due to degenerative mitral valve disease, left ventricular wall stress/circumferential contractile state was preserved despite extensive spherical remodelling. However the extent remodelling correlated with the development of symptoms.
366 Does intra-operative TEE underestimate ischemic mitral regurgitation? Importance of intra-operative loading conditions when assessing the mitral valve

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Background: Accurate assessment of mitral regurgitation (MR) severity is crucial for optimal selection of patients with ischemic MR for mitral valve surgery. Intra-operative transesophageal echocardiography (TEE) has been shown to underestimate ischemic MR due to the unloading effect of general anesthesia on the left ventricle. It has therefore been recommended that MR severity should be estimated preoperatively.

Purpose: To test the hypothesis that under appropriate loading, intra-operative TEE would be an invaluable tool in MR assessment.

Methods: We prospectively studied 23 patients (age 68±9 y, 13 men) with ischemic MR undergoing coronary bypass surgery. Transthoracic echocardiography (TTE) was performed 1.4+1.5 d preoperatively, and intra-operative TEE was performed after induction of general anesthesia before (TEE1) and after (TEE2) adjusting of loading conditions. Preload was adjusted using fluids (if pulmonary wedge pressure <15 mmHg), and the afterload increased using IV phenylephrine aiming at systolic blood pressure of 160 mmHg. MR severity was estimated off-line by 2 blinded observers semi-quantitatively using color Doppler and pulmonary venous flow, and quantitatively using the proximal isovelocity surface area (PIVA) method.

Results: (Table) Intra-operative TEE did not underestimate MR severity after adjusting loading conditions in any of the patients.

Conclusions: Intra-operative TEE did not underestimate ischemic MR, after adjusting loading conditions. Failure to adjust afterload with fluids and phenylephrine. Preoperative TEE may underestimate ischemic MR in patients with unloaded left ventricles.

MR Assessment

<table>
<thead>
<tr>
<th>SBP (mmHg)</th>
<th>MR grade</th>
<th>ERO (cm²)</th>
<th>RV (cm³)</th>
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<tr>
<td>Prop TTE</td>
<td>125+/−23</td>
<td>2.0+/−1.0</td>
<td>0.15+/−0.12</td>
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<tr>
<td>TEE1</td>
<td>110+/−15</td>
<td>1.5+/−1.0</td>
<td>0.11+/−0.10</td>
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<tr>
<td>TEE2</td>
<td>165+/−18</td>
<td>2.6+/−1.1</td>
<td>0.20+/−0.15</td>
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</tbody>
</table>

SBP = Systolic blood pressure, ERO=Effective regurgitant orifice area, RV=Regurgitant volume. *p<0.01, **p<0.001 (vs preop TTEE).

367 Evaluation of color M-mode Doppler flow propagation velocity in patients with isolated chronic mitral regurgitation

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Correct assessment of left ventricular diastolic function in patient with volume overload due to isolated mitral regurgitation using conventional pulse wave Doppler of mitral valve inflow velocities is difficult.

Aim: To evaluate relative new and less preload dependent index of left ventricular filling derived by color M-mode Doppler echocardiography flow propagation velocity in patients with isolated chronic mitral regurgitation and preserved left ventricular systolic function.

Methods: Sixty-two patients (mean SD, age 43 ±13 years) with isolated chronic mitral regurgitation and preserved left ventricular systolic function (ejection fraction >60%) were studied by Doppler echocardiography (HDI 5000, Philips). Patients subdivided into a group with mild mitral regurgitation (1st group, n=22), a group with moderate mitral regurgitation (2nd group, n=18), and a group with severe mitral regurgitation (3rd group, n=17). Mitral regurgitation severity was assessed using regurgitant fraction (regurgitant volume was calculated by PISA method). Flow propagation velocity was obtained by M.J. Garcia’s method. 15 healthy participants were included as control group.

Results: There was no significant difference of flow propagation velocity between 1st and control groups (86±24 cm/s vs. 68±32 cm/s; P=0.84). In 2nd and 3rd groups flow propagation velocity was lower (52±23 cm/s and 47±17 cm/s, respectively; P<0.05). Comparison with control and 1st groups (P<0.05). Significant correlation was found between mitral E velocity, E/A relation and flow propagation velocity in 1st group (r=0.65 and r=0.76 respectively; P=0.01) and control group (r=0.61 and r=0.73 respectively; P<0.01). There was not significant correlation between these indexes in 2nd and 3rd groups. In all patients groups with mitral regurgitation significant correlation between regurgitant fraction and flow propagation velocity was not found.

Conclusion: The current study demonstrates that flow propagation velocity values decrease in patients with more significant mitral regurgitation. Flow propagation velocity seems to be a preload-independent measure of diastolic function in patient with mitral regurgitation and possible relationship between impaired diastolic function in patient with isolated moderate and severe chronic mitral regurgitation. Flow propagation velocity may be use in characteristic of left ventricular filling pattern in patients with isolated chronic mitral regurgitation.

368 Longitudinal left ventricular dysfunction is a mechanism of secondary mitral regurgitation in patients with heart failure

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Background: Secondary mitral regurgitation is a major component of severe heart failure, causing pulmonary hypertension and volume overload, which in turns potentiates left ventricle remodelling. The main mechanism responsible for secondary mitral regurgitation, as shown by three-dimen- sional echocardiography, is subvalvar friction, with apical and outward displacement of the papillary muscles. Consequently, the papillary muscles tether the mitral leaflets apically, leading to decreased width of the coaptation zone, and resulting in mitral regurgitation. The causative nature of subvalvar friction might be an impairment of the longitudinal contraction of the left ventricle, however no detailed mechanisms have been described.

Aims: To investigate the relation between secondary mitral regurgitation and longitudinal systolic function in patients receiving cardiac resynchroni- sation therapy for severe heart failure.

Methods: 22 patients, aged 63±8 years, were studied during sinus rhythm (unpaced), during left ventricular pacing, and during biventricular pacing. Echocardiography was used to assess mitral valve morphology and function, and global and regional systolic function. Longitudinal function was calculated from the average of the systolic velocities of the six basal myocardial segments recorded from the apical (4C, 2C, and 3C) views by tissue Doppler.

Results: Mean systolic longitudinal velocity increased from 3.6±0.9 cm/s to 4.1±0.9 cm/s with left ventricular pacing (p<0.01), and from 3.7±1.1 to 3.9±1.0 cm/s with biventricular pacing (p<0.09). Heterogeneity of myocar- dial velocities decreased by 0.33±0.44 (38%) with left ventricular pacing, and by 0.27±0.31 (31%) with biventricular pacing, making left ventricular longitudinal contraction more coordinated. Long-axis and short-axis systolic dimensions decreased, and the left ventricle became less spherical. The severity of mitral regurgitation decreased: vena con- tracta diameter fell from 3.5±1.7 to 4.1±1.5 mm with left ventricular pacing, and from 5.2±1.7 to 4.0±1.7 mm with biventricular pacing (both p<0.05), correlating with the increase in mean systolic longitudinal velocity (r=-0.49 for left ventricular pacing and r=-0.87 for biventricular pacing, both p<0.05).

Conclusions: A major mechanism of secondary mitral regurgitation in patients with severe heart failure is the decrease of the longitudinal contrac- tion of the left ventricle, causing a change in the systolic shape of the left ventricle which becomes more spherical, with an increase in subvalvar friction.

369 Fate of atrial myocardium in severe mitral regurgitation: in the aspect of programmed cell death


Backgrounds: Long standing pressure and volume overload to the atrium can induce electrophysiological alteration and contractile dysfunction in patients with severe mitral regurgitation (MR). From the view point of the molecular aspects, the fate of atrium in severe MR has not been evaluated.

Methods: We retrospectively reviewed the medical records of 16 patients (M/F=8:8, mean age=52±12) with severe MR underwent valve replace- ment surgery. The subjects were divided into 2 groups according to the duration of symptom/group I, symptom duration ≤12 months, n=10; group II more than 12 months, n=6). Using the specimens of atrial myocardium obtained during surgery, immunohistochemical staining was performed for TUNEL assay, expression of a FAS, BAX and BCL-2 family. Results: 1. Apoptotic index of TUNEL assay(Figure) was 31.1±12.6% in group I and 49.0±4.3% in group II(p<0.01). 2. FAS expression was 42.1±14.4% in group I and 27.8±10.5% in group II(p<0.05). 3. FAS expres- sion in group I with atrial fibrillation(AF) (49.3±6.9%) was higher than group II and group I without AF (29.2±12.5%(p<0.001). 4. The apoptosis of atrium was not related to the echocardiographic parameters and hemody- namic indices.

Conclusion: Programmed cell death of atrial myocardium in severe MR might be the early molecular pathologic changes rather than late sequelae. The causality between programmed cell death and arrhythmia should be further investigated.

Tunnel assay of atrial myocardium
Determinants of exercise-induced changes in mitral regurgitation in patients with prior anterior myocardial infarction and left ventricular dysfunction


Background: Presence of ischemic mitral regurgitation (MR), as well as its increase with exercise in patients with previous myocardial infarction (MI) are related to adverse prognosis.

Objective: The objective of the study was to assess the determinants of exercise-induced changes in MR in patients with prior anterior myocardial infarction and LV dysfunction.

Methods: Twenty-six consecutive patients with ischemic MR due to prior anterior MI, ejection fraction (EF) <45% in sinus rhythm underwent exercise-echocardiographic testing on treadmill using Bruce protocol. Patients with exercise-induced ischemia were not included in our study. Effective regurgitant orifice (ERO) of MR was quantitated at rest and after peak exercise. Exercise-induced changes in ERO were compared with baseline echocardiographic characteristics as well as with exercise-induced changes in mitral deformation (coaptation distance, mitral annular diameter, tenting area) and global LV function (end-diastolic and end-systolic LV volumes (Vmax); EF); Vt, Vp, EFt, EFp, FS
diastolic and end-systolic LV spherical volumes (Vt, Vp respectively).

Results: Ischemic MR increased with dynamic exercise (increase in ERO) in all patients from 16.8±5.6 mm² to 29.7±10.0 mm². Exercise-induced changes in ERO were not related to the severity of MR (ERO-rest= t=0.34, p=0.0941) or to the severity of LV dysfunction (EF-rest, t=−0.18, p=0.436) at rest. Exercise-induced changes in ERO correlated best with those in coaptation distance (r=0.56, p=0.003) and in tenting area (r=0.59, p=0.002). Exercise-induced changes in ERO were not related to those in mitral annular diameter (r=−0.37, p=0.059 end-diastolic and end-systolic sphericity indices (r=−0.13, and r=−0.15, respectively, pNS for both). However, at the end of stepwise multiple regression model (entry criterion a univariate p<0.10) the exercise-induced changes in coaptation distance (partial r=0.59, p<0.001) and tenting area (partial r=0.45, p=0.024) were found to independently correlate with exercise–induced changes in ERO (generalized r²=0.48, p<0.001).

Conclusions: Exercise-induced changes in severity of ischemic MR in patients with LV dysfunction due to prior anterior myocardial infarction were independently related to changes in coaptation distance and tenting area and not to those in mitral annular diameter and global LV function. Exercise-induced changes in severity of ischemic MR, were not related to the degree of ischemic MR or LV dysfunction at rest.

Inverse relation between degree of mitral regurgitation and left atrial function

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Background: Increasing severity of mitral regurgitation (MR) is associated with increasing left atrial (LA) volume which, in turn, may improve LA function via the Starling mechanism. However, data are lacking on the relation between LA volume and LA function.

Methods: We studied LA function in 118 consecutive patients referred for TEE (age 60±16) who were in sinus rhythm with/without MR but with no other significant valvular lesions. LA dimensions were measured (lateral-medial, antero-posterior and superior-inferior) and the following LA volumes were estimated (as the product of the 3 dimensions): maximal (Vmax), minimal and volume preceding LA contraction. LA function was evaluated by calculating total and active atrial stroke volumes (SVmax and SVa respectively), total and active atrial emptying fractions (EFt and EFa respectively) and fractional shortening (FS) in each dimension.

Results: Patients were divided into groups (Gp) by severity of MR: Gp 1 (N=19); Gp 2 (N=29) and moderate MR (N=28); Gp 3—moderate MR (N=10). In table are mean values for parameters of LA size and function. Gp 3 patients had the largest LAs, but their SVa and SVa did not increase. A significant decrease in EFt and EFa as well as a decrease in FS in all 3 dimensions was noted in Gp 3 patients.

Conclusions: In groups of patients with increasing degrees of MR, maximal LA volumes were increased, SV was maintained but LA function decreased. Thus, increased LA volumes secondary to MR afforded no functional benefit and may be detrimental to LA function.

Table

<table>
<thead>
<tr>
<th>Vmax (ml)</th>
<th>SVmax (ml)</th>
<th>SVa (ml)</th>
<th>EFt (%)</th>
<th>EFa (%)</th>
<th>FSmax (%</th>
<th>FSap (%)</th>
<th>FSsi (%)</th>
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<tr>
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<td>86</td>
<td>19</td>
<td>52</td>
<td>33</td>
<td>27</td>
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<td>19</td>
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<tr>
<td>Gp 2</td>
<td>108*</td>
<td>45</td>
<td>20</td>
<td>44*</td>
<td>26*</td>
<td>21*</td>
<td>18*</td>
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<tr>
<td>Gp 3</td>
<td>172*</td>
<td>50</td>
<td>16</td>
<td>30*</td>
<td>14*</td>
<td>12*</td>
<td>10*</td>
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</table>

*p<0.05 or less vs Gp 1; p<0.05 or less vs Gp 2 (Student’s t-test).

Repair or replacement surgery in severe mitral regurgitation with apparently preserved left ventricular function: echocardiographic follow-up

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Background: Severe mitral regurgitation (MR) may be responsible for left ventricular (LV) remodelling and irreversible LV dysfunction with important prognostic implications. Surgical timing is determined by the onset of symptoms, LV dilatation and/or LV systolic dysfunction. Due to volume overload, LV systolic function is often overestimated and normal values can be present despite significant muscle dysfunction. This fact must be taken into consideration when referring patients to surgery if post-operative LV systolic dysfunction is to be avoided.

Objectives: To study the evolution of the echocardiographic parameters of a group of patients (P) with MR, and an apparently preserved LV function, submitted to mitral valve repair or replacement. To determine if there were differences between the patients with repair versus replacement surgery.

Methods: We studied 35 consecutive patients (24 men, mean age 62±13 years) submitted to surgery for severe MR due to rheumatic disease (8 P) or mitral valve prolapse (27 P). Patients with plurivacular disease, previous cardiac surgery or coronary disease were excluded. A transthoracic echocardiogram was performed within a month of surgery and again 6 to 9 months after this procedure. 20 P (57%) were submitted to mitral valve replacement with mitral apparatus preservation (2 after intra-operative transesophageal echocardiogram documentation of repair failure) and 15 P (43%) to mitral valve repair. Results: No deaths occurred during surgery or follow-up. After surgery, there was a significant reduction of the LV end diastolic volume (167.0±62 ml to 121.8±39.6 ml, p<0.0001) and LV ejection fraction (EF) (62.7±9.8 ml to 54.4±11.8 ml, p<0.0001). The reduction in the LV EF was similar in P submitted to mitral valve repair versus replacement. 9 P (24%) had an EF below 50% after surgery as compared to 2 (5.7%) prior to surgery (p<0.049). No significant changes were encountered in the LV end systolic volume, left atrial dimension or pulmonary artery systolic pressure.

Conclusions: Six months after surgery for severe MR, in a population with apparently preserved LV systolic function, post-surgical incidence of depressed EF (<50%) was still 25%. These results may indicate the need for stricter echocardiographic criteria for referral of patients with MR to surgery. In this population, the type of operation had no impact on the outcome, a result that emphasizes the importance of mitral valve apparatus preservation.
Can surgery improve the natural history of patients having severe mitral insufficiency and markedly impaired left ventricle function? Portal hypertension and marked left ventricle function?

Abstracts

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Mitrval valve surgery may improve the early follow-up symptoms in severe mitral valve insufficiency (MI) and markedly impaired LV function but the late evolution of the LV dysfunction in operated pts still raise doubts.

Purpose: early and midterm follow-up of the clinical and functional parameters in patients with mitral valve replacement (MVR) or valve plasty (MPL) and impaired LV function.

Methods: retrospective study of 39 pts (26 M,13 F,median age 66.3±9.1 y.o.) having severe(MI) and EF below 30%,operated between 1997-2003 in our Institute. All pts had 3-4 degree MI (76% ischemic MI, 25.6% degenerative e/o rheumatic, 2.0% mitral prolaps). 31 pts had significant coronaopathy, 21 with myocardial infarction and 6 with LV aneurysm; 9 pts had mitral valve prolaps. 31 pts had significant coronaopathy, 21 with myocardial infarction and 6 with LV aneurysm; 9 pts had mitral valve prolaps. 31 pts had significant coronary disease and 9 with myocardial infarction; 8/39 pts had cardiac transplant:one with MVP and the other with MVR. Associated procedures: CABG (31 pts), aortic valve replacement (9 pts), LV plasty in 6 pts. Complications: shock in 2 pts, anesthesia in 5 pts, atrial fibrillation in 4 pts, 2 pts had cardiac transplant:one with MVP and the other with MVR. Complications: shock in 2 pts, anesthesia in 5 pts, atrial fibrillation in 4 pts, 2 pts had cardiac transplant:one with MVP and the other with MVR.

Results: Follow-up ranged period from 1 to 12 years. In groups A/B: 5/6 pts died, 2/1 underwent reoperation and 5/3 were lost during FU (p<NS). Atrial fibrillation did not differ between the 2 groups. Group A demonstrated statistically significant (SS) LVEDD decrease postoperatively (p<0.05), Table 1 and remained constant at FU. LVESD was also decreased (p<0.05), FS and EF showed a trend to improve during FU (NS) and VT also showed improvement (p<0.05). In group B, LVEDV was decreased (p<0.05), but increased (non-SS)later at FU. LVESD remained high resulting in a decrease of FS and EF (p<0.05), which remained unchanged during FU, as well as VT.

Conclusion: MVr in pts with non-ischemic MR and preoperatively LV dysfunction, probably due to LV geometry protection achieved by preservation of the subvalvular apparatus.

Table 1

<table>
<thead>
<tr>
<th>Group</th>
<th>PRE</th>
<th>POST</th>
<th>FU 1</th>
<th>FU 2</th>
<th>FU 3</th>
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<tr>
<td>MVr/MVR</td>
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<td>MVr</td>
<td>MVr</td>
<td>MVr</td>
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<td>LVEDD(mm)</td>
<td>51±5</td>
<td>59±7</td>
<td>53±5</td>
<td>58±7</td>
<td>52±5</td>
<td>&lt;0.05</td>
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<td>LVESD(mm)</td>
<td>43±3</td>
<td>42±7</td>
<td>39±3</td>
<td>41±7</td>
<td>38±3</td>
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<td>EF(%)</td>
<td>28±5</td>
<td>44±7</td>
<td>31±5</td>
<td>46±7</td>
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<td>FS(%)</td>
<td>13±4</td>
<td>13±4</td>
<td>15±2</td>
<td>14±2</td>
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</tbody>
</table>

Mitral valve repair vs replacement for non-ischemic mitral regurgitation in patients with preoperatively depressed left ventricular systolic function. A Doppler echocardiographic study

N.T. Kouri, I. Ikonomidou1, D.D. Kontogianni2, G.S. Gourniout2, E.M. Kalkindi3, H.A. Grassos2, D.K. Babalis1, P. Nihoyannopoulos1, Athens, Greece, 1Hammersmith Hospital, Imperial College, London, United Kingdom, 2Western General Hospital, Athens, Greece

Mitral valve repair (MVr)preserves left ventricular (LV) function better than mitral valve replacement (MVR). The aim of this study was to evaluate these 2 procedures in patients (pts) with preoperative LV dysfunction, secondary to chronic degenerative mitral regurgitation (MR) and to follow-up (FU) them with repeated postoperative echocardiographic evaluations.

Patients and methods: 45 pts were divided in two groups: group A (27 pts) and group B (18 pts). Group A pts were in NYHA II at the end of FU, Group B pts were in NYHA III. The cause of MR was floppy MV (Group A) and MVP (Group B). The NYHA class improved (40% of the pts were in NYHA II at the end of FU). The pts without significant coronary disease (8/39) had worse clinical and survival parameters than pts with ischemia because the CABG perioperative mortality. The pts without significant coronaryopathy had worse clinical and survival parameters than pts with ischemia because the CABG performed concomitantly with MI surgical correction in pts with severe MI can substantially improve the post-operative LV function.

Distinctive characteristics of chordal rupture associated with rheumatic mitral valve disease and floppy mitral valve, and the impact of the infective endocarditis on chordal rupture

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We aimed to investigate the clinical, transthoracic and transesophageal echocardiographic characteristics of chordal rupture (CR) complicating the floppy mitral valve (FMV) and rheumatic mitral valve disease (RMDV). The study comprised 176 consecutive pts. Aortic valve regurgitation (MR) operated in our institution between 1993 and 2004. FMV was diagnosed in 64 of the 176 pts (36%), RMDV was in 79 pts (45%), infective endocarditis (IE) complicating native valves, RMDV or FMV was in 21(13%), papillary muscle ischemia was in 20(11%), and aortic stenosis, aneurysm or dissection, and miscellaneous etiologies were in the remainder. Anterior mitral leaflet (AML) was more frequently associated with CR in RMDV (87% vs 20%, p<0.05) whereas CR related to posterior leaflet (PML) was more frequent in pts with FMV (75% vs 11.4%, p<0.05). CR due to FMV was associated with an older age (p<0.001), male sex, the longer AML, PML and chordae, and a larger mitral annulus circumference. The mean age of pts who underwent MVP, MVr or MVr was statistically significant (p<0.05) and the correla-

Table 2

<table>
<thead>
<tr>
<th>CR</th>
<th>FMV</th>
<th>RMDV</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>AML</td>
<td>21 4</td>
<td>75 3</td>
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</tr>
<tr>
<td>PML</td>
<td>3 6</td>
<td>13 5</td>
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</tr>
<tr>
<td>chordae</td>
<td>2 4</td>
<td>4 4</td>
<td>0.001</td>
</tr>
<tr>
<td>Aortic valve</td>
<td>2 4</td>
<td>2 4</td>
<td>0.001</td>
</tr>
<tr>
<td>Aneurysm</td>
<td>2 4</td>
<td>2 4</td>
<td>0.001</td>
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<tr>
<td>Dissection</td>
<td>2 4</td>
<td>2 4</td>
<td>0.001</td>
</tr>
<tr>
<td>Miscellaneous etiologies</td>
<td>2 4</td>
<td>2 4</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Mitral pressure halftime revisited - Could it be useful in patients undergoing percutaneous mitral commissurotomy

O. Fondard, A. Scheuble, A. Cachier, A. Vahanian. Paris, France

Mitral pressure half-time (PHT) is well validated for the assessment of MR but its clinical and survival parameters than pts with ischemia because the CABG performed concomitantly with MI surgical correction in pts with severe MI can substantially improve the post-operative LV function.

Background: Mitral Pressure Half-Time (PHT) is well validated for the assessment of MR but its clinical and survival parameters than pts with ischemia because the CABG performed concomitantly with MI surgical correction in pts with severe MI can substantially improve the post-operative LV function.
378 Patterns of haemodynamic responses during exercise are related to exercise tolerance in patients with severe mitral stenosis with few or no symptoms


Purpose: In patients with severe mitral stenosis (MS) and few or no symptoms, exercise echocardiography (EE) is recommended to assess the evolution of mean mitral gradient (MG) and systolic pulmonary artery pressure (sPAP) (ACC/AHA guidelines). However, individual response is variable and cut off values have been mainly defined at peak stress. The purpose of our study was to assess the different patterns of haemodynamic responses with EE during exercise and their relationships to exercise tolerance.

Methods: 31 patients (19 females, mean age =49±13 years [25-77], sinus rhythm =26) with severe MS (MVA=1.25±0.18 cm² [0.85-1.5]) and few or no symptoms (NYHA I: n=9, NYHA II: n=22) were prospectively studied during EE (20 W increase every 3 minutes). MG and sPAP were measured at rest and peak (p<0.0001). Exercise was stopped in 16 pts because of dyspnea (Gp 1) and in 15 pts because of fatigue (Gp 2). At rest, no difference was observed between the two groups as regards MVA, MG and sPAP. Peak heart rate and blood pressure at peak stress were similar in the 2 groups. Gp 1 showed earlier and higher rate of increase of MG and sPAP during exercise. Peak MG and sPAP values were similar in the two groups.

Conclusion: In patients who have severe MS and no or few symptoms, early haemodynamic changes observed during EE but not obtained at peak stress distinguished patients who stopped exercise because of dyspnea from those who stopped because of fatigue. The pattern of increase in MG might be more discriminant to evaluate the exercise capacity, rather than peak sPAP.

Results

<table>
<thead>
<tr>
<th></th>
<th>MG Gp 1</th>
<th>MG Gp 2</th>
<th>p</th>
<th>sPAP Gp 1</th>
<th>sPAP Gp 2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest</td>
<td>8/8/6</td>
<td>6/6/3</td>
<td>NS</td>
<td>32/4/6</td>
<td>36/4/8</td>
<td>NS</td>
</tr>
<tr>
<td>20 W</td>
<td>17/16/6</td>
<td>16/6/6</td>
<td>NS</td>
<td>47/11/10</td>
<td>50/12/10</td>
<td>NS</td>
</tr>
<tr>
<td>30 W</td>
<td>25/21/6</td>
<td>17/6/6</td>
<td>0.009</td>
<td>56/11/11</td>
<td>54/11/11</td>
<td>NS</td>
</tr>
<tr>
<td>60 W</td>
<td>28/28/8</td>
<td>20/5/5</td>
<td>0.008</td>
<td>67/7/10</td>
<td>57/10/10</td>
<td>0.014</td>
</tr>
<tr>
<td>Peak</td>
<td>28/28/7</td>
<td>26/9/9</td>
<td>NS</td>
<td>69/8/11</td>
<td>70/10/10</td>
<td>NS</td>
</tr>
</tbody>
</table>

379 Relationship between mitral stenosis progression rate to demographic and echocardiographic findings in patients with mitral valve stenosis

N. Liel, N. Liel-Cohen1, E. Rotem2, Y. Henkin1, A. Abuful1, H. Reuveni2, Soroka medical center, omer, Israel, 1Soroka University Medical Center, Beer Sheva, Israel, 2Ben Gurion University of the Negev, Beer Sheva, Israel

Introduction: Mitral stenosis (MS) is a major health outcome in patients with rheumatic fever. Its incidence has decreased in the past decades but data on patient characteristics is limited. Therefore, we investigated the relationship between patients characteristics (demographics and echocardiographic) to MS severity and rate of stenosis progression.

Methods: Demographic and echo data of MS patients were identified from the computerized database of the echocardiography laboratory in Soroka Medical Center. This laboratory provides echocardiographic examinations (echo) to more than 95% of enrollees of Clalit Health Care services in the southern region of Israel. Only echos done prior to valvuloplasty and valve replacement were included.

Results: 546 patients with MS were identified. The mean age was 54.1±14.2 years, 78.2% females and 14.7% of Bedouin origin, 238 (44%) of these patients had 2 or more echos with a mean of 33±20 months between the first and last echos. Patients with one and patients with >2 echos had no significant difference in demographic variables. (table) Among patients with two or more echos no correlation was found between valve area and gender, ethnicity or age. The mean rate of MS progression was 0.098±0.16 cm² per year/patient. During first echo, 34.5% of the patients had atrial-fibrillation (AF) rhythm. The rate of MS progression was similar in patients with AF and sinus rhythm (SR).

28 patients converted from SR to AF between the first and the last echos. This group had a higher stenosis progression rate as compared to patients stable in their rhythm (0.12±0.25 converted, 0.10±0.16 SR, 0.09±0.13 AF, p<0.05).

Conclusions: The progression rate of mitral stenosis is not related to age, ethnic origin and gender and is similar to previous reports. Only new appearance of AF is associated with a higher rate of MS progression. Further studies with longer follow up periods are needed.

Echocardiographic findings

<table>
<thead>
<tr>
<th></th>
<th>First echo</th>
<th>Last echo</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA anterior posterior mm</td>
<td>46±9</td>
<td>46±9</td>
</tr>
<tr>
<td>LA superior inferior mm</td>
<td>62±11</td>
<td>64±13</td>
</tr>
<tr>
<td>Left ventricular function FS%</td>
<td>40±9</td>
<td>40±10</td>
</tr>
<tr>
<td>Pulmonary pressure mmHg</td>
<td>46±13</td>
<td>49±16</td>
</tr>
<tr>
<td>Mitral valve area</td>
<td>1.8±0.6*</td>
<td>1.6±0.5*</td>
</tr>
</tbody>
</table>

*P<0.05.

380 Clinical use of real time 3D-echocardiography in mitral stenosis after percutaneous mitral commissurotomy


Background: Commissural splitting is the main mechanism by which mitral valve area increases after Percutaneous Mitral Commissurotomy (PMC). However, assessment of commissural opening by 2D-Echocardiography is hindered by the complex three-dimensional shape of the mitral valve. In contrast real time 3D-Echocardiography seems ideally suited for this purpose but has never been evaluated. The aim of the present study was to compare the respective value of 2D- and 3D-Echocardiography for the assessment of the degree of commissural opening after PMC.

Methods: Twenty-four hours after PMC, commissural opening was simultaneously assessed by 2D- and 3D-Echocardiography. Sequences were digitally stored and reviewed by an experienced physician (level III). 2D and 3D sequences were analyzed blinded one from each other and in a random order. For both modalities, medial and lateral commissural opening were semi-quantitatively scored as 0—none, 1—mild, 2—partial, and 3—complete. Analysis was performed overall and separately for each commissure.

Results: Twenty-four consecutive patients (mean age 45±15 years, 58% female, 42% atrial fibrillation) were included in the present study. Post procedure mitral valve area was 1.8±0.3 cm² and mean transmitial gradient 5±1 mmHg. All except 3 had a final valve area >1.5 cm². 2D- and 3D-echocardiographic assessment of degree of commissural opening is presented in the Table. Overall, degree of agreement between the 2 methods was weak (kappa =0.43) and 2D-Echocardiography significantly underestimated the degree of commissural opening (p<0.05). Similar results were observed when analysis was performed separately on medial or lateral commissure.

Conclusion: These preliminary results suggest that after PMC 3D-Echocardiography provides a more accurate assessment of commissural opening. Diagnostic value of this new modality of commissural assessment deserves additional studies.

Degree of commissural opening

<table>
<thead>
<tr>
<th>Degree of commissural opening</th>
<th>Complete</th>
<th>Partial</th>
<th>Mild or none</th>
</tr>
</thead>
<tbody>
<tr>
<td>2D-Echocardiography</td>
<td>21 (44%)</td>
<td>16 (33%)</td>
<td>11 (23%)</td>
</tr>
<tr>
<td>3D-Echocardiography</td>
<td>29 (61%)</td>
<td>15 (31%)</td>
<td>4 (8%)</td>
</tr>
</tbody>
</table>
381 Relationship between intravascular hemolysis and microbubbles detected by transoesophageal echocardiography in the vicinity of mechanical mitral prosthetic valves

B. Heshmati, T. Goren, M. Aktaa, A.K. Bilge, Z. Bugra, B. Ummann, B. Ozben, M. Merc. Istanbul Faculty of Medicine, Istanbul, Turkey; Istanbul faculty of Medicine, Istanbul, Turkey.

Background: The significance of microbubbles (MBs) associated with mechanical prosthetic mitral valves (MVP) detected by echocardiography has not been fully understood yet. There are few studies on this relationship with intravascular hemolysis and results are not satisfactory. In this study, the relationship between intravascular hemolysis and MBs was investigated.

Patients and methods: Transoesophageal echocardiography (TEE) was performed in 39 consecutive patients (26 women; mean age 45 ± 11 years) with normally functioning MVP by transthoracic echo. Thirty-four of MVP were bileaflet. The control group consisted of age-matched 30 healthy volunteers (18 women; mean age 45 ± 12 years) and only hemolysis parameters were measured in this group. MBs detected by TEE were classified to four categories according to their densities in the left atrium (LA); 0 (n=2); no MBs; 1 (n=11): MBs detected rarely in contact with the valve and only in some cardiac cycles; 2 (n=9): MBs detected in all cardiac cycles, in a distance no more than 1 cm from the valve; 3 (n=17): MBs detected numerous in all cardiac cycles and in a distance more than 1 cm from the valve. The patients were divided into two subgroups according to their MBs density in LA; group 1 (n=13): low density group (category 0 and 1); group 2 (n=26): high density group (category 2 and 3). Hemolysis was evaluated by assays of serum haptoglobin, lactic dehydrogenase, indirect bilirubin, reticulocyte count, hemoglobin and schistocytes.

In addition serum iron and iron binding capacity were measured. Two subgroups and control group were compared with regard to the existence of hemolysis.

Results: No differences in age, sex, date of valve replacement, rhythm, EF and size of LA were found between two subgroups. Serum haptoglobin, LDH and schistocyte levels of the patients and control groups were significantly different (0.02 vs 0.07 ml/L, p<0.001; 675.9±218.6 vs 354.8±69 U/L, p<0.001; 0.29±0.37 vs 0.05±0.08%, p<0.001). In addition, serum iron was significantly lower in the patients (74.7±29.3 vs 102.3±36.6 µg/dl, p=0.002). These findings revealed that there was significant hemolysis in the patients. The hemolysis parameters of group 1 and group 2 were similar. We did not find any linear correlation between MBs density and hemolysis parameters.

Conclusion: In this study, intravascular hemolysis occurring in the patient with MVP was confirmed once again. However, this study suggest that MBs which were thought to be results of microcavitation have no additional hemolytic effects.

382 Presence of paraprosthetic moderate to severe mitral regurgitation may prevent embolic events in patients with prosthetic mitral valves

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Background and aim: Thromboembolism is the major chronic risk for patients with mechanical prosthetic heart valves. Although optimal oral anticoagulation is the key determinant for embolic events (EE) in these patients, other factors may also contribute to this complication. We studied the prevalence and determinants of embolic events in patients with mitral prosthetic heart valves undergoing transoesophageal echocardiography (TEE).

Method: The study group included 284 patients (120 male and 164 female, mean age 43.2±10.6 years) who underwent a TEE study to evaluate patients with prosthetic valve functions.

Results: Clinical and TEE findings of the patients were as follows: Atrial fibrillation in 170 (59%) patients, prosthetic valve thrombus in 61 (21%) suboptimal INR (INR<1.8) in 76 (26%) pts, left atrial spontaneous echocardiographic contrast (SEC) in 40 (14%) patients, paraprosthetic moderate-severe mitral regurgitation (MR) in 36 (12%), left atrial (LA) and/or left atrial appendix (LAA) thrombus in 49 (17%), LA and/or LAA outflow velocities <0.25 m/s in 28 patients (10%), left atrial diameter >6 cm in 56 (20%). Eighty patients had a history of EE in the previous 6 months (%28). In no patients were there any EE in the presence of paraprosthetic moderate to severe MR. Both with univariate and multivariate analysis presence of prosthetic valve and LA and/or LAA thrombus, absence of paraprosthetic moderate-severe MR, suboptimal INR, atrial fibrillation were found to be independent predictors for embolic events.

Conclusion: Although the presence of prosthetic valve and LA and/or LAA thrombus, suboptimal INR and AF predict EE, clinical and echocardiographic data support the protective effect of paraprosthetic moderate to severe MR against embolic phenomena in pts with mitral prosthetic valves.

383 Functional evaluation of the prosthetic aortic valve using supine bicycle exercise echocardiography for detection of prosthetic-patient mismatches

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Purpose: Patients with prosthetic aortic valve and normal left ventricular function may have persistent symptoms during exercise, because of patient-prosthesis mismatch. In that case, conventional resting echocardiography may fail to demonstrate the abnormality in prosthetic aortic valve function. We hypothesized that echocardiographic evaluation of prosthetic aortic valve during supine bicycle exercise reveals hemodynamic abnormality in patients with mismatched prosthetic aortic valve.

Method: Supine bicycle stress echocardiography was performed to evaluate the hemodynamic performance of prosthetic aortic valve in 55 patients (35 men; mean age 51±12 years) at least 1 year after aortic valve replacement. Patients with abnormal left ventricular systolic function or other concomitant valve dysfunction were excluded. Echocardiographic imaging including Doppler indices of aortic valve were obtained in each 3-minute stage (with 25 W workload increments up to symptom-limited peak exercise) of supine bicycle ergometer protocols. Result: Mean systolic pressure gradient (MSPG) significantly increased from 16.3±6 mmHg at baseline to 28.5±9 mmHg during peak exercise (p<0.001). Baseline MSPG was not different between patients with persistent symptom after operation (n=20) and patients with no symptom (n=35) (16.6±7.9 mmHg vs 15.9±5.6 mmHg, p=NS). However, in symptomatic patients, peak exercise MSPG was significantly higher (32.4 mmHg vs 23.1±8 mmHg, p<0.01). The percentage change of MSPG was significantly higher in symptomatic patients compared with that in asymptomatic patients (105.3±48% vs 82.1±35%, p<0.01). In patients with lesser LV mass reduction after operation (LV mass index<150, n=18), MSPG was significantly higher (40.6±17.3 mmHg vs 28.3±12.5 mmHg, p=0.04).

Conclusion: Supine bicycle exercise echocardiography is useful in predicting the mismatched prosthetic aortic valve earlier.
385
The association between different degrees of tricuspid regurgitation on tricuspid valve annular velocities using tissue Doppler imaging
V. Daniecek, Y. Shapiro1, D. Weisenberg1, M. Mansur1, A. Battler1, A. Sagie1, Assaf-Harofeh Medical Center, Zerifin, Israel, 1 Rabin Medical Center, Bellinson Campus, Petach-Tikva, Israel
Purpose: Tissue Doppler imaging (TDI) is a relatively new technique for estimation of LV and RV function from the velocities recorded from mitral and tricuspid annulus, respectively. However the influence of tricuspid regurgitation (TR) severity on TDI velocities recorded from tricuspid valve annulus is unknown. We hypothesized that TDI variables are influenced by significant TR and therefore it may have effect on RV function estimation. The purpose of this study was to examine the influence of different degrees of TR on tricuspid valve annular velocities using TDI.
Methods: 93 consecutive pts (mean age 59±17 y.) with various degrees of TR who were referred to the echocardiography laboratory for various reasons and had a good quality echocardiograms composed the study group. Pts were divided into 3 groups according to the degree of TR. Group 1-34 pts with mild TR; group 2-32 pts with moderate TR and group 3-27 pts with severe TR. Pts with tricuspid prosthesis or pacemaker were excluded. Tissue Doppler variables were recorded from the lateral annulus and 3-5 beats were averaged. These variables included: Systolic wave “S” and diastolic waves “Ea” and “Aa”.
Results: TDI “S” and Aa waves were significantly lower in patients with more severe TR 15.4 vs. 14.1 vs 13.8 cm/sec in groups 1, 2 and 3, respectively for S wave, P<0.049; 19.1 vs. 15.9 vs. 13.8 cm/sec for the respective groups regarding Aa; P=0.008; Ea wave was not significantly differed among the groups. In the subgroup of 76 pts with normal RV function difference in systolic function and severity of TR was significant.
Conclusions: Significant TR has significant impact on annular velocities Sa and Aa measured by TDI. Therefore when assessing RV function by TDI the presence and severity of TR should be taken into account.

386
Adquired Von Willebrand syndrome and bleeding risk in aortic stenosis. Correlation with echocardiographic parameters
Introduction: Aortic stenosis (AS) has been associated with high risk of bleeding due to an acquired Von Willebrand Factor (VWF) deficiency. Objectives: To know the prevalence of VWF deficiency in AS and its clinical implications. To correlate this deficiencies with echocardiographic parameters of severity of AE. Methods: In 53 patients with severe AE were prospectively analysed the VWF (VW antigen and VWF ristocetin). We investigate bleeding history (modified Rapaport questionnaire) and clinical conditions of determination of VWF. Patients were divided in two groups: estables (ambulatory) and admitted in Emergency Unit by unstable condition. Results: 16.3% of patients presented VWF deficiency. In all patients with VWF deficiency, the blood sample was obtained in stable condition (n=27). Therefore, all patients admitted in Emergency Unit (n=25) showed normal or elevated levels of VWF (97 vs 240, p<0.01). The abnormal elevation of VWF was observed in this situations: acute heart failure (56%), acute coronary syndrome (32%) or fever (12%) associated to VIII factor deficiency correlated with severity of valve disease by echocardiographic parameters.

387
Disclosure by strain Doppler echocardiography of differences in myocardial deformation in mitral and aortic regurgitation
E. Pettersen, K. Andersen, H. Ihlen. Rikshospitalet University Hospital, Oslo, Norway
Purpose: We hypothesized that assessment of myocardial deformation during isovolumic contraction (IVC) and relaxation (IVR) might add to the current information on different left ventricular function in mitral (MR) and aortic regurgitation (AR).
Methods: Patients with severe MR (n=16) or AR (n=10) with no or moderate symptoms were examined with strain Doppler echocardiography. Peak longitudinal strain rate and strain were measured in the mid segment of the interventricular septum during IVC, systole and IVR.
Results: Patients with MR had evident myocardial shortening during IVC as opposed to those with AR (Table). In contrast, myocardial lengthening during IVR was more pronounced in patients with AR than with MR. Systolic shortening did not differ between the groups.
Conclusions: Dysfunction in MR and AR were present during IVC and IVR. Myocardial shortening during IVC in the MR group was probably due to concomitant onset of regurgitation to the left atrium. Increased lengthening during IVC in the AR group might at least partly be consequent to the onset of AR. The lack of difference in systolic myocardial shortening challenges the previous assumption of facilitated ventricular emptying during the ejection phase in MR.

Table - Strain rate and strain

<table>
<thead>
<tr>
<th>Strain rate (1/s)</th>
<th>Strain (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MR</td>
<td>AR</td>
</tr>
<tr>
<td>IVC</td>
<td>-1.1±0.5</td>
</tr>
<tr>
<td>Systole</td>
<td>-1.2±0.3</td>
</tr>
<tr>
<td>IVR</td>
<td>0.8±0.7</td>
</tr>
</tbody>
</table>

Values are mean±SD.

388
Plasma NT-proBNP is a potential marker of disease severity and the presence of symptoms in patients with chronic rheumatic valve disease
V. Davutoglu, A. Celik1, M. Aksoy, Y. Sezen, S. Soydinc, N. Gunay2, Gaziantep, Turkey, 1 Gaziantep University, Gaziantep, Turkey, 2 University of Gaziantep, Gaziantep, Turkey
Background: A noninvasive marker of disease severity and presence of symptom is demanding in patients with chronic rheumatic valve disease (RVD). Aim: We sought to test the utility and usefulness measuring of N terminal pro B type natriuretic peptide (NT-proBNP) in chronic phase of RVD. We also evaluated whether echocardiographic measures are interrelated with pro-BNP.
Methods: The study comprised 92 patients with RVD (mean age of 40 (14--14 years) and 50 age/gender matched control subjects. Functional status of subjects were assessed. Detailed echocardiographic examination was performed and mitral valve score was estimated. Venous blood samples were taken for measuring the level of NT-proBNP.
Results: The plasma levels of pro-BNP, rose with increasing severity of mitral valve stenosis (p<0.001), increasing severity of mitral valve score (p<0.001), increasing severity of mitral regurgitation (p=0.013), presence of mitral valve calcification (p<0.001), presence of tricuspid valve stenosis (p<0.001), increasing severity of tricuspid regurgitation (p<0.011), presence of aortic stenosis (p=0.043), decreasing left ventricular ejection fraction (p<0.001), presence of left atrial thrombus (p=0.0019), and with increasing left atrium dimensions (p=0.002).
Conclusion: NT-proBNP levels in patients with chronic RVD is a potential marker of disease severity and the presence of symptoms.
389 Contribution of selected serum inflammatory mediators to the progression of chronic rheumatic valve disease, subsequent valve calcification and functional class

V. Davutoglu, A. Celik1, M. Akyoy, Y. Sezen, S. Turkmen, S. Soydinc, I. Akdemir. Gaziantep University, Gaziantep, Turkey. 1Gaziantep University, Gaziantep, Turkey.

Background: The mechanism of the underlying principle of the progression of chronic rheumatic valve disease (RVD) and subsequent valve calcification is yet not clearly understood. We aimed to determine whether serum markers of inflammation have impact on severity of chronic RVD, subsequent valve calcification, and functional class.

Methods and results: Of the 92 patients with RVD, 27 were male and 65 were female. They had a mean age of 40 +/- 14 years. The control group consisted of age and gender matched 50 subjects without echocardiographic signs of RVD. All patients were enrolled to echocardiographic evaluation in respect of rheumatic valve severity, valve calcification, and functional class. Cytokines (interleukin-6 [IL-6], interleukin-2 receptor [IL2R], interleukin-8 [IL-8], tumor necrosis factor-alpha [TNF-α]) and serum inflammatory markers (fibrinogen, hs-CRP) were measured in all subjects. Plasma levels of IL-6, IL-8, IL-2R, TNF-alpha, and hs-CRP were significantly higher in patients with RVD than control subjects (p < 0.001). There were significant correlation between mitral score and fibrinogen (p = 0.002), IL-6 (p = 0.007), TNF-alpha (p = 0.001), and hs-CRP levels (p < 0.001). Fibrinogen, hs-CRP, IL-6, TNF-alpha, and IL-2R were correlated with functional class severity. IL-6 and TNF-alpha were strongly correlated with valve calcification (p < 0.001).

Conclusion: Chronic phase of RVD is associated with ongoing serum inflammatory mediators which are strongly correlated with severity of valve involvement, valve scarring, subsequent valve calcification, and decreasing functional status. Future research in this important area should focus on the critical question whether the antiinflammatory drugs might reduce progression, morbidity and mortality of patients with chronic RVD.

391 Medium-term follow-up in patients with acute aortic dissection


Proximal acute aortic dissection (PAAD) is a life-threatening disease. Prompt reliable diagnosis and early surgical intervention reduce the high risk of mortality. The aim of this study was to analyze the risk factors for complications after surgery in patients with PAAD. Between January 2000 and December 2003 urgent surgical intervention for PAAD was performed in 41 pts indicated by transoesophageal echocardiography. Six pts had Marfan syndrome, 35 pts had hypertension. According to De Bairey classification 13 pts was in DB type-I, 28 pts in DB type-II. Intramural haematomata was detected in three pts. 4 pts died immediately after the diagnosis, 10 pts died between postoperative period (two pts with Marfan syndrome). 27 pts (65.8%) were discharged from the institute. The mean postsurgical follow-up time was 24.5 months (1 month -44 months). Six pts had eventfree follow-up. 1 pt died in the fourth postoperative month because of acute myocardial infarction. Surgical intervention was necessary in 5 pts because of urgent surgical indication (rupture at intima and aneurysm at int). Among them 2 pts had Marfan syndrome. 1 pt had elective surgical intervention because of severe aortic regurgitation (AR). 20 pts had no worsening in AR and systolic left ventricular function.

In conclusion: Morbidity is high in pts with proximal acute aortic dissection even after successful surgical intervention. Marfan syndrome is a risk factor for early and late complications.

392 Distribution of atherosclerotic changes of the thoracic aorta in patients with aortic dissection


Background: Atherosclerosis, a lesion of the intima, is one of the mechanisms that weaken the aortic wall and contribute to the development of aortic dissection (AD). The aim of the present study was to evaluate by transoesophageal echocardiography the distribution of aortic atherosclerotic changes in patients (pts) with AD.

Methods: We assessed thoracic aortic atherosclerosis (TAA) in 93 consecutive pts who underwent TEE in our laboratory and were diagnosed with AD. Sixty pts (44 males, 16 females) had proximal (Stanford type A) and 33 pts (22 males, 11 females) had distal (Stanford type B) dissection.

Results: Severe TAA, with plaques thicker than 3 mm were detected in 37/93(40%) pts. Plaques >3 mm were found in 24/33(73%) of type B and in 13/60(22%) of type A dissection (p = 0.0001). When we analyzed the findings at the three segments of the thoracic aorta, no patient had severe atherosclerosis of the ascending aorta in either group, while 5/33(15%) of type B vs 3/60(5%) of type A (p = 0.01) and 24/33(73%) of type B vs 11/60 (18%) of type A (p = 0.00001) dissection pts had severe TAA of the aortic arch and the descending thoracic aorta respectively.

In addition, pts with type B dissection were older (69 vs 58 years, p = 0.0003), had hypertension more frequently (85% vs 55%, p = 0.004) and did not differ (p = NS) in hypercholesterolemia, diabetes and smoking.

Conclusion: Severe TAA is common in the descending thoracic aorta and is associated with type B dissection. These findings indicate that the contribution of atherosclerosis in the development of aortic dissection is confined mostly in pts with distal dissection without involvement of the ascending aorta.

393 Transoesophageal echocardiography in the diagnosis of coeliac trunk and superior mesenteric artery involvement in aortic dissection

G.A. Gustavo Avegliano, Z. Gomez Bosch1, N. Rivas, A.E. Arturo Evangelista, M.T. Mariateresa Gonzalez-Alujas, H.G. Herminio Garcia Del Castillo, J.S.S. Jordi Soler-Soler. Hospital Vall d’Hebron, Barcelona, Spain. 1Hospital Vall d’Hebron, Barcelona, Spain

Although TOE is one of the most useful techniques for the diagnosis of aortic dissection (AD), its role in the assessment of coeliac trunk and suprarenal mesenteric artery involvement has not been established.

Methods: In 41 consecutive patients with AD who underwent TOE and angiography (AO), dissection of these vessels, compression of the ostia and connection to the false lumen were assessed. Five patients had mesenteric angiography.

Results: Normal flow velocity of coeliac trunk and mesenteric artery in the ostium ranged from 0.7 to 1.5 m/sec. In patients with false lumen ostium compression flow velocity was > 2.5 cm/sec. Vessels dissection was visualized by 2 different coded flow and intimal flap identification in all cases.

Conclusions: TOE is highly useful in the diagnosis of coeliac trunk and superior mesenteric artery involvement in aortic dissection, providing morphologic and haemodynamic information which is crucial for the correct management of mesenteric ischaemia by endovascular treatment.

394 TOE predictor factors of aorta dilatation in type B dissection evolution

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The role of TOE in the prediction of aorta dilatation in the subacute phase of an aortic dissection (AD) is not established.

Objective: The objective of this study was to assess predictor factors of aorta dilatation in type B dissection.

Methods: In 87 consecutive AD, 40 surgically treated type A and 47 type B, a TOE was performed before discharge and CT or MRI annually (m: 50±33 m). TOE variables were defined by echo, colour Doppler and contrast. High pressure of false lumen (FL) was derived by the flow of entry tear and contrast movement in FL. During follow-up 9 Type B and 6 Type A required surgery or endovascular treatment and 10 type B and 3 type A died. Type B group has similar age to type A (57±12 vs 53±13 y) and basal maximum diameter (41±8 vs 38±7 mm).

Results: Multivariate analysis showed that maximum diameter >45 mm, large entry tear >7 mm and high pressure pattern of FL were related with greater dilation rate. Greater dilation rate was higher in patients who died (6.5±7.5 vs 2.4±3.6 mm; p<0.05)

Conclusion: TOE prior to discharge in aortic dissection patients, permits identification of predictive factors for complications and should be used for endovascular treatment indication.

Maximum aortic diameter enlargement

<table>
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<td>Surgically treated type A</td>
<td>2.5 (5.2)</td>
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<td>Proximal entry</td>
<td>3.3 (5.1)</td>
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<tr>
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<td>Diameter &gt;45 mm</td>
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<td>2.3 (3.3)</td>
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</table>

Enlargement (mm/year).
395 Usefulness of contrast echocardiography in aortic dissection assessment by traoosopheagal echocardiography
Z. Gomez Bosch, G.A. Gustavo Avegliano1, A.E. Arturo Evangelista, M.T.G.A. Maria Teresa Gonzalez-Alujas, H.G. Hermilio Garcia del Castillo, J.S.S. Jordi Soler-Soler1, Hospital Vall d’Hebron, Barcelona, Spain, 1Hospital Vall d’Hebron, Barcelona, Spain

TOE is a highly useful technique for aortic dissection (AD) diagnosis. It is limited when defining some morphologic and dynamic characteristics which may be important for therapy and prognosis.

Objective: To assess the usefulness of contrast echocardiography on the TOE information, regarding: entry tear location, false lumen flow direction, retrograde arch dissection and arterial branch involvement.

Methods: 60 consecutive patients, 37 type B AD, and 23 type A after surgical treatment, underwent TOE. TOE standard protocol with colour Doppler was used prior to Sonovues contrast administration (3 ml). The whole study was video recorded. Information obtained by standard protocol and by contrast was assessed by two blind observers.

Results: Contrast permitted identification of 14 entry tears in distal ascending aorta not diagnosed by standard method, arch retrograde dissection in 9 cases, arterial branch involvement in 12 and clearly better assessment of false lumen flow dynamics in all cases. In 35 (58%) studies the information obtained with contrast was clinically useful for correct management.

Conclusions: Contrast echocardiography significantly improves information obtained by TOE in aortic dissection assessment and should be used systematically prior to surgical or endovascular treatment.

396 Simvastatin but not levothyroxine improves endothelial function in subclinical hypothyroidism
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Background: Patients with subclinical hypothyroidism (sHT) have impaired endothelial function probably related to dyslipidemia. The present study compares the effects of simvastatin versus levothyroxine [L-T(4)] on lipid profile and endothelial function in patients with sHT.

Methods: Patients with sHT were randomized into 3 groups to receive no treatment (n=10), L-T(4) 100 µg/day (n=14) or simvastatin 20 mg/day (n= 14) for 6 months. Endothelial function of brachial arterial was assessed noninvasively using high resolution ultrasound at baseline and after 6 months. We measured flow-mediated endothelium-dependent vasodilation (FMD) and glyceryl trinitrate-induced endothelium-independent vasodilation (GTNMD).

Results: Serum lipids were significantly lower following simvastatin: total cholesterol 217.2±28.9 mg/dL vs. 176.6±31.9 mg/dL (p=0.002), triglycerides 159.8±97.2 mg/dL vs. 105.3±38.5 mg/dL (p=0.006), non-HDL-cholesterol 166.2±34.6 mg/dL vs. 126.9±34.4 mg/dL (p=0.001). FMD increased significantly in simvastatin treatment group (7.8±3.6% vs. 14.5±6.1% (p=0.005). Serum lipids and FMD did not change significantly with L-T(4) treatment and in no treatment group. GTNMD was unchanged in none of the three groups.

Conclusion: Simvastatin but not levothyroxine treatment significantly improves endothelium-dependent flow-mediated dilatation of the brachial artery and dyslipidemia in patients with sHT. Improvement in brachial artery endothelial function may be explained by the hypolipidemic effects of simvastatin treatment. These findings also suggest a role for dyslipidemia in endothelial dysfunction and the risk for cardiovascular disease in sHT.

397 Long-term L-arginine therapy improves endothelial function assessed by brachial artery vasoreactivity test in patients with normal coronary arteries
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Background: About 10-15% of patients referred to coronary angiography because of recurrent chest pain have normal coronary arteries. Prior study demonstrated that long-term oral L-arginine therapy for 6 months improved coronary small-vessel endothelial function and chest pain in patients with non-significant (<40% diameter stenosis) coronary artery disease (CAD). Thus, the present study was designed to test the hypothesis that long-term oral L-arginine supplementation for 6 months improves endothelium-dependent flow-mediated dilation (FMD) of peripheral vessels assessed by a non-invasive brachial artery vasoreactivity test (BRT) in symptomatic patients with normal coronary arteries.

Methods: We prospectively assessed endothelial function in 58 consecutive patients with stable angina pectoris [Canadian Cardiovascular Society (CSS) class II-III] who were referred to our laboratory 30±10 days after normal coronary arteries were found on coronary angiography. After an overnight fast and after all cardiovascular medications had been discontinued for “d 12 hours, endothelium-dependent brachial artery FMD and endothelium-independent nitroglycerin-mediated vasodilatation (NTG) were assessed using high resolution (15 MHz) linear array ultrasound. A severe endothelial dysfunction (n<6% FMD) was observed in 26% (15/58) of the patients (mean age 66±11 years, mean left ventricular ejection fraction 52±9%, mean body mass index 28±3 kg/m²), who were recruited into the current study. Oral L-arginine (CarginineTM, Coraltis Ltd., Israel) was given at a dose of 5 g daily for 6 months to all study participants. Patients were instructed to avoid taking other medication, over-the-counter vitamins, or amino acids. After 6 months, a repeat endothelial function assessment was performed.

Results: %FMD %NTG/day CSS class Baseline: 4.5±1/1.2, 8.5±1/1.4, 2.7±1/1.9, 2.4±1/0.4 6-month follow-up:9.8±1/1.5, 9.7±1/1.6, 0.4±1/0.5, 1.0±1/0.4 p-value 0.03 0.55 <0.01 <0.01 Values are expressed as mean±SD; %FMD, %NTG= change from baseline in brachial artery diameter caused by FMD and NTG, respectively; SL, NTG= sublingual nitrate pills.

Conclusion: Long-term oral L-arginine therapy for 6 months improves peripheral endothelial function assessed by BRT and is associated with significant improvement in symptoms in patients with anginal syndrome and normal coronary arteries. Thus, L-arginine is a therapeutic option in symptomatic patients with dysfunctional endothelium.
Noninvasive assessment of endothelium-independent vasodilation in human coronary and peripheral circulation: a combined ultrasound and MRA study

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**Background:** The assessment of brachial artery and coronary response to exogenous nitrates is a marker of endothelium-independent vasodilation and may have prognostic impact.

**Aim:** to evaluate the relation between endothelium-independent human coronary and peripheral circulation.

**Methods:** Coronary magnetic resonance angiography (MRA) was performed in 16 healthy volunteers (8 males; age 30±9 years). We used a high spatial resolution sequence (cine Spiraled Gradient Echo) for imaging of coronary artery lumen (left anterior descending in 14, right coronary artery in 2 patients). After the baseline imaging sublingual nitroglycerin (NTG) (0.3 mg) was administered. In all subjects short axis views of the coronary artery were serially acquired from 1 up 10 minutes after NTG administration. Percent dilation in the coronary artery was measured off-line. On a different day, within one week and in random order, also a brachial artery ultrasound study was performed by observers blinded to the other test.

**Results:** The mean NTG-induced maximal percent dilation in the coronary artery was higher than that in the brachial artery (43±6% vs 23±6%; p<0.01). Following NTG, maximal luminal dilation in the coronary arteries was not correlated with that in the brachial arteries (r=0.07, p>0.05). The time to peak vasodilation was 283±129 sec in coronary and 284±94 sec in the brachial artery, with no interpatient correlation (r=0.16, p>0.05).

**Conclusion:** In healthy humans, entity and timing of endothelium-independen coronary and peripheral vasodilation elicited by exogenous nitrates are unrelated.

**Figure**

Comparison of the effects of carvedilol and metoprolol on blood pressure and endothelial function in patients with hypertension and type-2 diabetes mellitus

E. Fabian, L. Nagy\(^1\), M. Csany\(^2\), Budapest, Hungary, \(^1\)University of Szeged, Szeged, Hungary

The aim of present study was to compare the effects of carvedilol and metoprolol on the blood pressure, endothelial function and metabolic parameters of patients with hypertension and type 2 diabetes.

**Patients and methods:** 36 patients with well-controlled type 2 diabetes, mild/moderate hypertension and impaired endothelial function (flow mediated dilatation of brachial artery, <5%) were randomized to either 2×12.5 mg of carvedilol (n=19) or 50 mg of metoprolol succinate (n=17) daily. The dose of study drugs was doubled after 4 weeks if the patient had not reached the 130/80 mmHg target blood pressure. Endothelial function was evaluated by FMD and the levels of tissue plasminogen activator (t-PA), plasminogen activator inhibitor-1 (PAI-1) and vascular cell adhesion molecule (VCAM-I).

**Results:** Heart rate and blood pressure significantly decreased in both groups during the 12 week study period without significant differences between the blood pressure and heart rate lowering effect of two drugs. FMD increased with carvedilol significantly (2.72±1.11% vs 5.50±2.28%; p=0.0001), while it did not change with metoprolol succinate (3.41±0.89% vs 3.99±1.18% p=0.0523). The FMD alteration was significantly higher with carvedilol (p=0.0012). Laboratory parameters did not change significantly.

**Conclusions:** 12 week long carvedilol treatment significantly improved the endothelial function in patients with hypertension and type 2 diabetes, but the effect of metoprolol was not significant. There was no difference in the heart rate and blood pressure lowering effect of two drugs. The favorable effect of carvedilol could be due to its other effects.

**Key words:** endothelium, hypertension, diabetes mellitus, beta-blocker.

**Table**

| FMD (%) | 4.9±3.2 | 4.3±3.4 | 6.2±3.4 | 5.7±2.8 |
| NMD (%) | 15.8±7.3 | 14.9±8 | 13.3±4.1 | 14.5±4.5 |
| WBC (×103) | 7.4±2.3 | 6.1±2.5 | 7.4±2.9 | 4.3±3.2 |

**Treatment with recombinant granulocyte colony stimulating factor improves endothelial function**

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Studies have shown that granulocyte colony stimulating factor (GCSF) may modulate vascular tone via endothelial receptors or indirectly by release of other cytokines in vitro. We examined the effects of GCSF administration on endothelial function in vivo.

**Methods:** We studied 42 women with surgically excised breast cancer (stage II) who were scheduled to receive a 5 day course of s.c. recombinant human GCSF (5ug/kg). In order to prevent neutropenia after adjunctive chemotherapy, B-mode and Doppler brachial artery ultrasonography was used to assess flow-mediated, endothelium-dependent dilatation (FMD%) and nitrate-mediated, endothelium-independent dilatation (NMD%) of the brachial artery in all patients. Measurements were performed at baseline before chemotherapy (FMD, NMD 0), before (FMD, NMD 1) and 2 hours after the first s.c. injection of GCSF and at the end (FMD, NMD 3) of a 5-day treatment with GCSF. White cell blood count (WBC- mm\(^3\)) was assessed at the above time periods (0,1,2,3).

**Results:** There were no differences between baseline FMD(FMD0) and FMD before the first GCSF injection (FMD1) (p>ns). Analysis of variance showed that FMD significantly increased 2 hours after the first GCSF injection (FMD2) and remained improved at the end of GCSF treatment (FMD3) compared to FMD before treatment (FMD1) (P<0.05, table), NMD remained unchanged throughout the study. After chemotherapy, WBC (WBC1) was reduced compared to baseline WBC (WBC0) but was increased after the first injection of GCSF (WBC2) and remained within normal limits at the end of GCSF treatment (WBC3). (table, p<0.05)

**Conclusion:** Treatment with GCSF improves endothelium-dependent dilatation of the brachial artery whereas does not affect endothelium-independent dilatation in vivo. Our findings suggest that treatment with GCSF stimulates endothelial function and thus, may be used to facilitate neovascularisation of the injured region during procedures of myocardial regen- eration in patients with heart failure.

**Macrophage colony stimulating factor (MCSF) has been linked to atherosclerosis in animal models**

N. Tsokos, I. Ikonomidis, P. Katsichis, C. Papadimitriou, I. Lekakis, G. Vamvakou, M. Mavrikakis, Alexandra Hospital, Univ. of Athens, Athens, Greece, \(^2\)Alexandra General Hospital, Athens, Greece

Increased circulating macrophage colony stimulating factor levels are associated with severe atherosclerosis of the peripheral arteries

I. Ikonomidis, J. Lekakis, A. Papada\(^1\), T. Papaoannou\(^1\), A. Protegorou\(^1\), G. Vamvakou\(^1\), C. Papamichail\(^1\), M. Mavrikakis, Alexandra Hospital, Univ. of Athens, Athens, Greece, \(^2\)Alexandra General Hospital, Athens, Greece

Macroplage colony stimulating factor (MCSF) has been linked to atherosclerosis. We investigated the relation of MCSF serum levels a) to extent of coronary and extracoronary atherosclerosis b) to procoagulant factors, namely C-reactive protein (CRP) and homocysteine.

**Methods:** We examined 90 patients with angiographically proven CAD and 20 controls with similar age and standard risk factors but no CAD at angiography. Extent of CAD was expressed as number of diseased vessels. All patients underwent measurement of a) serum MCSF, high sensitivity CRP (mg/l) and homocysteine (micromol/l) and b) carotid (CIMT) and femoral artery (FIMT) intima-media thickness by ultrasound sonography.

**Results:** Patients had higher MCSF and CRP levels than controls (p<0.05). Increased MCSF was related to increased CRP and homocysteine and FIMT (r=0.40, r=0.21, r=0.24 respectively, p<0.05). Analysis of variance showed that MCSF and CRP serum levels increased according to the number of diseased coronary vessels (p<0.05). Patients with plaques in peripheral vessel (n=15) had higher median MCSF (310 (240-777) vs 250 (140-422), p<0.05) and CRP (4.8 (2.7-17.8) vs 3.2 (1.3-6.2) p<0.05) than those with <3 plaques. ROC curve analysis showed that an MCSF>340 Î¼g/ml and a CRP>3.3 mg/l had a sensitivity and a specificity of 72% and 54% (area: 68% (CI: 55-83), p<0.05) and 64% and 55% (area: 65% CI: (53-77), p=0.06) respectively for prediction of >3 plaques in peripheral vessel.

**Conclusion:** Increased MCSF serum levels are associated with elevated CRP and homocysteine in patients with CAD and may predict presence of severe extracoronary atherosclerosis.
403 The spectrum of echocardiographic findings in Marfan Syndrome
C. Ginghina, B.A. Popescu1, I. Stoian1, M. Serban1, I. Ghiorgiu1, A. Pau1, I. A. Teodorescu, M. Simineu1, E. Apetrei1, 1Instit. of Cardiovascular Diseases, Bucharest, Romania, 1Institute of Cardiovascular Diseases, Bucharest, Romania

Background: The diagnosis criteria in Marfan Syndrome (MS) include phenotypic expression at bone skeletal, eyes, cardiovascular system, lungs and central nervous system.

The aim: The study of echocardiographic (ECHO) findings spectrum in MS, the appreciation of ECHO contribution in evaluation of patients (pts) with MS.

Methods: There were analysed 53 pts with MS (aged between 18-61 years old, 35 males) admitted in a ten years period 1991-2004. All pts were clinical and paraclinical (EKG, X-R, ECHO) evaluated: 18 pts made catheterization and aortography, to 15 pts we proceed an CT exam: to 11 pts MRI. The ECHO study was made in 2D, M-mode, spectral and color Doppler, TTE and TEE. We calculated the aortic (Ao) dilatation by appreciation of absolute diameter, progression rate, Ao distensibility (syst/Ao area x pulse pressure) and Ao rigidity index – (syst/pressure/diast.pressure x diast.Ao diameter)/syst.Ao diameter-diast.Ao diameter).

Results: There were studied also the first degree relatives of pts with MS.

Results: The spectrum of ECHO findings to the pts with MS included the modification of Ao root 47 pts (90%), mitral valve (MV) system 19 pts (35%), pulmonary artery (PA) dilatation – 9 pts (12%), tricuspid valve prolap (TVP) – 6 pts (8%) and intratral septum aneurism (IASA) – 5 pts. Although the most affected structure in MS is MV in our cases the most affected was the Ao dissection risk rise with the Ao diameter rising (correlation coefficient r=0.93). The Ao dilatation progression rate was 1.7 mm/year. The ECHO study in families with MS has allowed: an early noninvasive diagnosis for cardiac lesions, an early initiation of treatment (beta-blockers) by appreciating of MV disease with proving out family history (Ao diameter 47 +/- 9 vs 40 +/- 7, p < 0.001). On the ECHO data was established the surgical proper moment to the asymptomatic pts (Ao diameter >55 mm), the postoperative follow-up data (aneurism at the anastomosis level – 1 pts, prosthesis distension – 1 pt, distal dissection 2 pts).

Conclusions: The spectrum of ECHO finding in MS is frequency has dominant the Ao determination followed by MV modification, PA dilatation, TVP, IASA. Associated determination of several cardiac structure were more frequent (68%) than the uniques lesions (32%). The ECHO examination in MS has allowed: an early noninvasive diagnosis of the type of coarctation followed by the appreciation of the moment for initiate the medical or surgical treatment, the postoperative follow-up and the evaluation of families with MS.

404 Doppler flow profile in the abdominal aorta reflects collateral blood flow in patients with coarctation of aorta

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Background: Loss of pulsatile systolic abdominal aortic flow and the presence of continuous diastolic flow are frequently encountered in patients with significant aortic coarctation. The reason for this abnormal flow velocity profile is uncertain.

Hypothesis: Collateral networks contribute to the abdominal aortic flow pattern in patients with significant aortic coarctation

Methods: Nine patients (age 32-6 years, 5 male) underwent Doppler echocardiographic examination and magnetic resonance imaging (MRI) prior and between 2 to 9 months post coarctation stenting as part of routine follow up. Descending aorta blood flow profile was studied using continuous wave Doppler. Measurements were made on the maximum abdominal aortic systolic (S) and diastolic (D) velocity and the ratio S/D which reflects the degree of pulsatile blood flow profile was calculated. The presence of collateral network and the percentage flow through the collaterals were calculated using MRI.

Results: Prior to coarctation stenting, 8 out of the 9 patients had continuous abdominal aortic flow with mean S/D ratio of 1.8±0.8. The collateral network was reported to be extensive in 6 patients, moderate in 1 patient and mild in 2 patients. The mean ratio of collateral flow from the descending thoracic aorta to the abdominal aorta was 51.4±25.0% which was reduced to 1.29±28.7% post stenting (p=0.003). Eight of the 9 patients reverted back to pulsatile flow with aortic low diastolic velocity. The remaining patient maintained the continuous flow pattern. The mean S/D ratio for the group increased from 3.4±1.3 (p=0.004) suggestive of greater flow pulsatility. The collateral networks became mild in 6 patients, moderate in 1 patient and the remaining patients did not have magnetic resonance angiography. The S/D ratio was inversely correlated with MRI collateral flow assessment, (r=-0.627, p=0.012).

Conclusion: The abdominal aortic Doppler flow pattern may be explained by the presence and extent of the collateral networks present in patients with aortic coarctation.

405 What data can be expected from the echocardiography in sinus of Valsalva aneurysm?

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Background: Valsalva sinus aneurysm (VSA) is an uncommon condition caused by the separation of the aortic wall media from the valve ring tissue. Cardiac catheterization (cath) and retrograde aortography are traditional considerations for the diagnosis of VSA. Echocardiography (echo) as a single minvasive method could make the diagnosis of VSA.

Purpose: The assessment of the value of echo to estimate VSA; comparison of echo information with cath-angiography, surgery and anatomopathological data.

Methods: The study group consisted of 29 patients (pts) (mean age 41.1±5 years; M/F=19:10) diagnosed as having VSA hospitalized between 1998 all of them being explored by echo (2D, color Doppler, TTE and TEE) and cardiac cath. The diagnosis accuracy regarding direct visualization, location, morphology, extension, haemodynamic consequences (with determination of pulmonary pressure), complications of VSA and associated cardiac lesions of the two methods were compared. Also, there were compared with surgical data (19 pts. operated) and necropic data (15 pts).

Results: Out of the 178.136 echo studies performed in a 15 years interval, the 29 pts with VSA represented 0.016%. The right coronary sinus was most frequently involved (79%) the noncoronary sinus was involved in 14% of VSA cases and the left coronary sinus in 7% of them. A single coronary sinus was usually affected (89.5%) in three pts the pathologic process involved more than one coronary sinus, 2 of them had Marfan syndrome and had Arkelingion spondylosis. Ruptured VSA formed the majority of our group (25 pts) out of which 19 had ruptured VSA in the right cardiac chambers. Most of the pts with VSA were associated with other cardiac lesions (19 pts). Compared the diagnosis accuracy of echo by the “gold standard” – cardiac cath – the sensibility was 93% and the specificity was 100%. The discrepancies between the 2 methods arose regarding the site of rupture and the associated lesions. The correlation between echo and cath was r=0.91, between echo and surgery was r=0.95 and between echo and patholog was r=1.

Conclusions: Echo can reliably diagnose VSA (sensitivity 100%) regarding direct visualisation, site, morphology of the lesion and brings important information (sensibility 93%) regarding the extension and complication of VSA as well as associated cardiac lesions; In the vast majority of cases, the diagnosis accuracy of VSA by echo makes cardiac cath unnecessary; Echo was most valuable in unruptured VSA cases with nonspecific clinical presentation.

406 Dilatation of aorta in bicuspid aortic valves

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Background: Bicuspid aortic valve (BAO) may be associated with dilatation of the aorta and cistic medinecrosis. However, the influence of hemodynamic abnormality (aortic stenosis: AS or aortic regurgitation: AR) is not clear.

Purpose: To determine whether aortic dimensions are dependent on the severity of aortic valve disease in adults with BAO

Methods: We evaluated 104 consecutive patients with BAO, 39 women (37.5%), 25 patients (24%) had the history of coarctation (COA) repair in the age of 9.3 ± 3.5 years, 8 women had Turner syndrome, 5 pts had Turner syndrome. Group A comprised 55 patients with none, small or mild AS or AR, group B comprised 49 patients with moderate or severe AS or AR, 3 pts from group A and 32 pts from group B were indicated for cardiac surgery.

Results: table:

Conclusion: Proximal ascending aorta was dilated in both groups, regardless of the hemodynamic severity of aortic valve disease. However, patients with mild or none AS or AR had more often the history of coarctation repair in childhood. Aortic bulbus was dilated in the group with significant aortic valve disease.

Table

<table>
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<tr>
<th>Group A</th>
<th>Group B</th>
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<tr>
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<td>48</td>
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<tr>
<td>age</td>
<td>37 ± 12.9</td>
<td>40 ± 13.4</td>
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<tr>
<td>septum (mm)</td>
<td>11 ± 2.2</td>
<td>14 ± 3.2</td>
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<tr>
<td>posterior wall (mm)</td>
<td>10.7 ± 0.9</td>
<td>13 ± 3.0</td>
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<tr>
<td>LVEDD (mm)</td>
<td>49 ± 11.6</td>
<td>53 ± 10.5</td>
</tr>
<tr>
<td>LVESD (mm)</td>
<td>31 ± 6.4</td>
<td>34 ± 7.9</td>
</tr>
<tr>
<td>EF</td>
<td>67 ± 11.7</td>
<td>63 ± 9.0</td>
</tr>
<tr>
<td>NYHA (1-4)</td>
<td>2.8 ± 0.4</td>
<td>2.1 ± 0.8</td>
</tr>
<tr>
<td>aortic annulus (mm)</td>
<td>25 ± 15.4</td>
<td>20 ± 14.9</td>
</tr>
<tr>
<td>bulbus (mm)</td>
<td>36 ± 4.9</td>
<td>45 ± 15.6</td>
</tr>
<tr>
<td>ascending aorta over 50 mm</td>
<td>5x</td>
<td>5x</td>
</tr>
<tr>
<td>dissection</td>
<td>1x (1.8%)</td>
<td>1x (2.0%)</td>
</tr>
<tr>
<td>history of COA operation</td>
<td>20x (36%)</td>
<td>5x (10%)</td>
</tr>
</tbody>
</table>
407 Changes in arterial hemodynamics caused by sildenafil
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Background: Sildenafil is reported to decrease vascular resistance and have no effect on cardiac contractility. However, changes in hemodynamics may derive from those in cardiac function. Wave intensity has the potential to separate cardiac (downstream) from peripheral (upstream) influences on blood flow. We used wave intensity to study the effects of sildenafil on arterial hemodynamics. Wave intensity is defined as the product of the time derivatives of blood pressure (dP/dt) and velocity (dU/dt). The value of the initial positive wave (WP) of wave intensity in a cardiac cycle indicates the initial ventricular impulse, and the interval between the R-wave of ECG and WP (R-WP) is equivalent to the pre-ejection period (PEP).

Methods: We studied 15 normal volunteers (age 27.59 years) who were randomised in a double-blind crossover fashion to receive a single oral dose of sildenafil 50 mg or placebo on 2 separate study days. Using an ultrasonic wave intensity measurement system, which is built into ultrasonic equipment (SSD 5500, Aloka, Japan), we measured carotid arterial wave intensity non-invasively. Differences were analyzed by repeated-measures ANOVA.

Results: The maximum U and peak dU/dt and WP increased (P<0.001), and R-WP was shortened (P<0.001) after sildenafil compared with placebo. Systolic pressure and peak dP/dt did not show significant changes. These effects continued 90 minutes after sildenafil.

Conclusions: The significant increase in WP and the shortening of PEP indicates the increase in the maximal ventricular power and the maximal rate of power rise, which reflects enhanced cardiac contractility. However, due to the increase in vascular resistance, systolic pressure did not increase despite the increased blood velocity.

409 Magnetic resonance coronary angiography and late-enhancement magnetic imaging in children with arterial switch operation for transposition of the great arteries
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Purpose: In older subjects who have undergone the arterial switch operation, there remains concern about the development of late coronary artery complications. Furthermore, the degree of possible myocardial damage resulting from coronary surgery has not been defined in older asymptomatic subjects.

Objectives: To demonstrate the feasibility of magnetic resonance (MR) coronary imaging and define myocardial damage in children who have undergone arterial switch for transposition of the great arteries.

Methods: Sixteen asymptomatic subjects with arterial switch for transposition of the great arteries were studied (mean age 10.8±1.3 years). MR coronary angiography, late-enhancement MR imaging, global ventricular function and regional wall motion were assessed. Fifteen children were awake during imaging; one was imaged under general anesthesia.

Results: Diagnostic images of the ostium and proximal coronary artery were acquired in 72% of coronary arteries imaged (n=22/32); this rose to 100% in subjects older than 11 years (n=7). No ostial stenoses or kinking were seen. In all subjects, the proximal ostia of the coronary arteries were visualized. Normal coronary arrangement was noticed in thirteen subjects; whereas, coronary anomalies were detected in three. These findings were in full agreement with the surgical findings at the time of operation. Two subendocardial viability defects were detected, corresponding to a known compromise of the artery supplying that territory at the time of surgery. Global left and right ventricular function were preserved, with no regional wall abnormalities.

Conclusions: We have demonstrated that diagnostic MR coronary angiography can be performed in the majority of subjects who have undergone arterial switch for transposition of the great arteries. Furthermore, we have demonstrated that there were no unexpected areas of myocardial infarction, suggesting that patients surviving to this age did not have asymptomatic episodes of myocardial damage at the time of surgery.

410 Regional aortic function studied by three-dimensional echocardiography
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Aortic pulsation is caused by the arterial blood pressure variation during cardiac cycle. Thickening of arterial intima, as well as the presence of atherosclerotic plaques may influence vessel pulsation by increasing wall stiffness. There is no data available concerning regional changes in aortic elasticity in relation with local wall thickness and the magnitude of atherosclerosis. The study group comprised 48 patients (33 men, 15 women, mean age 54±11 years) referred to our echocardiographic laboratory for transesophageal echocardiography (TEE). TEE probe was placed at the depth of 35 cm. The spatial interval between acquired intervals was 3°. The reconstructed datasets were reviewed and the border between the aortic wall, plaque and lumen was determined. The reconstruction of two-centimeter-long segment of aorta was divided by coaxial planes into four longitudinal sections. Thereafter the diastolic and systolic radius of each section, thickness of atherosclerotic plaques and intima-media thickness in each section were measured. The regional a-index was calculated as Ln (systolic pressure/diastolic pressure)/relative change in regional aortic lumen, where relative change in regional aortic lumen was calculated as the difference between aortic lumen volume in systole and diastole divided by aortic lumen volume in diastole. In the aortic segments analyzed. The volume of the examined sections of the aortic segments ranged from 0.6 cm3 to 4.1 cm3 (mean 1.6±0.7 cm3) in systole and from 0.5 cm3 to 3.7 cm3 (mean 1.4±0.7 cm3) in diastole. The pulsation of the aortic sections varied from 0.04 cm3 to 0.79 cm3 (mean 0.3 cm3), which constituted 1 to 21% (mean 6.4%) of the section volume. The thickness of atherosclerotic plaques in the studied aortic sections ranged from 0.03 mm to 1.87 mm (mean 0.21±0.026 mm at the intima-media thickness was within the range 1.26 mm to 3.61 mm (mean 1.87±0.39 mm). The regional a-index of the individual section ranged from 1.6 to 97.1 (mean 12.5±14.6). The regional a-index was statistically significantly dependent on the intima-media thickness (r=0.43, p<0.001).

We found no significant correlation between a-index and the thickness of atherosclerotic plaques in the studied segments (p=0.96).

Conclusions: Transesophageal three-dimensional echocardiography facilitates quantitative analysis of aortic wall stiffness and regional a-index measurements. The local variability of a-index is correlated with intima-media thickness, but not with the thickness of atherosclerotic plaques.
411 Intravascular ultrasound imaging and histological validation of aorta

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Background and purpose: It has been shown in several in-vitro studies that IVUS images correlate well with histology and angiography. The existing data on IVUS examination of large-diameter elastic arteries are scant. The aim of this study was to compare the IVUS images of aorta with the reference method - histological sections, by evaluating the accuracy of measurements performed at corresponding aortic segments.

Materials and methods: 15 human aortic specimens were derived from post-mortem examination and in-vitro imaging was performed, including measurements of vessel diameters and cross-sectional areas at 3 separate short-axis views of each segment. Corresponding regions of interest obtained with histology (HIST) were subsequently evaluated and parameters matched to those by IVUS were calculated.

Results: Total of 45 pairs of measurement were compared. Mean aortic internal diameter (AID) on IVUS was 14.4 mm (SD 2.7 mm) and intima thickness (IT) was 0.6 mm (SD 0.8 mm). The corresponding AID observed with HIST was 13.2 (SD 2.6 mm) and IT - 0.3 mm (SD 0.03). An overall agreement between IVUS and HIST was high, yielding correlation ratio of 0.99. The highest level of agreement was observed for external vessel area (EVA) validation - correlation ratio 0.96. The largest discrepancy was observed for IT and media thickness, with correlation ratios of 0.61 and 0.72, respectively.

Conclusions: Our data suggest that examination of aorta with IVUS is feasible and may provide additional information in assessment of cardiovascular pathology. More complete risk stratification, which includes IVUS examination of aorta, is an important factor to determine the necessity for early preventive treatment, especially in patients with normal coronary arteries.

412 Predictive value of carotid intima-media thickness in women with suspected coronary artery disease

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Introduction: True recognition of coronary artery disease (CAD) in women is often challenging, since CAD in many women is manifested with atypical symptoms. False positive treadmill test also often appears in healthy female subjects. Assessment of early atherosclerotic lesions at peripheral arteries might facilitate the differentiation of whose women with CAD from whose without. This study aimed to compare carotid intima-media thickness (IMT) in women with and without CAD.

Material and methods: Group I included 92 women (mean age 61.3 ± 9.5) with coronary artery disease confirmed on angiography. Control group consisted of 30 women (mean age 59.1 ± 6.0) without any lesions on coronary angiograms. Maximal intima-media thickness (IMT) was assessed in all patients at both common carotid (CCA), bulb (BULB) and internal carotid (ICA) arteries and expressed as a mean value.

Results: There were no differences between groups with regard to age, and BMI, however CAD women were more often hypertensive, hyperlipaemic, diabetic, and cigarette smokers. Age over 65 y.o. (p = 0.016), hypertension (0.017), smoking (p = 0.009) and diabetes (p = 0.011) showed the strongest association with IMT in multivariable regression analysis. IMT of CCA, BULB and ICA was significantly greater in women with CAD, compared to control group (Fig. 1). IMT mean value over 1.1 mm was strongly predictive of concomittant CAD with sensitivity of 74% and specificity of 89.7%.

Conclusion: Carotid intima-media thickness represents early atherosclerotic changes at peripheral arteries and it is strongly predictive of CAD in women. Mean maximal value of IMT over 1.1 mm can predict CAD with sensitivity of 74% and specificity of 90%, despite wide influence of other atherosclerotic risk factors on its performance.
414 Increased velocity and rate of systolic blood pressure changes during 24 h are related to increased carotid intima media thickness and left ventricular hypertrophy in hypertensive patients.

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Blood pressure variability during 24 h is associated with target organ damage in hypertensive patients. We investigated whether the velocity (vSPB24) and acceleration (aSPB24) of systolic blood pressure changes of systolic pressure during 24 h are related to carotid intima media thickness (IMT) and left ventricular (LV) mass in hypertensive patients.

Methods: We performed a 24 hour-ambulatory blood pressure (ABP)-heart rate monitoring, carotid and cardiac ultrasound for assessment of LV mass and IMT of common and internal carotids respectively, in 666 newly diagnosed hypertensives receiving no antihypertensive treatment and in 254 healthy controls. The mean value of the IMT from the right and left carotids was used in the analysis. The vSPB24 and aSPB24 were calculated by computer analysis of the ABP recordings, as the ratio of first and second derivatives of the distance between changes of SBP values over time. CIcthroid blood pressure and standard atherosclerotic risk factors were noted in all patients and controls.

Results: vSPB24 and aSPB24 (mean i-/SD) were increased in hypertensives compared to controls (0.6 ± 0.5 vs. 0.5 ± 0.3 mmHg/s and 6.5 ± 2.0 vs. 5.8 ± 1.3 mmHg/s respectively, p < 0.001). In hypertensives, vSPB24 and aSPB24 were related to clinic SBP (r = 0.19 and r = 0.14, p < 0.001), mean SBP24 (r = 0.30 and r = 0.23 p < 0.001), IMT of the common carotids (r = 0.22 and r = 0.13, p < 0.001) and internal carotids (r = 0.23 and r = 0.14, p < 0.001) and LV mass (r = 0.11 and r = 0.10, p < 0.05). In multivariate analysis, vSPB24 and aSPB24 were related to the IMT of the common carotids (r = 0.23 and r = 0.14, p < 0.001) and LV mass (r = 0.12 and r = 0.11, p = 0.05) independently of age, SBP, HR and standard atherosclerotic risk factors. Only vSPB24 was independently related to IMT of the internal carotids (r = 0.10, p = 0.005). The correlations were also confirmed in healthy controls although the relation of vSPB24 and aSPB24 to IMT of the carotids was not independent of age in the multivariate model.

Conclusions: Hypertensive patients have faster and steeper changes of systolic blood pressure during 24 h compared to healthy subjects. The velocity and the acceleration of the changes of systolic blood pressure during 24 h are related to carotid intima media thickness and left ventricular mass independently of age, systolic blood pressure and standard atherosclerotic risk factors.

415 Intima-media thickness in different segments of carotid artery in a healthy adult population. Reassessment of normal values

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Although an increase in carotid artery (CA) intima-media thickness (IMT) as measured by B-mode ultrasound is considered an indicator of systemic and coronary atherosclerosis, the values of normal IMT in different segments of CA in the healthy adult population are not well established. Recent studies suggest that IMT might be lower than previously believed. However, these studies usually have included a limited number of healthy subjects, and IMT was not always evaluated in corresponding segments of CA. Aim of the present study was to determine IMT in 3 main segments of extracranial carotid artery in a group of 503 healthy subjects recruited into the RISC-EGIR study. Study subjects were between 30 and 60 years of age, normotensive, and free of cardiovascular diseases; their plasma cholesterol, triglycerides and fasting glucose were ≤ 7.8, 4.6, and 7.0 mmol/l, respectively, and all had normal oral glucose tolerance test. Ultrasound examination of right and left carotid artery was performed in 22 European centers according to a standardized protocol and recorded on SVHS-tapes. Images were digitized in a single reading center by a single operator using a computerized system. IMT was measured in as many as 12 different CA sites. The mean value of 3 measurements was used to assess IMT in each site and IMT was expressed separately for common carotid artery (CCA), carotid bulb and origin of internal carotid artery (ICA). The study population was relatively young (age: 45±8 years), with a slight prevalence of females (58%). Mean IMT in CCA, Bulb and ICA were: 0.60±0.08, 0.75±0.14 and 0.60±0.12 mm, respectively. In all carotid segments, IMT (related to age (mm) in the outpatient hypertension clinic, or in patients with LV hypertrophy.

Conclusion: Reduced aortic distensibility is associated with LV diastolic dysfunction in newly diagnosed hypertensive patients even in the absence of traditional risk factors.
418 Decreased aortic distensibility in patients with acromegaly - A transthoracic echocardiographic study
Background: Acromegaly is associated with increased cardiovascular risk. The aim of the present study was to compare the aortic distensibility indices between acromegalic and control cases.
Patients and methods: 9 treated acromegalic patients were recruited (group 1). Their results were compared to 15 control patients without coronary artery disease (group 2). Elastic modulus (E(p)) and Young’s circumferential static elastic modulus (E(s)) were used as aortic distensibility indices. E(p) and E(s) were evaluated during transthoracic echocardiography from ascending aorta parameters and blood pressure data. Results: The occurrence of traditional risk factors were similar between the patient groups. The mean growth hormone level was 5.5 ± 3.0 μIU/ml in the acromegalic patients. 8 patients were operated and treated with or without long-acting octreotide. One patient was before the operation. Data are presented in the table.
Conclusions: Aortic distensibility of patients with acromegaly was reduced (E(p) and E(s) were increased) as compared to control cases.

419 Can ultrasound measurements of arterial mechanics monitor changes with caffeine and tobacco?
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Arterial stiffness is important in the prognosis of cardiovascular disease. The role of cigarette smoking is a well-known risk factor, but mechanisms of vascular damage are unclear. The effect of caffeine on the cardiovascular system is controversial.
Hypothesis: Cigarette smoking and caffeine cause acute increases in arterial stiffness, which can be measured using wave intensity (WI).
Methods: We used a high-resolution ultrasound system (Aloka SSD-5500, Tokyo) to measure diameter and flow in the right common carotid artery. Blood pressure (BP) was measured by sphygmomanometry in the right arm. We derived instantaneous changes in wave intensity (calculated as the product of pressure and velocity changes with respect to time) and in wave speed (WS) with simultaneous measurement of brachial blood pressure (BP) with an automatic device. Aortic stiffness index (beta) was calculated according to the formula: beta = ln (Ps/Pd)/[(Dmax - Dmin)/Dmax] where Ps and Pd are systolic and diastolic pressures respectively, Dmax and Dmin are the radial artery diameters measured. Blood pressure at the moment of TEE and evaluation by the noninvasive techniques was slightly lower but not significantly: Ps 153.3 ± 24.3 vs 160.6 ± 27.9 mmHg (p = n.s.), Pd 96.1 ± 15.8 vs 79.8 ± 15.5 cmHg, although the heart rate was significantly higher during TEE: 83.19 ± 4.73 vs 73.6 ± 14.8 bpm (p = 0.001).
Conclusions: Beta was significantly correlated with PWV r = 0.48 (p = 0.01), AG r = 0.42 (p = 0.05) and ESP r = 0.45 (p = 0.01). We found no correlation of beta with AI.

421 Echocardiographic assessment of the aorta biophysical properties in end-stage renal disease patients
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Background: The focus of attention in preventing and treating cardiovascular disease today is shifting toward the arterial wall. Aortic stiffness is a major predictor of cardiac risk.
Methods: We assessed in 75 Hemodialysis (HD) patients (age: 59.9 ± 11.9 years, mean time on HD 79.2 ± 51.6 months) and in 71 normal age- and sex- matched subjects, the biophysical properties of the aorta (AO) using a novel Doppler echocardiographic method. The AO annulus, ascending AO diameter in systole (Aos) and diastole (Aod) by M-mode were calculated. AO length (L) from ascending to descendent AO from the supravalvular view and the time (T) taken for the Doppler signal to travel the A0L distance was measured. Pulse wave velocity (PWV) was calculated as A0L/T; AO compliance (AOC) = 2 x [(Aos - Aod)/ystolic (SBP) - diastolic blood pressure (DBP)]; pressure strain elastic modulus (PSEM) = (SBP-DBP)/(AOC - A0d)/AOd; beta index = ln (SBP/DBP)/(A0c - A0d)/AOd.
Results: Table 1 shows the differences in HD patients and controls. In HD patients PWV was correlated with age (r = 0.699; p < 0.001) and time on HD (r = 0.463; p < 0.01), while PSEM was correlated with age (r = 0.469; p < 0.01).
Conclusion: The biophysical properties of the aorta in uremic subjects were significantly altered compared to control. The ensuing aortic wall stiffness is likely due to arteriosclerosis, a process that causes dilatation and stiffening of the arteries, in combination with atherosclerosis that typically disturbs conduit function. Increased age and duration of the uremic state can accelerate these pathological changes in HD patients.
423 Assessment of left ventricular volumes and ejection fraction by live 3D-contrast enhanced echocardiography compared with cine magnetic resonance imaging


Background: Magnetic resonance imaging (MRI) is recognized as a reference technique to calculate left ventricular (LV) volumes and ejection fraction (EF). Recently introduced, live threedimensional echocardiography (3D) can be used with echo contrast agent to assess LV function. We sought to compare MRI and 3D echo with contrast enhancement.

Methods: 27 patients (22 M, 63 ± 11 y) underwent both MRI and 3D echo on consecutive days. 3D echo was performed using a commercial system (Sonos 7500, Philips, The Netherlands) using a matrix probe technology. MRI was acquired during intravenous injection of PESDA with a mechanical index of 0.6-0.8. and were post processed using a dedicated software (4D Cardioview, Tomtec, Germany). This allows to draw manually endocardial border on several planes and to reconstruct LV volumes. MRI was performed using a 1.5 T (Philips Interax CV, The Netherlands) system. Ten serial short axis images were obtained in 20 cine phase using a balanced fast field echo VCG gated sequence. Analysis of MRI images was performed semi automatically with dedicated software. End diastolic volume (EDV), end systolic volume (ESV) and EF were calculated and compared for both techniques using paired t test and linear regression.

Results: Mean EDV was 140 ± 66 ml by MRI and 152 ± 70 ml by 3D (r = 0.96, p < 0.001), mean ESV was 92 ± 56 ml by MRI and 109 ± 71 ml by 3D (r = 0.97, p < 0.001), EF was 40 ± 17% by MRI and 34 ± 20% by 3D (r = 0.87, p < 0.005).

Conclusion: 3D echo with contrast enhancement is as accurate as MRI to assess LV function.

424 Semi-automatic left ventricular endocardial border detection method for 4D ultrasound data

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Purpose: We propose a new semi-automatic endocardial border detection method (4DSAD) for LV volume estimation in 4D (3D + time) cardiac ultrasound data.

Methods: 4D data was acquired with the Fast Rotating Ultrasound transducer (FRU) developed at the Thoraxcenter, Rotterdam: a conventional phased array probe rotating at high speed. A typical dataset is acquired at 360 rotations/minute and 100 images/second over 10 seconds, producing about 1000 2D images. An image subset is automatically selected for analysis, containing typically 10 equidistant rotation angles in 16 cardiac phases.

In 4DSAD, contours are manually drawn in 2 perpendicular planes in ED and ES. From these 4 contours, a 3D shape model and endocardial edge profile are derived in ED and ES; these are interpolated over all cardiac phases. For all other images, a 2D shape and edge profile is calculated and a contour is detected automatically using profile matching and dynamic programming. 3D shapes are constructed for all phases and LV volumes calculated.

Results: 4DSAD was evaluated on FRU data of 14 post-infarct patients against MRI. 2 independent observers determined full-cycle US LV volumes with 4DSAD (4 contours, no corrections); another observer determined ED/ES MRI volumes by manual analysis. Good correlations of 4DSAD were found with MRI ED/ES volumes (y = 0.76x – 30, r = 0.94) and low interobserver variability (y = 1.005x – 17, r = 0.943) over full-cycle volume estimations (see fig). A high consistency in tracking the user-defined initial borders over space and time was observed.

Conclusions: 4DSAD offers fast and precise contour detection. It shows good correlations with MRI ED/ES volumes and low interobserver variabilities. Further development and evaluation is ongoing.

425 Freehand 3D-echocardiography for assessment of volumes: an in-vitro and in-vivo evaluation of automatic border detection

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Background: The aim of the present study was to evaluate the accuracy of automatic border detection after acquisition with freehand 3D echocardiography for the assessment of heart cavity volumes.

Methods: Five balloons were filled with different quantities of water (70-150 ml). Additionally, magnetic resonance imaging (MRI) and freehand 3D-echocardiography with 4D-LV-Analysis (Tomtec) was performed in 30 patients. End systolic (ESV) and end diastolic (EDV) volumes, as well as ejection fraction (EF) were obtained after automatic border detection in six 2D-images without manual correction by three different observers (O1-O3). In the immobile balloons ESV and EDV were appointed by chance.

Results: In-vitro measured volumes significantly correlated with the amount of fluid fillings (ESV: r = 0.92, p < 0.01; EDV: r = 0.92, p < 0.01). The in-vitro results were reproducible also by different observers (O1-O3). In two out of 30 patients the systems was not able to calculate the parameters. Additionally, in-vivo measurements of ESV, EDV and EF did not show any significant correlations with MRI (O1: ESV: r = 0.20; EDV: r = 0.48; EF: r = 0.07). Similar results were obtained by the additional observers (O2: ESV: r = 0.45; EDV: r = 0.01; EF: r = 0.28; O3: ESV: r = 0.31; EDV: r = 0.18; EF: r = 0.16). Volumes were underestimated by all observers (O1: ESV: -41.7 ± 62.4 ml; EDV: -25.1 ± 111.3 ml; O2: ESV: -10.6 ± 54.5 ml; EDV: -15.2 ± 111.7 ml; O3: ESV: -7.1 ± 68.4 ml; EDV: -13.2 ± 94.3 ml).

Conclusions: Automatic border detection showed significant correlations in the condition of optimal image quality such as water-filled balloons. However, automatic border detection without manual correction with freehand 3D-echocardiography does not show reliable results in clinical settings.
426 Assessment of left ventricular diastolic function using volume-time curves by real-time three dimensional echocardiography


AIM: To assess left ventricular (LV) diastolic performance by analysis of volume-time curve (VTC) of LV using real-time 3D echocardiography (RT3DE) in comparison with conventional methods with 2D Doppler echocardiography.

METHODS: Ten subjects with normal LV systolic function (EF: 58±4%) and 5 patients with global LV dysfunction (EF: 32±13%) underwent RT3DE. VTCs were generated using 3D computer software (4D LV analysis, TomTec) in every subject. VTCs was sampled at intervals of 1 millisecond. The adjusted rate of volume difference (AdV/dt) was defined as the rate of volume difference (dV/dt) adjusted by LV end diastolic volume (LVEDV) in percentage (dV/LVEDV/dt [%/sec]). Two peak AdV/dt during early and late diastole were measured (Figures) and the ratio of early to late AdV/dt was then calculated. Using 2D Doppler echocardiography, E and A velocity of transmural flow with the ratio (E/A) and E' velocity of the mitral annulus were assessed.

RESULTS: The ratio of early to late AdV/dt showed a significant correlation with E/A ratio (r=0.78, p<0.05). Peak AdV/dt during early diastole showed a significant correlation with E' velocity (r=0.76, p<0.05). However, there was no significant correlation between peak AdV/dt during early diastole and E' velocity (r=0.18, p>0.05).

CONCLUSION: Adjusted rate of volume difference of LV during diastole from volume-time curve using RT3DE can be used as an alternative marker for LV diastolic function.

427 Contrast-enhanced real-time 3D stress echocardiography: quantitative and qualitative measures of global and segmental left ventricular function

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BACKGROUND: Real-time 3D echo (RT3DE) has potential benefits for dobutamine stress echocardiography (DSE) by reducing acquisition times and eliminating off-axis acquisition errors. RT3DE may also add incremental value with accurate assessment of global and regional function, as well as LV mechanical dyssynchrony (LVMD), which is sometimes seen as tardocrisis or dyskinesis in positive DSE.

METHODS: 20 patients underwent DSE with 2D and RT3DE echo. 2D images were interpreted by an expert reader. RT3DE data sets were obtained at baseline and peak stress and were cropped into apical 4-, 2- and 3-chamber views for visual wall motion interpretation. RT3DE datasets were analysed offline to produce time-volume curves for global and regional volumes. A Systolic Dyssynchrony Index (SDI) was defined based on dispersion of times to minimum volume for each of the 16 myocardial segments, and visualised with a high resolution polar map (Fig. 1).

RESULTS: Wall Motion Score Index (WMSI) by 2D and RT3DE echo showed excellent correlation at both baseline and peak stress (R=0.95 and 0.84 respectively, p<0.02). 3D LV EF in patients with abnormal DSE was significantly lower at peak stress (48.2±22.7 vs. 74.8±5.6, p<0.03). In patients with a normal DSE, the SDI was low at both rest and peak stress (3.04±1.4 and 3.8±1.6 respectively). In patients with abnormal stress response, the SDI was higher at both rest and peak stress (11.8±9.5 and 15.5±11.5 respectively). SDI at peak stress was statistically higher in patients with abnormal DSE (p<0.05), while at baseline it approached statistical significance (p=0.07 – Fig. 2).

CONCLUSIONS: Contrast-enhanced RT3DE is a sensitive and practical technique for DSE and provides incremental data for LV systolic function and segmental coordination.

428 Agreement between 3-dimensional echocardiography and cardiac magnetic resonance imaging in measuring indices of left ventricular structure and function


Accurate non-invasive assessment of (LV) structure and function is important in the diagnosis and management of patients with cardiac disease. Cardiac magnetic resonance (CMR) has shown high accuracy and reproducibility in measuring volumetric and functional LV indices. This study was designed to test the accuracy of 3-dimensional echocardiography (3DE) as compared with CMR in patients with good acoustic windows.

METHODS: 64 subjects with good acoustic windows, including 40 cardiac patients with LV ejection fraction (EF)<45%, 14 patients with EF>45% and 10 volunteers with normal LV function underwent 3D echo using a Philips Sonos 7500 scanner equipped with a x4 xMATRIKX transducer using xSTREAM 3D architecture. The subjects also underwent CMR on a 1.5 T Signa CV/i scanner (GE Medical Systems) using ECG-triggered breath-hold gradient-echo FIESTA imaging. Volumetric assessment was performed using analytical 4D LV-Analysis software (TomTec) for 3DE and MRI Mass software (Medis) for CMR.

RESULTS: We found no significant difference in the mean values of the indices measured with 3DE and CMR: LV end-diastolic volume (EDV): 202±73 vs 195±72 ml, p=0.60; LV end-systolic volume (ESV): 121±66 vs 118±68 ml, p=0.78 and LV EF (43±15 vs 44±16%, p=0.60) and there was an excellent correlation between the indices (r=0.97 for EDV, r=0.98 for ESV and r=0.94 for EF). Bland-Altman analysis revealed bias of -7 ml for EDV, -3 ml for ESV and 1% for EF with limits of agreement (2SD) of 26 ml, 22 ml and 10%, correspondingly.

CONCLUSIONS: 3DE provides accurate quantification of LV volumetric and functional data as compared with current gold standard of non-invasive cardiac imaging. CMR. 3DE can be recommended for the assessment of LV structure and function in subjects with good acoustic windows.
430 Identification of individual scallop prolapse of the mitral valve: head to head comparison of 2DTEE, 3DTEE vs 2D and 3D transthoracic echocardiography

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Recent advances in cardiac surgery extended mitral valve (MV) repair also to complex MV prolapse (MVP). A pre-operatory correct assessment of MV anatomy is essential to surgical design and although 2D echocardiography (ECHO) provides precise informations about individual scallop of the two leaflets, three dimensional (3D) echo could increase the understanding of more complex abnormalities of MV apparatus. Aim of this study was to evaluate feasibility and accuracy of transesophageal (TEE) and transthoracic (TTE) 3D ECHO in the evaluation of MVP in patients referred to surgical repair, and to compare 2DTEE, 3DTEE and 3DTTE data to surgical findings.

Forty-one patients with MVP underwent a routine 2DTEE exam including 3DTEE acquisitions (3DLIVE system: Sonos 7500, Philips Medical Systems, Andover MA) the day before surgical procedure, and 2DTEE and 3DTEE intraoperatively. Individual MV scallops were examined. Anatomical characteristics such as billowing, flail, leaflet clefts, chordal rupture or annular calcifications were annotated. Sensitivity (SENS), specificity (SPEC) and accuracy (ACCUR) with surgical inspection were calculated. Intra and interobserver variability was calculated for 3D data.

Results: Mean number of 3DTEE acquisition/patient was 6.6±3.3 a mean acquisition/analysis time was 7±4 min. One 3DTEE acquisition was obtained in each pt in a mean time of 4±1 min; off line 3DTEE reconstruction time was 3.3±2 min. Quality of 3DTEE was insufficient 10%, sufficient 34%, good 43% 3DTEE, optimal 13%. Quality of 3DTEE was sufficient 28%, good 56%, optimal 16%. Table shows SENS, SPEC and ACCUR for the evaluation of the three scallops of PMV and AMV. P3 evaluation showed a slightly lower accuracy by 3D techniques. 3DTEE and 3DTTE are feasible and not time consuming. Good concordance with surgery allows a very complete description of individual scallops of PMV and AMV. P3 evaluation showed a slightly lower accuracy by 3D techniques. A trend to false positive diagnosis of P3 prolapse was observed.

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PML: posterior mitral leaflet; AML: anterior mitral leaflet.

431 Three dimensional shape and size of the tricuspid annulus in normal subjects: comparison study with the mitral annulus using real-time three dimensional echocardiography


Aim: To evaluate 3 dimensional (3D) shape and size of normal tricuspid annulus comparing with the mitral annulus using newly developed 3D computer software.

Methods: Nine Left ventricular (LV) and nine right ventricular (RV) volumetric images were acquired using real-time 3D echocardiography (RT3DE) from 17 normal subjects. LV and RV volumetric data were segmented into 16 rotational apical planes (angle increment=18°16') around the rotational axis from the apex through the center of the mitral and tricuspid annulus using newly developed 3D software (TomTec, Co). Two hinge points of leaflets were traced in each plane during early systole. The mitral and tricuspid annuluses were slightly larger than those of the mitral annulus during early systole. The TTE and TEE were realized using Philips Sonos 7500 with D2 software.

Results: 3D shape of the tricuspid annulus showed round or oval shape with flatter appearance compared with the mitral annulus revealing “saddle” shape appearance (Figures). Both 3D surface (10.4±1.6 vs 8.9±0.9 cm², p=0.01) and projected area (9.8±2.1 vs 7.8±0.9 cm², p=0.01) of the tricuspid annulus were statistically significant. There was a moderate correlation with the 2D area method (R=0.67, p=0.0001). Table shows SENS, SPEC and ACCUR between MVCO/LVOTCO and PISA calculations (R=0.47 and 0.47 for peak regurgitant flow and EROA respectively).

Conclusions: RT3DE provides simple and quick quantification of mitral regurgitation. It is a useful tool for less experienced interpreters and will be valuable where the MR jet cannot be seen, such as prosthetic MR.

432 Assessment of mitral regurgitation by real-time 3D echocardiography provides a swift and reproducible method for quantification of mitral regurgitation

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Background: Qualitative assessment of mitral regurgitation (MR) on 2D is accurate in expert hands, however quantitative measures rely on geometric assumptions which do not always hold true. Real-time 3D echo (RT3DE) provides novel and potentially more accurate methods for quantification of MR.

Methods: 78 patients with any degree of MR and no other significant valve disease underwent 2D and RT3D echo. Severity of MR was graded by an expert reader on a 6-point scale based on 2D morphology. 2D quantification was performed with the area method and, where possible, PISA calculations. For RT3D quantification, 2 indices were created: the ratio of cardiac at the mitral and LVOT positions calculated by 3D flow quantification, and the ratio of peak regurgitant volume to LA volume.

Results: 43% had grade 1/6 while 14% had grade 6/6 MR on 2D echo. Flow quantification was performed in under 60 sec for each patient. ANOVA of the ratio MVR/LVOT showed that this could differential all grades of MR, with only the difference between mild and mild-moderate MR not being statistically significant. There was good correlation with the 2D area method (R=0.77, p=0.0001). The ratio MVR/LVOT showed almost equally good correlation with the area method (R=0.73, p=0.021). PISA calculations could be performed in 17 patients. There was a moderate correlation between MVCO/LVOTCO and PISA calculations (R=0.47 and 0.39 for peak regurgitant flow and EROA respectively).

Conclusions: RT3DE provides simple and quick quantification of mitral regurgitation which correlates well to 2D assessment of MR. This may be a useful tool for less experienced interpreters and will be valuable where the MR jet cannot be seen, such as prosthetic MR.
434 Throracosternal three-dimensional echocardiography: feasibility and routine diagnostic value in 350 adult patients

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Abstracts

Purpose: Coronary angiography allows the assessment of severe coronary lesions, but early atherosclerotic lesions are not identified reliably. Conventional reconstructions from intravascular ultrasound (IVUS), stack the frames as acquired during the catheter pull back to form a straight three-dimensional (3D) volume, but don’t account for the vessel bending. To overcome these limitations a new method (3D IVUS) were developed combining data from intravascular ultrasound and biplane angiography.

Methods - Results: The IVUS catheter is advanced in the coronary artery and, before the start of pull back, a biplane coronary angiogram (BBA) with contrast injection is performed. The BBA images along with the simultaneous ECG signals are recorded in DICOM format at a rate of 30 frames/sec. From the BBA data set, two, end-diastolic, single frames are selected, one from each projection. The IVUS catheter trajectory is interactively marked at each projection and a particular algorithm is applied to convert the BBA data set into 3D trajectory. The ultrasound data set is obtained by a 40 MHz 3F sheath-based catheter at an automatic pull back speed of 0.5 mm/sec and the images along with the ECG signals are recorded on S-VHS videotape at a rate of 25 frames/sec. The S-VHS ultrasound data are digitized at the working station with a frame grabber and the end-diastolic frames are selected. To extract the lumen and external elastic membrane contour from each selected frame, a special image process algorithm is applied. Each segmented frame is placed perpendicularly to the catheter’s 3D trajectory at specific locations, according to the frame number, the catheter pull back time and the frame acquisition rate. The absolute orientation of the entire set of frames is determined comparing the reconstructed 3D artery silhouette with the lumen outline at both angiographic projections. Using a specially designed computer algorithm the inner and outer contours were supported by parametric curves generated by special functions of the frame data, creating the 3D lumen and wall volume respectively. The reconstructed artery can be utilized for plaque volumetric analyses, real 3D geometry reconstruction, and calculated right atrium volume. In all studied cases (n=48), 3D geometry and right atrium volume of the object was reconstructed by the aforementioned CNN-based prototype system. Accuracy of the reconstruction was 97.4% (range 99.9 - 94.6%).

Conclusions: 3D IVUS is a new technique that is capable of rapidly and accurately generating in vivo real 3D reconstructions of coronary arteries.

This technique allows the cardiologist to perform accurate plaque volumetric and hemodynamic analyses.

436 Who will and who won't benefit from resynchronisation therapy? Can 3D Echo provide the answers?

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Background: Cardiac resynchronisation therapy (CRT) is an effective intervention for patients with significant left ventricular mechanical dysynchrony (LVMV). While QRS prolongation has been shown to be a poor marker for LVMV, this is commonly used to select patients for CRT. Real-time 3D echo (RT3DE) provides a novel method for quantifying LVMV and may be of value in patient selection.

Methods: 21 patients with prolonged QRS duration (68±5 years) underwent CRT for treatment of NYHA class II/III heart failure. Ten had ischaemic cardiomyopathy. 2D and RT3D echo was performed prior to implantation and post device optimisation. Offline analysis produced global and segmental time-volume curves and a Systolic Dysynchrony Index (SDI) was calculated from dispersion of times to segmental contraction (Fig 1).

Results: There was a moderate correlation between SDI and QRS duration (R=0.43) prior to implantation. 3 patients experienced no symptomatic benefit from CRT. All other patients experienced significant symptomatic improvement with an average decrease of 1.5 NYHA classes. In all responders, a significant reduction of the SDI was noted (7.3±5 post CRT vs. 15.7±4.2 pre CRT), along with significant increase in LVEF (10±1.8%). The reduction in SDI correlated well with pre CRT SDI (R=0.65). Non-responders had a significantly lower SDI pre CRT with no significant reduction. In multivariate analysis including QRS duration and 2D echocardiographic measures, only SDI pre CRT could differentiate responders from non-responders (Fig 2).

Conclusion: Patients with significant LVMV appear to derive most CRT. RT3DE can identify non-responders amongst patients fulfilling standard criteria for CRT.

Figures 1 and 2

437 Initial clinical experience with the model based 3D echocardiography boosted by cellular neural network (CNN) computer technology

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Abstracts

Purpose: The conventional 3D reconstruction methods are inaccurate in 3D volumetric calculations. The aim of our work is to develop a more accurate 3D reconstruction and volume measuring method using the revolutionary analogic CNN-based computer system.

Methods: CNN based experimental system had been designed and implemented for efficient 3D echocardiography image analysis and reconstruction. The 3D model is reconstructed from 2D projections taken at different angles by an electronically controlled TE transducer. Analysis of 2D slices (filtering, segmentation, contour tracking and content/context based recognition) is designed as an analogic CNN-UM algorithm, while the 3D reconstruction (contour sub-sampling-interpolation, 3D rotation-translation, and poligonal reconstruction) from the reduced data set as a DSP algorithm.

Results: Validation of the 3D reconstruction and volumetric modul had been performed for phantom objects (n=48). 3D geometry and right atrium volume of the object was reconstructed by the aforementioned CNN-based prototype system. Accuracy of the reconstruction was 97.4% (range 99.9 - 94.6%).

Conclusions: The CNN-based 3D reconstruction method provides accurate volume determination and correct 3D reconstruction. This method can enhance similar measurements within the heart in the future.
438 Feasibility and usefulness of Real Time 3D echocardiography (RT3D echo) in the foetus

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Aim: We performed RT3D echo in 9 foetuses examined in the fetal echocardiographic laboratory of our Department, to test feasibility and usefulness of this new technique.

Method: The patients were randomly selected among pregnant women who underwent a screening fetal 2D-echocardiography to rule out congenital heart disease. Gestational age varied from 19 to 34 weeks. We used a Sonos 7500 equipment with 2 to 4 MHz 3600 elements volume. Full volume acquisitions were stored in the hard disk of the machine and further elaborated off-line. We evaluated the heart anatomy, fetal face, limbs and genitilia.

Results: Three to 8 full-volume acquisitions were performed in each patient, lasting 4-8 sec. each. Off-line elaboration of the 3-D images required from 20 to 40 minutes. Heart: a cardiac malformation was present in 4 (TAC in 1, Aorto-ventricular tunnel + VSD in 1, TOF in 1 and PA+IVS in 1). RT3D echo confirmed the 2-D echo diagnosis in all and gave a better understanding of the dimension and spatial position of the VSD and of the Aorto-ventricular tunnel, as well as of the anatomy of the truncal valve and relation to the ventricles. Face: in 4 cases the fetal face was depicted clearly and no genetic syndrome was suggested in 3. In the 4th case, a small chin with prominent forehead and an abnormal profile suggested a DiGeorge phenotype. In 2 other cases, we could not separate the profile of the face from the adjacent placenta, and the physiognomy could not be visualized. Limbs: in the 5 fetuses in whom we attempted we could clearly visualize arms and legs, as well as hands and feet, and bone abnormalities could be excluded. Genitilia: genitilia could be clearly studied in all the fetuses, and major abnormalities like hypoplasia and epispadias could be excluded in the males.

Conclusions: RT3D echo was feasible in all 9 fetuses, lengthening the examination time by only a few minutes. It adds a better understanding of dimensions and spatial relations of the cardiac structures in malformed hearts. Furthermore, it permits a thorough examination of physiognomy, small parts and genitilia, identifying fetuses in whom a genetic syndrome is more likely to be present. The lack of a sculpting tool to permit separation of adjacent curved surfaces, like the placenta and the fetal face, and the long elaboration time are the major draw-back to routine clinical use.

440 New insights, geometry and spatial relationship of the amplatzer device: a 3D transesophageal study in patients undergoing atrial septal closure

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Percutaneous closure of atrial septal defect (PDA) defects has been expanded thanks to the new fourth generation buttoned devices also in cases with large PDA with small anterior rims or PFO with complex anatomy. Few data are available concerning the geometric and spatial relations of the device with the adjacent structures. Three-dimensional echocardiography (3D) allows a realistic in vivo description of atrial septal occluders (ASO).

Aims of the study were to define characteristics of anatomy of ASD and PFO by 3D in a large population of consecutive cases undergoing transcatheter closure with the Amplatzer device and to correlate pre-closure anatomy to the morphology and positioning of ASO, including potential interference with the adjacent anatomical structures.

Eighty-eight patients referred for transcatheter closure of ASD (58 pts) or PFO (30 cases) were enrolled in the study. They all underwent 3D TEE before and after the procedure performed under general anaesthesia. No complications occurred; in 4 ASD cases the procedure aborted. 3D imaging allowed a complete visualization of the ASO in the remaining 84 cases. The dimensions of the implanted devices obtained by 3D TEE matched closely with the nominal dimensions and 2D and 3D examinations excluded interference with the adjacent structures. However, in 16 cases (10 ASD, 6 PFO cases) a linear indentation of the aortic root by the two discs of the device was demonstrated by 3D and these images (two linear compressions well defined from an aortic en-face view) were seen in patients with larger devices (22.3±5.2 vs 18±6.3 mm) and small anterior rims (4±1 vs 7.2±3 mm) in ASD cases (and in 4 cases with larger devices in PFO cases (all 6 cases with PFO 35 mm ASO). At follow up (mean follow-up of 22.5 months) no complications related to device positioning or cardiac or aortic vessel compression was observed.

Conclusions: 3D echocardiography may define characteristics of the anatomy of ASD and PFO and gives new insights the correlation between pre-closure anatomy and positioning of ASO and potential interference of the device with the adjacent structures. Despite feasibility, safety and effectiveness of transcatheter closure of ASD and PFO defects with the Amplatzer ASO, our data suggest caution in the choice of device size trying to avoid very large occluders particularly in the presence of ASD with small anterior rims or PFO with large aneurysms. Long-term follow-up will be necessary to evaluate the effects of large ASO on the aortic root.
442
Aortic wall distensibility and stiffness index in neonates with coarctation of the aorta: A potential marker for persistent hypertension?
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Despite successful surgical correction the long term morbidity of patients with coarctation of the aorta is increased due to persistent arterial hypertension. Reduced elasticity of the aorta may play a major role in the onset of this problem. Non-invasive assessment of the elastic properties of the aorta (aortic distensibility = AD; and wall stiffness index = WSI) is feasible using M-mode echocardiography and online blood pressure measurement. Purpose of this study was the evaluation of the AD and WSI in neonates with aortic coarctation primary to corrective surgery and short time after correction (median 12 days postoperatively) compared to age- and weight-matched normal controls.

Methods: M-mode measurements of ascending and abdominal aortic diameters were performed. Blood pressure was determined oscillometrically on the right arm and leg. AD (1/kPa x E-3) and WSI were calculated. Patients (n = 14) had a median age of 12 days (range 2 days to 8 months) and median weight of 3.3 kg (range 2.7 to 6.5 kg), while controls (n = 13) had a median age of 16 days (range 3 days to 24 days) and a median weight of 3.3 kg (range 2.4 to 4.0 kg).

Results: In the patient group ascending AD was significantly reduced preoperatively compared to normal controls (79.3 ± 65.2 vs. 100.4 ± 24.1; p < 0.05) and remained so postoperatively (p = 0.005). Patients’ pre- and postoperative values (mean ± SD) showed no significant differences (preop vs. postop: 62.5 ± 66.9; 26.2 ± 22.6; p = 0.83).

Postoperative ascending aortic WSI was significantly increased compared to healthy controls (4.2 ± 2.6 vs. 2.6 ± 0.6; p < 0.05). Preoperative values (p = 0.1) and measurements before and after surgery (5.6 ± 4.9 vs. 4.2 ± 2.6; p = 0.66) showed no significant differences.

In the descending aorta pre- and postoperative AD values and WSI did not differ significantly compared to normal controls.

Discussion: Our data show that ascending aortic distensibility of neonates with severe aortic coarctation is reduced compared to normal controls not only preoperatively but also in the short term follow-up after successful operation. Further studies are necessary to show whether this vascular abnormality is of clinical relevance in the long term prognosis of these patients.

443
Outcome of Ross operation in patients with congenital aortic valve stenosis
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Objective: The aim of the study was to access the clinical and psychological results following aortic valve replacement with a pulmonary valve autograft (Ross procedure).

Background: The Ross procedure is an attractive surgical option for patient with aortic valve disease especially for children, woman of childbearing age, and young active people. The main benefit of this operation is that there is no need for anticoagulation. QoL in these patients may be affected by the risk of the homograft degeneration and the need for re-operation in the future.

Methods: Included in this study were 49 patients ranging in age from 14 to 48 years (the mean age 30.48 ± 9.84), who were operated on for aortic congenital stenosis. The mean follow-up was 34.95 ± 15.30 months. Echocardiography was performed before the surgery, 3 to 6 months following surgery, and once a year thereafter. During the last check-up all patients underwent resting transthoracic echo, 24 hour ECG and maximal exercise test on bicycle ergometer followed by stress echocardiographic evaluation.

For assessment of QoL we have used the short form health survey (SF-36) and the polish version of Purpose in Life Test (PIL) for quantitative assessment of life purpose. The results of psychological tests were compared with age, gender, education matched control group. We present early and last check-up results of our study.

Results: Regression of left ventricular hypertrophy (IVS-14.04 ± 7.47 vs 11.80 ± 3.20 mm and LV dimension (LVd) 51.06 ± 6.92 vs 44.33 ± 4.84 mm) is observed. At present 5 of 49 patients (10.20%) have mild autograft insufficiency and 3 (6.12.00%) have moderate aortic regurgitation. The maximal mean rest pressure gradient across the autograft increased during observation from 3.03 ± 5.60/1.00 ± 1.36 mmHg to 5.56 ± 1.77/2.80 ± 1.00 mmHg and across homograft from 10.56 ± 10.90/4.27 ± 2.02 mmHg to 14.40 ± 9.21/7.78 ± 5.25 mmHg.

Pulmonary insufficiency was graded as none (n = 35), mild (n = 9) and moderate (n = 5).

Stress echo evaluation confirmed good hemodynamic homograft and autograft function. The maximal mean pressure gradients across homograft and autograft during exercise were 22.60 ± 16.90/11.86 ± 8.59 mmHg and 11.06 ± 5.10/5.28 ± 2.06 mmHg. There were good physical capacity and no arrhythmias in patients’ group. There were differences between the groups in QoL index (patients vs healthy -38.14 ± 19.00 vs 34.69 ± 15.06, p < 0.01) and 6 scales of QoL and PIL test.

Conclusion: This study provides evidences that after the Ross operation patients are currently asymptomatic and enjoy a normal social lifestyle.
445
Multiple interatrial septal defects - Frequency of appearance and morphological features
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Background: Multiple atrial septal defects (ASDs) are a morphological variant of interatrial septal defects about which there is little data in literature, but that became more important in the last few years since this type of ASDs may benefit from transcatheter closure.

Objective: to determine the frequency of multiple ASDs, their morphological features and the association with other cardiac anomalies.

Methods: It is a retrospective study on 337 patients with ASD admitted in our Institute between the 1st of January 2000 and the 17th of May 2004. Patients with multiple ASDs were selected upon their transthoracic and/or transesophageal echocardiography (TTE and/or TEE) and their morphological features and associated anomalies were studied. In patients who have undergone a surgical repair of the defect, the echocardiographic findings were compared with surgical data.

Results: 14 patients of 263 (for whom an echocardiographic examination was available) had multiple ASDs (5.3%) with an "increase" in frequency in the last year (7 patients of 41 - 17%). Most of the patients (10 of 14) were diagnosed with multiple ASDs by a transthoracic 2-D color Doppler examination. In the majority of cases (11 patients) the multiple ASDs were of ostium secundum type - 7 patients with a double defect (picture) and the others with a multperforated septum.

Conclusions: Multiple interatrial septal defects are relatively rare (5.3%), with an increasing frequency due to better echocardiographic techniques in the last years. Nine of 14 patients were diagnosed by echocardiography as having double defects and a multperforated septum was found in the other 5 cases. The most frequent associated anomalies were the septal aneurysm and the anomalous pulmonary venous connections (each in 4 patients).

446
Mitral valve’s area in children with pulmonary atresia/stenosis and interventricular right-to-left shunt - Echocardiographic study
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Introduction: Small, but not primary hypoplastic mitral valve is a common finding in children with diminished pulmonary flow and interventricular right-to-left shunt. When ASD is absent or very small, mitral orifice’s area depends directly on LA inflow. Mitral flow represents total pulmonary flow to-left shunt. When ASD is absent or very small, mitral orifice’s area decreases significantly (p<0.001) 2-4 weeks after creation of B-T, TrV remains normal. Neonates with PDA-depending pulmonary flow /N.B.: before PGE1 infusion/ have a normal mitral valve area.

Methods: Forty six children aged 1 day to 5 years with cyanotic heart defects: pulmonary atresia (n.15) or severe stenosis (n.31) and absent ASD were examined before and after creation of B-T anastomosis and during PGE1 infusion. Control group consists of 50 healthy children. Serial aortic valve measurements of MV and TrV annulus were performed in apical 4-C in early diastole, indexed areas and its ratios were calculated applying circular geometry.

Results: Control group.ind.area of MV 3.74±0.75 cm²/m² and of TrV 4.13±0.8 cm²/m², and their index 0.908±0.071 with very good correlation (r=0.93, p<0.001).

Children with diminished pulmonary flow of a different severity /N.46/critical (Qp/Qs<0.45):MVA 2.68 cm²/m² TrVA 5.14 cm²/m² index MV/TrV 0.51 moderate (0.45 mild (0.7):before B-T anastomosis: MVA 3.0 cm²/m² TrVA 5.5 cm²/m² index MV/TrV 0.54 2-4 weeks after B-T: MVA 4.38 cm²/m² TrVA 6.34 cm²/m² index MV/TrV 0.7112-18 months after B-T: MVA 3.98 cm²/m² TrVA 5.61 cm²/m² index MV/TrV 0.72MV area raised significantly (p<0.001) 2-4 weeks after creation of B-T, TrV remains normal. Neonates with PDA-depending pulmonary flow /N.B.: before PGE1 infusion/MVA 2.09 cm²/m² TrVA 4.44 cm²/m² index MV/TrV 0.45, after PGE1 infusion: MVA 2.82 cm²/m² TrVA 4.63 cm²/m² index MV/TrV 0.59. Even very small MV ostium becomes greater.

Conclusion: 1/ In pulmonary atresia/stenosis with interventricular right-to-left shunt mitral valve is small due to the degree of pulmonary flow restriction, especially in neonates with ductus-depending pulmonary vascularisation, 2/ Mitral valve’s area increases promptly to amelioration of pulmonary flow, 3/ Ratio of indexed areas of a-v valves can be useful in repeated evaluation in this group of patients.

447
Echocardiography and cardiac magnetic resonance for the evaluation of congenital aortic stenosis. A correlation study
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Purpose: Echocardiography (Echo) has become the most commonly used technique to evaluate Aortic Stenosis (AS). Echo has some limitations, particularly the assessment of the severity of stenosis. CMR is a new non-invasive imaging technique that has advantages over echo in cases of aortic stenosis. The aim of our study is to evaluate the feasibility of CMR to study the aortic valve area and compare the results with echo.

Methods: We studied 16 pts with moderate to severe congenital AS, mean age: 12.8±2.8 years. The left ventricular mass (LVM), stroke volume, end diastolic volume and the peak aortic gradient were measured with both, Echo and CMR. The aortic valve area was measured using the continuity equation with Echo and by planimetry with CMR. A linear regression analysis was performed to describe the correlation between the two techniques.

Results: There was an excellent correlation between the two techniques for the LVM (r=0.96, p<0.001). Also strong correlations were noted for the stroke volume (r=0.75, p<0.01), the end diastolic volume (r=0.86, p<0.01) and the peak gradient (r=0.79, p<0.01). The measurements of the aortic valve areas yielded a weak agreement (r=0.44, p>NS).

Conclusion: In a congenital AS population, the different parameters measured by CMR correlated well with the ones calculated by Echo. Nevertheless, some differences were perceived for the aortic valve area calculation. These data suggest that CMR could be an alternative to Echo for the evaluation of patients with congenital AS.
448 Prediction of significant shunt in children with atrial septal defect using transthoracic and transesophageal echocardiography

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The aim of the study was to assess the right ventricular volume overload and predict the hemodynamically significant shunt in children with secundum atrial septal defect (ASDII) by transthoracic (TTE) and transesophageal echocardiography (TEE).

The study group consisted of 60 children with ASDII, 41 girls and 19 boys aged from 1.3 years to 18.3 years, mean value 10.9 ± 4.8 years. They were divided into group I - 44 children with hemodynamically significant shunt and group II - 16 children with insignificant shunt.

In both groups the right ventricle was assessed using the following parameters from TTE: TTERVD1/TTELVD1 (the ratio of left-to-right inflow ventricular diameter), TTERVD2/TTELVD2 (the ratio of left-to-right mid-ventricular diameter), TEERTAVD (the ratio of left-to-right ventricular area) and analogical parameters from TEE: TEERVD1/TTELVD1, TEERVD2/ TTELVD2 and TEERTAVD/TEELVD.

The mean values of the obtained parameters were: TTERVD1/TTELVD1 in group I: 1.16 ± 0.16 while in group II: 0.77 ± 0.1; TTERVD2/TTELVD2 in group I: 1.09 ± 0.12 and in group II: 0.77 ± 0.1; TEERTAVD/TEELVD in children from group I: 1.24 ± 0.26, in group II: 0.71 ± 0.1; TEERVD1/ TTELVD1 in group I: 1.16 ± 0.15 in group II: 0.9 ± 0.1; TEERVD2/TTELVD2 in patients from group I: 1.11 ± 0.15 and from group II: 0.84 ± 0.12 TEERTAVD/ TEELVD in group I: 1.27 ± 0.2 and in group II: 0.82 ± 0.17.

All measurements in children from group I were significantly larger (p < 0.0001) than in group II. Using univariate logistic regression better predictors for significant shunt was found by TTE parameters compared to TEE. The best predictor was TTERVD1/TTELVD1.

Multiple logistic regression was used to identify children with significant shunt. Probability of significant shunt can be predicted with sensitivity of 100% and specificity of 75% with the aid of expression: 1/(1 + exp(30.0 - 8.88 TTERVD1/TTELVD1)).

Conclusions: 1/ The ratios of left-to-right dimensions from TTE as well as from TEE can be used to assess the right ventricular volume overload in children with ASDII. 2/ The indexes from TEE are better predictors of significant shunt than parameters obtained from TEE, the best predictor occurred the ratio of left-to-right mid-ventricular diameter from TTE. 3. The significant shunt in children with ASDII can be detected on the basis of the logistic model equation.

449 Echocardiographic characterization of pulmonary valvar leaflet in tetralogy of Fallot

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Background: Surgery for Tetralogy of Fallot (TOF) involving a trans-annular patch usually damages the pulmonary valve (PV). PV morphology is important to surgeons as it influences surgical technique, which may produce long-term pulmonary insufficiency (PI). Description of the type of leaflet morphology before surgery in TOF has rarely been described or investigated.

Methods: We performed high parasternal short axis imaging, rotating the transducer clockwise to the position where we could identify the pulmonary annulus and leaflet morphology. Leaflet motion was observed using slow motion digital replay throughout the cardiac cycle to define valve morphology accurately. We noted the position of the commissure on the anterior surface of the right ventricle to determine whether the leaflet would have to be incised during trans-annular incision. A total of 14 patients who had pre-operative ultrasound evaluations and surgical repair of TOF performed in our institution from January 2002 to March 2004 were included and we compared PV morphology to that description from surgical findings.

Results: Overall feasibility was 93% for HHUD and 95% for SE (p < 0.04). All P with malignant arrhythmia had significant IP. Conclusions: 1/ Cardiac arrhythmias were present in 13.5% of studied adult P after total surgical correction of Fallot’s tetralogy and in 3.5% of cases malignant form of the arrhythmia was found.

2/ The only clinical finding differentiating patients with significant ventricular arrhythmias from other adults patients after complete correction of Fallot’s tetralogy was significant pulmonary insufficiency.

3/ Significant pulmonary insufficiency was present in all patients with malignant ventricular arrhythmia.

450 Reliability of routine linear measurements made by expert sonographers on hand-held ultrasound devices

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Hand-Held ultrasound devices (HHUD) represent a novel diagnostic opportunity for routine bedside cardiac imaging. Easy availability of structural and functional informations might improve clinical approach in ambulatory and hospital setting, but not much exist about accuracy of cardiac linear measurements made by expert sonographers on HHUD. Aim of our study was to compare quantitative data obtained by sonographers on HHUD after formal, goal-oriented training (200 full examinations) with the results obtained by expert cardiologists on a state of the art echo-Doppler machine (SE) considered as gold standard.

Methods: 112 consecutive pts (mean age 61, males = 64, atrial fibrillation: 12) referred for in-hospital (48%) or ambulatory routine 2D echocardiography were considered. All pts underwent full 2D cardiac examination made by the sonographer equipped with HHUD (Optigo, Philips MS) and by the cardiologist equipped with SE (Sonos 5500, Philips MS). On-line linear measurements (mm) of diastolic and end-systolic left ventricular transverse diameters (LVEDD, LVESD), aortic root (Ao), left atrium (LA), end-diastolic interventricular septum (IVS) and posterior wall (PW) thickness were calculated in leading edge - leading edge modality on 2D parasternal long-axis view by both operators in blind conditions.

Results: Overall feasibility was 93% for HHUD and 95% for SE (p < ns). Excellent diagnostic concordance was obtained for LVEDD (K = 0.75), LA (K = 0.76), IVS (K = 0.77) measurements; good concordance was observed for PW (K = 0.66), Ao (K = 0.64), PW (K = 0.67) measurements. A very high linear correlation (p < 0.001) between HHUD and SE was observed for LVEDD (r = 0.920), LVESD (r = 0.964), Ao(r = 0.931), LA (r = 0.964), IVS (r = 0.927) and PW (r = 0.896). A difference superior to two standard deviations between the couples of measurements was observed in 2 pts for LVEDD (2%), 3 pts for LVESD (3%), 2 pts for Ao (2%), 7 pts for LA (7%), 9 pts for IVS (9%) and 5 pts for PW (5%).

Conclusions: In a general population referred for routine 2D echocardiography, linear measurement of basic cardiac structures made on parasternal long-axis view by expert sonographers equipped with HHUD was highly reliable. Further studies are needed to better identify the minimum level of competence required for routine clinical use of HHUD.
Conclusion: HC ultrasound technology has the potential to provide rapid, accurate, and cost-effective answers in the evaluation of patients referred for urgent echocardiography.

Methods: In a tertiary hospital, 52 patients, age 58 ± 20 years, 17% women, who required urgent echocardiography during non-working hours and weekends, underwent a HCU by the consulting cardiologist at the patient’s bedside. The HCU device used in the study, OptiGo from Philips Medical Systems, is equipped with 2-dimensional and conventional color-flow Doppler. Cardiologists performed a focused HCU (study to elucidate the referral clinical question).

Results: HCU studies were done in intensive care unit (47%), emergency room (26%), medical department (21%), and recovery room (6%). Mean duration of HCU study was 6 min. Indications for echocardiography were chest pain and dyspnea (37%), hypotension post cardiac surgery (32%), chest trauma (16%), shock (11%), and complications after coronary intervention (4%). There were 76 clinical questions (ventricular function, pericardial effusion, regional wall motion abnormalities, valvular lesions, pulmonary hypertension, prosthetic valve function) that cardiologists had to address. HCU provided clinically relevant information in 89% of the patients. Due to inappropriate visualization, cardiologists were unable to assess ventricular function and regional wall motion abnormalities in 3 patients. Due to the lack of spectral Doppler, HCU was incapable to provide information in 3 patients (pulmonary hypertension, prosthetic valve function).

Conclusions: HCU is feasible and renders important information in most of the patients referred for urgent cardiac assessment and helps cardiologists consulting at the bedside. As these devices become equipped with more diagnostic elements, their impact on patient management will be further enhanced.

545 Cost-effectiveness of portable echocardiography: a pilot randomized study in the out-patient clinic

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Introduction: Portable echocardiography (PE) might have a great impact on the clinical assessment of non-invasive patients. However, few data are available about its clinical utility and cost-effectiveness in the real clinical practice.

Aim: To assess clinical utility and cost-effectiveness of PE performed by consultative cardiologists in the out-patient clinic of Treviso Hospital.

Methods: We enrolled 113 consecutive patients submitted to our out-patient clinic for elective cardiac examination and with clinical indication to perform a subsequent standard echocardiography (SE). Patients were assessed by four cardiologists experienced in cardiac ultrasound and randomly assigned to group A and B. Patients in group A (54, 24 males, age 65 ± 15) were referred to the SE laboratory according to the regular schedules of our hospital; waiting time to get the SE done was recorded. In patients of group B (59, 36 males, 69 ± 12) the cardiac consultant, immediately after the clinical assessment, performed a quick PE with OptiGo (Philips Medical Systems, Andover, MA, USA) and reported whether the information provided by the PE was adequate to answer the clinical question (the indication for the study), and second assessed by four cardiologists experienced in cardiac ultrasound and randomized to group B to confirm the clinical diagnosis. HCU was done in 48 hours as protocol. We estimated the cost of PE and SE examination upon the following data; total cost of the device, ammortization time, medical and nurse time dedicated to the examination.

Results: In group A and B the requested clinical questions for SE were: assessment of left ventricle function (33% and 42%) and hypertrophy (18% and 12%) and assessment of aortic stenosis (13% and 14%). In group A the average waiting time to get the SE done was 38 days. In group B PE was considered adequate to answer the clinical question in 25/59 (42%) patients. In 4/25 (16%) SE did not confirm the PE data: we observed overestimations of mild valve pathology in 3 patients and underestimation of mild left ventricle function in 1 patient. Only in 1 patient these differences resulted in minor changes of the management (earlier follow-up). No changes of therapy were observed. The estimated examination cost was about 45 Euros for SE and 5 euros for PE. A total amount of 1.125 Euros might have been spared in this small group of patients by a standard use of PE. Average PE examination time was 3.4 minutes.

Conclusions: In our study population a quick PE examination performed by cardiac consultants could have potentially answered an important part of the most common clinical questions, resulting in reduced time to diagnosis and lower costs for our hospital.

546 Role of ultrasound stethoscope in primary care patients screening for left ventricular dysfunction

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Background: Although echocardiography is relatively simple and noninvasive, it is not feasible to use it to screen all patients at risk for left ventricular (LV) dysfunction. The use of ultrasound stethoscope (US) is increasing; however, smaller, portable ultrasound stethoscopes are now available. They enable accurate evaluation of LV function, as demonstrated by side-by-side comparison with standard echocardiography. Below we present the results of screening for heart failure and left ventricular systolic dysfunction with the use of ultrasound stethoscope in primary care setting.

Methods: Based on primary care medical records of adults living in the town of Ilza (population: 5551), we selected 518 patients with either risk factors for LV dysfunction or previous diagnosis of heart failure. The inclusion criteria were: age 55 years or older and one of the following: hypertension with organ damage, diabetes mellitus, coronary heart disease or history of heart failure. Using ultrasound stethoscope we assessed the chamber size, left ventricular ejection fraction (EF) on the eye-ball basis, wall thickness and contractility. Primary care physician diagnosis of heart failure was either confirmed or refuted by the investigators.

Results: 175 patients answered our mail invitation (mean age 65.8 years, 57% female), in 41 patients (23%), 25 female and 16 male, diagnosis of heart failure was made by the primary care physician prior to the study. In another 40 (23%) patients heart failure was not recognized. Among patients with recognized heart failure 24 (58.3%) had left ventricular systolic dysfunction, defined as EF<50%, as estimated with US. However, 12 patients (41.5%) had EF<35% but in 29 (72.5%) EF was not measured. In 15 patients EF was not measured. Seventeen patients (41.5%) had EF<50%. Among remaining 40 patients with heart failure symptoms, 11 (27.5%) had EF<50% but in 29 (72.5%) EF was not measured. In 15 patients EF was not measured. Seventeen patients (41.5%) had EF<50%. Among remaining 40 patients with heart failure symptoms, 11 (27.5%) had EF<50% but in 29 (72.5%) EF was not measured. In 15 patients EF was not measured.

Conclusion: A significant proportion of heart failure cases and asymptomatic left ventricular dysfunction remains unrecognized by primary care physicians. Screening with ultrasound stethoscope in a primary care population at risk adds significant information to the clinical diagnosis of heart failure.
Utility of hand-carried ultrasound for consulting cardiology and its repercussion on the Echo-Lab

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Recent advances in electronic miniaturization have resulted in the creation of small hand-carried ultrasound devices (HCU). These units offer clinically acceptable two-dimensional image quality for rapid “quick-look” bedside diagnostics. We evaluate the utility of HCU in an outpatient consulting and its repercussion on the Echo-Lab.

Since January 2003 we have an HCU (Phillips OPTIGO) in the outpatient consulting. Before that, all echocardiograms requested were referred to the central Echo-Lab. In the first 4 months of 2002 (from January to April) 1066 patients were seen in that outpatient consulting and 209 p (20%) were referred to the Echo-Lab for an echocardiogram. During the same period but in 2003, 1039 patients were seen and only 105 p (10%) were referred to the Echo-Lab. In this period 141 studies were performed with the HCU. 114 of them (81%) were considered of enough quality and no further information was considered necessary. In the second period (January to April 2003) 130 of the 141 HCU studies were performed in patients in its initial visit and in most of them the information obtained was enough for clinical management.

We emphasize that the HCU studies were performed by a cardiologist with knowledge on echocardiography level II.

Conclusions: 1) HCU devices provide valuable information immediately during cardiology consultation, specially for the initial visit. This information may have an immediate impact on clinical decision-making and patient care. 2) The use of an HCU device has an important repercussion on the Echo-Lab activity, with a considerable decrease in the number of the studies requested.

Triage patients in emergency room using hand-held ultrasound device for suspected pulmonary embolism

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Background: The diagnosis of pulmonary embolism (PE) remains difficult in emergency room. Right to left ventricular end-diastolic area (RVEDA/LVEDA) ratio is published as the most accurate echocardiographic index of right ventricular obstruction in acute PE. Recently, hand-held ultrasound device (HHD) has been proposed as an echocardiographic tool at the bedside. The purpose of this study was to determine the value of HHD for triage patients with suspected PE referred to emergency room using simplified 2D echo criteria.

Methods: During 6 months, we prospectively studied 103 consecutive patients with suspected PE in emergency room. After a clinical probability scoring system and D-dimer assessment, 28 patients were excluded (considered as no PE) and the other 76 patients (mean age 62±17 years) underwent a venous ultrasonography, a transthoracic echocardiography with HHD and a CT-scan (considered as the gold standard). Patients with normal CT-scan and deep venous thrombosis underwent a pulmonary angiography. Each exam was obtained in a blind fashion. The diagnosis of deep venous thrombosis rested on venous incompressibility. Right ventricular dilatation was assessed using RVEDA/LVEDA ratio with a cut-off value of 0.6.

Results: Pulmonary embolism was present in 31 patients. The sensitivity (Se) and specificity (Sp) of venous ultrasonography was 58% and 93%, respectively. The efficiency of HHD was better in patients with dyspnea (Se 73%, Sp 67% vs. 42% and 74% in pts with chest pain). Using HHD, the Se and Sp of a combined strategy (echocardiography and venous ultrasonography) was respectively 87% and 69%. The Se of this combined strategy was significantly improved as compared to venous ultrasonography alone (p<0.01), even when the Sp was lower (p=0.003).

Conclusion: This prospective study suggests that HHD may be a reliable echo tool using 2D simplified criterion for triage patients with suspected PE in emergency room.
New Doppler indices in evaluation of the RV function

2 December 2004, 8:30 to 10:00
Location: Room 2

**ORAL SESSIONS**

**106**
Tissue Doppler derived right ventricular pre-systolic velocity in the trained heart: an index of supernormal performance


**Purpose:** Pulsed Tissue Doppler (TD), already proposed as reliable method for the assessment of right ventricular (RV) myocardial function, shows a myocardial positive pre-systolic velocity (PSVm), occurring during myocardial pre-contraction time (PCTm) and preceding systolic velocity (Sm). Aim of this study was to evaluate characteristics and determinants of RV PSVm in the trained heart, in relation to standard Doppler echocardiography.

**Methods:** 19 top-level male rowers (mean age 19 years) and 19 healthy men were assessed by standard Doppler echo and pulsed TD of RV tricuspid annulus (apical 4-chamber view). Myocardial Sm and diastolic (Em, Am) velocities (all cm/sec), Em/Am ratio and myocardial time intervals (PCTm, contraction time, relaxation time − RTm, (all ms) were measured. PSVm (cm/sec) was also evaluated. The ratio between tricuspid inflow E velocity and Em of tricuspid annulus (RV E/Em ratio) was determined to estimate RV filling pressure.

**Results:** The 2 groups were comparable for age, blood pressure and body mass index. Heart rate was lower (p<0.0001) and left ventricular mass higher (p<0.001) in athletes than in controls (p<0.0001). Athletes showed greater two-dimensional tricuspid annular systolic excursion (p<0.01) and higher RV wall thickness (p<0.05) while RV end-diastolic diameter and peak Tricuspid Regurgitation Pressure Gradient were higher in PE pts, 3.1 vs. 2.8 cm, p<0.05 and 36 vs. 26 mmHg, p<0.001, respectively. The regional systolic velocities of the RV free wall were similar in the 2 groups, RV end-diastolic diameter and peak Tricuspid Regurgitation Pressure Gradient were higher in PE pts, 3.1 vs. 2.8 cm, p<0.05 and 36 vs. 26 mmHg, p<0.001, respectively. No significant relation of PSVm was found with heart rate or RV wall thickness, Am (β=0.54, p<0.005) and RV E/Em ratio (β=0.40, p<0.05) were independent predictors of PSVm (cumulative R²=0.36, SE=−0.02, p<0.001).

**Conclusions:** TD-derived RV PSVm, as well as RV Sm, of tricuspid annulus indicates supernormal RV myocardial function in athletes. The increase of PSVm in the trained heart is associated mainly to a greater myocardial atrial contraction and, to a lower extent, to lower RV filling pressure.

**107**
Right ventricular strain by tissue doppler echocardiography in patients with pulmonary embolism

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**Introduction:** Conventional 2D echocardiography studies have indicated that strain in the Right Ventricle (RV) free wall in pulmonary embolism (PE) may be most pronounced in the mid segment, known as the “McConnell sign”. Tissue Doppler Imaging (TDI) can quantify regional strain. We have found elevated strain values in the mid segment of the RV free wall in three consecutive cases of acute sub-massive PE that normalized after thrombolysis. Based on this we did the present study regarding regional RV strain in patients (pts) with PE.

**Methods:** 135 (age 67.9±16.6 [mean±SD] 52% females) consecutive circulatory stable pts with suspicion of PE referred for Ventilation/Perfusion (V/Q) lung scan had a same day echocardiography incl. TDI (SONOS 7500, apical 4 chamber view, blinded to the V/Q scan) performed.

**Results:** 32 pts had high probability and 53 had low probability (control group) of PE at the V/Q scan. Age, blood pressure, the tricuspid annular plane systolic excursion were similar in the 2 groups. RV end-diastolic diameter and strain were significantly elevated in pts with larger perfusion defects, i.e. >25% −0.01 vs. -13.9%, p<0.05. Conclusion: TDI strain analysis of the RV free wall clearly demonstrated increased strain in especially the mid part of the RV in circulatory stable pts with PE and may be a new tool for identification of RV strain in acute increase in RV afterload.

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**RV TDI Velocity and Strain**
108 Improved right heart function after continuous positive airway pressure treatment in obstructive sleep apnea

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Purpose: Pulmonary hemodynamic changes and pulmonary hypertension is associated with obstructive sleep apnea (OSA). Data over right heart alteration and function in OSA are scarce. We sought to investigate right and left heart function in OSA patients by echocardiography, and assess the effect of continuous positive airway pressure (CPAP) treatment after 6 months.

Methods and materials: Seventeen patients (M/F:10/7) with OSA, and 17 age matched controls (M/F:10/7) had a routine 2-D Doppler echocardiographic examination, and pulsed wave tissue Doppler (PWTID) mapping of systolic (Sm) and diastolic velocities (early, Em; late, Am) of the mitral, and tricuspid annulus, and the right ventricular (RV) free wall. The RV performance index (PI) was determined from the ratio of the sum of the isovolumic times and ejection time. All patients also had lung function tests, arterial blood gas analysis and a polysomnography. The echocardiography was repeated 6 months after treatment with CPAP.

Results: The apnea-hypopnea index (AHI) was 41±22. There was no difference (p>0.05) between patients and controls regarding age: 59±12 versus 55±9 years, and LV ejection fraction (LVEF): 62±8 versus 64±5.5%. However significant differences could be seen between, body mass index: 31.7±4 versus 25.4±3.8 kg/m²; central venous pressure: 7±5 versus 2±3 mmHg; RV end diastolic dimension: 3.8±0.7 versus 2.6±0.3 cm; pulmonary arterial systolic pressure (PASP): 38.6±8 versus 18.5±5 mmHg; septum thickness:1.3±0.3 cm versus 0.91±0.2 cm; RV PI: 0.32±0.11 versus 0.21±0.03; MV Sm: 8.17 versus 12.8±2.4; TA Sm: 12.6±1.8 versus 15.4±1.2 cm/s; and RV Sm: 11.5±2.1 versus 13.8±1.1 cm/s (for all variables p<0.05). Regression analysis showed a strong correlation between AHI versus PWTID derived indices of RV function (r=−0.60, p<0.01). Six months after CPAP treatment there was symptomatic improvement in all patients. The data post treatment are as follows: HR: 64±9/min; systolic/diastolic BP: 144/87 mmHg; PASP: 28±7 mmHg; septum: 12±2.6 cm (p=0.05 for all versus baseline data); LVEF=67±4%; RV PI0.28±0.08; TA Sm:13.9±1.3 cm/s; and RV Sm:12.9±1.7 cm/s (p<0.05).

Conclusions: A strong correlation was found between AHI and PWTID derived indices of systolic RV function. Six months after CPAP treatment there was significant improvement in symptoms, hemodynamic data, and right heart function. PWTID imaging is a quantitative, simple way of assessing RV function, and may be potentially useful in the follow up and assessment of effects of treatment in OSA.

109 The value of Tei-index for the echocardiographic diagnosis of right diastolic dysfunction in patients with chronic obstructive pulmonary disease

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Chronic obstructive pulmonary disease (COPD) is a common cause of pulmonary parenchymal disease that cause pulmonary hypertension and right ventricular (RV) dysfunction. However, the assessment of RV function is technically difficult because of the complicated geometry of the RV. The recently proposed Tei index allows non invasive and quantitative estimation of ventricular function without geometric evaluation. It is calculated as the quotient: (isovolumic relaxation time + isovolumic contraction time)/ ejection time.

Purpose: The aim of this study was to evaluate the diagnostic role of Tei index in patients with chronic obstructive pulmonary disease (COPD).

Methods: 46 patients with severe COPD were studied. Patient were divided into 2 subgroups according to pulmonary artery systolic pressure: 25 patients (16 male and 9 female, age 60.2±2.5) with pulmonary hypertension (group1) and 23 (13 male and 10 female, age 56.8±3.9) patients with normal pulmonary artery pressure (group 2). As a control group, 25 (13 male and 10 female, age 57.4±4.1) normal subjects were studied (group 3). Tei index, was obtained from tricuspid and pulmonary Doppler flow velocity.

Results: Patients in group I had higher RV Tei index (0.60±0.2 vs 0.39±0.1 vs 0.30±0.15) higher tricuspid E/A velocity (58±8.03 cm/s vs 54.7±0.76 vs43.8±0.37 cm/s), lower tricuspid E velocity (31.1±0.3±59.9±028.8±57.2±72.1 cm/s), longer isovolumic relaxation time (9RVTr: 103.2±4.5 vs 87.10 vs 76.6±9.9 ms) than group 2 and 3. (p value group 1 vs 2 and 3; p value group 2 vs 3 p N.S)

Conclusion: Patients with COPD complicated by pulmonary hypertension have frequently RV dysfunction. Tei index allows simple, non invasive and nongeometric estimation of RV dysfunction in patients with COPD and pulmonary hypertension.

110 A novel tissue Doppler index of right ventricular contractility as strong independent prognostic factor in pulmonary hypertension

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The function of hypertrophic RV, which is the main prognostic factor in severe pulmonary arterial hypertension (PAH) is particularly difficult to assess non-invasively. Myocardial acceleration during isovolumic contraction (IVA) obtained in tissue doppler imaging (TDI) have been recently shown as a load independent non-invasive index of RV elastance in animal model. The aim of our study was to assess whether IVA is an independent prognostic factor in patients with PAH.

Material and methods: 40 patients mean age 41.6±14 with severe PAH (mean PAP 62±18.3 mmHg) were assessed and followed for up to 36 months. Echocardiographic examination and TDI were performed on the day of diagnostic right heart catheterization. Signals of TDI were recorded from tricuspid annulus at the free wall of RV in four-chamber apical view and IVA was measured as described in published data. According to ROC analysis the optimal cut-off value of IVA in the selections of deaths was assessed.

Results: The mean value of IVA was 3.26 m/s² ±1.19. Value of IVA 3 m/s² significantly (p=0.02) differentiated survivors from non-survivors. This value of IVA reached 80% negative predictive value (NPV) for death. Multivariate Cox proportional hazard analysis revealed IVA <3 m/s² (HR 4.67 p=0.02), 6-minute walk distance (HR 0.98 p=0.01, and right atrial pressure (RAP) >12 mmHg (HR 4.96 p=0.009) as independent factors of mortality.

Conclusion: Easily and quickly obtainable non-invasive TDI parameter- myocardial acceleration during isovolumic contraction reflects depressed RV contractility function and is strong independent prognostic factor in PAH.

111 Big endothelin, interleukin 6 and right ventricle function assessed by Tissue Doppler imaging

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Aim: Big endothelin (BE) and interleukin6 (IL 6) belong to the important substances which are bound with the severity of heart failure. We compared the patients with high and low BE and IL6 level in the connection with haemodynamics, function of left (LV) and right ventricle (RV).

Study group: 155 patients with chronic heart failure, ejection fraction of left ventricle (EF LK) less than 40%, NYHA II-LV, mean age 51.8±8.8 years, 129 male, 26 female, CAD 86, DCMP 69.

Methods: Echocardiography with dimensions of LV, volumes and ejection fraction, tissue Doppler echocardiography (TDE) of tricuspid annular motion with evaluation of systolic velocity (Sa), early (Ea) and late (Aa) diastolic velocities, right heart catheterization with measurement of mean pulmonary artery pressure (MPAP), pulmonary wedge pressure (PCWP), central venous pressure (CVP), and pulmonary vascular resistance (PVR). The levels of big endothelin and interleukin 6 were evaluated by ELISA methods.

Median of big endothelin was 1.66 pmol/l, median of interleukin 6: 2.3 pmol/l. Group A had BE=1.66, group B<1.66 pmol/l. For IL 6 evaluation group A had the level> 2.3 ng/l and group B< 2.3 ng/l.

Results: Patients with higher BE, group A, had the values by right heart catheterization significantly higher than the group B: MPAP 31.5±12.8 vs 23.9±11.6 mmHg, p<0.004, PCWP 22.1±9.6 vs 16.4±9.1 mmHg, p< 0.005.

Sa, which reflects the systolic function of right ventricle, was lower in group A: 10.4±2.3 vs 11.6±2.4 cm/s, p< 0.02. The dimension of RV was also larger in group A patients: 34.0±7.0 vs 30.8±4.5 mm, p< 0.03.

Patients with higher IL6, group A', had also larger dimension of RV 34.0±7.4 vs 30.1±6.4 mm, p< 0.03, and lower Sa wave: 10.4±2.2 vs 11.8±2.4 cm/s, p<0.0005. There were no differences between the groups in right heart catheterization: MPAP 27.3±12.5 vs 27.3±12 mmHg, ns and PCWP 19.1± 17.9±10.0 mmHg, ns.

Conclusion: The levels of big endothelin and interleukin 6 are higher in those patients with chronic heart failure who beside the LV dysfunction have also the dysfunction of right ventricle.
ORAL SESSIONS

New diagnostic implications for stress echo

2 December 2004, 11:00 to 12:30

Location: Room 2

266 Prognostic value of dobutamine stress echocardiography in patients with right bundle branch block


Purpose: Right bundle branch block (RBBB) is associated with an increased mortality, however, the prognostic value of dobutamine stress echocardiography in patients with RBBB has been ill defined.

Methods: 176 consecutive patients (mean age 64±11 years, 131 men) with RBBB underwent dobutamine stress echocardiography. Follow-up was successful in 173 of 176 (98%) patients. Ten patients underwent early (<60 days) revascularization and were excluded from the analysis, hence the prognostic data are based on 163 patients. End points during follow-up were hard cardiac events (cardiac death and non-fatal myocardial infarction) and all cardiac events (hard events and late revascularization). Cox regression models were used to identify independent predictors of cardiac events.

Results: A total of 110 (67%) patients had an abnormal dobutamine stress echocardiography. During 4.3 year follow-up, 57 (35%) deaths occurred of which 37 (23%) were due to cardiac causes. Nonfatal myocardial infarction occurred in 9 (5%) patients. Patients with an abnormal dobutamine stress echocardiography had a significant higher incidence of hard and all cardiac events (p<0.05 and p<0.001 respectively). Independent predictors of hard cardiac events in a multivariable analysis model were age (HR 1.04 CI 1.01-1.08), and heart failure (HR 2.3 CI 1.1-5.1). An abnormal dobutamine stress echocardiography was the strongest predictor of hard cardiac events (HR 3.0 CI 1.2-7.4).

Conclusions: Dobutamine stress echocardiography provides prognostic information, incremental to clinical data in patients with RBBB.

Figure 1

Kaplan Meier curve

267 Beneficial effect of coronary revascularization in patients with ischemic cardiomyopathy and viable myocardium: not only improvement in resting LVEF

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Background: In patients with ischemic cardiomyopathy and substantial viability, resting left ventricular ejection fraction (LVEF) not always improves after revascularization. Whether these patients exhibit an improvement in peak-stress LVEF is unknown.

Aim: This study was prospectively designed to evaluate the response of LVEF to high-dose dobutamine infusion in patients with and without improvement in resting LVEF after revascularization.

Methods: Before and 9-12 months after revascularization, radionuclide ventriculography (RNV) and dobutamine stress echocardiography were performed in 50 patients with ischemic cardiomyopathy (LVEF 32±8%) and substantial myocardial viability (at least 4 viable segments). Patients were divided into Group 1, patients with, and Group 2, patients without significant improvement in resting LVEF (at least 5% by RNV) after revascularization. The response of LVEF during dobutamine stress echocardiography was compared in these 2 groups.

Results: Groups 1 and 2 were comparable for baseline characteristics, resting LVEF and number of viable segments (7±4 v 6±2, p=NS). After revascularization, the LVEF response during DSE significantly improved in both groups (both p<0.001). Interestingly, although resting LVEF had not improved in Group 2, peak-stress LVEF after revascularization did (p<0.001, Figure 1). Group 1 patients had however a higher amount of increase in peak-stress LVEF (p<0.01). NYHA and CCS functional classes decreased in both groups.

Conclusions: Although patients with viable myocardium did not always improve in rest LVEF after revascularization, stress LVEF improved in all patients; assessment of improvement of resting function may not be the ideal end-point to evaluate successful revascularization.
268 Value of levosimendan stress echocardiography for the detection of myocardial viability

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Purpose: In our study we compared the new inotropic agent levosimendan in stress echocardiography (LSE), relatively to dobutamine stress echocardiography (DSE) for the prediction of recovery of left ventricular (LV) dys-synergies after revascularization, in patients with acute myocardial infarction.

Methods: Thirty five patients were enrolled in our study. These patients had suffered a previous myocardial infarction, had LV dysfunction and they were scheduled for revascularization (22 for coronary angioplasty and 13 for bypass surgery). First they underwent low-dose DSE (5-10 mg/kg/min). Then, levosimendan was infused at least 1 hour after dobutamine infusion, at 2 doses of 12 and 24 mg/kg, over a 5 minutes period each. LV wall motion score was assessed using a 16-segment model. Images were compared side by side in quad screen format by two independent observers without the knowledge of the patients clinical, scintigraphic, or angiographic data. The presence of contractile reserve was defined as an improvement in segmental wall motion score by 1 or greater grade, following infusion of low dose dobutamine, or levosimendan in two or more dyssynergic segments.

All patients also underwent resting echocardiography within 6 months after successful revascularization.

Results: No major adverse events occurred during levosimendan or dobutamine administration. Dobutamine infusion resulted in elevation of heart rate relative to levosimendan (10±4 pulses/min, Versus 5±2 pulses/ min respectively). The 548 segments studied, 220 (40%) were dyssynergic at rest. Dobutamine-induced contraction resulted in 173 (25%) abnormal segments, while 90 (16%) of them showed functional improvement after revascularization. During LSE 110/220 (51%) dyssynergic segments improved and 100/110 (91%) of them recovered function after revascularization. A significantly lower sensitivity of DSE was noted, compared to LSE (75% Versus 94% respectively, p<0.001) but both methods had similar specificity (99% Versus 91% respectively, p=ns) for the prediction of the recovery of LV hypokinetic segments after revascularization.

Conclusions: Levosimendan stress echocardiography seems to predict postrevascularization recovery of LV dysfunction with higher accuracy than dobutamine stress echocardiography, and therefore seems promising as a new method for assessing myocardial viability before revascularization. Furthermore, levosimendan is a safe drug that can be used in stress echocardiography without remarkable side effects.

269 Dipryidamole versus dobutamine stress echo - Comparison of strain response in different ischemic substrates


Strain-rate imaging (SRI) has been shown to distinguish different ischemic substrates in dobutamine stress echocardiography (DSE). Dipryidamole stress echo (DySE) is currently used as an alternative for DSE in coronary artery disease, but no studies on SRI in DySE have been reported.

Study aim: to compare changes in systolic myocardial strain (S) during a repetitive (4 pulses/min) dobutamine infusion in both normal and chronically ischemic segments.

Methods: Fifty variables (70-100%) were calculated within 4 weeks, by implanting a copper coated stent into the circumflex coronary artery. At 4 weeks the pigs were divided into 3 groups according to resting (BL) radial strain (S). The strain-rate imaging (SRI) in these 3 groups was then compared to low dose (upto 20 μg/kg/min) DSE (Fig 1 left), (Repetitive) stunning (RSTUN) (n=7) that was defined as mildly, but significantly reduced BL S/SR and an increase at DSE 20 μg/kg/min. The rest was divided into non-transmural (NT) (n=5) reduced BL S/SR, no response to DSE and transmural infarction (T) (n=6) (BL S<5%, no response to DSE). An additional group of 7 pigs was enrolled as a control (C).

After recovery of the DSE, DySE (0.84 mg/kg.min) was performed and data was acquired 1 min and 20 min after ending the infusion. Echocardio- graphic M-mode RF data (PowerVision6000, Toshiba) of the interlateral wall (=segment at risk) was acquired in a SAX view at mid papillary level and processed for SRI.

Results: Results of high dose DySE and recovery are shown in Fig 1 right. Neither in C, NT nor T a response in S was found. However, in RSTUN, S/SR increased.

Conclusions: Responses in S for different ischemic substrates (RSTUN,NT) to high dose DySE compare with DSE and can distinguish different ischemic substrates taking into account resting strain values.

Figure 1

270 Superiority of transthoracic 3D dobutamine stress echocardiography for the assessment of ischemia: a comparative study with simultaneous 2D dobutamine stress echocardiography. thallium SPECT and QCA

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Purpose: Transthoracic 3-dimensional dobutamine stress echocardiography (3D DSE) may be more accurate in identification of wall motion abnormalities compared to 2D DSE, since multiple planes can be reconstructed.

Methods: In 77 patients (pts), with known or suspected coronary artery disease (CAD) and without previous Q wave myocardial infarction or structural heart disease both 2D and 3D DSE (up to 40 μg.kg-1.min-1: atroipine) was performed. At the end of each 3 minute stage both 2D and 3D DSE (random order) were acquired. For 2D DSE standard parasternal and apical views were recorded on videotape. 3D DSE at each stage was acquired through an apical fan-like sweep within 3 minutes, using multiple breath holds and ECG triggering (Freehand transthoracic echocardiography; Tom-Tec®). Thus, 40-80 beats were acquired during each stage and post processes. The analyzed data on the software were performed shortly afterwards, and after 3-4 hours, and quantitative coronary angiography (QCA) within 3 months.

Results: QCA was performed in 2D DSE and Ti in 77, and 3D DSE in 77 patients. Thirty four pts (56%) had significant CAD. Sensitivity and specificity for the overall diagnosis of ischemia for 2D and 3D DSE, compared with QCA were, respectively, 47%, and 78%, and 91% and 72% with an agreement and Kappa of, respectively, 61%, and 0.24, and 83% and 0.65.

Conclusions: in patients with an adequate acoustic window 3D DSE is highly feasible with a far out superior sensitivity and equal specificity compared to conventional 2D DSE. The greatest gain in sensitivity was achieved in the left circumflex and right coronary artery territories.

271 Inflammatory status and outcome of dobutamine stress echo: evidence for relationship

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Introduction: Interleukin-6 (IL-6) and CRP levels have been related to clinical outcome in coronary artery disease (CAD). IL-6 mediates the isch-emia-reperfusion myocardial injury, is elevated in acute coronary syn-dromes and has an independent negative inotrope coronary blood flow contribution to the occurrence and persistence of regional wall motion abnormalities (RMWAs) in stable CAD.

There are no data concerning underlying inflammatory status and pres-ence of ischemia during dobutamine stress echo (DSE). We investigated the relationship between cytokine and CRP levels and DSE outcome.

Methods: 66 consecutive patients with known stable CAD were referred for DSE (9 women, age 60±11). In 18 pts significant CAD had previously been established in 18 pts, with previous myocardial infarction (MI). Plasma levels (pg/ml) of IL-6 and tumor necrosis factor-a (TNFa) were measured at rest (R), peak (P) and during recovery (Rec), 15-30 min post DSE, whereas CRP was measured only at R. A 16 segment model was used for DSE analysis. Regional wall thickening score was estimated at R and P. Treatment was not discontinued for DSE.

Results: CRP and resting IL-6, TNFa were not affected by gender, previous MI or EF <35%. 25 pts had an ischemic DSE (Isch), 21 had evidence for viability (Viab), whereas 20 had neither ischemia nor viability (N). At R, CRP levels were higher in pts with Viab (Isch/Viab/N: 3.1 : 3.2 vs 5.3±6.7 vs 1.8±1.8, p=0.05). CRP was equally increased in pts with/without an increased amount of viable tissue (>4 segments) (5.2±7 vs 5.2±5) or in those with/without a biphasic response (4.3±3.9 vs 5.5±6.6). TNFa was increased in pts with Viab at Rec: Isch/Viab/N: 1.6±1.5 vs 6.4±3 vs 1.7±1.8 p=0.001. IL-6 was increased at P and Rec in the biphasic re- sponses: P: 6.9±6.7 vs 2.4±1.3, p=0.02 and Rec: 11.2±11.1 vs 2.5±1.6, p=0.007. Ischemia by itself was not related to any parameter. Resting levels of CRP, IL-6 and TNFa were not related at R, P and Rec to RMWA score and peak changes, presence of left ventricular hypertrophy, ECG ischemic changes during DSE, occurrence of ventricular arrhythmias or prolonged recovery of RMWA.

Conclusion: In chronic CAD, detection of viability by DSE is related to increased resting CRP as well as to increased cytokine production. Biphasic responders have greater cytokine levels post DSE. These findings can be ascribed to the process of hibernation.
Diagnostic value of echocardiographic dobutamine test with the application of tissue tracking for the imaging of ischemia


Despite an established position of traditional dobutamine echocardiography (DE) especially for detection of one vessel disease (1VD), new imaging methods of critical obstructions in coronary arteries are sought after. Tissue tracking (TT) is a new echocardiographic modality based on Doppler tissue, enabling the assessment of longitudinal apex oriented movement of myocardium. The aim of the study is to determine the value of TT during dobutamine stress for detection of critical obstructions in epicardiac vessels.

Methods and results: Traditional dobutamine test compliant with a standard protocol /10.20,30.40 ug/kg /H11001 atropine/ was performed with Vivid 7 /GE/ system in 20 consecutive patients (11) men with myocardial ischemia, normal systolic function of left ventricle (LV) and sinus rhythm, previously qualified for coronary angiography due. Initial echocardiographic examination was performed in apex views/4Ch, 2Ch, 3Ch/to assess resting ejection fraction (EF), segmental systolic function (resting WMSI) and systolic longitudinal myocardial movement (TT), visualised with a 7 coloured band expressing different degrees of apex oriented movement. The TT test was repeated at every dobutamine load and recorded. Further, assessments of segmental systolic function and of TT value for individual segments using a 16-segment division of the left ventricle were performed at rest and at peak load to determine the average TT value (avgTT). Then a ROC curve/receiver operator characteristic curve/ was plotted to determine an increase TT (dTTavg) value to detect /H11022 50% coronary artery stenosis./H11021

The best discriminating value for the presence of critical stenosis is a /H11021 0.46cm TT increase between rest and exercise. The results are presented in table 1.

Conclusions: TT allows evaluating systolic function at rest and at exercise in non-invasive, semiquantitative way. A high diagnostic value of the dobutamine test with TT surpasses traditional dobutamine tests, although the small size of the examined population is a challenge for future research.

<table>
<thead>
<tr>
<th>Stress</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dobutamine WMSI</td>
<td>72%</td>
<td>100%</td>
<td>85%</td>
</tr>
<tr>
<td>Dobutamine TT avg</td>
<td>100%</td>
<td>89%</td>
<td>90%</td>
</tr>
<tr>
<td>p</td>
<td>0.05</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Changes in myocardial deformation during acute infarction and reperfusion with respect to the presence of a residual stenosis in the infarct related artery

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It was observed that the occlusion (OCC) of a coronary artery results in an immediate decrease in systolic deformation of the myocardium. However little is known about the influence of a residual stenosis in the infract related artery (IRA) on recovery of the myocardium during reperfusion (REP).

Aim: The aim of the study was to determine changes in deformation assessed by strain-rate imaging with respect to the presence of a stenosis in the IRA after REP of an acute myocardial infarction (AMI).

Methods: In group I (N=9 pigs) copper stents were implanted in the circumflex artery (LCx) to produce a stenosis (30-95%) within 4 weeks. Subsequently, the LCx was occluded by inflation of a PTCA balloon for 90 min proximal to the stenosis. After REP the animals were observed for 90 min. Group II (N=9 pigs) got an AMI without previous stenosis. Ultrasound RF-data were acquired (PowerVision6000, Toshiba) and end-systolic strain (Ses) and the post-systolic strain index (PSI) were analysed.

Results: The baseline Ses was significantly lower in group I compared to group II (41±3% vs. 58±5%; p<0.05). From the first min of OCC there was an abrupt decrease in Ses in both group I and II. Independently from the presence of a residual stenosis Ses remained decreased during REP (Figure 1). At the first min of OCC there was a significant increase in PSI in both groups (group I: 26±4% to 54±10%, p<0.01; group II: 4±2% to 56±11%, p<0.01), which remained at the end of REP. No significant differences between the groups for PSI during OCC and REP were observed.

Conclusion: OCC is associated with a significant decrease in Ses and an increase in PSI. During the early period of REP the myocardial deformation remains impaired independently from the presence of a residual stenosis in IRA.

Figure 1
314 Evaluation of systemic stem cell therapy by real-time myocardial contrast echocardiography

Objectives: Mesenchymal stromal cells (MSCs) have the potential to regenerate myocardial tissue but direct intracoronary administration of MSCs may compromise the coronary microcirculation. We tested the hypothesis that intravenous infusion of bone-marrow-derived MSCs have beneficial effects on infarct size and myocardial function in chronic myocardial ischemia which can be visualized by real-time myocardial contrast echocardiography (MCE).

Methods: Myocardial infarction was induced in pigs by proximal LAD occlusion. Animals received autologous and allogenic MSCs (~1×10^6 per kg bodyweight) 48 h post myocardial infarction by intravenous infusion and the treatment effect was assessed at 1 month. Risk area, infarct size and myocardial function were assessed by MCE and standard histological methods.

Results: All groups had similar baseline characteristics. After 1 month the autologous MSC group had significantly higher body weight (37.6±5 vs. 31.4±4 kg, p=0.04), higher heart weight (102.2±19 vs. 87.0±10 g), fractional area shortening (45.6±6 vs. 29.4±4%, p=0.01), and the infarct size was lower (25.8±8 vs. 38.1±10%, p=0.01) compared to vehicle. Similarly, allogeneic MSCs had a higher increase in body weight (40% vs.31%, p=0.04), fractional area shortening (42.9±3 vs. 29.4±4%, p=0.02), and the infarct size was lower (38.1±10% vs. 48.1±10%, p=0.01) compared to vehicle.

Conclusions: Systemic delivery MSC limits myocardial infarct size and is an attractive approach for tissue repair. MCE is useful to evaluate risk area and microvascular perfusion after stem cell transplantation.

315 Real-time myocardial perfusion study during pharmacological stress echocardiography

The recently developed non-invasive imaging methods are associated with their administration of myocardial contrast echocardiographic (MCE) agents to assess myocardial perfusion in real time (RT). Our purpose was to apply RT-MCE during Dobutamine stress echocardiographic (DSE) studies in a population of 28 cases of coronary artery disease, mean age 56±12 years, 61% (17/28) male gender. We used the classical DSE protocol with Dobutamine increase dose of 5 µg/kg/min every 3 min stage, till the maximal dose was achieved, followed by iv atropine. We established as diagnostic criteria of myocardial ischemia during DSE RT-MCE studies, the presence of new perfusion defects by RT-MCE and/or segmental wall motion abnormalities (SWMA) in at least 2 adjacent left ventricular (LV) myocardial wall segments. We performed 2D imaging acquisition with a multifrequency 3V2c probe and secondary harmonic 4.0 MHz, in basal, low dose, peak and recovery stages. In basal and peak stages, RT-MCE was done with ultrasound contrast agent SonoVue(O Sonosite/Bracco, Rovi SA, Italy), 1/2: ivial in iv bolus followed by the remaining dose during a 3 min iv infusion. RT-MCE imaging acquisition was done with 2D COI-Contrast software (Seqia C256, Siemens-Acuson, Germany), focus located at the mitral annulus level, mechanical index of 0.10-0.15, Doppler MBM destructive imaging technique, QRS triggering and synchronization, 0.75 ms time delay of imaging sequential acquisition, ROI including the entire LV myocardium. We used a 2D transthoracic echocardiographic approach with the parasternal short axis, apical 2-, 3- and 4-chambers views. All cardiac cycles with perfusion/destruction sequential imaging technique that gives additional information about the segmental coronary microcirculation dynamics during pharmacological induced myocardial ischemia, adding new diagnostic criteria in a significant percentage of cases submitted to this method.


Background: Ischemia Modified Albumin(IMA) measured by the Albumin Cobalt Binding test is a new quantitative biomarker which measures cobalt binding capacity of albumin modified as a result of myocardial ischemia. Previous studies have shown that IMA is a very sensitive marker of myocardial ischemia in the emergency setting and following percutaneous interventions. We investigated its dynamic changes in patients(pts) with induced ischemia during dobutamine stress echocardiography(DSE).

Methods: We studied 76 pts(mean age 60±10 years; 57 males). Thirty five pts(46%) had a known coronary artery disease,30(39%) a prior myocardial infarction and,40(53%) were on beta-blockers therapy. Forty-two pts(55%) underwent a coronary angiography. Among them,29(69%),had at least one significantly diseased vessel. Dobutamine was given up to 40 µg/kg/min: atropine up to 1 mg. A positive stress test was defined by the occurrence of at least one of the following: angina, ST segment depression ≥2 mm or a new wall motion abnormality. IMA was measured at baseline and immediately after DSE completion.

Results: Angina, ST segment depression and, or a new or worsening wall motion abnormality were observed in 14%, 14% and 16% of pts respectively; A positive stress test was observed in 29% of pts. Mean IMA value increased significantly from 99.5±14 to 109±17 U/mL (p<0.0001). By univariate analysis, ST segment depression was the only predictor of IMA increase (22±19 vs 9±14 for pts without ST segment changes p=0.009).

Conclusions: IMA is a sensitive marker for myocardial ischemia in the setting of DSE. However in this study, it could not predict epicardial stenosis as assessed by conventional wall motion analysis.

317 Echocardiographic markers of myocardial viability and reperfusion - Combined assessment of segmental lengthening/ shortening ratio and regional compliance by strain Doppler echocardiography
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Background: In acute myocardial ischaemia measurement of the ratio between systolic lengthening and total shortening (L/S ratio) by strain Doppler echocardiography (SDE) can differentiate between dyskinetic segments that are entirely passive and those that are partly active. Furthermore, in entirely passive segments regional compliance by SDE is a marker of necrosis. We investigated if combined assessment of L/S-ratio and compliance can be used to assess myocardial viability and reperfusion.

Methods: In 15 anaesthetized dogs we measured LV pressure and long axis strain by SDE. The LAD was occluded for 15 min (n=5) and 4 hrs (n=10), with 3 hrs reperfusion (n=5) or no reperfusion (n=5). Necrosis was identified by TTC-staining and oedema by water fraction. L/S-ratio and compliance (systolic lengthening divided by LV systolic pressure rise) were calculated by SDE.

Results: From 15 min to 4 hrs of LAD occlusion compliance and systolic lengthening decreased by 30% (p<0.05) and 40% (p<0.05). The L/S-ratio was unchanged during ischaemia (0.82±0.06 at 4 hrs, p<0.05), indicating passive segments. TTC staining showed necrosis and the water fraction increased (p<0.05). Reperfusion for 15 min caused further reductions in compliance and systolic lengthening by 35% and 40% (p<0.05), but no change in L/S-ratio. With 15 min reperfusion of viable myocardium L/S-ratio decreased from 0.84±0.03 to 0.56±0.07 (p<0.05). With no reperfusion compliance and L/S-ratio did not change.

Conclusions: These results suggest that combined assessment of L/S-ratio (step 1) and compliance (step 2) in acute coronary occlusion and reperfusion may be used to identify viable myocardium and may serve as reperfusion markers (Figure).
Vascular function assessment in patients with heart disease

2 December 2004, 16:30 to 18:00
Location: Room 2

ORAL SESSIONS

Vascular function assessment in patients with heart disease

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Background: Abnormalities in endothelium-dependent, flow-mediated dilation (FMD) may be assessed noninvasively in the brachial artery by high frequency ultrasound. The prognostic value of systemic endothelial dysfunction remains uncertain in coronary artery disease (CAD).

Aim: To establish the prognostic value of ultrasonically assessed systemic endothelial function in CAD patients.

Methods: 195 in-hospital patients (63 females; age 60±10 years) with known or suspected CAD were studied with FMD of brachial artery by noninvasive ultrasound. All patients underwent clinical and resting 2D-echocardiography evaluation (including assessment of ejection fraction and left ventricular mass index) and were followed-up for a mean of 23±13 months.

Results: In the follow-up, 49 patients had at least one event: there were 17 deaths (9 cardiac), 4 non-fatal myocardial infarctions, and 18 late clinically driven revascularization procedures. Left ventricular mass index, but not FMD, separated patients with or without events (figure). At multivariate analysis, echocardiographically assessed ejection fraction (odds ratio: 1.66; 95% confidence interval: 0.91-3.02; p=0.098), and angiographically assessed CAD (odds ratio: 2.57; 95% confidence interval: 1.29-5.28; p=0.010) were independent prognostic predictors.

Conclusion: In patients with known or suspected CAD, systemic endothelial dysfunction does not show a significant prognostic value. Echocardiographic indices of structural left ventricular damage have a stronger prognostic value than functional indices of peripheral vascular damage in risk stratifying ischemic patients.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>CTRL</th>
<th>HF-</th>
<th>HF+</th>
<th>ANOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVEDV (ml)</td>
<td>79±8</td>
<td>116±6</td>
<td>154±15*** &amp;</td>
<td>P=0.001</td>
</tr>
<tr>
<td>EF (%)</td>
<td>64±3</td>
<td>50±3*</td>
<td>41±3** &amp;</td>
<td>P&lt;0.001</td>
</tr>
<tr>
<td>MAP (mmHg)</td>
<td>106±9±4.8</td>
<td>95±9.3±0.2*</td>
<td>92±2.9**</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td>AIX (%)</td>
<td>112±2.24</td>
<td>119±2.6</td>
<td>119.5±2.9</td>
<td>P=0.17</td>
</tr>
<tr>
<td>PBF (mls)</td>
<td>0.60±0.02</td>
<td>0.66±0.01*</td>
<td>0.66±0.02*</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td>PWV (m/s)</td>
<td>12.6±2.1</td>
<td>10.1±0.8</td>
<td>13.1±1.3</td>
<td>P=0.22</td>
</tr>
<tr>
<td>DTTI (ms)</td>
<td>76±6</td>
<td>78±5</td>
<td>61±4* &amp;</td>
<td>P&lt;0.05</td>
</tr>
</tbody>
</table>

* ** *** P<0.05, P<0.01, P<0.001 resp. vs. CTRL; & P<0.05 vs. HF-.
Background: Cardiovascular disease is the most common cause of mortality in rheumatoid arthritis (RA) patients. Carotid intima-media wall thickness (IMT) increase and the presence of carotid plaques are indicators of generalized atherosclerosis.

Objective: To seek for the presence of subclinical atherosclerosis in long-term treated RA patients without clinically evident atherosclerosis or its complications and to assess whether demographic or clinical factors affect the development of atherosclerotic disease.

Methods: Forty-seven Caucasian patients fulfilling the 1987 American College of Rheumatology classification criteria for RA were recruited from our hospital. Patients were required to have been treated for at least 5 years, including current treatment with one or more disease-modifying antirheumatic drugs. Patients with diabetes mellitus, renal insufficiency, hypertension, cardiovascular or cerebrovascular disease and smokers were excluded. Forty-seven matched controls were also studied. Carotid IMT and carotid plaques were measured in the right common carotid artery.

Results: Patients had greater carotid IMT (0.779±0.164 mm) than did controls (0.699±0.129 mm; p<0.010). Sixteen (34%) patients showed carotid plaques compared with only 7 (15%) controls (p<0.031). There was a positive correlation between the age at the time of study and the carotid IMT (OR=6.8 IC 95% [1.77-26.11]; p=0.005). Also, RA patients with carotid plaques had a significantly longer disease duration (mean: 21.0 years) and more extra-articular manifestations (63%) than those without plaques (12.7 years and 26%, respectively). Patients with carotid plaques had significantly greater carotid IMT (0.859±0.116 mm) than those without plaques (0.739±0.171 mm) (p=0.014). Both age at the time of the study (OR=1.13 IC 95% [1.02-1.27]; p=0.024) and disease duration (OR=1.4 IC 95% [1.01-2.07]; p=0.05) were the best predictive factors for the development of severe morphological expression of atherosclerotic disease.

Conclusions: Long-term treated RA patients have severe subclinical atherosclerotic findings related to both age at the time of the study and disease duration.

472 Regional biophysical properties of the thoracic aorta and exercise capacity in dilated cardiomyopathy

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Background: Aortic (AO) stiffness modulates left ventricular (LV) function and it has been suggested that it also affects exercise tolerance in Heart Failure (HF) patients.

We studied the biophysical properties of the aorta, using a new echocardiographic method and their relationship with exercise capacity in patients with non-ischemic dilated cardiomyopathy (NIDC) and mild to moderate HF (NYHA II-III).

Methods: Thirty-four patients with angiographically proven NIDC, aged 54±11 years, in sinus rhythm, Left Ventricular Ejection Fraction (LVEF) 34.8±12.7%, and 40 normal underwent to an echocardiographic study. The AO annulus, proximal ascending AO diameter in systole (AOs) and diastole (AOD) was measured using M-Mode echo.

We also measured the AO length (L) from ascending to descending AO from the suprasternal view and the time (T) taken for the Doppler signal to travel the AOL distance was calculated. Pulse wave velocity (PWW) = AOLT/PSEM (pressure strain elastic modulus) = (Systolic/SBP)×Diastolic (DBP)/B1 (Blood pressure)/(AOs - AOD)/AO and beta index=ln(SBP/DBP)/(AOs - AOD)/AO were calculated. A cardiopulmonary exercise test were also performed to all patients and exercise duration, maximal Oxygen consumption (mVO2) and predicted for age and body mass index mVO2 were also measured.

Results: Patients showed increased AOs diameter (31.4±3.9 mm vs 28.5±2.8 mm; p=0.03), PWW (3.9±2.1 vs 0.35±1.5 m/sec; p=0.01), PSEM (657±321 vs 412±136 mmHg; p=0.001) and beta index (6.3±2.7 vs 4.4±1.2; p<0.001) compared to controls.

PWW measured with this new technique found to correlate with PSEM (r=0.47, p=0.001) and b-index (r=0.48, p=0.001). NIDC patients exhibited decreased maximal Oxygen consumption (mVO2)(23.3±3.9 vs 29.2±4.2 ml/kg/min; p=0.001), PR mVO2(87.1±16.6 vs 97.5±6.6; p=0.001) and exercise duration (1116±388 vs 1877±423 sec; p=0.001) compared to controls.

A significant correlation was found between predicted mVO2 and PSEM (r=-0.39, p=0.02), PWW(r=-0.32, p=0.04) and beta index (r=-0.48, p<0.001).

Conclusions: AO biophysical properties are affected rather early in the course of HF syndrome. Regional thoracic AO properties, testing by this new method, seems to have clinical importance in these pts.
Radial peak systolic S and SR were significantly lower in group 2 compared to group 1 only in RVFW (Table 1).

**Conclusions:** S and SR imaging demonstrate that radial deformation of the LVPW and longitudinal deformation of the RVFW is decreased during acute rejection and can also be useful in monitoring and diagnosing rejection of at least grade IB.

**Methods:** The study population consisted of 30 heart transplant patients who underwent a total of 90 biopsies. Standard echocardiography, together with Doppler myocardial imaging, were performed in all pts within 2-3 hours after endomyocardial biopsy.

For longitudinal deformation, S and SR data were acquired from the intra-ventricular septum, left ventricular (LV) free wall and right ventricular free wall (RVFW). For radial deformation from the LV posterior wall (LVPW). Data were analysed using a dedicated software package (SPEQLE).

**Results:** Radial peak systolic S and SR were significantly lower in group 2 compared to group 1. Longitudinal systolic S and SR were decreased in group 2 compared to group 1 only in RVFW (Table 1). The results of standard echocardiography with mitral and tricuspid annular Doppler motion velocity were not found to be significantly different between these groups.

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**Table 1**

<table>
<thead>
<tr>
<th>Strain Rate (s⁻¹)</th>
<th>Strain (%)</th>
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<tbody>
<tr>
<td><strong>Group 1 &lt; IB</strong></td>
<td><strong>Group 2 &gt; = IB</strong></td>
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<tr>
<td><strong>Group 1 &lt; IB</strong></td>
<td><strong>Group 2 &gt; = IB</strong></td>
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<tr>
<td>LVPW 4.0±1.1</td>
<td>2.8±0.9*</td>
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<tr>
<td>LV free wall</td>
<td>2.2±1.0</td>
</tr>
<tr>
<td>Septum 1.7±0.8</td>
<td>1.7±0.6</td>
</tr>
<tr>
<td>LV free wall</td>
<td>2.4±1.1</td>
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<tr>
<td><strong>p &lt; 0.001 vs ISHLT &lt; IB; * p &lt; 0.05 vs ISHLT &lt; IB; mean values ±SD.</strong></td>
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</table>

**Statins but not ACE-inhibitors slow aortic stenosis progression**

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**Background:** So far, there is no accepted medical treatment to affect development or progression of calcific aortic stenosis (AS). Recently, hydroxymethylglutaryl coenzyme A reductase inhibitors (statins) as well as angiotensin-converting enzyme inhibitors (ACEI) have been shown to slow aortic valve calcium accumulation. While several studies also suggest that statins may reduce the hemodynamic progression of AS, no data are available for ACEI or the combination of both drugs. Therefore, the aim of the present study was to assess the effects of ACEI, statins and their combination on the hemodynamic progression of AS.

**Methods:** 211 pts (70±10 years, 104 female) with native AS, normal left ventricular function and no other significant valvular lesion who were examined between 2000 and 2002 and who had two echocardiograms separated by at least 6 months were included. 102 pts received treatment with an ACEI, 50 pts received statin therapy and 32 pts received both. Effect of medical treatment on hemodynamic progression was assessed.

**Results:** Annualized increase in peak aortic jet velocity for the entire study group was 0.32±0.44 m/s/yr. Hemodynamic progression was significantly reduced in patients treated with statins (0.10±0.41 m/s/yr) compared with those who were not (0.39±0.42 m/s/yr; p < 0.0001) but was not significantly affected by ACEI. Velocities increased by 0.29±0.44 m/s/yr and by 0.35±0.44 m/s/yr in pts with and without ACEI treatment, respectively (p < 0.29). Furthermore, ACEI did not have an additional effect on AS progression when given in combination with a statin (0.11±0.42 vs. 0.08±0.43 m/s/yr for statin + ACEI vs. statin only; p < 0.81). Statin treated pts were older and had more frequently CAD than those without this treatment while pts with and without ACEI therapy did not differ in this regard. Cholesterol levels did not correlate with hemodynamic progression, neither in the group receiving statins nor in the group who did not.

**Conclusion:** Despite their previously shown effect on aortic valve calcium accumulation, ACE-inhibitors do not appear to slow AS progression. However, statins significantly reduce the hemodynamic progression of both, mild to moderate and severe AS, an effect that may be unrelated to cholesterol lowering.
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Should QRS duration be used as a marker for left ventricular mechanical dyssynchrony? An assessment by real-time 3D echocardiography

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Background: Left ventricular mechanical dyssynchrony (LVMD) has emerged as a therapeutic target in cardiac resynchronisation therapy for chronic heart failure, highlighting its importance. QRS duration is widely used to identify VMD, even though it has been shown to be a poor surrogate marker. We investigated the prevalence of LVMD using Real-Time 3D Echo (RT3DE), which provides a novel assessment of segmental coordination.

Methods: 78 normal subjects and 178 patients with cardiovascular disease and normal LV function or various degrees LV dysfunction underwent 2D and RT3D echocardiography. In RT3DE, volumetric analysis was performed to created time-volume curves for regional volumes, and we created a Systolic Dyssynchrony Index (SDI) based on the dispersion of times to minimum volume for each of the standard 16 segments, expressed as percent of cardiac cycle duration.

Results: In subjects with normal LV systolic function, segmental contract was highly synchronised (SDI 3.5 ±1.6), SDI was 5.4 ±3.5, 10 ±8.7 and 14.7± 6.7 for mild, moderate and severe LV dysfunction respectively. A very good inverse logical correlation was found between LVF and SDI (R²=0.78, p<0.0001). This correlation with LVF persisted regardless of QRS duration (R²=0.75 and 0.78 for QRS duration of <120 or > 120 ms respectively). QRS duration of > 120 ms could identify only 50% of patients with SDI >3SD above the range for normal subjects.

Conclusions: Reduced systolic function is associated with increasing prevalence of LVMD on RT3DE, irrespective of QRS duration, which is a poor surrogate marker for intraventricular dyssynchrony. This may be a valuable assessment of LV function, particularly in patients considered for CRT.

Figures 1 and 2

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The wall thickness as a marker of artery status after the reperfusion therapy acute myocardial infarction.

An experimental study

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Reperfusion (REP) of acutely infarcted myocardium (AMI) induces an immediate increase in diastolic wall thickness (DT). Little is known either about the mechanisms causing that increase or its relation to the luminal diameter of the artery prior to AMI.

Study aim: to determine changes in DT during AMI and REP in respect to the status of the infarct related artery.

Methods: In group I (n =9 pigs), copper-coated stents were implanted into the circumflex artery (LCx) to produce a stenosis (range 30-95%) within 4 weeks by intima hyperplasia. Subsequently, an AMI was established during a 90 min occlusion (OC) of the LCx proximal to the stenosis by inflation of an angioplasty balloon. After REP (with TIMI II-III flow), the animals were followed for 90 min. In group II (n=9 pigs), without stenosis, the same OC-REP protocol was performed. M-mode data of the at-risk segment (PowerVision6000, Toshiba) were acquired in a short axis view. Changes of the posterior DT were assessed relative to their baseline (BL) values (prior to the 90 min OCC). For each group, using a statistical model, temporal changes were tested using an approximate F-test.

Results: (Figure 1) After 90 min of OCC no significant change in DT was observed in either group. In group II, the DT increased (p<0.05) during REP and reached 202±15% of BL DT at 90 min, confirming previous results. In group I, there was a trend towards an increase in DT (140±20% of BL DT at 90 min), which was not significant. At each time of REP there was a difference between group I and II (Mann-Whitney U-test, p<0.05).

Conclusions: Sudden changes in DT during REP are related to luminal diameter within residual stenosis of infarct related artery and this could be due to the reduction in perfusion pressure.
525 Long term cardiac resynchronisation therapy in refractory heart failure: relation of LV diastolic function to the outcome
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Background: Restrictive left ventricular (LV) diastolic pattern had negative prognostic value in heart failure (HF). Cardiac resynchronisation therapy (CRT) showed to improve cardiac function in refractory HF. However, the effect of CRT on the behaviour and on the prognostic value of LV diastolic pattern is not known.
Methods: We studied pts with ischaemic or idiopathic cardiomyopathy underwent CRT for refractory HF, NYHA class III or IV, despite optimal drug treatment, severe LV ejection fraction reduction, QRS duration >150 ms and echocardiographic interventricular mechanical delay (inter-d) >40 ms. We performed Doppler echocardiography before CRT and after 1,3,6,12 and 24 months to evaluate LV diastolic function; restrictive diastolic pattern was defined by E-deceleration time (E-dt) >140 ms, IVRT >55 ms, ratio of E and A-wave (E/A) on transmitralic flow >1.7 and ratio of the systolic and diastolic component of pulmonary venous flow (S/D) <0.5.
Results: Diastolic function parameters were evaluable in 20 patients (pts, mean age 69 ± 4 years). At baseline, 14 pts had restrictive pattern; out of them, 10 pts (71%) had regression of this pattern within one month and were alive after 24 months. The degree of diastolic dysfunction before CRT in pts with persistent restrictive pattern was significantly worse than in pts with LV diastolic function improvement (E-dt 110 ± 30 vs 123 ± 18 ms, IVRT 45 ± 10 vs 48 ± 8 ms, E/A 2.4 ± 0.6 vs 1.9 ± 0.8, S/D 0.4 ± 0.2 vs 0.4 ± 0.3, p < 0.05). All 4 pts showing persistent restriction died during follow up.
Conclusions: In this selected population with refractory HF, the mechanical resynchronisation by biventricular pacing resulted in early regression of LV restrictive diastolic pattern in the majority of patients. Persistent restrictive diastolic pattern despite CRT was associated with worse baseline diastolic parameters and the worst outcome. Therefore, the behaviour of LV diastolic pattern during CRT showed better prognostic performance than basal diastolic pattern di per sé.

526 Exercise echocardiography: new investigation to select patients for cardiac resynchronization.
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Introduction: Selection of heart failure (HF) patients for resynchronization depends on EKG or echocardiographic rest criteria. However, clinical inclusion parameters are mostly based on functional exercise signs. Biventricular pacing yields in 30% of non-responder patients. We hypothesized that left ventricular (LV) dysynchrony could differ from rest to exercise yielding in clinical consequences in terms of resynchronization efficiency.
Method: 50 HF patients (EF<35%) and 30 controls were studied by echocardiography at rest and during exercise. Conventional parameters, Tissue Doppler and Strain electro-systolic delay (ESD) were measured before and during symptom-limited exercise. Data were expressed as ESD delay indexed to RR delay.
Results: At rest, 58% patients presented LV dyssynchrony based on ESD parameter (0.067 ± 0.016 vs 0.019 ± 0.013 in control, p<0.01). 17% of these patients were characterized by an ESD ‘normalization’ from rest to exercise (0.080 ± 0.009 to 0.034 ± 0.008, p<0.01). 14% patients without LV dysynchrony at rest exhibited a significant increase of ESD from rest to exercise (0.039 ± 0.012 to 0.086 ± 0.026, p<0.01). Exercise variations of LV dyssynchrony were highly correlated with those of cardiac output and mitral regurgitation (r=0.66 and 0.62, respectively). Finally, in our population, exercise echo identified 31% of misclassified patients between rest and exercise.
Conclusion: Exercise in heart failure patients modifies significantly LV dysynchrony degree. These variations of dysynchrony were demonstrated to be highly correlated with LV function parameters. This new concept is of high consequence for patients selection.
Echocardiography evaluation of asynchrony in patients with heart failure: which is the better criteria for asynchrony definition?

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Biventricular pacing is an adjunctive therapy for patients with chronic heart failure (HF) and left bundle branch block. However, up to 20% of patients don’t respond to this therapy. Several echocardiographic criteria have been proposed as a good tool to better identify asynchrony. But it is unknown if it is mandatory to perform all of them or only some. Our aim was to assess whether left ventricular asynchrony was present in patients with HF comparing conventional Doppler echocardiography (CD) and TDI asynchrony analysis, and relate this data to QRS complex duration.

Patients and methods: Thirty consecutive patients with HF, left ventricular dysfunction (ejection fraction <40%) and sinus rhythm scheduled for routine examination were included in the study. According to QRS width patients were divided in 2 groups: group A, QRS > or equal to 130 ms (n=14), and group B, QRS<130 ms (n=16). CD asynchrony was assumed if aortic pro-ejective period was >140 ms and/or delayed activation of posterolateral left ventricular wall was present. TDI asynchrony was analysed by 2 different criteria: septal to lateral (S-L) delay >60 ms or a maximal difference in the time to peak myocardial sustained velocity between any two of the LV segments (Max Ts) >100 ms.

Results: No differences between groups were found in baseline characteristics and heart rate. Ejection fraction was 27%±8. Table shows asynchrony incidence by different criteria. By CD, up to 14% of patients in group A didn’t present asynchrony. By TDI the asynchrony incidence in group B was greater than with CD criteria (group B: 44% by S-L delay, and 50% by Max Ts>100 ms). There was no correlation between asynchrony measured by CD and TDI.

Conclusions: 1) Asynchrony incidence in patients with wide QRS is lower by TDI than by CD and in patients with narrow QRS is greater by TDI than by CD. 2) No correlation has been found between CD and TDI asynchrony analysis. 3) Well-defined echocardiography criteria for asynchrony are necessary to better guide the patient selection for biventricular pacing.

Global and regional parameters of dyssynchrony in ischemic and non-ischemic cardiomyopathy

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Background: Left ventricular mechanical dyssynchrony (LVMD) has prognostic value for patients undergoing biventricular pacing. Real-time 3D echo (RT3DE) can provide qualitative and quantitative assessment of LVMD. We compared how this assessment correlates to 2D and tissue Doppler (TD) quantification of LVMD.

Methods: 50 patients (58±11.5 years) underwent 2D, TD Imaging and RT3DE echo. On 2D, LVMD was quantified with the septal-to-posterior wall motion delay (SPWMD), in colour TD, curved M-Modes were reconstructed offline for the 12 non-apical segments (Fig 1, left panel). Dyssynchrony indices were calculated as the standard deviation (SD) of times to peak isometric contraction (TIC), peak systolic velocity, minimum strain and early and late diastolic velocities. In RT3DE, a full volume acquisition of the LV was analysed offline to create global and segmental time-volume curves (Fig 1, right panel). A systolic dyssynchrony index (SDI) was created based on dispersion of times to minimum volume for each segment.

Results: The best correlation with SDI was observed for the SD of times to minimum strain (R=0.46). A less significant correlation was found for SD of times to isometric contraction and peak systolic velocity (R=0.33 and 0.26 respectively). There was only a weak correlation between SDI and times to peak diastolic velocities (R=0.17 and 0.33 for early and late velocities). There was a moderate correlation with SPWMD (R=0.40, p<0.001).

Conclusions: RT3DE provides an intuitive analysis which compares all cardiac segments directly, and appears to be a robust method for quantification of LVMD, which correlates best to the dispersion in times to peak longitudinal shortening in tissue Doppler. A correlation of similar strength was seen on 2D echo with SPWMD.
530 Assessment of left ventricular asynchrony using volume-time curves of 16 segments: comparison with Tissue Doppler imaging


Purpose: To evaluate left ventricular (LV) asynchrony with volume-time curves (VTC) of 16 segments using real-time three dimensional echocardiography (RT3DE) and to compare with Tissue Doppler imaging (TDI).

Methods: Ten patients with LV dysfunction (ejection fraction: EF: 27 ± 8%, mean age: 62 ± 14 years) and 10 normal controls (EF: 62 ± 4%, mean age: 40 ± 11 years) underwent RT3DE. In each subject, VTC of 16 segments were generated with 3D computer software (4D LV analysis, TomTec). The time that LV volume reached to end systolic volume on VTC was defined as end systolic time. LV asynchrony was determined by standard deviation of end systolic time of 16 segments. TDI analysis for measurement of electromechanical coupling time of LV was performed in 8 segments (base and mid LV walls). LV asynchrony with TDI was determined by maximal difference between the longest and the shortest electromechanical coupling time.

Results: There was no significant difference of QRS duration between patients with LV dysfunction and control (84.0 ± 21.7 ms vs 79.0 ± 21.3 ms, p = 0.61). Standard deviation of end systolic time was significantly larger in patients with LV dysfunction than in controls (57.1 ± 18.0 ms vs 11.3 ± 5.5 ms, p < 0.01). Maximal difference of electromechanical coupling time was also significantly larger than controls (70.5 ± 27.1 ms vs 52.0 ± 14.0 ms, p < 0.01) and showed negative correlation with LVEF (r = −0.689, p < 0.01). Standard deviation of end systolic time was well correlated with maximal difference of electromechanical coupling time (r = −0.692, p < 0.001) and also revealed significant negative correlation with LVEF (r = −0.852, p < 0.01).

Conclusions: We suggest that standard deviation of end systolic time of 16 segments from VTC using RT3DE may be a useful parameter to evaluate LV asynchrony.

531 Functional capacity evaluation of echo-guided “AV optimized” patients with double-chamber pacemakers using exercise echocardiography


Introduction: AV optimization is not a “common” practice in patients with DDD pacemaker. Presently in our centre we are doing individual AV optimization guided by Doppler echocardiography.

Objective: We aimed to detect any difference in functional capacity of DDD “AV optimized” pacemaker patients using the treadmill exercise echocardiography.

Methods: We studied 10 patients (6 men) with DDD pacemakers, mean age 55 ± 14.7 years with normal left ventricular systolic function. All presented 100% ventricular pacing with atrial synchrony in resting and during the exercise with modified Bruce treadmill protocol. Having all patients with nominal pacemaker settings we evaluated exercise capacity and maximal oxygen consumption at rest, first stage, second stage and post exercise.

We then optimized the AV interval guided by Doppler echocardiography (changed the AV interval every 10 ms to get the longest diastole duration without truncate de transmural A wave) and repeated all the evaluation 15 days later. T student test was used for statistical analysis.

Results: In all patients was possible to get good quality registers. Exercise test duration was 428.5 ± 230.7 and 556.3 ± 257.6 pre e post AV optimization respectively with p = 0.008; there was no statistical difference in heart rate at rest and peak exercise, before and after AV optimization.

Conclusions: 1. Individual AV optimization guided by Doppler echocardiography allows substantial increase in functional capacity; 2. This improvement is the result of increase systolic volume and consequently cardiac output increment during the exercise.

532 Tissue Doppler assessment of left ventricular asynchrony in patients with LBBB and without severe systolic dysfunction

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Aim of the study was to evaluate determinants of myocardial systolic activation delay of both left (LV) and right (RV) ventricle in patients with left bundle branch block (LBBB) with and without severe systolic dysfunction.

Population and methods: 71 patients (pts) with complete LBBB were divided in two groups according to the different level of ejection fraction (EF): (group A; 53 pts 66.2 ± 6.8 years 18M/15F) with moderately reduced EF (between 30% and <40%), and (group B; 38 pts 63 ± 11.2 years 22 M/16 F) with normal or mildly reduced EF (>40%). All pts underwent standard Doppler echo and pulse Tissue Doppler Imaging (TDI). The following regional parameters were evaluated in 5 different basal myocardial segments (LV anterior, inferior, septal, lateral walls - RV lateral wall); systolic (Sm), early- and late-diastolic (Em and Am) peak velocities. Pre-contraction time (PCTm; from the beginning of Q wave of ECG to the onset of Sm) was calculated as index of myocardial systolic activation. Intraventricular systolic synchronization was analysed by the difference of PCTm in different LV myocardial segments. Interventricular activation delay (Inter-del) was calculated by difference of PCTm between the most delayed LV segment and RV lateral wall.

Results: The two groups were comparable for age and sex. Pts of group A showed increased heart rate (83.4 ± 10.9 vs 70.2 ± 12.2, p < 0.01), LV end-diastolic diameter (89.8 ± 9 vs 55.6 ± 6.4 mm; p < 0.001), and prolonged QRS duration (164.2 ± 18 ms 146.1 ± 13 , p < 0.01) compared to group B. Group A showed reduced myocardial both systolic and diastolic peak velocities and a significant intraventricular delay (44.6 ± 22 vs 23.3 ± 4, p < 0.01) in activation of LV inter wall, with increased PCTm (182.76 ± 88 vs 106.4 ± 0.01). Increased Inter-del was documented in pts of group A (82.7 ± 35.8 vs 48.2 ± 32.8, p < 0.001). In the overall population, Inter-del was inversely related to EF (r = −0.485, p < 0.01) and to the standard deviation of end diastolic diameter (r = −0.487, p < 0.01). Standard deviation of end diastolic time was well correlated with maximal difference of electromechanical coupling time (r = −0.692, p < 0.001) and also revealed significant negative correlation with LVEF (r = −0.852, p < 0.01).

Conclusions: The impairment of interventricular systolic synchrony is related to LV dilatation and systolic dysfunction even in the absence of severely reduced EF. Our data could influence criteria for selecting patients suitable for cardiac resynchronization therapy.
534 Myocardial systolic activation delay in patients with right ventricular dual-chamber pacing and either normal or impaired left ventricular function

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Aim of the study: to evaluate determinants of myocardial activation delay of both left (LV) and right (RV) ventricle in patients with right ventricular dual-chamber pacing (RVP) and either normal or impaired LV ejection fraction (EF).

Methods: 22 patients with RVP and idiopathic dilated cardiomyopathy (group A) and 25 patients with normal LV global systolic function (sick-sinus syndrome or atrio-ventricular block) (group B), underwent standard Doppler echo, pulsed Tissue Doppler and coronary angiography. By use of TDI, the following regional parameters were evaluated in 5 different basal myocardial segments (LV anterior, inferior, septal, lateral walls - RV lateral wall): systolic (Sm), early- and late-diastolic (Em and Am) peak velocities. As index of myocardial systolic activation was calculated: precordial Q-Sm and Am peak velocities and a significant delay in activation of LV lateral wall, with intraventricular systolic dyssynchrony was analyzed by difference of Q-Sm in different LV myocardial segments. Interventricular activation delay was calculated by difference of Q-Sm between RV lateral wall and the most delayed LV segment.

Results: patients of group A showed increased QRS duration and LV end-diastolic diameter, and reduced LV EF (31.3 ± 4.8% vs 58.9 ± 4.6%; p < 0.001). BMI, patients of group A showed reduced myocardial peak velocities and a significant delay in activation of LV lateral wall, with increased regional intraventricular delay (p < 0.001). In addition, patients with diametrical anatomy showed a more pronounced interventricular dys-synchrony (p < 0.001). By ROC curve analysis, a cut-off value of 55 ms of intraventricular delay showed 86% sensitivity and 90% specificity in identifying patients with impaired EF. No correlation was evidenced between the QRS width and the interventricular electromechanical delay (r = 0.26, NS) or the intra-LV electromechanical delay. In the overall population, by multivariate analyses, LV end-diastolic diameter (beta = 0.52; p < 0.001) and LV EF (beta = -0.58; p < 0.0001) were the only independent determinants of interventricular activation delay.

Conclusions: The QRS width is not a reliable tool to identify RVP patients with ventricular mechanical asynchrony. Pulsed DMI is an effective non-invasive technique for assessing the severity of regional delay in activation of LV walls in patients with RVP. The impairment of interventricular systolic synchrony is strongly related to LV dilatation and to the degree of global systolic dysfunction, and may therefore select patients RVP patients who would respond to biventricular pacing.

536 Echocardiographic contractile recovery and left ventricular remodeling after primary angioplasty: role of myocardial blush

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Background: Despite the prompt recanalization of the infarct related artery in patients (pts) with acute myocardial infarction (AMI), an adequate reperfusion at the tissue level may not occur, thus conditioning pts prognosis. Sinus syndrome or atrio-ventricular block (group B), underwent standard dual-chamber pacing (RVP) and either normal or impaired LV ejection fraction (LV EF).

Methods: The QRS width is not a reliable tool to identify RVP patients with ventricular mechanical asynchrony. Pulsed DMI is an effective non-invasive technique for assessing the severity of regional delay in activation of LV walls in patients with RVP. The impairment of interventricular systolic synchrony is strongly related to LV dilatation and to the degree of global systolic dysfunction, and may therefore select patients RVP patients who would respond to biventricular pacing.

Results: After primary PCI, analysis of MB can provide a better definition of successful reperfusion, and seems to be a strong predictor of left ventricular remodeling.

Conclusions: After primary PCI, analysis of MB can provide a better definition of successful reperfusion, and seems to be a strong predictor of left ventricular remodeling.

537 Left-ventricular longitudinal function in patients with heart failure and preserved ejection fraction

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The presence of symptoms and signs of heart failure, abnormal diastolic function and preserved ejection fraction have been defined as diastolic heart failure. The systolic velocities measured at the mitral annulus by pulsed tissue Doppler imaging (TDI) and the displacement of the mitral annulus by M mode are likely to be indexes of global longitudinal function of the left ventricle. The aim of this study was to evaluate the longitudinal subendocardial systolic function in patients with heart failure and normal ejection fraction. We studied 42 patients with heart failure who had normal ejection fraction calculated from B-mode images according to Simpson’s rule and with A/E ratio <1 calculated from transmirtal Doppler flow. Systolic (s) and diastolic velocities (e,a) were measured by TDI at the level of the septal and lateral mitral annulus. Displacement of the mitral annulus was measured from apical view by M mode. The results were compared with a control group of 22 age-matched voluntary healthy persons.

Results: Patients with heart failure and preserved ejection fraction, who seem to have pure diastolic dysfunction might have also systolic subendocardial dysfunction, as assessed in longitudinal axis, by measuring mitral annulus velocities with pulsed TDI. These findings suggest that pure diastolic dysfunction is probably rare and that some systolic dysfunction is present in patients with heart failure and normal ejection fraction.

Results: Control (22) 64% 1.16 11.4 8.5 1.2 8.7 1.3 mm
Heart failure (42) 66% 0.76 7.6 11.9 0.63 6.2 9.1 mm

Results: Control (22) 64% 1.16 11.4 8.5 1.2 8.7 1.3 mm
Heart failure (42) 66% 0.76 7.6 11.9 0.63 6.2 9.1 mm
New parameters for left ventricular function in atrial fibrillation: based on the relationship between intervals and performance

C.J. Kim, H.S. Ko, W.S. Ryu. Chung-Ang Univ Hosp, Seoul, Korea, Republic of

**Purpose:** In atrial fibrillation (AF), it is difficult to measure left ventricular (LV) function quantitatively due to irregular RR intervals. However, those give the opportunity to apply theoretical hemodynamic and mechanical mechanisms clinically. This study was designed to obtain new parameters representing LV function independent of RR intervals.

**Methods:** AF patients were divided into two groups according to LV function estimated visually: Normal (n=9) and LV dysfunction (n=9) groups. LV outflow peak ejection velocity (Vpe) was measured by Doppler echocardiography. The relationships between Vpe and preceding (RR-1) or preceeding RR intervals (RR-2) were obtained using logarithmic equations, from which squared correlation coefficient (r²), slope, Vpe at RR-1 or RR-2-1 second (Vpe-1), and the ratio of slope to Vpe-1 (Slope/Vpe-1) were calculated.

**Results:** Among parameters between RR-1 and Vpe, Slope/Vpe-1 was higher in LV dysfunction group than in Control group (p<0.004). When only coordinates with RR-1 from 0.6 to 1 second were included, slope (p=0.011) and Slope/Vpe-1 (p=0.000) were higher in LV dysfunction group than in Control group. Among parameters between RR-2 and Vpe, Slope/Vpe-1 (p=0.000), slope (p=0.002), and r² (p=0.008) were different between two groups. In multiple logistic regression analysis, Slope/Vpe-1 between RR-2 and Vpe was only independent parameter. However, Slope/Vpe-1 between RR-1 and Vpe in the coordinates with RR-1 from 0.6 to 1 second had the most potent discriminating power. Positive and negative predictive values were 100% and 89% respectively (figure).

**Conclusion:** new parameters based on the relationship between intervals and LV performance might be useful to evaluate LV function quantitatively in AF.

540 Epicardial left ventricular volumes - A new method for simultaneous 2-D echocardiographic estimation of LV ejection fraction and muscle mass

H. Awadalla. Ain Shams University Medical School, Cairo, Egypt

**Objective:** To establish a much easier way of measuring the ejection fraction that will try to overcome some of the main drawbacks of estimation of left ventricular ejection fraction by 2D echocardiography.

**Patients and methods:** Two hundred and three patients with suspected cardiac disease were enrolled in the study. These patients underwent echocardiography. Assessment of the LV systolic function through estimation of the ejection fraction by delineation of both the end-diastolic epicardial/endocardial borders and the end-systolic epicardial/endocardial borders in the apical four or two chamber views was done by a separate operator. This was achieved using offline analysis from the same worksation for all the cases enrolled in the study.

The volumes obtained were used to assess the left ventricular ejection fraction through using the equations included in Table 1.

**Results:** The mean and standard deviation for LV mass measured by 2-D was 100.723±39.643 in diastole and 91.955±39.416 in systole. The mean and the standard deviation for estimation of the EF by the standard 2-D method and the new method utilizing the epicardial volumes and EDV were 51.30 ±10.47 and 50.74 ±10.45 respectively. Excellent correlation was found between the two methods with an r value of 0.901 and P value of <0.001 which is considered to be very highly significant. The mean and the standard deviation for estimation of the EF by the standard 2-D method and the new method utilizing the epicardial volumes and ESV were 51.30 ±10.47 and 50.74 ±10.45 respectively. Excellent correlation was found between the two methods with an r value of 0.876 and P value of <0.001 which is considered to be also very highly significant.

**Conclusions:** Ejection fraction estimation through the use of the epicardial volumes and one endocardial volume (either the EDV or ESV) is as valid as the classic method of estimating the EF through endocardial volumes and represent an alternative method for assessing the EF when either endocardial border during diastole or systole is difficult to trace.

<table>
<thead>
<tr>
<th>Table 1</th>
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<tbody>
<tr>
<td><strong>Ejection Fraction</strong></td>
</tr>
<tr>
<td>Ep EDV</td>
</tr>
<tr>
<td>Ep EDV</td>
</tr>
<tr>
<td>Where Ep EDV = epicardial end-diastolic volume, Ep ESV = epicardial end-systolic volume, En EDV = endo-cardial end-systolic volume.</td>
</tr>
</tbody>
</table>

541 The mitral flow propagation velocity - Not an independent parameter of the left ventricular diastolic function

T. Baron, T. Godzicki. Jagiellonian University, Krakow, Poland

**Background:** In the echocardiographic assessment of left ventricular diastolic function the older indices like E/A ratio are strongly dependent on heart rate. It has been suggested that mitral flow propagation velocity, a novel parameter employed in the assessment of diastolic function might be independent of factors such as heart rate and left ventricular preload.

**Objective:** The aim of the study was to establish the factors influencing the mitral flow propagation velocity in treated hypertensive patients.

**Methods:** The study was conducted in 139 patients with treated hypertension and preserved LV systolic function (EF>45%) without history of MI. In all subjects an echocardiography, conventional blood pressure and antropometric measurements were performed. Diastolic function was described as Doppler flow peak velocities of mitral E-wave (E), mitral A-wave (A), mitral flow propagation velocity (Vp) and pulmonary venous flow parameters (PS, PD, PA, PAdur).

**Results:** The average age of 57 men and 82 women was 62.5±11.9 years. The on-treatment blood pressure averaged 144.6±20.8/88.1±12.9 mmHg, heart rate 64.5±8.6 bpm, the mitral flow propagation velocity (Vp) averaged 47.4±12.5 mm/sec.

In the correlation analysis, Vp was related to age (r=0.27, p=0.001) but not to heart rate. In multiple regression model, Vp was independently influenced by both age (beta=0.30, p=0.008) and heart rate (beta=0.27, p=0.04) but not with other possible confounders (duration of hypertension, SBP, DBP, LVM). The analysis in age groups (below or at and above 62 years -- the group median age) demonstrated that Vp was independent of heart rate in younger but not older hypertensive (beta=0.43, p=0.04).

**Conclusion:** The notion that mitral flow propagation velocity (Vp) is heart rate independent seems to hold true for younger but not older hypertensive individuals.

542 Estimation of end-diastolic pressure with isovolumetric relaxation index in patients with diastolic dysfucntion

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**Objective:** Isovolumetric relaxation time (IVRT) measured with continuous wave Doppler imaging depends on the rate of active relaxation and end-diastolic pressure. It is suggested that left ventricular diastolic dysfunction begins with the deterioration of active relaxation which results in prolongation of IVRT. However, an increase in left ventricular stiffness entails shortening of IVRT due to end-diastolic pressure elevation. This is not the case when IVRT is measured with pulsed-wave Doppler tissue imaging.

Then, IVRT prolongs with the progression of diastolic dysfunction independent of end-diastolic pressure. The aim of this study was to investigate the correlation between end-diastolic pressure and IVRT index which is the ratio of IVRT measured with pulsed-wave Doppler tissue imaging to IVRT measured with continuous wave Doppler imaging.

**Methods:** A total of 26 male subjects with diastolic dysfunction (aged 56 years ±9.2) were enrolled in the study. End-diastolic pressure was obtained invasively during routine cardiac catheterization before contrast application. IVRT was measured with continuous wave Doppler imaging from aortic valve closure click to the onset of mitral inflow and with pulsed-wave Doppler tissue imaging from the end of S wave to the beginning of E wave. Statistical analysis of correlation between end-diastolic pressure and IVRT index was performed.

**Results:** In patients with diastolic dysfunction correlation between IVRT index and end-diastolic pressure (mean 17.84 ±7.22) was statistically significant (r=0.7, p=0.001).

**Conclusions:** These preliminary data suggests that IVRT index is a good predictor of end-diastolic pressure in patients with diastolic dysfunction.
543 Comparison of myocardial performance index and flow velocity propagation in the left ventricular function estimation
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Department of Cardiology, Szczecin, Poland

Both systolic and diastolic left ventricular (LV) function are clinically important. Myocardial performance index (MPI) – Tissue Doppler imaging (TDI) is known as a good method of LV global function estimation. There are some data suggesting, that flow velocity propagation (Prop) depends on diastolic and systolic LV function as well.

The aim of our study was a comparison of MPI and Prop in patients with different types of LV dysfunction in the course of coronary artery disease. The total cohort of 111 patients (30 F, 81 M) aged 32-80 years (mean 57.6±9.2) was divided into 4 subgroups: 25 control subjects with normal systolic and diastolic LV function (C), 29 patients with an impaired relaxation (Rel), 32 pts with pseudonormal inflow pattern (PN) and 25 pts with restrictive pattern (Res), Pts with significant arrhythmias and valvular dysfunction were excluded. The mean age was similar in all subgroups.

In all studied subjects MPI (PW Doppler), Prop (M-mode colour Doppler), LV ejection fraction, E and A waves velocity, E/A ratio and Prop/ratio and correlations between these parameters were measured. MPI was lower in C (0.55±0.13) than in Rel (0.66±0.19, p<0.05) and PN (0.6±0.13, p<0.02) but not in Res (0.59±0.17). Prop was significantly higher in C than in other groups; there was no differences in Prop between Rel, PN and Res. High correlations between EF and Prop were found in the entire study group. Similar correlations were noted in subgroups. Significiant correlations between MPI and Prop were found in Res (r=-0.40) in the entire study group and in Rel (r=-0.53) were found as well between MPI and EF in Res (r=-0.54). E/A slightly correlated with Prop, E/Prop and MPI only in the simple subgroups.

Conclusion: Among studied parameters E/Prop ratio was the best indicator of global (systolic and diastolic) LV dysfunction. Prop and MPI did not determine the degree of LV diastolic dysfunction in patients with low EF.

544 The evolution of global ventricular function using the myocardial performance index during heart failure induced by myocardial infarction in rodents

Introduction: The Myocardial Performance Index (MPI) reflects combined systolic and diastolic left ventricular (LV) function and comprises of the sum of isovolumic contraction (ICT) and relaxation time (IRT) divided by ejection time (ET) (Tei C. J. Cardiovasc 1995:26:129). Long term follow-up of global LV function using MPI and trans-thoracic echocardiography (TTE) has not been reported in rodents with myocardial infarction (MI).

Methods: Sprague-Dawley rats (n=9) underwent LAD coronary artery ligation (MI group). A control group (CG) (n=10) was performed without the MI. TTE was performed every 2 weeks over an 8 week period. Parameters measured were: ICT, IRT, ET, ejection fraction (EF), relative wall thickness (RWT), LV fractional shortening (LVFS), LV mass. Velocity of circumferential fibre shortening (vch), heart rate (HR) and cardiac output (CO). Comparing the two groups was performed to determine statistical significance with "p"<0.05 and "p"<0.001.

Results: ICT was compromised at week 2 (*), 4 (*), 6 (*) and 8 (**). ET remained stable for the 2 groups. IRT was not different between groups but did rise compared to baseline in MI (*). Therefore, the MPI increased in the MI group (Figure). The EF was comparable at baseline (73.3±6.3% vs 68.9±8.1% respectively) but reduced significantly at week 2 until week 8 (all **). The same applied for RWT with a baseline of 1.87±0.2 mm (Co) vs 1.78±0.15 mm (MI) and reduction at week 2 until week 8 (all **). LVFS attenuated from week 2 until week 8 (all **). CO and vch were compromised in the MI group (all **).

Conclusion: The MPI is more representative of cardiac dysfunction compared to CO, HR and RWT. TTE assessed and tracked MPI may be a useful, representative and reproducible index of systolic and diastolic ventricular function.

545 Carotid pulse wave intensity can define augmented left ventricular loading
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The development and progression of left ventricular (LV) dysfunction in patients with hypertension is related to augmented central aortic afterload associated with increased wave reflections from ageing conduit arteries. There are no established non-invasive tools for studying this interaction. Pulse wave intensity has been developed as a non-invasive method of assessing functional changes of left ventricular contractility and as a marker of the relaxation of LV and deceleration of flow. In order to develop new indices, we measured wave intensity in the common carotid artery (CCA) using prototype hardware (Aloka SSD-5500 ultrasound machine with a 7.5 MHz linear-array probe) and analysed the data using specifically designed software (Matlab).

Methods: We studied 99 healthy adult volunteers (52±13 years; 55 M, 44 F). The right CCA was imaged and the arterial diameter was measured by automated wall tracking and calibrated for pressure. The velocity was derived from Doppler colour flow. Wave intensity is the product of instantaneous rates of change of velocity and pressure. Using applications of the water hammer equation, local wave speed was calculated during early systole from a pressure-velocity loop, and then separated forwards and backwards travelling waves were calculated. Statistical analysis of correlations between separated wave analyses and age were performed using Spearman’s test.

Results: The amplitude of the forward compression wave (FCW), an index of LV contractile function, decreased with age (r=-0.33, p<0.001). On average, the amplitude of the backward compression wave (BCW) was 24.5±% of the FCW. The ratio of BCW to FCW decreased with age (r=-0.33, p<0.001). Local wave speed increased with age (r=0.43, p<0.001). The percentage of forward wave travel generated by the LV in early systole that occurred unopposed by reflections (before onset of BCW), was 54±21% (r=0.53, p<0.001). This also increased with age (r=0.53, p<0.001).

Conclusion: We conclude that analysis of separated wave travel of pulse wave intensity in the common carotid artery is a promising new technique for the study of ventriculo-arterial coupling. These indices may allow non invasive assessment to monitor drug treatment designed to unload the left ventricle.

546 Choosing apical long-axis instead of two-chamber view gives more accurate biplane echocardiographic measurements of left ventricular ejection fraction
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Biplane 2D-echocardiography is widely used for measuring left ventricular ejection fraction (EF). We sought to evaluate whether the apical long-axis (LAX) rather than two-chamber (2CH) view, in combination with four-chamber (4CH) view, improved accuracy and reproducibility of biplane echocardiographic EF. Magnetic resonance imaging (MRI) was the preferred reference method.

Methods: In 100 consecutive cardiac patients standard apical views were digitised and acquired with Vivid 7 (GE Vingmed) with colour harmonic imaging, and repeated after iv. SonoVue® or Definity®, using low-power pulse harmonic imaging, MRI of short axis sections through the LV was performed with TrueFISP application on a 1.5 T Symphony® (Siemens) scanner. Echo and MRI LV volumes and EF were calculated by manual endocardial tracing and disc summation methods. Thirty randomly selected patients were evaluated for interobserver variability.

Results: Feasibility for biplane analysis increased from 68 to 75% by substituting 2CH by LAX. Sixty-two patients had all apical views traceable and could be compared to MRI. Precontrast limits of agreement (LoA) for EF was -19.1 to 9.0% (EF units) using 2CH view, narrowing down to -14.6 to 6.7% using the LAX view (Figure, left plots). With contrast enhancement the corresponding LoAs narrowed from -10.5 to 6.1%, to -7.3 to 3.8%, respectively (Figure, right plots). Between observers, LoAs for baseline EF narrowed from -11.7 to 14.7% (2CH) to -12.4 to 9% (LAX), and with contrast from -8.3 to 8.6%, to -6.2 to 6%, respectively. Conclusion: Combining the LAX rather than the 2CH view with 4CH view improved feasibility, accuracy and reproducibility of biplane echocardiographic EF measurements in non-selected cardiac patients, both at baseline and with contrast.

Time course of the MPI

Figure
547 Echocardiographic myocardial performance index in heart transplantation
S. Frea, G. Barberis, M. Iachanis, M. Morello, M. Bobbio, G.P. Trevi. Molinette Hospital, Turin, Italy

Introduction: Early detection of rejection is crucial in heart transplant patients. Myocardial performance index (MPI) is a Doppler derived systolic and diastolic index that has been in the follow up of a variety of diseases with myocardial dysfunction. Aim of the study was to determine whether this index has a prognostic value for the evaluation of cardiac transplant patients.

Methods: We enrolled 63 consecutive patients (mean age 55.3 years, M/F 3.5:1) who had a heart transplantation from at least one year (mean 5.3 years). Patients underwent a complete echocardiographic study and repeated clinical evaluation in the outpatient clinic. Subtracting ejection time from the time between cessation and onset of mitral inflow and dividing by ejection time derived MPI. A cut off value of 0.47 was used. Clinical events were considered to be heart failure, need for hospitalisation and cardiac death.

Results: MPI did not correlate with age, duration of the transplantation, hypertension or left ventricular hypertrophy. Patients with clinical events had an MPI index significantly higher (0.55) to those without events (0.34; p<0.001). 40% of patients with events had a MPI>0.47 and only 5% of patients with events had a MPI<0.47. (r=-0.001; IC 0.15 - 0.55). In the multiregression model with age, EF, MPI as independent variables and events during follow up as dependent variable, both MPI and EF were statistically correlated with the incidence of events. In particular EF and MPI showed a borderline significant inverse correlation (p=0.05, r -0.42).

Conclusion: Systolic dysfunction coexits and usually precedes diastolic dysfunction in patients with heart transplant. EF is not enough to evaluate the left ventricular global performance in patients without cardiovascular disease.

548 Influence of low-T3 syndrome on left ventricular global performance: assessment by Tei index
M. Bianchi, M.G. Castiglioni. Cisanello Hospital, PISA, Italy

Background: The cardiovascular system is very sensitive to thyroid hormone, and a wide spectrum of cardiac changes has long been recognized in overt thyroid dysfunction. Mounting evidence indicates that low-T3 syndrome has important clinical effects and prognostic implication but cardiovascular impairment has not been study in detail. A combined myocardial performance index (isovolumic contraction time plus isovolumic relaxation time divided by ejection time derived MPI. A cut off value of 0.47 was used. Clinical events were considered to be heart failure, need for hospitalisation and cardiac death.

Methods: A total of 20 consecutive patients (10 male and 10 female, age 68.5±4.1) with low T3 state and 20 carefully age- and sex-matched euthyroid subjects (10 male and 10 female, age 68.5±4.1) were studied. The thyroid function profile evaluation (TSH, FT3, FT4) were performed in all study subjects. Using conventional echo-Doppler methods, parameters assessed were: ejection fraction, peak velocities of early (E) and late (A) diastolic filling, the E/A ratio, deceleration time, isovolumic contraction time, isovolumic relaxation time, ejection time and Tei index (substracting ejection time from the interval between cessation and onset of the mitral flow). They were divided in two groups: group I, 20 patients with low T3 state with free T3 (FT3)<1.71 pg/ml and group II (control group), 20 patients with normal FT3>3.171 pg/ml. All the patients studied didn’t have cardiovascular disease.

Results: Patients in group I had higher mitral peak A velocity (0.94±0.22 vs 0.75±1.6 m/s), longer isovolumic relaxation time (IVRT 14.1±27.5 vs 7.5±6.1 m/s), longer isovolumic contraction time (ICVT 14.1±27.5 vs 75.6±1.64 m/s), lower mitral E velocity (0.57±0.22 vs 0.75±1.6 m/s), older isovolumic relaxation time (IVRT 14.1±27.5 vs 7.5±6.1 m/s), longer isovolumic contraction time, isovolumic relaxation time, ejection time and Tei index (substracting ejection time from the interval between cessation and onset of the mitral flow). They were divided in two groups: group I, 20 patients with low T3 state with free T3 (FT3)<1.71 pg/ml and group II (control group), 20 patients with normal FT3>3.171 pg/ml. All the patients studied didn’t have cardiovascular disease.

Conclusion: Aim of the study was to investigate the effects of low T3 state on the left ventricular global performance in patients without cardiovascular disease.

549 Tei-index and diastolic dysfunction of left ventricle in acute myocardial infarction
N. Nearchou, A. Tsakiris, E. Karatzis, M. Lolaki, K. Plessa, M. Tetsirikos, P. Max instrument, P. Skoutas. Hellenic Red Cross Hospital, Athens, Greece

Purpose: Tei index; a Doppler-derived index of global myocardial performance, showed satisfactory relation with changes of systolic left ventricle (LV) dysfunction, keeping an inverse relation with ejection fraction. Aim of the present study was the investigation of Tei index’s behavior in relation with the severity of diastolic dysfunction of LV, in patients (pts) experiencing acute myocardial infarction (AMI), a field where data are still lacking.

Methods: 105(77 males) pts experiencing their first AMI were enrolled in the study. In terms of the severity of LV diastolic dysfunction, they were partitioned into four groups. A 25 pts with normal diastolic function regarded as control group (CG) b) 36 with decreased peak filling rate (DFR) c) 33 with impaired relaxation (IR) d) 11 with pseudonormal/restrictive physiology (PN/R). A complete evaluation was performed in all patients, including MPI as a combined systolic and diastolic echo-Doppler parameters as well as detection of the index at the 8.07±0.96 post infarction day.

Results: The index in patients with IR (0.77±0.05) was significantly higher compared with the value of patients of either CG (0.53±0.03; p<0.01) or DFR group (0.65±0.02; p<0.01), while between the last two groups no difference was detected. On the other hand, the index in PN/R group (0.59±0.05) was lower from the index of IR group (p<0.01) and didn’t differ from those of CG (p=NS) or DFR group (p=NS); “pseudonormalization” of the index.

Conclusion: Tei index undergoes “pseudornormalization” in group PN/R; a limitation that does not enable the index to reflect the severity of LV diastolic dysfunction in AMI pts.

550 Comparison of transthoracic echocardiography and bipolar voltage map based on CARTO system in patients with severe left ventricular dysfunction after myocardial infarction

Nonfluoroscopic 3-D electroanatomical mapping system (CARTO) is a novel method using to distinguish infarcted from healthy myocardium and to detect myocardial viability. However, in previous studies patients (pts) with severe left ventricular (LV) dysfunction were excluded.

The aim of this study was to compare global function and segmental wall motion of the LV echocardiography with segmental electrical activity in CARTO in pts with the post infarction LV depressed function and ventricular tachycardia.

A comparative analysis was performed in 14 pts (11 men, 65±10 years old) qualified to radiofrequency endocardial ablation using CARTO system. Before mapping LV global function and 12 segmental wall motion score index (WMSI) were assessed by echocardiographist. The segmental contraction was described using semiquantitative scoring system. The bipolar voltage map was made during electroanatomical mapping and it was compared with the LV echocardiogram using special computer program. There were analyzed contraction of 153 segments in echocardiographic examinations and bipolar voltage of 1173 points of electroanatomical maps. The LV ejection fraction was 20-40%, mean 31.7% and WMSI was 1.3-2.6, mean 1.6.

There was a significant difference as regards bipolar voltage between akinetic segments and hypo- and normokinetic segments (tab.1).

A comparative analysis was performed in 14 pts (11 men, 65±10 years old) qualified to radiofrequency endocardial ablation using CARTO system. Before mapping LV global function and 12 segmental wall motion score index (WMSI) were assessed by echocardiographist. The segmental contraction was described using semiquantitative scoring system. The bipolar voltage map was made during electroanatomical mapping and it was compared with the LV echocardiogram using special computer program. There were analyzed contraction of 153 segments in echocardiographic examinations and bipolar voltage of 1173 points of electroanatomical maps. The LV ejection fraction was 20-40%, mean 31.7% and WMSI was 1.3-2.6, mean 1.6.

Table 1

<table>
<thead>
<tr>
<th>Contraction</th>
<th>Number of points</th>
<th>Mean bipolar voltage [mV]</th>
<th>SD ANOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-normokinesis</td>
<td>497</td>
<td>1.41</td>
<td>1.8</td>
</tr>
<tr>
<td>2-hypokinesis</td>
<td>538</td>
<td>1.75</td>
<td>2.5</td>
</tr>
<tr>
<td>3-akinesis</td>
<td>138</td>
<td>0.75</td>
<td>1.2</td>
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</tbody>
</table>
551 Diagnostic value of tissue tracking in patients with suspected coronary heart disease with normal segmental systolic function

<table>
<thead>
<tr>
<th>Authors</th>
<th>University, Location</th>
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<tbody>
<tr>
<td>K. Wita, A. Rybicka, A. Wiera, J. Kozierski, M. Ciesielczyk</td>
<td>University of Medicine, Wroclaw, Poland</td>
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</table>

Aims: Both resting electrocardiographic examination and conventional two-dimensional echocardiography are of limited use in identifying patients with stable angina. Tissue tracking (TT) is a new echocardiographic modality based on Doppler tissue which makes it possible to assess longitudinal apex-oriented myocardial displacement. The aim of the study is to define the diagnostic value for the stratification of patients with significant coronary heart disease (CHD).

Methods and results: The study was performed using ultrasound machine Vivid7/GE/GE 36 consecutive patients with good acoustic window, poor resting LV function and sinus rhythm previously qualified for coronary angiography. In all patients evaluation of longitudinal systolic movement of myocardium (TT) in apex views proved, visualized with 7-color band denoting different stages of systolic movement towards the apex. Group A consisted of 16 patients (57% of men) of average age 54.5 years who did not have significantly CAD (<50%). Group B comprised 20 patients including 58% of men with significant CAD. Statistical analysis was performed using Kolmogorov-Smirnov or ANOVA Friedman test when appropriate. Group B despite a similar rate of hypertension and diabetes incidence and similar pharmacological treatment had lower values of calculated TT and the difference was statistically significant. Coexistence of multivessel disease was accompanied by a bigger decrease in global TT value compared to one-vessel disease. This difference was not statistically significant.

Conclusion: TT allows to assess global function of LV in a quick, non-invasive, and half-quantitative way. LV function defined in this way seems to be useful, easy to perform, reproducible diagnostic method. Patients with significant coronary heart disease have symptomatic lower TT value.

Table 1

<table>
<thead>
<tr>
<th>Group</th>
<th>HT</th>
<th>DM</th>
<th>BB</th>
<th>ACEI</th>
<th>WMSI</th>
<th>LVEF</th>
<th>HR</th>
<th>TTavg</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>12</td>
<td>4</td>
<td>16</td>
<td>10</td>
<td>65</td>
<td>69</td>
<td>1/4</td>
<td>2.3</td>
</tr>
<tr>
<td>B</td>
<td>13</td>
<td>19</td>
<td>14</td>
<td>14</td>
<td>61</td>
<td>63</td>
<td>4.4</td>
<td>0.3</td>
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</table>

552 Prevalence and pattern of left ventricular remodeling in relation to reperfusion strategy in acute myocardial infarction

<table>
<thead>
<tr>
<th>Authors</th>
<th>University, Location</th>
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<tbody>
<tr>
<td>B. Brzezinska, K. Loboz-Grudzien, A. Kowalska, L. Sokalski, J. Jaroch, M. Sledziona, J. Wachtz, J. Slawin</td>
<td>University of Medicine, Wroclaw, Poland</td>
</tr>
</tbody>
</table>

The prevalence and pattern of left ventricular remodeling (LVR) in relation to reperfusion strategy in acute myocardial infarction (AMI) has not been well defined yet. The study was undertaken to evaluate the incidence and pattern of LVR with respect to reperfusion strategy in acute myocardial infarction. The prevalence and pattern of left ventricular remodeling (LVR) in relation to reperfusion strategy in acute myocardial infarction was described, and in 27- global dysfunction due to significant coronary heart disease have symptomatic lower TT value.

553 Prognostic value of left ventricular systolic function parameters in patients with heart failure

<table>
<thead>
<tr>
<th>Authors</th>
<th>University, Location</th>
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<tbody>
<tr>
<td>J. Drozdz, M. Krezminska-Pakula, P. Dryja, M. Pilewka, M. Ciesielczyk, K. Wierzbowska-Drabik, L. Chrzanowski</td>
<td>Medical University of Lodz, Lodz, Poland</td>
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Objective: Coronary heart disease /CAD/ is the most important parameter for the evaluation of prognosis in patients with de-

Table 2

<table>
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<tr>
<th>Parameter</th>
<th>Cut-off value</th>
<th>Accuracy</th>
<th>Specificity</th>
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<tr>
<td>LVEF</td>
<td>&lt;40%</td>
<td>92%</td>
<td>92%</td>
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<tr>
<td>HR</td>
<td>&gt;85 bpm</td>
<td>72%</td>
<td>71%</td>
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<tr>
<td>TT avg</td>
<td>&gt;5 cm/s</td>
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<td>75%</td>
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Conclusion: The left ventricular ejection fraction still remains the most important parameter for the evaluation of prognosis in patients with heart failure (HF).

554 Correlation of new left ventricular diastolic function parameters with NYHA class

<table>
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<tr>
<td>K. Wierzbowska, J.K. Drozdzt, M. Pilewka, M. Ciesielczyk, J.D. Kasprzak, M. Krezminska-Pakula</td>
<td>Medical University of Lodz, Lodz, Poland</td>
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Objective: We compared pulmonary vein flow (PVF), propagation and pulse tissue Doppler data (TTE) between age-matched pts after myocardial infarction (MI) divided according to NYHA class to mild (class I and II) and advanced HF group (III and IV). We then found cut-offs for the best detecting pts with advanced HF.

Methods: We examined 60 patients with MI. Group with mild HF symptoms (group 1) consisted of 24 and group with advanced symptoms (group 2) of 36 patients. The test was performed between age-matched pts after myocardial infarction. In all patients evaluation of longitudinal systolic movement of myocardium (TT) in apex views proved, visualized with 7-color band denoting different stages of systolic movement towards the apex. Group A consisted of 16 patients (57%) of men of average age 54.5 years who did not have significantly CAD (<50%). Group B comprised 20 patients including 58% of men with significant CAD. Statistical analysis was performed using Kolmogorov-Smirnov or ANOVA Friedman test when appropriate. Group B despite a similar rate of hypertension and diabetes incidence and similar pharmacological treatment had lower values of calculated TT and the difference was statistically significant. Coexistence of multivessel disease was accompanied by a bigger decrease in global TT value compared to one-vessel disease. This difference was not statistically significant.

Conclusion: TT allows to assess global function of LV in a quick, non-invasive, and half-quantitative way. LV function defined in this way seems to be useful, easy to perform, reproducible diagnostic method. Patients with significant coronary heart disease have symptomatic lower TT value.

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Conclusion: The left ventricular ejection fraction still remains the most important parameter for the evaluation of prognosis in patients with heart failure (HF).
Relationship between heart failure symptoms and common echocardiographic parameters of systolic and diastolic left ventricular function
K. Wierzbowksa, J.K. Drozdz, M. Plewka, M. Krzeminska-Pakula, J.D. Kasprzak, Medical University of Lodz, Lodz, Poland

Background: Despite of wide conviction about importance of echocardiography in the assessment of patients with heart failure the interdependence between severity of heart failure symptoms measured by the most popular NYHA classification and echocardiographic parameters of left ventricle systolic and diastolic function is not thoroughly examined.

Objective: Our aim was to compare commonly used two-dimensional and Doppler echocardiographic parameters between age-matched patients after myocardial infarction divided according to NYHA class to mild (class I and II) and advanced heart failure group (III and IV). Then we found cut-off values for parameters the best detecting patients with advanced symptoms of heart failure and calculated their diagnostic value.

Methods: We performed clinical assessment and transthoracic echocardiography in 60 patients with myocardial infarction at least 6 days after acute coronary syndrome. Group with mild heart failure symptoms (group 1) consisted of 24 and group with advance symptoms (group 2) of 36 persons. Mean age was similar in both groups (57±10 and 62±12 years respectively) but resting heart rate was significantly higher in group 2 (68±7 vs. 77±14).

Results: In group with advanced heart failure left ventricle (LV) systolic and diastolic dimension were significantly higher (57±9 vs 49±7 for diastolic; p<0.001 and 48±11 vs 39±8 mm for systolic dimension; p<0.001). LV ejection fraction (EF) was lower (28±6 vs 42±9%) and left atrium larger (46±5 vs 42±6 mm; p=0.007) than in group 1. Among diastolic parameters in patients with NYHA III and IV class duration and deceleration times of early and atrial mitral inflow waves were shorter than respective parameters in group with mild heart failure symptoms. E/A ratio was higher in advanced heart failure patients (1.4±1.1 vs 0.9±0.4; p=0.05) with restriction and pseudonormalization of mitral inflow more frequent in this group (56% vs 12%). Optimal cut-offs for markers of advanced heart failure with the highest specificity were: specificity Edt/< 0.136 92%At/ 0.155 88%Et/ 0.147 88%Ea/ 0.125 92%

Conclusions: Patients after myocardial infarction presenting with mild and advanced heart failure symptoms differ significantly according commonly assessed echocardiographic parameters. In our group the most specific markers of high NYHA class were shortened early wave deceleration time and increased E/A ratio indicating presence of severe diastolic dysfunction in strongly disabled patients.

Comparison of acoustic densitometry and dobutamine echocardiography in the assessment of myocardial viability
R. Panovsky, J. Meluzin, V. Kincl, B. Fischerova, F. Stetka, echocardiography in the assessment of myocardial viability Comparison of acoustic densitometry and dobutamine stress echocardiography (DSE) performed for detection of myocardial ischemia, has not been fully clarified.

The aim of this study was to search for any relationship between BNP serum levels and left ventricular diastolic dysfunction during DSE.

Methods: Consecutive patients (pts) were submitted to DSE study for detection of myocardial ischemia. All pts were blood sampled before and 1 hour after DSE study, in order to assess BNP serum levels. BNP serum levels were measured with an ELISA (ROCHE Elecsys 1010) (pg/ml).

Results: One hundred and twenty eight (128) pts (aged 55.6±11.18, 95 males) were submitted to DSE study. Sixty two (48.4%) pts had previous history of coronary artery disease, 19 (14.8%) pts had diabetes mellitus, 63 (49.2%) pts had hypertension, 52 (40.6%) pts had diastolic dysfunction of the left ventricle, 53 (41.4%) had left ventricular hypertrophy (intraventricular septum >12 mm) and 11 (8.5%) had ejection fraction <40%. Increased BNP levels (>80 pg/ml) were measured in 69 (53.9%) pts. Myocardial ischemia during DSE was detected in 33 (25.7%) pts. BNP serum levels did not change significantly post DSE study, in pts with DSE induced myocardial ischemia (162.6±176.6 vs 162.7±175.1 p=0.99). On the contrary, in pts without DSE induced myocardial ischemia, BNP serum levels increased significantly after the study (127.4±144 to 133.3±151 p=0.01). However baseline BNP serum levels either normal (<80 pg/ml) or increased, remained normal or increased after the study respectively (p=NS). Logistic regression analysis revealed that age, diabetes mellitus, normal diastolic function, and ejection fraction, but not sex, hypertrophy of left ventricle, hypertension, or DSE induced myocardial ischemia, can predict absence of BNP serum levels within normal limits (<80 pg/ml), both pre and post DSE study. Multivariate logistic regression analysis demonstrated that age and normal diastolic function are independent predictors of normal BNP serum levels, both pre and post DSE study, regardless of presence of myocardial ischemia.

Conclusions: Diastolic dysfunction of the left ventricle is related to increased BNP serum levels, both pre and post DSE study.

Echocardiographic assessment of end diastolic wall thickness can be used as a marker of reperfusion in transmural and partial thickness infarcts
L. Herbots, E. Erogul, J. D’Hooge, P. Claus, V. Daemraukaita, M. Gori, B. Bijnen, S. Janssens, E. Rademakers, G. Sutherland, University Hospital Gasthuisberg, Leuven, Belgium, 1University Hospital Gasthuisberg, Leuven, Belgium

Background: Recent experimental studies have suggested reperfusion of an acute transmural myocardial infarct results in the immediate development of massive intramural oedema. If the resultant wall thickness could be detectable by echocardiography, it could act as a marker of acute myocardial reperfusion and reperfusion injury. Whether these changes occur in the clinical setting and what happens after the study respectively (p=NS). Logistic regression analysis revealed that age, diabetes mellitus, normal diastolic function, and ejection fraction, but not sex, hypertrophy of left ventricle, hypertension, or DSE induced myocardial ischemia, can predict absence of BNP serum levels within normal limits (<80 pg/ml), both pre and post DSE study. Multivariate logistic regression analysis demonstrated that age and normal diastolic function are independent predictors of normal BNP serum levels, both pre and post DSE study, regardless of presence of myocardial ischemia.

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Methods: We prospectively studied 22 patients (55±11, 20 men) immediately after and 5 days after primary PTCA for acute ST-elevation infarction. Patients were divided into a group with partial thickness infarcts (n=5) or a group with transmural infarcts (n=17) as assessed with MRI delayed enhancement imaging. End diastolic wall thickness (EDWT) in the infarcted segments were measured with 2D echocardiography, apical windows and compared to a remote area from each patient.

Results: EDWT in the transmural infarcts was significantly increased compared to EDWT in the partial thickness infarcts and in remote segments (1.48±0.13, 1.20±0.13, 1.03±0.10 cm respectively (p<0.001). This significant difference disappeared at end systole because of impaired function in both transmural and partial thickness infarcts [Figure]. At day 5, these findings were still present.

Conclusions: Sudden increase in end diastolic wall thickness after PTCA of a transmural infarct can be used as a marker of myocardial reperfusion up to 5 days after the infarct. Partial thickness infarcts will also have an increased EDWT, but significantly less than transmural infarcts.
559
Relation of left ventricular diastolic function and plasma levels of TNF-α, IL-6 in patients with coronary artery disease and preserved left ventricular systolic performance

W. Kosmala, M. Przewlocka-Kosmala, W. Mazurek. Medical University, Wroclaw, Poland

Inflammation seems to play a significant role in the pathogenesis of coronary artery disease (CAD) as well as in progression of systolic heart failure. Whereas other inflammatory processes also promote left ventricular (LV) dysfunction, it has not been evaluated so far.

Aim: To investigate the association of plasma TNF-α, IL-6 and IL-10 with Doppler indexes of LV diastolic function in patients with preserved LV systolic performance.

Material and methods: Studied group consisted of 143 pts aged 62.2±1.8 years with stable effort angina and LV ejection fraction >50%. 85 pts had single-vessel disease whereas 58 multivessel disease. Each patient underwent echo study including estimation of: peak velocity of early (E) and late (A) transmirtal flow, deceleration time of E wave (DT), isovolumic relaxation time (IVRT), ratio diastolic isovolumic index (TD), E/ (E TT) and A (AT) wave transit time to the LV outflow tract, flow propagation velocity of E wave (Ep). Laboratory measurements comprised evaluation of plasma TNF-α, IL-6 and IL-10 levels by radioimmunnoassay method and plasma ANP and BNP levels by radioimmunoassay.

Results: Significant correlations were found out for IL-10 and Ep (r=-0.49, p=0.01), Ep (r=-0.65, p=0.003), E(TT) (r=-0.43, p=0.04) and E(TT)/ATT (r=-0.69, p<0.001). TNF-α correlated with Ep (r=-0.38, p=0.01). Demonstrated correlations of ANP and BNP with indexes of LV diastolic function were weaker than those of cytokines (ANP-Ep r=-0.30, p=0.05, ANP-DT r=0.05, BNP-Ep r=-0.04, BNP-DT r=-0.04, BNP-ETT r=0.46, p<0.01, BNP-ETT/ATT r=0.53, p<0.01). The independence of associations between IL-10 and Ep, E(TT), E(TT)/ATT as well as between TNF-α and Ep was shown in multivariate analyses including age, gender, drug assignment, plasma levels of all evaluated cytokines and natriuretic peptides, LV ejection fraction, interventricular septum and posterior wall thickness, LV mass index. Other echo parameters did not correlate either with plasma cytokines or natriuretic peptides.

Conclusions: The relation between plasma cytokines and indexes of LV diastolic performance might suggest the role of inflammatory processes in the development of LV diastolic dysfunction in CAD pts. IL-10 reflecting immunologic upregulation as a response to inflammation may be another useful marker in evaluation of LV diastolic dysfunction in these pts.

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Early outcome post ventricular surgical restoration modo Meninconiti in ischemic heart failure patients. Left ventricular evaluation using global and regional echo indexes

T. Kukulski, M. Di Donato 1, R. Przybylewski 2, D. Puszczewicz 2, T. Kukulski, M. Di Donato 1, R. Przybylewski 2, D. Puszczewicz 2, Institute of Cardiology, Zabrze, Poland, 1 Milan, Italy, 2 Silesian Center for Heart Diseases, Zabrze, Poland, 3 Silesian Center for Heart Disease, Zabrze, Poland.

Rationale: Surgical ventricular restoration (SVR) has been proved an effective technique for the treatment of post anterior myocardial infarction. Echo measurements can provide information on both hemodynamic left ventricle (LV) but also indirectly on myocardial fiber shortening.

Methods: Twenty heart failure patients (2F, 58±6 yrs, NYHA I/IV) with dominant anterior akinesia underwent LV restoration using a calibrated Mannequin. Early postoperative assessment was performed up to 14 days post operation. Echo data for both global and regional analysis were acquired in apical view. Longitudinal Strain and strain rate measurements were averaged for septal and lateral segments.

Results: Early after operation LV volume reduction resulted in decreasing both EDVI abd ESVI (see table), increasing EF (34±8 vs 43±6%, p<0.002) and no significant change in fractional shortening (FS, 26±7 vs 23±3%, p<0.79). The reshaping of LV resulted in improvement of sphericity index (SI, 85±15 vs 71±9% p<0.01). Using ultrasound strain rate and strain measurements we demonstrated significant improvement in longitudinal shortening of LV lateral segments (see table).

Conclusions: Improvement in longitudinal myocardial shortening may serve as a marker of mildward stress reduction after volume decrease and LV shape correction. Using ultrasound strain it is now possible to measure recovery of the myocardial function and document early beneficial effects of SVR procedure.

Table

<table>
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</table>

Global and regional indexes.

561
Relation of left ventricular systolic and diastolic function to left ventricular geometry in hypertrophic cardiomyopathy

W. Kosmala, M. Przewlocka-Kosmala, J. Orzeszko, W. Mazurek. Medical University, Wroclaw, Poland

The objective of the study was to evaluate the relation of left ventricular (LV) geometric pattern and LV systolic and diastolic function in hypertrophic cardiomyopathy (HCM).

Material and methods: Studied group consisted of 102 HT pts aged 57.8±12.7 with excluded coronary artery disease. According to echocardiographic measurements each patient was classified into one of four patterns of LV geometry-normal geometry (NG)(n=20), concentric remodeling (CR)(n=29), eccentric hypertrophy (EH)(n=17) and concentric hypertrophy (CH)(n=36).

All pts underwent echocardiographic evaluation including estimation of peak early (E) and late (A) transmirtal velocity, deceleration time of E wave (DT), isovolumic relaxation time (IVRT) and tissue Doppler imaging of LV Analysis of tissue velocity curves comprised mean peak systolic velocity (Sm), mean peak early diastolic velocity (Em) and mean late diastolic velocity (Am) obtained from six basal segments of LV. The measure of LV systolic and diastolic asynchrony was the maximal difference in TS and in TE, respectively between any two of 12 mid and basal segments from apical views, where TS was the time from the beginning of QRS complex in ECG to Sm and TE the time from beginning of the E wave to Em.

Results: LV systolic function parameter-Sm was not statistically different among all studied groups. Significant differences in Em, Am, TS and TE were indicative of more profound impairment in LV diastolic function in CH group and, to a lesser extent, in CR and EH groups when compared to NG group.

There were no differences among all studied groups regarding other evaluated parameters of LV function.

Conclusion: HT pts with different LV geometric patterns differ with respect to LV systolic function, but not diastolic one. Deterioration of LV diastolic performance is the most advanced in pts with concentric hypertrophy.

562
Diagnostic and prognostic value of ejection fraction changes during dobutamine stress echocardiography: an objective assessment of coronary artery disease

C. Pedone, D. Poldermans 1, R. Krenning 1, A.F.L. Schinkel 1, R.T. Vann Domburg 1, E. Biagini 1, V. Rizzello 1, J.J. Bax 2.

Background: Dobutamine stress echocardiography (DSE) is an established technique for the diagnosis of coronary artery disease (CAD). It is based on the assumption that stress induced myocardial ischemia is defined by a subjective evaluation of regional wall motions abnormalities. This study tested the value of abnormal left ventricular ejection fraction (LVEF) changes during DSE for the assessment of coronary artery disease, in relation to the presence and extent of stress-induced ischemia and mid-long term prognosis.

Methods: The study population comprised of 106 consecutive patients (mean age 60±11 years, 73% men) with suspected or known CAD referred for DSE. Stress-induced ischemia was defined as the presence of new or worsening wall motion abnormalities. LVEF was measured with the Simpson’s biplane disk method at rest and during peak stress. Follow-up was successful in 104 (98%) patients. Four (4%) patients underwent early revascularization (within 60 days) and were excluded from further analysis. End-points during follow-up were hard cardiac events (cardiac death, non-fatal myocardial infarction) and all cardiac events (hard cardiac events and late revascularization).

Results: Stress-induced ischemia was present in 50 patients. LVEF changes in patients with and without stress-induced ischemia were considerably different. In patients without ischemia mean LVEF changes were (peak vs baseline) 11.1±5.6% and 5.8±8.3% in patients without and with ischemia (p<0.001). An abnormal LVEF response (rest to peak LVEF increase <−10%) was assessed in 59 patients. Importantly, the extent of ischemia, presented as the number of ischemic segments was related to LVEF changes at peak stress (y=1.1x+10.6x-0.002). During a mean follow-up of 5.3±2.1 years, 26% of patients died, 13% due to cardiac death, 5% patients had myocardial infarction, 38% underwent late revascularization. In patients with abnormal LVEF response during DSE all cardiac events (34 [58%] vs 14 [34%] p=0.02) and hard cardiac events (15 [25%] vs 6 [10%] p=0.04) occurred more frequently.

Conclusion: A reduced LVEF response at peak stress (<−10% increase) represents an objective parameter, in addition to wall motion analysis, to assess the presence of stress-induced myocardial ischemia during DSE. Failure of LVEF to significantly increase during dobutamine stress echocardiography identifies a group of patients with a higher risk of cardiac events.
553 Assessment of left ventricular function in asymptomatic hypertension patients

A. Kalina1, F. Szabó1,2, Budapest, Hungary, 1 MAV Hospital, Budapest, Hungary

Objective: To find out the most sensitive parameter of impaired left ventricular function by regular echocardiographic examination and tissue Doppler imaging (TDI) in asymptomatic essential hypertension patients with treated only ACEI and screened 24 h ambulatory blood pressure monitoring (ABPM).

Methods: 94 patients underwent ABPM (70:5 measurements/day) and they were divided into two groups: less than 15 percent time elevation (PTE) over normal (<=130/80 mmHg) blood pressure (group A) or more (group B). Subjects with other diseases affecting the structure of the heart, coronary heart disease and atrial fibrillation were excluded. The left ventricular (LV) ejection fraction (EF) was measured by Teichholz method and LV mass was calculated by Devereux equation. The analysis of longitudinal (L) myocardial function was estimated by TDI at the apical 4-chamber view, with the sample volume positioned within the basal septum, while the transversal (T) myocardial function was assessed at the parasternal long axis view, within the basal portion of posterior wall. In each case diastolic waves (E and A) and deceleration time (DT) were measured by TDI too.

Results: There was no significant difference between group A and B (46 subjects vs 48) in age (60.0±11.6 years vs 55.9±12.7), gender (male vs female 50% vs 50%), heart rate (70.1±9.6 beats/min vs 72.2±8.4), duration of hypertension (5.2±2.1 years vs 5.0±1.9), BMI (28.1±4.7 kg/m² vs 28.9±4.3), diurnal index of blood pressure (9.5±6.1% vs 11.3±6.0), LVEF (54.6±10% vs 55.6±9.6), LV mass index (126.0±47.5 g/m² vs 125.9±48.4 g/m²), E velocity (70.1±14.0 cm/s vs 72.2±16.1), transmirtal E/A (0.87±0.3 vs 0.94±0.32), DT of E wave (169.1±27.3 ms vs 164.4±23.9); and LV myocardial fibers E(L) (13.4±2.4 cm/sec vs 12.9±1.9 cm/sec) vs vs 17.1±3.0 cm/sec), E(A) (5.71±1.32 vs 5.82±1.15); and T myocardial fibers E(T) (12.6±1.9 cm/sec vs 12.0±2.1), DT(T) (164.2±37.0 ms vs 154.9±29.5), E(T) (5.93±1.02 vs 6.02±0.93). However the L myocardial E/A ratio (0.71±0.25 vs 0.6±0.24; P<0.032) was significantly different each other. At the same tine, at T myocardial E/A ratio (0.62±0.2 vs 0.55±0.19, P<0.085) tendency was observed only.

Conclusions: Beside the ACE-I treatment, the most sensitive marker of the LV dysfunction in asymptomatic hypertension patients was global diastolic dysfunction which was confirmed the L myocardial E/A ratio by TDI, but the evaluation of T myocardial E/A ratio by TDI was found useful, too. These profile can be used to help control the efficiency of antihypertensive therapy.

554 Echocardiographic changes after allogeneic peripheral blood stem cell transplantation.

L. Elbl1, M. Krejci1, I. Tomaskova2, J. Mayer1, Z. Koristek1, M. Doubek1, Brno, Czech Republic, 1 Faculty Hospital, Brno, Brno Czech Republic, 2 University Hospital, Brno, Czech Republic

Background: Cardiac complications are limiting factors regarding the success of high-dose chemotherapy supported by blood stem cell transplantation.

Methods: We studied age-matched 34 middle-distance runners, 39 controls. We used DTI from the apical 4-chamber view for lateral and medial sites, and 2-chamber view for anterior and inferior sites. From spectral traces we measured peak systolic velocity. Four-site average velocity (mean) was calculated as: mean=(M+L+I+A)/4, where M, L, I, and A peak systolic velocities (Sm) of the medial, lateral, inferior, and anterior mitral annulus, respectively. Heterogeneity index (HI) was calculated as = HI: (M-mean) + (L-mean) + (I-mean) + (A-mean)/4. Then, all subjects were under- went cardiopulmonary exercise testing.

Results: Maximal oxygen consumption in athletes was higher than those of control group (63.2±3.1 ml/kg/min and 41.1±2.7, respectively). LV mass, mass index, and Sm were higher in athletes compared with controls. Heterogeneity index in athletes was lower than that of control group (0.41±0.17 and 0.73±0.25, respectively). HTI also showed significantly inverse correlation with maximal oxygen consumption.

Conclusion: This study suggests HTI measured by DTI useful method for quantitative analysis of regional myocardial paterns in endurance athletes who present with better myocardial sistic properties. It may represent markers of aerobic training, allowing quantification of the degree of LV adaptation to endurance exercise.

556 Tissue Doppler imaging of the left ventricle in healthy elderly females does not support the concept of “isolated” diastolic dysfunction.

J. Soma, K. Dahl1, T.E. Widerøe1, University Hospital of Trondheim, Trondheim, Norway, 1 University Hospital of Trondheim, Trondheim, Norway

The concept of “isolated” left ventricular (LV) diastolic dysfunction has recently been challenged since LV systolic dysfunction can be demonstrated using tissue Doppler imaging (TDI), even in subjects with normal LV ejection fraction (EF). The purpose of this study was to investigate the relationship between indices of LV systolic and diastolic function estimated with conventional echocardiography and with TDI in 35 healthy elderly females (65 to 80 years). The subjects were divided into two groups according to the ratio of peak early diastolic flow velocity and peak early diastolic myocardial velocity (E/Em), which may serve as an index of LV filling properties. The group with high E/Em was characterized by higher age (72.4±4 vs 69.4±4 years, p<0.03), lower peak myocardial systolic velocity (Sm) (4.4±1.0 vs 5.9±0.9 cm/sec, p<0.0001) and lower long-axis motion amplitude assessed with tissue tracking (TT) (0.86±0.14 vs 1.07±0.15 cm, p<0.0001). The group did not differ with respect to EF (62.7±7 vs 60.6±8%, p=0.53). E/Em correlated with Sm (r = -0.57, p<0.0001) and with TT (r = -0.54, p<0.0001). There was also a significant correlation between Sm and Em (r = 0.35, p = 0.04). Age correlated with E/Em (r = 0.52, p = 0.02). Em correlated with TT (r = -0.60, p<0.001) and with ambulatory daytime systolic blood pressure (r = 0.54, p = 0.009), but not with Sm, TT or nor LV mass.

Conclusion: In healthy elderly females, LV diastolic dysfunction is associated with deterioration of LV long-axis contractility, despite normal indices of global LV systolic function. The concept of “isolated” LV diastolic dysfunction needs reconsideration.

557 Heterogeneity index measured by tissue Doppler imaging and exercise capacity in athletes

E. Kasikcioglu, H. Ofllaz1, H. Akhan2, A. Kayserioglu, B. Unman1, Z. Bugra1, F. Erzengin1, Istanbul Faculty of Medicine, Istanbul, Turkey, 1 Istanbul Faculty of Medicine, Istanbul, Turkey, 2 Eresik Cardiovascular Centre, Istanbul, Turkey

Background: Athlete’s heart is a left ventricular (LV) adaptation to long-term intensive training, which includes changes such as increased cavity diameter, wall thickness, and LV mass. Furthermore, it appears suitable to document the influence of sport activity on LV myocardial wall motion features of endurance-trained athletes, the aim of the study was to detect heterogeneity index assessed by pulsed DTI of endurance-athletes compared with normal control subjects.

Methods: We studied age-matched 34 middle-distance runners, 39 controls. We used DTI from the apical 4-chamber view for lateral and medial sites, and 2-chamber view for anterior and inferior sites. From spectral traces we measured peak systolic velocity. Four-site average velocity (mean) was calculated as: mean=(M+L+I+A)/4, where M, L, I, and A peak systolic velocities (Sm) of the medial, lateral, inferior, and anterior mitral annulus, respectively. Heterogeneity index (HI) was calculated as = HI: (M-mean) + (L-mean) + (I-mean) + (A-mean)/4. Then, all subjects were underwent cardiopulmonary exercise testing.

Results: Maximal oxygen consumption in athletes was higher than those of control group (63.2±3.1 ml/kg/min and 41.1±2.7, respectively). LV mass, mass index, and Sm were higher in athletes compared with controls. Heterogeneity index in athletes was lower than that of control group (0.41±0.17 and 0.73±0.25, respectively). HTI also showed significantly inverse correlation with maximal oxygen consumption.

Conclusion: This study suggests HTI measured by DTI useful method for quantitative analysis of regional myocardial patterns in endurance athletes who present with better myocardial sistic properties. It may represent markers of aerobic training, allowing quantification of the degree of LV adaptation to endurance exercise.

558 Figure
567
Left ventricular systolic and diastolic function after prolonged exercise assessed by tissue Doppler imaging

K. George, D. Oxboough1, J. Forster2, G. Whyte3, C. Stephenson, R. Shave1, E. Dawson4, John Moores University, Liverpool, United Kingdom, 1Leeds General Infirmary, Leeds, United Kingdom, 2Olympic Medical Institute, London, United Kingdom, 3Department of Anaesthesia, Rigshospita, Copenhagen, Denmark

Purpose: Assessment of segmental and global left ventricular (LV) function via tissue-Doppler imaging (TDI) to extend our knowledge of exercise-induced cardiac fatigue

Methods: Twenty-nine subjects (age 18-62 yr) volunteered to participate. They were assessed pre- and post-race (within 1 hour of finish) via longitudinal (five sites on the mitral annulus and mean) TDI myocardial velocities as well as by standard 2-D, M-mode and Doppler echocardiography. Body mass, heart rate and blood pressures were also recorded. Pre-post changes in LV function were analysed by repeated measures ANOVA and T-test. Delta scores for LV function were correlated with each other and alterations in LV loading.

Results: In systole longitudinal segmental and mean (17.6 ± 3.3 to 18.2 ± 3.6 cm.s-1, P = 0.05) were not different pre-post race. Ejection fraction and the LV systolic pressure-volume relationship were also unchanged post-race (P > 0.05). In diastole longitudinal segmental and mean TDI data were altered post-race such that the mean E/A ratio was significantly depressed (1.5 ± 0.34 to 1.16 ± 0.35, P < 0.05). Doppler mitral inflow E/A ratio was significantly reduced post-race (1.75 ± 0.46 to 1.05 ± 0.36, P < 0.05).

Conclusion: No significant change in LV systolic function was reported post-race. Changes in diastolic TDI myocardial velocities as well as Doppler mitral inflow data were reported. The aetiology of these changes remains to be determined.

568
Left ventricular relaxation and filling pressure due to systolic function in patients with congestive heart failure.

Tissue Doppler study

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Background: Doppler echocardiography (DE) is used to evaluate left ventricular diastolic function (LVDF). Tissue Doppler Imaging (TDI) records LVDF, irrespective of other factors.

Aim: To evaluate the value of Doppler variables and pulsed wave TDI for assessment of LVDF in patients (pts) with congestive heart failure (CHF).

Methods: We studied 110 pts with CHF, classified into two groups; group 1 with EF < 45% and group 2 with EF > 45%. Peak velocities of E and A mitral waves, E/A ratio and E wave deceleration time (DT) were assessed by DE. Peak E wave velocities of septal, lateral, anterior and inferior part of mitral annulus and basal segments were measured by TDI. E/Ea ratio, as an index of left ventricular filling pressure was calculated.

Results: table

Conclusion: Doppler Echocardiography and TDI may evaluate left ventricular relaxation, filling pressure and differentiate patients with impaired and preserved left ventricular systolic function.

569
Pseudorestriction - The special form of left ventricular filling

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Purpose: Long-term combined endurance-strength athletic training is associated with significant cardiac morphological changes. The aim of the study was to assess diastolic function of left ventricle (LV) in athletes with significant LV hypertrophy.

Methods: Study population consists of 10 male elite Olympic rowers 23 ± 2 years old. In all athletes M-mode, 2-D, PW, CW Doppler, Tissue Doppler and M-mode Colour Doppler echocardiography were performed. LV mass and LV remodelling were estimated according to Devereux formula and Ganau classification.

Results: In all athletes eccentric hypertrophy was diagnosed (relative wall thickness = 0.42 ± 0.02 and LV mass = 40.8 ± 25.9 g). Pseudorestriction pattern of LV filling (mitral E wave = 2.6 ± 0.5; E wave deceleration slope = 631 ± 46 cm.s²; isovolumetric relaxation time = 54 ± 11 ms). Opposite to this situation, maximal velocity of mitral annulus at early diastole (E) was 8.5 ± 3 cm.s; maximal velocity of early mitral flow propagation (Vp) was 84 ± 11 cm.s; E/E' was 3.2 ± 0.7 and E/ Vp was 1.0 ± 0.1. LV EF was normal (58 ± 3%).

Conclusion: Instead of eccentric hypertrophy with restrictive pattern of LV filling, diastolic function of LV in elite rowers was excellent - it is mean that this form of LV filling should be defined as pseudorestriction.

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Poor concordance of the commonly used echocardiographic measures of left ventricular diastolic dysfunction in patients with Fabry disease

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Introduction: Our purpose was to determine the concordance of different Doppler echocardiographic measures to define the classical patterns of diastolic dysfunction in patients with Fabry disease.

Hypothesis: Previously it has been shown that in patients with suspected heart failure but preserved ventricular systolic function, echocardiography shows a poor concordance between criteria for left ventricular filling and the prevalence of diastolic function. We hypothesized that the same might be applicable to Fabry patients (FP).

Methods: 40 FP with preserved left ventricular systolic function and consecutive Doppler-echocardiographies during enzyme replacement therapy have been examined. We measured the classical patterns of diastolic function such as peak velocities of transmitral flow patterns (E/A), deceleration time (DT), isovolumetric relaxation time (IVRT), peak velocities of pulmonary vein flow (S/D, atrial reversal AR) and tissue Doppler imaging (ed’ and e’a) of the lateral and septal mitral valve annulus.

Results: Assessment of diastolic function in patients with normal diastolic filling, impaired relaxation pattern and pseudonormal filling was as follows (table).

Conclusions: There is a poor correlation of indices of diastolic function in FP. Our findings suggest that the utility of most commonly used echocardiographic criteria to define diastolic dysfunction in FP is limited and should be used with caution.

Table

<table>
<thead>
<tr>
<th>Normal (n=24)</th>
<th>Impaired relaxation (n=10)</th>
<th>Pseudonormal filling (n=6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVRT</td>
<td>87%</td>
<td>78%</td>
</tr>
<tr>
<td>DT</td>
<td>95%</td>
<td>67%</td>
</tr>
<tr>
<td>E/A</td>
<td>91%</td>
<td>70%</td>
</tr>
<tr>
<td>S/D</td>
<td>91%</td>
<td>100%</td>
</tr>
<tr>
<td>Ar</td>
<td>25%</td>
<td>57%</td>
</tr>
<tr>
<td>TDI lateral ed’</td>
<td>91%</td>
<td>50%</td>
</tr>
<tr>
<td>TDI lateral e’a</td>
<td>91%</td>
<td>30%</td>
</tr>
<tr>
<td>TDI medial ed’</td>
<td>63%</td>
<td>100%</td>
</tr>
<tr>
<td>TDI medial e’a</td>
<td>38%</td>
<td>71%</td>
</tr>
</tbody>
</table>

Percentages of concordance between different indices of diastolic function.
571 Assessment of regional timing of left ventricular longitudinal movement by tissue synchronization imaging

Aim: To study the feasibility of a new semiautomatic echocardiographic modality called Tissue Synchronization Imaging (TSI) for measurement of the longitudinal left ventricular (LV) movement.

Methods and results: In 20 subjects with structurally normal hearts, TSI was used to measure the time aspect of the regional longitudinal LV systolic movement in the apical four chamber view, Inter- and intraobserver agreement and the beat to beat variation were tested and compared to previously manually measured peak systolic delay (PSD) between the interventricular septum (IS) and the lateral free wall (LFW) at basal and mid LV, respectively (n=19). TSI showed acceptable reproducibility and close correlation to manual measured PSD. The TSI method did not show false positive synchronous regional LV movement when synchrony was defined as a PSD of <25 ms. At the mean adjustment of the TSI interval, 76.9% of the synchronous LV patterns in basal LV were defined correctly.

Conclusions: The TSI method is accurate for clinical screening to reveal synchrony defined as a PSD of < 25 ms. At the present development the TSI method is not accurate enough to quantify regional systolic LV asynchrony, and for manual measurement of PSD is mandatory.

572 Are left ventricular filling pressures increased in systemic sclerosis with normal ejection fraction? A. Cohen. Saint-Antoine, Paris, France, 1Saint Antoine University, Paris, France

Introduction: Heart involvement, through pulmonary hypertension and left ventricular (LV) dysfunction is one of the main determinant of survival in patients (Pts) with systemic sclerosis (SS). The frequency of asymptomatic LV involvement is still debated. We undertook a case control study to evaluate LV filling pressures in Pts with proven SS and controls.

Methods: A comprehensive Doppler echocardiographic examination was undertaken in 69 SS Pts and 31 matched healthy subjects. The following trasmittal Doppler parameters were averaged on 3 consecutive beats: peak velocity during early (Em), E wave propagation velocity (Vp) and ratio (Em/Vp), atrial RV filling (Am) and ratio (Em/Am). Mitral annular velocities were obtained using Doppler myocardial tissue imaging, at its lateral site in early (Ea), late diastole (Aa) and ratio (Em/Aa). Tricuspid maximal regurgitation (TMR) velocity was used to assess the level of pulmonary pressure.

Results: Left ventricular ejection fraction (LVEF) and mass index (LVMI) were within normal limits. Conventional transmirtal Doppler parameters were not different in the 2 groups. Em/Vp, Em/Aa and TMR were significantly higher in SS Pts, although remaining within normal limits (table). Conclusion: Patients with SS and preserved LVEF exhibit a significant trend toward higher LV filling pressures compared with healthy subjects. This observation might reflect an early structural change related to microvascular myocardial damage.

Echocardiographic and Doppler parameters

<table>
<thead>
<tr>
<th>SS (N=69)</th>
<th>Controls (N=31)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>51±15</td>
<td>46±15</td>
</tr>
<tr>
<td>Mean LVMI (g/m²)</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td>Mean LVEF (%)</td>
<td>67±7</td>
<td>70±6</td>
</tr>
<tr>
<td>Em/Aa</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Mean left atrial area (cm²)</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>E/A ratio</td>
<td>1.62</td>
<td>1.34</td>
</tr>
<tr>
<td>Em/Am</td>
<td>6.75</td>
<td>5.76</td>
</tr>
<tr>
<td>TMR (m/s)</td>
<td>2.40±0.41</td>
<td>2.20±0.24</td>
</tr>
</tbody>
</table>

SS:systemic sclerosis.

573 Relationship of CA-125 levels with echocardiographic parameters of left ventricular function and filling pressures in patients with preserved ejection fraction
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Background: Carbohydrate antigen 125 (CA125) is a biological marker usually used for ovarian cancer diagnosis and monitoring. CA125 levels are increased in patients (pts) with heart failure (HF) and left ventricular (LV) systolic dysfunction, relating to HF severity and prognosis. Whether CA125 levels are associated with parameters of LV function and filling pressures in pts with preserved LV ejection fraction (EF) is not known.

Purpose: To assess the demographic, clinical, and echocardiographic predictors of CA125 levels in a consecutive series of pts with preserved LVEF.

Methods: We studied 45 consecutive pts with cardiac disease admitted in our Department (27 men, 74±10 years, referred for LV function assessment and having preserved LVEF (>-45%, mean 57±8%). All pts underwent a comprehensive echocardiographic study, including measurements of transmirtal flow: E, A, E/A ratio, EDV at baseline and during a standardized Valsalva maneuver; isovolumic relaxation time (IVRT); flow propagation velocity Vp by color M-mode; PW-pulmonary venous flow: S, D, Sm, D/S ratio, Ar; tissue Doppler Sm, Em, Am, and M-mode derived mitral annular plane systolic excursion (MACE) at four sites of the mitral annulus; LVEF and LV fractional shortening. Systolic pulmonary artery pressure (SAP) was estimated based on the tricuspid regurgitant jet velocity, Ed/Vp ratio; A duration; A velocity change and E/A change during Valsalva; mean Sm, Em, and MACE values; E/meanEm ratio were then calculated. Blood taken immediately before the echocardiography study was assayed for CA125 levels (ADVIA centaur, Bayer). Log-transformed CA125 values were used for statistical analysis because CA125 distribution was positively skewed.

Results: CA125 levels correlated with NYHA class (r=-0.4). In univariate regression analyses, the only significant correlates of CA125 levels were: A-wave velocity change during Valsalva (r=0.57, p<0.001), SAP (r=0.47, p=0.018), IVRT (r=0.33, p=0.054), and LVEF (r=-0.28, p=0.059). By stepwise multiple regression analysis, A-wave change during Valsalva emerged as the only independent predictor of CA125 levels (r=0.57, p=0.01).

Conclusions: In pts with preserved LVEF, CA125 levels correlate with symptoms and with echocardiographic parameters reflecting increased intracardiac pressures. The best independent predictor of CA125 levels was a validated noninvasive index of LV enddiastolic pressure: A-wave velocity change during a standardized Valsalva maneuver, reflecting the relation of CA125 with increased LV filling pressures in this setting.

574 Echocardiographic assessment of systolic and diastolic left ventricular function in children with scleroderma
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Heart pathology in children with scleroderma is poorly recognized. The aim of the study was to test the usefulness of echocardiographic assessment of systolic and diastolic performance of the left ventricle in this group of patients.

Methods: We studied 20 children with limited scleroderma (LS), age:13.6±2.9 years with no clinical signs or symptoms of heart disease. Control group (C) comprised 20 healthy children, age:13.6±2.9 years with no clinical signs or symptoms of heart disease.

Results: LV ejection fraction in LS, SS and C was: 70±10, 71±9 and 71±5 respectively, p=ns. E/A value (proportion of mitral inflow velocity in ventricular and atrial phase) was 1.59±0.3 and 1.58±0.3 for LS and SS respectively and was significantly lower in both groups in comparison to C: 1.85±0.3, p<0.01. ICT was 65±11 ms for LS and 64±11 ms for SS and was significantly longer than for C: 52±9 ms, p<0.05 for both LS and SS. IVRT was significantly longer in LS than in C: 80±12 ms vs 69±9 ms, p<0.05. ET was significantly shorter for SS as compared with C: 253±23 ms vs 271±16 ms, p<0.05. Tei index for both LS and SS was 0.55±0.1 and was significantly higher than for C: 0.4±0.1, p<0.05.

Conclusion: Echocardiographic assessment of systolic and diastolic parameters including the Tei index allows for early diagnosis of LV dysfunction in children with scleroderma even before clinical symptoms appeared. Interestingly LV dysfunction is present in both systemic and limited scleroderma.
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Relationship of carbohydrate antigen 125 levels with left ventricular diastolic dysfunction. Comparison with Doppler echocardiography

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Background: Carbohydrate antigen 125 (CA125) is a biological marker usually used for ovarian cancer diagnosis and monitoring. CA125 levels are increased in patients (pts) with heart failure (HF) and left ventricular (LV) systolic dysfunction, relating to HF severity and prognosis. However, the relation of CA125 with LV diastolic dysfunction (DD) has not been studied yet.

Purpose: To assess CA125 levels in patients with different degrees of LVDD.

Methods: 75 consecutive patients (53 men, 73±10 years), referred for LV function assessment were studied. A comprehensive Doppler echocardiography study was performed, including measurements of transmitral flow: E, A, E/A ratio, ED at baseline and during a standardized Valsalva maneuver; flow propagation velocity Vp; PW pulmonary venous flow: S, D, S/D ratio, Ar; M-mode derived mitral annular plane systolic excursion (MAPSE) at four sites of the mitral annulus; LV ejection fraction (EF). E/Vp ratio; Ar-A duration; A velocity change (Achange) and E/A change during Valsalva; mean MAPSE values were calculated. Right atrial (RAP) and systolic pulmonary artery pressures (SPAP) were estimated. Global LV diastolic function was staged as normal, stage 1 DD (E/A<0.75, Ar-A<0, Achange<0, E/Vp<1.5), stage 2 DD (E/A between 0.75 and 1.5, E dt<140, Ar-A>30, Achange<0, E/Vp<1.5), and stage 3 DD (E/A>1.5, E dt<140, Ar-A>30, Achange<0, E/Vp<1.5). At least 2 criteria consistent with stage 2 or 3 DD were required to be so classified. Blood taken at the time of echocardiography was assayed for CA125 levels (ADVIA centaur, Bayer). Log-transformed CA125 values were used for analysis because CA125 distribution was positively skewed.

Results: CA125 levels correlated significantly with LVDD stage (r=0.50, p<0.001). In univariate regression analyses, CA125 levels also correlated with LVEF (r=-0.41, p<0.001), mean MAPSE (r=-0.46, p<0.001), SPAP (r=-0.49, p<0.001), RAP (r=0.33, p=0.007), and NYHA class (r=-0.39, p=0.001). By stepwise multiple regression analysis LVDD was the only independent predictor of CA125 levels (r=-0.50, p=0.002). A CA125 value of 22 U/ml had a 70% sensitivity and a 78.4% specificity for detecting stage 2 and 3 LVDD (area under the ROC curve of 0.78).

Conclusions: CA125 levels are increased in proportion to the degree of LVDD. This study demonstrates the association of CA125 levels with parameters reflecting increased cardiac pressures and LV dysfunction. Properties of LV diastolic function may be an important determinant of CA125 levels, and measuring this inexpensive marker may be useful in detecting advanced stages of DD.

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Left ventricular dysfunction in experimental Chagas’ disease treated with Etanercept

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Purpose: Chagas’ disease affects more than 10 million people in Latin America. It leads to an inflammatory dilated cardiomyopathy in 30% of these patients as a late consequence of infection by protozoan Trypanosoma cruzi, producing worse outcome than other dilated cardiomyopathies. Previous animals studies have shown increased plasma levels of tumor necrosis factor in patients with chronic Chagas’ cardiomyopathy. The aim of this study was to evaluate the effect of Etanercept (soluble tumor necrosis factor receptor) on left ventricular (LV) function in T. cruzi-infected Syrian hamsters.

Methods: We studied by high-resolution echocardiography 60 female Syrian hamsters, divided into 3 groups: A) 20 control, B) 20 untreated T cruzi-infected, and C) 20 T cruzi-infected treated with Etanercept (2.5 mg/week over 10 weeks). The infected animals were peritoneal inoculated with T cruzi Y strain blood trypomastigotes. Echocardiogram was performed before infection, 8 months after infection (pre-treatment) and 11 months after infection (post- Etanercept treatment). We analyzed LV dimensions in diastole (LVDD) and in systole (LVSD), and fractional shortening (FS).

Results: Etanercept treated group presented a greater ratio of heart weight/ body weight (p<0.05) and a decrease in survival compared to other groups (p<0.05). Results are shown in table 1. (*p<0.05)

Conclusions: Etanercept treatment in experimental Chagas’ disease cardiomyopathy increased cardiac dilatation, LV dysfunction and mortality. This drug should be used with caution in patients with Chagas’ disease.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>LVDD (mm)</th>
<th>LVDD (mm)</th>
<th>LVSD (mm)</th>
<th>LVSD (mm)</th>
<th>FS (%)</th>
<th>FS (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.55</td>
<td>0.57</td>
<td>0.34</td>
<td>0.37</td>
<td>40.20</td>
<td>38.73</td>
</tr>
<tr>
<td>Infected</td>
<td>0.55</td>
<td>0.57</td>
<td>0.33</td>
<td>0.36</td>
<td>37.15</td>
<td>36.58</td>
</tr>
<tr>
<td>Infected+ Etanercept</td>
<td>0.54</td>
<td>0.63*</td>
<td>0.35</td>
<td>0.50*</td>
<td>38.55</td>
<td>21.97*</td>
</tr>
</tbody>
</table>

Echocardiographycal assessment of LV diastolic dimension, LV systolic dimension and fractional shortening before (6 months after infection) and after (11 months after infection) treatment with Etanercept.

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Usefulness of mitral anulus velocities for detection of rejection after heart transplantation

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Background: Endomyocardioal biopsy is a “gold standard” while diagnosing acute myocardial rejection. Tissue Doppler (TD) echocardiography allows detailed evaluation of overall left ventricular (LV) systolic and diastolic function. The objective of this study was to test the hypothesis that TD may play a role in the detection of LV dysfunction due to allograft rejection in heart transplant recipients.

Method and results: Peak systolic(S) and diastolic(E) mitral anulus velocities were measured by TD at the inferior site of mitral annulus and compared with results of the 320 endomyocardial biopsies (EMB). Doppler examinations and biopsies were performed at the same day. Biopsy was assessed according to International Society of Heart and Lung Transplantation biopsy grading. Student’s t-test was used for two-way comparison of data. Histologic analysis revealed 263 biopsies grade-0 (group-A), 47 biopsies grade-1’ (group-B) and 10 biopsies grade-2 or 3’ (group-C). Mean peak systolic velocity of the posterior mitral annulus was 125.52 mm/s in group A, reduced in group B to 118.12 mm/s (p<0.05), and diminished to 96, 67 mm/s in group C (p<0.05). Mean peak diastolic velocity in group A was 191.26 mm/s, whereas in group B decreased to 162.79 mm/s (p<0.05) and to 135.77 mm/s in group C (p<0.05).

Conclusions: Significant decrease of both systolic and diastolic mitral anulus velocities were detected in acute rejection grade-2-3. In rejection grade-1’ significant changes were found only in diastole. TD evaluation of the inferior mitral anulus velocities has the potential to discover the patients suffering from graft rejection. This may decrease the need of routine biopsies.
578 Asymptomatic left ventricular dysfunction in rheumatoid arthritis patients
Purpose: The incidence of rheumatoid arthritis (RA) is 1% and is associated with an excess mortality attributed to cardiac disease. It has been demonstrated that asymptomatic left ventricular dysfunction is associated with a high incidence of symptoms and death. We investigated the incidence of asymptomatic left ventricular systolic and diastolic dysfunction in this group using echocardiography. We also assessed the use of plasma BNP in these patients.
Methods: We recruited 26 asymptomatic patients fulfilling the ACR 1987 criteria for RA with no history of hypertension or heart disease. Clinical examination was performed to exclude any overt signs of heart failure. Standard echocardiography was performed, biventricular Simpson's method was used for volume assessment, diastolic function assessed via mitral valve Doppler indices with Valsalva manoeuvre if required. Left ventricular mass was calculated using the area length method. Blood was sampled for plasma BNP.
Results: 27% had impaired systolic function (EF < 50%), 42% diastolic dysfunction (30% impaired relaxation, 12% restrictive) and 54% left ventricular hypertrophy (mean mass 212 ± 68 g). BNP had a good linear correlation with EDV (r² = 0.63), moderately with ESV (r² = 0.62) and mass (r² = 0.40) but did not correlate with EF (r² = 0.00). When using a BNP level of 5 as a cut-off, BNP was 60% sensitive and 64.3% for the presence of systolic dysfunction.
Conclusion: There is a high degree of asymptomatic diastolic and systolic dysfunction in RA patients and also left ventricular hypertrophy, which may account for the excess mortality in this group. Plasma BNP may be a useful screening tool but may be less useful compared to non-rheumatic patients.

579 Longitudinal myocardial dysfunction in healthy older subjects as a manifestation of cardiac aging
Background: Abnormalities of longitudinal left ventricular (LV) contraction and relaxation may be early markers of cardiac disease. This study was designed to assess the relation between long-axis LV function and age in healthy subjects.
Methods: 118 healthy individuals aged 57 ± 19 years (range 20-90 years) with no evidence of cardiovascular disease underwent echocardiography with Doppler examination of transmural flow. To assess longitudinal LV function, systolic (Sm), early diastolic (Em) and late diastolic (Am) mitral annular velocities were measured using colour-coded tissue Doppler imaging.
Results: The left atrium was enlarged (p < 0.001) in subjects >/=60 years of age compared to those <60 years but there were no differences in LV volumetric indices and ejection fraction. Peak E velocity was lower (p < 0.001) and peak A velocity of transmural flow was higher in older subjects (p < 0.001) with a higher E/A ratio (p < 0.001) and longer isovolumic relaxation time (p < 0.001) indicative of impaired ventricular relaxation. Sm and Em mitral annular velocities decreased (p < 0.001) and Am velocity increased (p < 0.002) in the older group. Em velocity and Em/Am ratio showed a strong negative correlation with age (r = 0.80, p < 0.001 and r = 0.78, p < 0.001, respectively).
Conclusions: Global LV systolic function is preserved but long-axis systolic shortening is depressed in older individuals, indicating selective impairment of the longitudinal component of systolic contraction. The decline in early diastolic long-axis LV shortening and the changes in the pattern of transmural flow suggest impaired ventricular relaxation. These measures of cardiac function may be a useful index of normal cardiac ageing.

580 Diastolic function abnormalities in rheumatoid arthritis: relation with disease duration and severity
M. Abdellahim, A. Abber, A. Nabila. Cairo University, Cairo, Egypt
Background: Cardiac involvement is common in patients with rheumatoid arthritis (RA). Little is known about left ventricular diastolic function abnormalities in patients with RA.
Objectives: The aim of this study was to evaluate left ventricular filling abnormalities as early predictor of asymptomatic cardiac involvement in patients with RA.
Methods: This study enrolled 31 patients affected by RA and all had no evidence of cardiac disease, and compared with 10 age and gender matched control group. All patients were subjected to clinical evaluation and laboratory testing. All patients and control group were subjected to echo-Doppler study for assessment of the mitral flow and measurements of maximal early diastolic flow velocity (Peak E) (m/sec), maximal late diastolic flow velocity (Peak A) (m/sec), E/A ratio, the area under the atrial filling velocity curve (TVI of A) (m/sec). The total area under the mitral flow velocity curve (TVI of DF) (m/sec) and ratio of TVI of A /TVI of DF.
Results: There was a statistically significant impairment in left ventricular filling pattern in patients with RA compared to the control group as evidenced by decreased E/A ratio (0.96 ± 0.29 in the 31 RA patients versus 1.38 ± 0.19 in the control group, p = 0.0017). Also, there was a statistically significant difference in the TVI of A/TVI of DF (0.46 ± 0.16 in the patient group versus 0.33 ± 0.058 in the control group, p = 0.017). There was a significant negative correlation between the E/A ratio and the age of the patients with rheumatoid arthritis (p = 0.0181 & r = 0.4216). Interestingly, in patients with subcutaneous nodules, we found a significant correlation between E/A ratio and the number of swollen joints (p = 0.0341 & r = 0.3162). There was a significant correlation between TVI of A/TVI of DF and disease duration in patients with RA (p = 0.0029 & r = 0.46). There was a significant negative correlation between hemoglobin level and TVI of A/TVI of DF ratio (p = 0.00184 & r = 0.65).
Conclusions: The prevalence of diastolic dysfunction is high in patients with rheumatoid arthritis. This raises the importance of performing echocardiography in these patients particularly those with long disease duration, patients with seropositive sera especially when they have a concomitant of subcutaneous nodules and increased number of swollen joints.
Key words: Rheumatoid Arthritis - Early filling velocity - atrial filling velocity - Time velocity integral

582 Assessment of the presence of stress-induced pulmonary interstitial edema by chest ultrasound during exercise echocardiography in patients with heart failure
Background: Ecographic examination of lung surface may reveal multiple "comet-tail images" originating from water-thickened interlobular septa. Therefore, these images, which correlate with wedge pressure, could be useful for the non-invasive assessment of interstitial pulmonary edema.
Aim: To assess if, in patients with left ventricular systolic dysfunction, the appearance of "comet-tail images" during exercise indicates the appearance of interstitial pulmonary edema as result of impairment of hemodynamic response to exercise.
Methods: Fifty-three patients (mean age 66.5 ± 8.8 years) with rest ejection fraction 34.6 ± 8.6% underwent symptoms-limited exercise echo (30 watt/3 minute step). At rest and during exercise end-systolic (ESV), end-diastolic (EDV) volumes, stroke volume (SV) and systolic pulmonary artery pressure (sPAP) were calculated. The echographic chest examination were performed with Sonos 5500 in patients with the supine position at baseline and in the immediate post-exercise. The anterior and lateral chest scanning was obtained on the right and left hemithorax, from the second to the fourth (on the right side to the fifth) intercostal spaces, and from parasternal to midaxillary line. The number of comet-tail signs was recorded at the para-sternal, midclavicular, anterior axillary, and midaxillary sites. The sum of the comet-tail signs yielded a score denoting the extent of extravascular fluid in the lung.
Results: Comparing the values obtained at rest with those calculated at peak of the stress we found a reduction of EDV (180 ± 62.4 vs 168 ± 62.4 ml, p < 0.001) and ESV (121 ± 53.2 vs 110.3 ± 55.1 ml, p = 0.0001), an increase of sPAP (35.2 ± 10.5 vs 45.3 ± 20.7 mmHg, p = 0.0001) and no change in SV (32.1 ± 7.8 vs 32.6 ± 9.5 ml/m², p = ns). The "comet score" increased significantly from baseline to post-exercise (8 ± 16.9 vs 14.8 ± 23.8, p = 0.0001). Positive linear correlations were found between post-exercise comet score and peak stress EDV (r = 0.51, p = 0.0001) and peak stress ESV (r = 0.52, p = 0.0001) and between post-exercise comet score and peak sPAP (r = 0.57, p = 0.0001).
Conclusion: The comet-tail is a simple chest ultrasound sign of extravascular lung water that can be obtained also during exercise echocardiography and its evaluation could provide further information in the assessment of hemodynamic response to exercise in patients with heart failure.
583 Immunologic activation and myocardial remodeling in patients with heart failure
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Purpose: Immune-mediated regulation of myocardial collagen remains poorly understood. In a multicenter study we have determined the relationships between ventricular remodeling and the immunologic activation in patients with heart failure (HF), comparing dilated and ischemic cardiomyopathy.

Methods: We have studied 94 consecutive patients diagnosed of HF with dilated (n=46) and ischemic cardiomyopathy (n=48). We determined ejection fraction (LVEF), LV end-systolic volume index (LVESVI) and E/A. Plasma concentrations of TNF-α, sTNF-R1, sTNF-RII, IL-6 and IL-10 were measured. Serum amino-terminal procollagen type III levels (PIIINP) were calculated by radioimmunoassay.

Results: LVEF and LVESVI are higher in dilated cardiomyopathy compared with the ischemic group, p<0.05. However sTNF-R1, sTNF-RII and PIIINP were higher in the ischemic than in the dilated group (p<0.05). In the ischemic group, LVESVI correlated with IL-10 (r=0.41, p<0.05), and sTNF-RII (r=-0.31, p<0.05). PIIINP was found to correlate with sTNF-RII (r=0.28, p<0.05) and IL-6 (r=0.32, p<0.05) and sTNF-RII (r=0.33, p<0.05). In the group of dilated cardiomyopathy, LVEF and LVESVI correlated with IL-10 (r=0.39, p<0.05) and (r=0.36, p=0.05), respectively. PIIINP levels were found to do so with IL-6 (r=0.32, p<0.05) and sTNF-RII (r=0.32, p<0.05).

Conclusions: In HF the interaction of proinflammatory cytokines with extra-cellular collagen matrix results in progression of the syndrome and increase in ventricular remodeling. The immunologic implication is different depending on the etiology. Proinflammatory cytokines, TNF-alpha receptors and PIIINP levels are more elevated in the ischemic patients than in those with dilated cardiomyopathy. A more direct implication in LV remodeling was also found in the ischemic cardiomyopathy group.

584 Women with severely depressed left ventricular ejection fraction have less right ventricle dysfunction than men
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Objectives: To evaluate right ventricular dilatation and/or systolic dysfunction and its relation with invasively measured pulmonary pressures in men and women with severe left ventricular systolic dysfunction.

Background: Women with severe left ventricular systolic dysfunction have a better survival than men. Reasons for this are unknown. Right (RV) dysfunction is associated with higher mortality and worse clinical outcomes. The aim of our study was to compare RV dilation and dysfunction in men and women with severe LV dysfunction.

Methods: We studied 385 consecutive patients with left ventricular ejection fraction <35% and RV shortening fraction <25%, in whom invasive RV measurement was performed. The population of the study was divided into 4 groups: 1) 25 pts with normal diastolic function; 2) 36 pts with decreased peak-filling rate (DFR); 3) 33 pts with ‘‘impaired relaxation’’ (IR); 4) 11 pts with restrictive physiology (RF). Right atrial pressure (RAP), mean pulmonary artery pressure (mPAP) and mean pulmonary capillary wedge pressure (PVW) were measured. Significant functional mitral regurgitation (FMR) was defined as E/A<1.

Results: In all the groups, the data are presented as mean ± standard deviation. There were no differences between the 4 groups in age (61 ± 14 years), BMI (25 ± 3.8), LVEF (22 ± 4%), LVEDVI (131 ± 44), LVESVI (76 ± 27), RAP (18 ± 7), mPAP (35 ± 10) and PVW (15 ± 5). However, the RV end-diastolic pressure was significantly higher in pts with IR (23 ± 8) than in pts with normal (17 ± 7) or restrictive RV dysfunction (20 ± 6, p=0.03) and the RV systolic pressure was significantly lower in pts with IR (46 ± 21) than in pts with normal (53 ± 24) or restrictive RV dysfunction (54 ± 22, p=0.03). Pts with IR had a worse NYHA class, higher mPAP and RV systolic pressure, shorter exercise duration, more frequent use of beta-blockers and vasodilators.

Conclusions: In pts with severe LV dysfunction and normal RV filling pressures (E/A≥1), the presence of IR is associated with worse clinical outcomes and RV systolic dysfunction.

585 Clinical value of transmural inflow A wave deceleration time in the evaluation of diastolic dysfunction in patients with acute myocardial infarction

Purpose: Transmural inflow A wave deceleration time (Adt) is a promising doppler-parameter for the evaluation of left ventricular (LV) diastolic dysfunction. A negative correlation between Adt and the end-diastolic LV pressure has been found. The aim of the present study was to assess the Adt ability to detect the diastolic dysfunction type pattern in patients (pts) with acute myocardial infarction (AMI).

Methods: 105 consecutive pts (77 male) of mean age 60±10 years, with first AMI participated in the study. In terms of severity of diastolic dysfunction, the population of the study was divided into 4 groups: 1) 25 pts with normal diastolic function was regarded as control group (CG), 2) 36 pts with decreased peak-filling rate (DFR) 3) 33 pts with ‘‘impaired relaxation’’ (IR) (E/A<0.7, 4) 11 pts with restrictive physiology pattern (RF) (E/A>2, E-wave deceleration time<150 ms, Spv/Dpv>0.5). Besides the routine echo-doppler examination, Adt was also measured at rest and on the 8.07±0.96 post- MI day in all the subjects.

Results: The Adt in pts with IR (123±2 ms) was significantly prolonged in comparison to that of CG (87±1 ms), DFR group (99±2 ms) and RF group (84±1 ms, p<0.05). On the contrary, the Adt in RF group was shorter compared with those of either CG or DFR group (p<0.001 respectively), but was higher in DFR group in comparison to Adt value of CG (p<0.001).

Conclusions: 1) The Adt is a useful doppler-parameter for the detection of the type of LV diastolic dysfunction in pts with AMI. 2) A short Adt (<70 ms) characterized pts with RF, while a prolonged Adt (>115 ms) pts with IR.

586 Functional mitral regurgitation in idiopathic dilated cardiomyopathy; evolution and prognostic significance in tailored medical treatment
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Background: Functional mitral regurgitation (FMR) is frequent in dilated cardiomyopathy (DCM), mainly consequence of abnormal ventricular geometry and dilatation, and has adverse haemodynamic consequences and prognostic significance. Optimal treatment may decrease severity of FMR, mainly by improving ventricular abnormalities.

Aims of the study were to evaluate by means of Doppler echocardiography (echo) frequency and clinical characteristics of patients with DCM and significant FMR, evolution in tailored medical treatment and prognostic significance of FMR both at diagnosis and follow-up.

Methods and results: 415 pts with DCM were enrolled in Heart Muscle Disease Registry of Trieste since 1988, and evaluated at baseline and follow-up (6:1.4:2 months to 12 months, last follow-up) in medical treatment with ACE-I and beta-blockers. At enrolment 75% were males(45±15 years), NYHA III-IV in 27%, mean left ventricular ejection fraction (LVEF) 31%, restrictive filling pattern (RFP) in 32%, right ventricular (RV) dysfunction in 41%. Significant FMR (>1+ jet area ≥4 cm²) was present in 33% (2-24%), 3-4+ (9%). Pts with significant FMR had a worse NYHA class, longer history of HF, higher mean heart rate, lower systolic blood pressure, shorter exercise duration, less frequent treatment with beta-blockers; haemodynamically they were characterized by lower cardiac index and mean aortic pressure, and higher pulmonary artery and wedge pressures. At echo pts with significant FMR showed larger LV volumes, lower LVEF and RV shortening fraction, higher LV mass and sphericity index, larger left atrial area, and more frequent RFP. During follow-up (73 ± 42 months) 72 pts died (17%) and 34 (8%) were transplanted. Transplant-free survival was significantly lower in pts with significant FMR (p=0.0003). At 6 month follow-up LV volumes, sphericity index, mass and FMR jet area significantly decreased. LVEF, RV function and E-deceleration time increased. These improvements were maintained at follow-up. At multivariate analysis, in a model incorporating data at diagnosis and at 6 months, FMR area at 6 months was among the parameters significantly correlating with prognosis.

In conclusion, significant FMR is frequent in DCM, and it is associated with a worse functional and haemodynamic status and a more severe ventricular dilatation, dysfunction and remodelling. It frequently improves during follow-up in tailored medical treatment, with improvement of LV remodelling and function. Persistence of significant FMR at follow-up is an independent adverse prognostic sign for mortality and heart transplantation.
587 Pseudo-normal pattern of mitral valve infl ow - Is it caused by fluid retention? The changes after diuretic treatment (A. Lichodziejewska, K. Kurnicka, A. Lipinska, K. Grudzka, M. Czuryzych, J. Malysz, K. Koczaj-Bremier, D. Lisiewska-Pfiejler, Medical University, Warsaw, Poland, 4 Medical University, Warsaw, Poland)

Slowed left ventricle (LV) relaxation reflects a mild diastolic function (DF) impairment and occurs in age >55. Pseudonormalisation (PN) of mitral valve infl ow (MVF) in these persons suggests left atrial pressure (LAP) and LV diastolic pressure elevation and may be combined with slight signs of heart failure (HF). The aim of our study was to examine the effect of diuretics (DT) on ECHO parameters of LV-DV in patients pts with low exercise tolerance (ET) and PN of MVF.

Material and methods: The study group (S) consisted of 20 pts (14 F, 6 M; age: 68 ±16) with well-controlled mild/moderate hypertension (HA) and/or ischaemic heart disease (IHD) and/or diabetes 12(NIDDM) with low ET and PN of MVF in ECHO. Pts with any other disease, marked LV hypertrophy (>14 mm) and LV systolic dysfunction were excluded. The control group (C) completed 20 healthy persons with no complaints (14 F, 6 M; age: 69±15). In ECHO the parameters of MVF and pulmonary vein infl ow (PVF) were assessed. In S the first ECHO (S-I) was made before, and the second (S-II) after 2 weeks of DT treatment.

Results: Group S-I showed PN of MVF. The ratio of maximal velocity (Vmax) to early infl ow (E) and atrial reversal flow (A) was greater than 1 (1.2 ±0.1) and significantly higher than in C (0.8 ±0.2; p<0.001). Delay time of E (DcT; ms) in S-I was shorter than in C (232±148; p<0.001) and DcT was significantly longer (240.9±41.7; p<0.001) than in S-I. Isovolumic relaxation time (ms) in S-I was longer than in SII (78.2±11.4 vs. 69.5±10.2), but not significantly (NS). In S-I the PVF profile suggests slightly increased diastolic infl ow (E) and slightly decreased pulmonary vein infl ow (PVI) and Vmax of systolic infl ow (S) in S-I was higher than in S-II (52±16 vs. 37±18; p<0.03) and Vmax of diastolic infl ow (D) in S-I was higher than in S-II (25±16 vs. 7±6; p<0.001). The ratio of atrial reversal flow in S-I was greater than 1 and not differ significantly from C. Vmax of atrial reversal infl ow in S-I was greater than in S-II (33±5 vs. 30±5; NS). Hence after DT an expected diastolic infl ow pattern for the patient's age returned and also ET improved. Blood pressure and heart rate did not differ significantly.

Conclusions: In pts >55 years with compensated HA, IHD, NIDDM with low ET and PN of MVF treatment with DT improve ET and returns E/A; for this age group S-I. These results suggest that the fluid retention may be the reason of PN of MVF. 3. The assessment of MFV and PVF in pts with slight HF symptoms is a good method to reflect abnormal LV-DV and treatment efficiency.

588 There is an association of left ventricular diastolic function with heart rate variability in patients with systolic heart failure (E. Strzobinska-Migaj, A. Szyzko, H. Wochowicz-Baszynska, A. Baszko, R. Ochotny, Poznan, Poland, 4 Poznan, Poland, 5 Herzzentrum Berlin, Berlin, Germany, 6 Hospital General, Alicante, Spain, 7 Hospital General, Valencia, Spain, 2 Hospital La Fe, Valencia, Spain, 3 Hospital Peset, Valencia, Spain, 1 Hospital La Fe, Valencia, Spain, 8 Hospital Elche, Elche, Spain, 9 Hospital S Juan, Alicante, Spain, 10 Hospital General, Alicante, Spain, 11 Hospital General, Valencia, Spain)

Left ventricular diastolic dysfunction is common in patients with systolic heart failure. The restrictive filling pattern appears to be associated with advanced heart failure (HF) and may be related to the elevation of left atrial pressures. If left ventricular (LV) filling is assessed with Doppler echocardiography with assessment of restrictive filling pattern (E/A ratio) during end-stage heart failure appeared to be mainly related to the significant decrease of the IVRT, which was 115.3±20.1 ms in group A and 61.0±12.0 ms in group B patients.

Conclusions: In patients with severe LV systolic dysfunction (LVEF <35%) due to progressive shortenings of transmitral flow (E/A velocity ratio >2, E-wave deceleration time <150 ms) the shortening of the Tei index during end-stage heart failure appeared to be mainly related to the significantly lower (P<0.001) shortening of the Tei index, which was 115.3±20.1 ms in group A and 61.0±12.0 ms in group B patients.

589 NT-proBNP levels are related with ventricular volume indexes in patients with heart failure and troponin T and with matrix turnover in patients with positive troponin T (M. Rivera, R. Cortes, M. Portolés, M.J. Saracho Tello, B. Sevilla, F. Garcia de Burgos, R. Valero, V. Climent, R. Paya, A. Jordan, Hospital La Fe, Valencia, Spain, 2 Hospital La Fe, Valencia, Spain, 3 Hospital Peset, Valencia, Spain, 4 Hospital Elche, Elche, Spain, 5 Hospital S Juan, Alicante, Spain, 6 Hospital General, Alicante, Spain, 7 Hospital General, Valencia, Spain)

The clinical value of the Tei index is controversial, mainly because of the misleading changes during severe congestive heart failure. The measurement of cardiac troponin T (tnt-T) is a method for predicting outcome in patients with suspected unstable angina or myocardial infarction without persistent ST-elevation. It has also been used to stratify risk in patients with compromised heart function (HF). Aminotransferase (ALT) as a marker of this enzyme, which has been used as an indicator of collagen matrix turnover, NT-proBNP plasma levels are increased in ventricular dysfunction and HF and may be related with an increase in PIINP levels in tnt-T (+). In a multicenter study we have compared, in a cohort of patients with HF, NT-proBNP, PIINP, left ventricular end-systolic volume and end-diastolic volume indexes (LVEF, LVEDVI, LVEFct, EF, E/A and deceleration time (DT) in tnt-T (+) and tnt-T (-) patients.

Methods: We have studied 114 patients (82 males, 32 females, age 64 ±13, (27-87), diagnosed of heart failure (6 hospitals in the study). Patients were classified according to the NYHA. A specific questionnaire, modified Naughton protocol and echo-Doppler study were also performed on these patients. We collected blood samples that were analyzed at the same hospital and nt-T (ng/ml), NT-proBNP (pg/ml), PIINP (pg/ml) and LVEF, E/A (mm²), LV systolic dysfunction were excluded. The control group (C) completed 20 healthy persons with no complaints (14 F, 6 M; age: 69±15). In ECHO the parameters of MVF and pulmonary vein infl ow (PVF) were assessed. In S the first ECHO (S-I) was made before, and the second (S-II) after 2 weeks of DT treatment.

Results: Group S-I showed PN of MVF. The ratio of maximal velocity (Vmax) to early infl ow (E) and atrial reversal flow (A) was greater than 1 (1.2 ±0.1) and significantly higher than in C (0.8 ±0.2; p<0.001) and DcT was significantly longer (240.9±41.7; p<0.001) than in S-I. Isovolumic relaxation time (ms) in S-I was longer than in S-II (78.2±11.4 vs. 69.5±10.2), but not significantly (NS). In S-I the PVF profile suggests slightly increased diastolic infl ow (E) and slightly decreased pulmonary vein infl ow (PVI) and Vmax of systolic infl ow (S) in S-I was higher than in S-II (52±16 vs. 37±18; p<0.03) and Vmax of diastolic infl ow (D) in S-I was higher than in S-II (25±16 vs. 7±6; p<0.001). The ratio of atrial reversal flow in S-I was greater than 1 and not differ significantly from C. Vmax of atrial reversal infl ow in S-I was greater than in S-II (33±5 vs. 30±5; NS). Hence after DT an expected diastolic infl ow pattern for the patient's age returned and also the ET improved. Blood pressure and heart rate did not differ significantly.

Conclusions: In pts >55 years with compensated HA, IHD, NIDDM with low ET and PN of MVF treatment with DT improve ET and returns E/A ratio for this age group. These results suggest that the fluid retention may be the reason of PN of MVF. 3. The assessment of MVF and PVF in pts with slight HF symptoms is a good method to reflect abnormal LV-DV and treatment efficiency.
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Independent and incremental prognostic value of early mitral annulus velocity in patients with impaired left ventricular systolic function
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Objectives: This study sought to investigate the incremental prognostic value of non-invasive measure of early myocardial relaxation and left ventricular diastolic pressure in patients with impaired left ventricular (LV) systolic function.

Background: The early diastolic mitral annulus velocity (Em) reflects myocardial relaxation and is relatively load-independent in presence of impaired LV relaxation and compliance. The combined ratio of the early transmitral flow velocity (E) to Em~15 correlates well with elevated mean LV diastolic pressure. We hypothesized that both Em and E/Em would predict poorer survival in patients with LV systolic dysfunction.

Methods: Echocardiograms were prospectively obtained in 182 patients with impaired LV systolic function, defined as an LV ejection fraction (LVEF) <50%. Patients were followed for a median of 48 months. The end point was cardiac mortality. Results were analyzed at intermediate and long terms.

Results: 27 patients (15%) died in the initial median follow-up of 19 months. An E/Em ratio >15 was the strongest independent predictor of cardiac deaths (hazard ratio 1.03, 95% confidence interval 1.01 to 1.06). The addition of the E/Em ratio >15 to the clinical and echocardiographic model provided incremental information in predicting cardiac mortality. 9 more cardiac deaths (total 36 cases/20%) occurred at the end of the follow-up period. Em emerged as an independent predictor of survival (hazard ratio 0.61, 95% confidence interval 0.45 to 0.82). The addition of Em <3 cm/s ((log-rank statistic 8.9, p <0.003) was associated with excess mortality and further improved the prognostic utility of the above model (p=0.038).

Conclusions: Both E/Em >15 and Em <3 cm/s are powerful predictors of cardiac mortality in patients with LV impairment. Em provides incremental prognostic data at intermediate term whereas Em emerges as the best prognosticator in long-term follow-up, incremental to other clinical or echocardiographic variables, including the ratio E/Em.

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Prognostic value of the manoeuvre of Valsalva in patients with systolic dysfunction
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Purpose: To investigate the prognostic value of the changes induced by the maneuver of Valsalva (MV) on the left ventricular filling in patients with systolic dysfunction and either pseudonormal or restrictive patterns.

Methods: 36 patients were included, with sinus rhythm, dilated left ventricle, depressed ejection fraction and E/A ratio bigger than 1. Filling velocities were recorded before and after three non-standardized MV, as deep and as possible, during at least 6 seconds, and the lowest E/A ratio was considered. When patients were included after an episode of heart failure, echo was performed before discharge, once treated. The velocity of propagation of E wave was measured to exclude normal filling patterns.

Results: The E/A ratio remained bigger than 1 in 12 patients (group A) and turned into an abnormal relaxation pattern in 24 (group B). 6 patients showed a restrictive pattern. During a mean follow up of 18 months 8 patients died, 6 in group A (67%) and 2 in group B (83%, p 0.005). In restrictive group, 5 in pseudonormal, 12 patients died or suffered severe heart failure, 8 in group A (67%) and 4 in group B (17%, p =0.003). The reversibility of the filling pattern was associated with lower risk of death and both hospitalization and death (HR 0.06, 95% CI 0.01-0.48 and 0.11, 95% CI 0.03-0.43, respectively). The presence of a pseudonormal filling pattern was also associated with a significant increase of survival versus restrictive pattern (HR 0.21, CI 95% 0.05-0.97). Multiple regression analysis, including peak E velocity, peak A, E wave deceleration time and ejection fraction showed that the reversibility after the MV was an independent predictor of survival.

Conclusion: The transformation of a pseudonormal or restrictive filling pattern in an abnormal relaxation pattern after a maneuver of Valsalva predicts a lower risk of death or severe heart failure in the population with systolic dysfunction.

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In patients with heart failure, left ventricular cavity area reflects N-terminal pro-brain natriuretic peptide plasma levels

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Purpose: N-terminal pro-brain natriuretic peptide (NT-proBNP) may be used in the diagnosis of heart failure (HF) and ventricular dysfunction. Left ventricular (LV) functional parameters (LV end-diastolic and end-systolic volume indexes, LV ejection fraction, atrio-ventricular plane displacement) have been shown to correlate with the peptide levels. LV two-dimensional cavity area from end diastolic (LVEDA) and end systolic (LVESA) and LV fractional area change (LVFAC) reflects changes in LV morphology and function without using geometric assumptions.

Methods: We have studied 114 patients diagnosed of heart failure (82 males, 32 females), age 64±13, (27-87), (6 hospitals were involved in the study). A specific questionnaire, modified Naughton protocol and echo-Doppler study were performed on these patients. We also collected blood samples to determine NT-proBNP (pg/ml). LVEDA (cm²), LVESA (cm²), LVFAC, LVEDA/m² (LVEDA), LVESA/m² (LVESA) and ejection fraction (EF) were also calculated.

Results: For the whole population, NT-proBNP was 1381±1751, EF 38±11, LVEDA 43±13, LVESA 33±11 and LVFAC 25±9. When we compared NT-proBNP with LVEDA we found r=-0.3 p<0.01, with LVESA, r=-0.4, p<0.0001 and with LVFAC, r=-0.4, p<0.0001. When we compared NT-proBNP with LVEDA and LVESA we found r=-0.4, p<0.0001 and r=-0.5, p<0.0001, respectively.

Conclusions: In this multicenter study we found a good correlation of NT-proBNP plasma levels with LV two-dimensional cavity areas (LVEDA, LVESA) and LVFAC. The correlations improved when we normalized the peptide values by body surface area. These results must be further studied for their potential diagnostic and prognostic consequences.

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Relation between levels of Carbohydrate Antigen 125, brain natriuretic peptide and echocardiographic parameters in heart failure patients
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Background: Recent studies showed that serum levels of the tumoral marker Carbohydrate Antigen 125 (CA125) are increased in patients (pts) with congestive heart failure (CHF). There is little information, however, on the relation between CA125 and Brain Natriuretic Peptide (BNP), well known marker of CHF. Aim of the present study is to evaluate the relationship between CA125/BNP levels, echocardiographic parameters and symptoms in pts with different degrees of CHF.

Methods: We studied a series of 71 consecutive pts (51 males; 20 females; mean age 72±10 years) with different degrees of CHF (NYHA I-II: 38; III: 24; IV: 9 pts). A history of coronary artery disease was present in 55 pts (77%). All pts underwent independent evaluation of symptoms, transthoracic echocardiography, and measurement of serum levels of CA125 (ADVIA centaur, Bayer) and BNP (ADVIA Centaur; Bayer).

Results: Mean values of both CA125 and BNP increased progressively with the NYHA Class (see table 1). A direct linear correlation was found between CA125 and BNP (r=0.58; p<0.001). A significant correlation was observed between left ventricular ejection fraction and both BNP (r=-0.51; p<0.001) and CA125 (r=-0.36; p<0.01). E wave deceleration time was correlated significantly only with BNP (r=-0.31; p=0.05), while the correlation with CA125 was weaker (r=-0.24; p=0.055). Both markers were significantly correlated (p<0.05) with mitral regurgitation (MR): MR 0-1/3: BNP 286±726, CA125 22±27, IM 2/3: BNP 932±1209, CA125 34±35, IM 3/3: BNP 894±1686 pg/ml, CA125 73±139 U/ml.

Conclusions: Serum levels of CA125 are significantly correlated with NYHA class in pts with CHF, showing a BNP-like behaviour. The values of this “new” marker are directly correlated with BNP levels. Both CA125 and BNP are correlated with ejection fraction and MR. BNP seems to be more correlated than CA125 with deceleration time of mitral E wave. Further studies are needed to clarify if CA125 could provide additional information for the best clinical management of pts with CHF.

Table 1

<table>
<thead>
<tr>
<th>NYHA I-II</th>
<th>NYHA III</th>
<th>NYHA IV</th>
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<tbody>
<tr>
<td>Ca 125 (U/ml)</td>
<td>19±25</td>
<td>30±30</td>
</tr>
<tr>
<td>BNP (pg/ml)</td>
<td>191±208</td>
<td>424±429</td>
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p<0.001
Abstracts

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Big endothelin-1 and N-terminal pro-brain natriuretic peptide plasma levels. Its relationship with systolic and diastolic function in subjects with heart failure

M. Rivera, R. Cortes, M. Portoles, A. Jordan, B. Sevilla, V. Climent, R. Peset, R. Valero, F. Sogorb, V. Miros, Hospital La Fe, Valencia, Spain, 1Hospital La Fe, Valencia, Spain, 2Hospital Etche, Etche, Spain, 3Hospital Peset, Valencia, Spain, 4Hospital General, Alicante, Spain, 5EYES, Valencia Spain, 6Hospital S Juan, Alicante Spain, 7Hospital La Fe, Valencia Spain

Purpose: The endothelin (ET-1), a potent vasoconstrictor, is activated in heart failure (HF) and its levels have been used as prognostic factor and target for therapeutic interventions. Natriuretic peptide (NT-proBNP) plasma levels are increased in ventricular dysfunction and HF and may be related with an increase in ET-1. We have compared in a multicenter study, big ET-1 with NT-proBNP and aldosterone plasma levels and with ventricular function parameters, ejection fraction (EF), mitral flow propagation velocity (Vp) and atrioventricular plane displacement (AVPD).

Methods: We have studied 103 patients (78 males), that had been diagnosed of heart failure (6 hospitals were involved in the study). A specific questionnaire and echo-Doppler study were performed on these patients. We also collected blood samples and patients were classified according to the NYHA. All plasma samples were centrally analyzed and NT-proBNP (pg/ml), aldosterone (pg/ml) and big ET-1 (fmol/ml) were determined. EF, AVPD (mm) and Vp (cm/s) were also calculated.

Results: For the whole population, big ET-1 was 1.03±0.75, NT-proBNP 1304±1658, aldosterone 168±102. EF 37±11, Vp 37±11 and AVPD 8±1.7. When we correlated big ET-1 with NT-proBNP we found r=0.5, p<0.0001, with EF, r=-0.3, p<0.01, with Vp r=-0.3, p<0.01 and with AVPD r=-0.21, p<0.05. Big ET-1 relationship with aldosterone was NS.

In the dilated cardiomyopathy subgroup, we found r=0.6, p<0.0001 with NT-proBNP. When dividing big ET-1 levels (Pc 25.64, Pc 50 0.86, Pc 75 1.19) in quartiles and compared with the corresponding NT-proBNP, EF, Vp and AVPD values, we found p<0.0001, p<0.01, p<0.05 and p<0.05, respectively.

Conclusions: In this multicenter study we found a good correlation of big ET-1 and NT-proBNP plasma levels. Big ET-1 is inversely related with EF, Vp and AVPD. These findings give us new insights of the ventricular function relationships with the neurohormonal activation implicated in the HF progress and may help in the search for therapeutic interventions.

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Can brain natriuretic peptide be used to reduce pressure on the echocardiography in patient service?

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Introduction: Demand for echocardiography in hospitalised patients places a great burden on cardiology departments, prolongs in-patient stay and delays clinical decision-making. Brain natriuretic peptide (BNP) is used as a ‘rule out’ test in patients with suspected heart failure. Can BNP level perform a similar role in patients referred for in-patient echocardiography?

Aims: To assess 1) proportion of referred patients with BNP levels below the cut-off level of 100 pg/ml, 2) frequency of major echocardiographic abnormalities (MEA) that may alter in-patient management.

Methods: Blinded BNP measurement in 100 consecutive in-patients attending for echocardiogram at a University Teaching Hospital. Patient demographics, indication for echo and results were recorded. Sub-group analysis was performed in those referred for LV function assessment or suspected valvular heart disease (LV/Valve group). MEA recorded were a) moderate or severe LV systolic dysfunction (LVSD) b) LV dilatation c) moderate or severe left heart valvular stenosis or regurgitation, d) estimated pulmonary artery systolic pressure >50 mmHg e) severe right heart lesion f) large pericardial effusion.

Results: 36% of all tested and 37% of LV/Valve group had BNP levels <100 pg/ml. MEA were found in 2 patients with BNP<100 pg/ml cf. 35 with BNP>100 pg/ml (P<0.0001). Mild LVSD detected in 6 (17%) patients with BNP<100 pg/ml cf. 15 (37%) with BNP>100 pg/ml (P>0.07). In LV/Valve group MEA found in 2 (7%) patients with BNP<100 pg/ml cf. 23 (53%) with BNP>100 pg/ml (P<0.0001).

Conclusion: A high proportion of patients referred for in-patient echo have normal BNP levels. In these patients, major echocardiographic abnormalities are unlikely. The safety of BNP screening in this setting warrants large-scale study.

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BNP level and left ventricular posterior wall and interventricular septal thickness

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Background: Secretion of BNP is reportedly regulated by left ventricular wall tensions but there are few studies on the relationship between ventricular structure and BNP level. This study analyzes the impact of interventricular septal thickness (IVST) and left ventricular posterior wall thickness (LVPWT) on BNP level.

Methods: Data on 182 inpatients admitted for CHF with a BNP >100 pg/ml was collected for the period from January and May 2004 and analyzed for BNP level, serum creatinine, BUN, LVEF, left ventricular end systolic and diastolic volume, IVST, and LVPWT. A BNP level of 500 pg/ml was used to divide the patient population in to two groups. Data was analyzed using SPSS 10.0.

Results: Linear regression analysis demonstrated that LVEF (r=-2.38 p<0.02) is an independent predictor of BNP >500 pg/ml. In addition to EF, our study found IVST >10 mm (r=-1.78, p<0.05) and LVPWT (r=-1.34, p<0.08) to be independent predictors of a BNP >500 pg/ml. The inverse association between BNP and LVPWT was further strengthened for individuals with LVPWT <10 mm (r=-1.88, p<0.06).

Conclusion: Although LVEF is the single most important predictor of BNP level, increased posterior wall tension indicated by decreased left ventricular posterior wall thickness, and increased interventricular septal thickness of >10 mm are other predictors of higher BNP level in patients with CHF.

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The correlation between N Terminal proB Natriuretic Peptide (NTproBNP)and abnormal left ventricular dimensions in patients with suspected LV impairment in the community. Prospective comparative study

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Objectives: To determine the correlation between NT proBNP levels in patients referred from the community with symptoms and signs of suspected left ventricular (LV) impairment and LV systolic and diastolic dimensions.

Study design and method: Patients referred by their GP to cardiac clinics with new onset symptoms and signs of LV impairment were considered for the study.

All patients underwent a full cardiologic assessment that included history and examination, echocardiography (to determine ejection fraction and 2D parasternal long axis LV systolic and diastolic dimensions) and measurement of NT proBNP using Roche Elecsys assays. Subjects with raised creatinine >1.40 were excluded as NT proBNP is predominantly renally cleared. NT proBNP was particularly used because of the superior sample stability.

EF of less than 50% was used as a cut off value for diagnosing impaired left ventricular function on echocardiography. Normal dimensions were estimated from previous population studies (LVED 4-5.5 cm, LVES 2.5-4.0 cm). Based on Receiver Operator Curve (ROC) NT proBNP level of 125 pg/ml was taken as the cut off value for normal LV function.

Sensitivity and specificity of NT proBNP for increased LV 2-D dimensions were determined using ROC curve. Negative & positive predictive values were calculated. Likelihood ratios were also calculated to indicate how much the probability of dilated LV changes from baseline when the NT proBNP result is high.

Results: A total of 220 patients were included. Mean age was 66. 45% females.

ROC curve shows that NT proBNP level of 125 pg/ml is 87.5% sensitive and 46% specific for abnormal end diastolic dilatation. It is 100% sensitive and 50% specific for abnormal end systolic dilatation. NT proBNP is a marker for cardiac remodelling therefore more studies are required to look at LV mass and volume.
Results: 50% were calculated to determine the ability of NT pro BNP in picking up and positive predictive values of NT pro BNP at the cutoff level for EF determined in previous population study. Sensitivity, specificity, negative Receiver Operator Curve (ROC) was established to determine the most nine Patients with establishes diagnosis of heart failure and patients with creatinine. Echocardiography was used to determine 2D EF and long axis examination, echocardiography, ECG, CXR, NT proBNP level and serum Background and aim of study: Ventricular systole involves longitudinal of NT BNP at level of 125 for abnormal long axis function was 98%, 50 patients had Long axis M-mode amplitude measurements. Sensitivity of NT BNP at level of 125 for abnormal long axis function was 98%, specificity 80%, NPV 99% and PPV of 76%. Conclusion: NT pro BNP is highly sensitive with high NPV for abnormal long axis function. Results are comparable to 2-D EF. Specificity and PPV are not very good. This confirms that NT proBNP is a very good rule out test for left ventricular impairment at an early stage.

Methods: During 2003 we enrolled 192 consecutive patients with b-TM that visited our Institution for routine examinations. The Institution is considered the major reference center for b-TM in Greece. Of the 192 patients, 86 were men (25-67 years old) and 104 women (26-65 years old). By tissue Doppler imaging (TDI), systolic myocardial velocities were sampled continuously in the RV (Stv) and LV (Smv) free wall. From the apical four-chamber view early colour M-mode Doppler flow propagation (Ep) through the left ventricle was recorded, as an index of left ventricular global function and suction.

Results: Multiple linear regression analysis showed that BNP levels were inversely associated with Stv (b = -0.12, p = 0.008), Smv (b = -0.11, p = 0.03), Ep (b = -0.23, p = 0.001) and left ventricular ejection fraction (b = 0.1, p = 0.026), after controlling for age, sex, ventricle. The echocardiographic parameters are not very good. (Table 1).

Method: Patients referred from the community with new onset symptoms or signs of suspected left ventricular impairment were considered for this study. They underwent full cardiovascular assessment including clinical examination, echocardiography, ECG, CXR, NT proBNP level and serum creatinine. Echocardiography was used to determine EF and long axis amplitudes of lateral, septal, inferior and anterior walls using M mode. NT proBNP was measured using Roche Elysys immunoassay. Patients with establishes diagnosis of heart failure and patients with creatinine >140 were excluded as BNP is renally cleared. Receiver Operator Curve (ROC) was established to determine the most sensitive and specific cut-off point for NT proBNP level in relation to EF of 50%. Mean M mode long axis amplitude of all walls was calculated for each patient and this was regarded abnormal if it was less than 2 mm as determined in previous population study. Sensitivity, specificity, negative and positive predictive values of NT proBNP at the cutoff level for EF of 50% were calculated to determine the ability of NT pro BNP in picking up patients with abnormal long axis function

Results: 220 patients were included. 45% females. 125 mg/dl was found to be the most sensitive and specific cutoff level for EF of 50% (97% & 78% respectively).

50 patients had Long axis M-mode amplitude measurements. Sensitivity of NT proBNP at level of 125 for abnormal long axis function was 98%, specificity 80%, NPV 99% and PPV of 76%.

Conclusion: NT pro BNP is highly sensitive with high NPV for abnormal long axis function. Results are comparable to 2-D EF. Specificity and PPV are very good. This confirms that NT proBNP is a very good rule out test for left ventricular impairment at an early stage.

Methods: We studied 80 patients with dyspnea referred for echocardiography to evaluate left ventricular function. Patients with abnormal systolic function or any systemic disease were excluded. Serum levels of N-terminal pro-brain natriuretic peptide (NT pro-BNP) and Brain Natriuretic peptide (BNP) were measured at the same time of the echocardiography study. Patients were classified according diastolic filling pattern, pulmonary vein velocity, and doppler tissue imaging (DTI).

Results: Patients with diastolic dysfunction had higher BNP and NT-proBNP levels. The BNP and NT-proBNP levels had a positive correlation with the index of early left ventricular filling (E velocity) that combined with pulsed tissue doppler in the annulus peak E velocity (E/e).
Correlations of proBNP level and heart failure in atrial fibrillation


The role of natriuretic peptides (proBNP) in the diagnosis and prognosis of heart failure is well known, but there are controversial data in patients with atrial fibrillation (AF).

The aim of our prospective study was to determine in patients with AF the correlation between the clinical signs, the left ventricular ejection fraction (EF), measured by transthoracic echocardiography (TTE), and the proBNP level.

Methods: The patients after cardioversion were divided into the proBNP levels: 1) > 45% (59 patients: 48-NYHA I, 11-NYHA II-III), group I. 2) EF > 45% (14 patients: 6-NYHA I, 8-NYHA II-III). ProBNP (Roche) was determined by immunoassay (normal values 84-222 pg/ml) before cardioversion (day 0) and after at day 30. 60 patients were present at the day’s control, amongst them 46 have sinus rhythm (SR). Mann-Whitney t test, the Kruskal-Wallis test and the statistical analysis.

Results: There was a good correlation between the proBNP level and the NYHA class at day 0, (NYHA/patient number/proBNP: 1/54/170), 11/3 199/42, p = 0.0001) and there were significant differences between the proBNP level of patients with SR and AF (173 ± 321 versus 199 ± 109, p = 0.0023). There was significant difference between the proBNP levels measured at day 0 and day 30 in the 46 patients with SR (314 ± 311 versus 173 ± 321, p = 0.0148) both in 36 patients with EF > 45% (p = 0.023) and in 10 patients with EF < 45% (p = 0.001). However, there were no difference between the proBNP levels at day 0 and day 30 in 14 patients with AF (219 ± 172 versus 199 ± 109, p = 0.641). There was no correlation at day 30 between the proBNP level and heart rate neither in patients with SR (p = 0.610) nor in patients with AF (p = 0.986).

Conclusions: The proBNP levels of patients with AF are in good correlation with the NYHA stage, and the EF. ProBNP level decreases in maintained SR. This decrease is not dependent on the EF and the heart rate. The proBNP level is higher in AF than in SR.

606 Higher level of BNP is seen in congestive heart failure patients with echocardiographic evidence of pulmonary hypertension

R. Shrivastava, S. Nannapaneni. Unity Health System, Rochester, United States of America

Background: Congestive heart failure (CHF) patients with low ejection fraction (EF) usually have higher brain natriuretic peptide (BNP) level, whereas patients with normal EF may have a wide range of BNP. This study was done to find out the impact of different clinical and echocardiographic variables on degree of BNP elevation in CHF patients with EF > 45%.

Methods: Information was collected on all patients admitted to general medical floor with CHF (BNP > 100 pg/ml) from January to May 2004. Data was analyzed for correlation between BNP level and gender, clinical and radiographic evidence of chronic obstructive pulmonary disease (COPD), and echocardiographic evidence of left ventricular diastolic dysfunction and pulmonary hypertension in patients with left ventricular EF > 45% using SPSS 10.0.

Results: Of the 234 patients (mean age 78 years) fulfilling eligibility criteria 110 had EF > 45% and 124 had EF > 45%. BNP level was significantly higher in patients with EF < 45%. Amongst patients with EF > 45% female patients had significantly higher BNP level. It was not significantly different in patients with or without diastolic dysfunction. Patients with pulmonary hypertension had significantly elevated level of BNP whereas a higher level was also seen in patients without COPD. (Table 1).

Conclusion: This study validates that in patients with CHF low EF is the single most important predictor of a high BNP level. In patients with EF > 45% diastolic dysfunction alone did not have a significant impact on BNP level. Other associations with a higher BNP level were female sex, pulmonary hypertension, and absence of COPD.

Table 1

<table>
<thead>
<tr>
<th>Sex</th>
<th>Male/Female</th>
<th>44/80</th>
<th>482.14±60.23</th>
<th>0.236</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ejection Fraction</td>
<td>&lt;45%/&lt;45% 10/124</td>
<td>803.51±63.04</td>
<td>0.002</td>
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</tr>
<tr>
<td>Diastolic Dysfunction</td>
<td>&lt;0.0001</td>
<td>569.81±556.59</td>
<td>0.006</td>
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<tr>
<td>Pulmonary Hypertension</td>
<td>Yes/No</td>
<td>50/70</td>
<td>67.46±147.96</td>
<td>0.17</td>
</tr>
<tr>
<td>COPD</td>
<td>Yes/No</td>
<td>26/98</td>
<td>298.92±562.19</td>
<td>0.006</td>
</tr>
</tbody>
</table>

605 A simplified approach to determine responders of cardiac resynchronization therapy with tissue Doppler imaging


Purpose: Left ventricular (LV) dyssynchrony measured by tissue Doppler imaging (TDI) is hypothesized to predict the response to cardiac resynchronization therapy (CRT). To quantify LV dyssynchrony, standard deviation (SD) of the interval between QRS and onset of the systolic velocity (Ts0) of six LV segments is used. Reducing the number of investigated LV segments would increase clinical applicability for screening purposes.

Methods: 34 pts (25 men, age 70±8 years) with ischemic (19 pts) and idiopathic (15 pts) cardiomyopathy were included. QRS duration was 168±36 ms. Mechanical dyssynchrony was quantified with tissue Doppler using 3 models: (1) the SD of Ts0 in 6 basal segments, (2) difference in Ts0 of the inferoseptum and lateral wall (4-chamber view) and (3) difference in Ts0 of the anteroseptum and posterior wall (3-chamber view). Time intervals of Ts0 with optimal sensitivity and specificity were determined from ROC curves. Patients with LV end-systolic volume (LVESV) decrease of ≥ 10% after 3 months of CRT were defined as responders.

Results: There were 21 responders and 13 non-responders with a decrease in LVESV of respectively 20±10% and ±6±6%. Optimal time intervals to predict responders were a SD of Ts0 of ≥ 20 ms in the 6-segment model and a TS0 difference of > 30 ms in both 2-segment models (see table 1).

Conclusion: LV reverse remodeling after CRT is most accurately predicted by a six segment model. A simplified approach using the time interval between Ts0 of the anteroseptal and posterior segment is useful for screening purposes.

<table>
<thead>
<tr>
<th>Time interval</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Pos. predictive value</th>
<th>Neg. predictive value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20 ms</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Interosseal</td>
<td>82</td>
<td>75</td>
<td>86</td>
<td>69</td>
</tr>
<tr>
<td>Anteroseptal/Posterior</td>
<td>95</td>
<td>92</td>
<td>95</td>
<td>92</td>
</tr>
</tbody>
</table>

606 Long-term evaluation of interventricular delay in patients with biventricular pacemaker for heart failure. Can the Teli index play a role?


Background: Cardiac resynchronization therapy (CRT) is currently used to treat patients with refractory congestive heart failure and left bundle branch block. Compared with simultaneous CRT, tailored sequential biventricular pacing can further improve left ventricular (LV) function, but no data are currently available about optimization of the interventricular (VV) delay in patients with unoptimized VV delay at the time of implantation.

Methods: Ten consecutive patients (mean age 66:8 years, 5 males) with a biventricular pacemaker (InSync III, Medtronic Inc) unoptimized for VV delay at the time of implantation were evaluated at 6 month follow up at a basic heart rate of 60 b/min in DDD mode with an AV interval of 150 ms. For each patient, 4 VV delays were programmed with left or right ventricular pre-excitation (32, 8, 32, 8 ms) and at each VV delay the following ultrasound parameters were evaluated: LV ejection fraction (EF, %) by the modified Simpson’s rule, aortic velocity time integral (VTI, cm), Doppler dp/dt (mmHg/s) for systolic LV function; mitral E/A ratio, global LV filling time (FT, ms) for diastolic LV function; Teli index (tET)ET as an index of global LV performance. Differences between variables were evaluated by nonparametric ANOVA.

Results: Results are reported in the Table 1. There was no significant variation of LV-EF, VTI, dp/dt, E/A ratio, and FT at the 4 different VV delays, while the Teli index was significantly lower in group 1 and 2. Conclusions: In patients with unoptimized VV interval at the time of biventricular pacemaker implantation, variation of the VV delay at 6 month follow-up does not significantly modify indexes of systolic or diastolic function while the Teli index shows a significant slight reduction, suggesting that global LV performance could potentially be affected by VV delay programming.

Table 1

<table>
<thead>
<tr>
<th>LV 32 ms (group 1)</th>
<th>LV 8 ms (group2)</th>
<th>RV 8 ms (group 3)</th>
<th>RV 32 ms (group 4)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV-EF</td>
<td>45±11</td>
<td>45±13</td>
<td>41±14</td>
<td>45±11</td>
</tr>
<tr>
<td>VTI</td>
<td>196±50</td>
<td>207±65</td>
<td>194±72</td>
<td>190±56</td>
</tr>
<tr>
<td>dp/dt</td>
<td>831±152</td>
<td>861±202</td>
<td>870±317</td>
<td>846±206</td>
</tr>
<tr>
<td>E/A</td>
<td>0.64±0.14</td>
<td>0.78±0.24</td>
<td>0.68±0.23</td>
<td>0.72±0.15</td>
</tr>
<tr>
<td>FT</td>
<td>481±108</td>
<td>496±123</td>
<td>487±141</td>
<td>453±127</td>
</tr>
<tr>
<td>Teli index (tET)ET</td>
<td>1.07±0.35</td>
<td>1.05±0.35</td>
<td>1.12±0.39</td>
<td>1.21±0.35</td>
</tr>
</tbody>
</table>
607 Tissue Doppler to predict left ventricular reverse remodeling after cardiac resynchronization therapy: measuring onset or peak systolic velocity.

P. Vandervoort, A. Van Damme, P. Lancellotti, P. Unger on behalf of A. Meijer, H.H.M. Korsten, C.H. Peels. Catharina Hospital, Eindhoven, Netherlands, 1AZ VUB, Brussels, Belgium, 2ZOL, Genk, University of Antwerp, Belgium, 3AZ Sint Jan, Bruges, Belgium, 4CHU, Liege, Belgium, 5Hopital Erasme, Brussels, Belgium

Purpose: Left ventricular dysynchrony (LVD) measured by tissue Doppler imaging (TDI) is hypothesized to predict the response to cardiac resynchronization therapy (CRT). To quantify LVD, both the standard deviation (SD) of QRS to onset (TSO) or peak (TSP) systolic velocity is used. We prospectively investigated both methods in a six LV segments model.

Method: Patients were selected according to standard criteria. Echo-Doppler was performed before and 3 months after implantation. LVD was quantified as the SD of both TSO and TSP of 6 basal LV segments. Patients with LV end systolic volume (LVESV) decrease > 10% were defined as responders.

Results: A device was implanted in 34 patients (25 men, mean age: 70±8). Baseline QRS duration of 168±36 ms. Aetiology was ischemic in 19 and idiopathic in 14 patients (pts). The mean LV ejection fraction was 19±6% with a LV end diastolic volume of 25±10 ml. In 4 segments (2 pts) TSP could not be obtained due to a systolic velocity plateau. There were 21 responders and 13 non-responders. The mean decrease of LVESV was for the responders 20±10% and for the non-responders 0±6%. Both the SD of TSO and TSP were able to differentiate responders from non-responders giving a 100% sensitivity and specificity. With a cut-off value for the SD of TSO and TSP respectively of 21 and 30 ms.

Conclusion: LV dyssynchrony as obtained by TDI using a six-segment model is a reliable method of predicting LV reverse remodeling after CRT. To quantify LVD, both the standard deviation (SD) of TSO and TSP were able to differentiate responders from non-responders giving a 100% sensitivity and specificity. With a cut-off value for the SD of TSO and TSP respectively of 21 and 30 ms.

608 Echocardiographic evaluation of intraventricular dyssynchrony: a comparison between color TDI and pulsed wave TDI

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Background: Several parameters, both in Color (C) and Pulsed Wave (PW) Tissue Doppler Imaging (TDI) have recently been proposed to evaluate mechanical asynchrony. It is unknown wether large differences exist between C and PW TDI to evaluate intraventricular dyssynchrony (IVD) and wether results are interchangeable.

Methods: We evaluated IVD in controls (n=38) and pts with structural heart disease (n=35, EF<40%, QRS>120 ms). All subjects were in sinus rhythm. C and PW TDI signals were recorded in apical 4 and 2 chamber views. Off line we measured, both in C and PW TDI, time between onset of QRS and start of systolic motion: Electromechanical Delay (EMD) in 4 basal segments of the LV (sept, lat, ant and inf). We measured time between onset of QRS and peak systolic motion: Time To Peak motion (TPP), both in C and PW TDI, at the 4 basal LV segments. We calculated the following IVD parameters: Septal to lateral delay, dispersion (difference between longest and shortest time interval of the four LV segments) and the standard deviation of the 4 LV segments (SD4).

Results: Intra and interobserver variability were acceptable for EMD & TTP both in C-TDI and PW-TDI (coefficient of variation <10%). IVD parameters are presented in table 1.

Conclusion: Color and PW TDI dyssynchrony measurements have an acceptable observer variability and values are largely comparable in patients with poor LV function and broad QRS.

609 Role of real-time transthoracic 3-D echocardiography in the assessment of mechanical asynchrony

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Introduction: Mechanical asynchrony assessed with Real Time 3D echo-cardiography (RT3DE) is a new request for patients with left ventricular dysfunction. This asynchrony can be quantified using the Dyssynchrony Index (DI), which derives by calculating the standard deviation of the time, for each of the 16 segments (ASE model), to reach its minimum volume.

Hypothesis: Mechanical asynchrony measured using the DI may be correlated to the ejection fraction (EF) and to the length of the QRS complex in patients suffering from heart failure.

Methods: We investigated 35 patients with any degree of heart failure which were paired with 35 normal subjects. RT3DE scanning was performed using the SONOS 7500 and X4 transducer. The 4D full volume was then analysed offline using TomTec 4D LV Analysis to derive the global EF and DI. SPSS statistical software was used.

Results: From the 35 patients that were investigated 38% had mild, 40% moderate and 22% severe systolic dysfunction. The DI was 9.5 ± 1.1, 12.8 ± 1.2 and 17.5 ± 1.2 respectively, which was statistically significant higher than that observed in the normal subjects (5.6 ± 0.9; t-test); A strong negative correlation between EF and DI was found. (r=-0.78, n=35; p<0.001) The duration of the QRS complexes was <120 ms in 29%, between 120-140 ms in 26% and >140 ms in 45% of the patients. The DI was 6.1 ± 1.1, 13.2 ± 1.3 and 16.8 ± 1.09 respectively. There was a strong positive correlation between the duration of the QRS complex and the DI. (r=0.63, n=35; p=0.001).

Conclusions: RT3DE is an effective tool for quantifying mechanical asynchrony which is strongly correlated with systolic dysfunction and electrical asynchrony.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>PW TDI</th>
<th>PW TDI</th>
<th>Color TDI</th>
<th>Color TDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TTP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controls</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Septal to lateral delay (ms)</td>
<td>17±15</td>
<td>25±17</td>
<td>26±24</td>
<td>25±27</td>
</tr>
<tr>
<td>Dispersion (ms)</td>
<td>25±15</td>
<td>54±29</td>
<td>19±11</td>
<td>49±31</td>
</tr>
<tr>
<td>SD4 (ms)</td>
<td>11±7</td>
<td>25±14</td>
<td>9±5</td>
<td>25±16</td>
</tr>
<tr>
<td>Patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Septal to lateral delay (ms)</td>
<td>39±26</td>
<td>55±39</td>
<td>39±32</td>
<td>47±35</td>
</tr>
<tr>
<td>Dispersion (ms)</td>
<td>61±26</td>
<td>78±31</td>
<td>61±36</td>
<td>68±34</td>
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<tr>
<td>SD4 (ms)</td>
<td>29±13</td>
<td>37±15</td>
<td>28±16</td>
<td>33±16</td>
</tr>
</tbody>
</table>

*p<0.05 & **p<0.001 for the difference between controls and patients (t-test); §p<0.05 for the difference between PW and color TDI measurements (paired samples t-test).
610 Intra-atrial dyssynchrony in patients with structural heart disease and congestive heart failure. A colour tissue Doppler imaging study

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Background: Structural heart disease can create a substrate for atrial fibrillation (AF) by atrial fibrosis and heterogeneity of intra-atrial conduction. In the present study we evaluated intra-atrial dyssynchrony during sinus rhythm in patients with structural heart disease, using atrial colour tissue doppler imaging (TDI).

Methods: We studied 15 healthy controls (age 67±11 years) and 55 patients with ischemic and non-ischemic heart disease (age 67±9 years). In all patients, NT-pro Brain Natriuretic Peptide (NT-proBNP) levels were determined. Radionuclide left ventricular ejection fraction (LVEF) was determined using gated SPECT. Transthoracic echocardiography (GE, VIVID 7) was used to perform colour TDI of the atria during sinus rhythm. Measurements below the tricuspid and mitral annulus were selected on the right atrial free wall (RA), inter-atrial septum (IAS) and left atrial free wall (LA). The time differences between the onset of the A wave at RA, IAS and LA were taken as relative conduction times.

Results: The time difference between the onset of the A wave at RA and IAS (CT RA-IAS) is significantly longer in patients with structural heart disease (21±20 ms) compared to healthy controls (6±15 ms), p < 0.009. No significant time difference was found between IAS and LA (p = 0.62). When all patients were divided into two groups, patients with the highest tertile had significantly longer CT RA-IAS (p = 0.003 in Anova). Dividing patients into three groups of NT-proBNP level, a significant gradual increase of CT RA-IAS was noticed with increase in NT-proBNP levels (p = 0.016 in Anova). Patients with structural heart disease in NYHA class II and III had a higher conduction time compared to patients in NYHA class I (p = 0.055 in Anova).

Conclusions: Intra-atrial dyssynchrony is enhanced in patients with structural heart disease and congestive heart failure. Intra-atrial dyssynchrony is related to markers of severity of heart failure, including left ventricular ejection fraction, NYHA class and NT-proBNP levels. Evaluation of intra-atrial dyssynchrony by colour TDI can be used as a non-invasive marker for atrial fibrillation and heterogeneity of conduction in patients with congestive heart failure and/or structural heart disease.

611 Tissue Doppler imaging is better to BNP in predicting cardiac death in patients with chronic heart failure patients

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Background: In patients with chronic heart failure (HF), BNP has been shown to be more predictive of adverse cardiac events than most clinical parameters. In this study, we sought to investigate adds prognostic information over echocardiographic and Doppler measures.

Methods: We studied prospectively 40 patients with HF (EF <30%, M, 58±14 years) and severe LV systolic dysfunction (EF 25±8%). All patients underwent 2D echocardiography, Tissue Doppler (TDI), for the measurement of LV systolic and diastolic function. They also had blood sampling for BNP measurement (radio-immuno assay) on the same day. Follow-up was obtained by careful review of hospital records and direct telephone contact. Survival data were compared to baseline BNP and echocardiographic data.

Results: During the follow up (643±326 days), 53/32% (15%) patients died from cardiovascular causes (3 sudden death, 1 stroke and 1 HF). Mean baseline BNP was 77.6 pg/ml (range 5–202 pg/ml). Death was associated with significantly higher LV systolic wall stress (144±49 vs 49±49 cm²/m², p < 0.01), a lower aortic velocity time integral (16±5 vs 11±3 cm, p < 0.05) and a lower DTI septal early diastolic E’ wave (5.5±2 cm/s vs 2.7±0.6 cm/s, p < 0.0001). By ROC analysis, the best predictor of outcome was the ratio between TDI septal E’ and E mitral E/E’ (AUC = 0.9 [0.8–1]). The ratio between TDI septal E’ and E mitral E/E’ is strongly specific of events free survival [sensitivity=86%, specificity=100%]and E/E’ ratio >16 was highly predictive of cardiac death (sensitivity=75%, specificity=100%). By contrast, BNP values were unable to predict cardiovascular mortality (Figure).

Conclusion: In CHF, DTI septal E’ is superior to BNP in predicting cardio-vascular death.

612 Impact of long-term spironolactone treatment on regional myocardial function in left ventricular dysfunction measured by Doppler myocardial imaging

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The aim of the study was to assess whether long-term spironolactone (SP) treatment, in addition to standard therapy, may affect regional myocardial function in patients (pts) with left ventricular (LV) dysfunction, using pulsed wave Doppler myocardial imaging (PW-DMI).

Methods: We studied 42 pts with ejection fraction (EF) <40%. Patients were randomized to treatment with SP, titrated up to 50 mg/die (SP group, n=21) or control (C group, n=17). All pts echocardiography studies were performed at baseline, after 6 and 12 months after randomization. Regional myocardial function, was obtained from apical approach, with PW-DMI sample volume within any LV segment at basal and medium level. In each adequately visualized segment we calculated the peak myocardial velocity at systole (Vs), early diastole (Ve), atrial contraction (Va), and their ratio (Ve/Va) - index of regional dyastolic function.

Results: After six months in the SP group regional myocardial function of basal and medium LV segments showed: increased ratio Ve/Va by 15.2% (P < 0.01) and 13.3% (P < 0.02) and increased Vs by 12.5% (P < 0.05) and 9.8% (NS); after 12 months ratio Ve/Va increased by 19% (P < 0.001) and 17.3% (P < 0.001) and Vs by 14% (P < 0.001) and 11.5% (P < 0.005) compared to baseline values. In the C group after 6 months regional myocardial function of basal and medium LV segments slightly changed: ratio Ve/Va increased by 4.9% and 3.8% (NS both), and Vs increased by 3.2% and 3.3% (NS both); after 12 months ratio Ve/Va increased by 7.4% (P < 0.01) and 6.4% (P < 0.05) and Vs by 6.4% (P < 0.05) and 5% (NS) compared to baseline values. After 12 months ratio Ve/Va and Vs of basal LV segments were significantly increased compared to baseline values (P < 0.01 and P < 0.005) as well as of medium LV segments (P < 0.05) both in SP than in C group.

Conclusion: In LV dysfunction long-term treatment with low dose of SP in addition to standard therapy significantly increased the favorable modification of regional myocardial function induced by standard therapy alone. Those benefit changes of regional myocardial function have positive dynamic over treatment period.

613 Evaluation of the effects of trimetazidine with tissue Doppler echocardiography in patients with ischemic dilated cardiomyopathy

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Background: Ischemic dilated cardiomyopathy is a common cause of congestive heart failure. Numerous clinical trials have documented the beneficial effects of B-blockers, ACE inhibitors and spironolactone on left ventricular performance and mortality in patients with ischemic dilated cardiomyopathy.

Objectives: Trimetazidine is a pharmaceutical compound having myocardial anti-ischemic effects achieved independently of any changes in the oxygen demand-supply equation. The mechanism of intra-cellular acidosis, correction of disturbances of transmembrane ion exchange leading to calcium overload, prevention of an excessive production of free radicals, inhibition of the inflammatory reaction and an effect on platelets. In this study we searched the effects of trimetazidine on left ventricular functions in patients with ischemic dilated cardiomyopathy with tissue Doppler echocardiography.

Methods: We studied prospectively 40 patients with ischemic dilated cardiomyopathy between January 2000 and March 2001, who were referred to Istanbul University Cardiology Institute. Patients were imaged in the left lateral decubitus position using commercially available system (Acuson Sequa C 256 with 3.5 MHz probe). Standard 2-dimensional and tissue Doppler echocardiography were performed. Pulse tissue Doppler recordings were obtained at the 3 segments according to American Society of Echocardiography and mean value of the recordings was calculated. Trimetazidine was given to 20 of the 40 patients, the remaining 20 patients served as control group. After 6 months, tissue Doppler echocardiography was performed again and values compared with initial results.

Results: At baseline, isoluvatic relaxation time was 110, 33±13. 82 ms, E/A ratio was 0, 95±0.16 and S wave velocity was 10, 59±2. 25 cm/ s. After 6 months, in control group there was no significant change in isometric relaxation time (10±3 ±13.5) and E/A ratio (1.03±0.22 ±0.05) and there was decrease in S wave velocity (10.57±1.9 cm/s, p < 0.007), whereas in trimetazidine group isoluvatic relaxation time was significantly lower (90±0.50 ±7.97, p < 0.001), E/A ratio was significantly higher (1.61±0.19, p < 0.001) and there was no significant difference in S wave velocity (10.70±2.90 cm/s, p > 0.05).

Conclusions: Trimetazidine is effective in improving diastolic function in patients with ischemic dilated cardiomyopathy. There was no significant effect of trimetazidine on systolic functions.
614 Plasma level of BNP has a diagnostic role in diastolic heart failure
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Background: A major limitation in diagnosing DHF is the clinical assessment of CHF itself and the limitations of Doppler echocardiography in examining LV diastolic filling dynamics. This suggested the need for other objective measures of diastolic dysfunction. Data suggest that BNP partially reflects ventricular pressure, thus BNP levels could predict diastolic abnormalities in patients with normal systolic function.

Objectives: In this study, we hypothesized that elevated BNP plasma level could diagnose diastolic heart failure in patients with clinical heart failure and normal systolic function.

Methods and results: We studied 40 patients presented with clinical heart failure and normal systolic function (EF >50%) and 20 normal volunteers. All patients was subjected to full clinical evaluation, ECG and echo-Doppler study. Parameters of diastolic function included: E/A ratio, DT & TVi of A/TVi of DF. Patients were diagnosed as having diastolic dysfunction when two or more of the three criteria are abnormal. Plasma level of BNP was estimated by radioimmunoassay (extraction method). Patients who had clinical heart failure plus evidence of abnormal LV diastolic function (n=34) had a mean BNP plasma level of 82.9 ± 72.4 pg/ml. Normal subjects with normal LV diastolic function (n=20) had a mean BNP level of 3.75 ± 0.28 pg/ml. The area under the receiver-operator characteristic curve for BNP to detect diastolic heart failure was 0.93, the odds ratio was 29 and the 95% CI was, 2.8 to 303. A BNP value of 4.0 pg/ml has a sensitivity of 76.25%, a specificity of 85%, a NPV of 62.9%, and a PPV of 90.9% for detecting diastolic heart failure.

Conclusions: Estimation of BNP plasma level can reliably detect the presence of diastolic heart failure in patients with clinical heart failure and normal systolic function. This simple, noninvasive test may help to reinforce the clinical diagnosis of diastolic heart failure.

Key words: Diastole - Natriuretic Peptides - Heart Failure - Early filling velocity - atrial filling velocity - Deceleration time - Time velocity integral.

615 Prognosis of patients with ischemic cardiomyopathy after coronary revascularization: relation to viability and improvement in LVEF
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Background: The present study prospectively evaluated whether patients with viable myocardium and improvement in LVEF after revascularization had a different prognosis than those patients who do not improve in LVEF.

Methods: Before revascularization, radionuclide ventriculography (RVN) and dobutamine stress echocardiography (DSE) were performed to assess LVEF and myocardial viability, respectively. A patient with >4 or more viable segments was considered to have substantial myocardial viability (viable patients). Patients with <4 viable segments were defined nonviable patients. Nine to 12 months after revascularization, LVEF improvement was assessed by RVN. An improvement in LVEF of 5% or more was considered clinically significant. Patients were divided into Group 1, viable patients with LVEF improvement (n=27); Group 2, viable patients without LVEF improvement (n=15); Group 3, nonviable patients (n=48). Heart failure symptoms and cardiac events were evaluated during a 4 years follow-up.

Results: Preoperative clinical characteristics and LVEF were comparable in the 3 groups. After revascularization, the LVEF increased from 32±9% to 42±10% in Group 1, but did not change in Group 2 and in Group 3 (P<0.001 by ANOVA). Heart failure symptoms improved both in Groups 1 and 2, but not in Group 3 (P>0.001 by ANOVA). During the follow-up, the cardiac event rate was low (4%) in Group 1, intermediate (21%) in Group 2 and high (33%) in Group 3 (P<0.01), Figure 1.

Conclusion: The best prognosis after revascularization of patients with ischemic cardiomyopathy may be expected in viable patients who improve in LVEF. Patients without functional improvement have an intermediate prognosis and nonviable patients have the worst prognosis.

616 Late color M-mode Doppler propagation in the assessment of diastolic dysfunction in patients with dilated cardiomyopathy
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Background: We have previously showed that the ratio of early (Ep) to late (Ap) Color M-mode Doppler flow propagation through the Left Ventricle (LV) allows the differentiation between normal and pseudonormal filling pattern in patients with preserved LV systolic function. The aim of our study was to examine the impact of this index in the assessment of diastolic dysfunction in patients with impaired LV systolic function due to non-ischemic dilated cardiomyopathy (NIDCM).

Methods: We studied 90 patients, aged 58±11.3 years, LV Ejection Fraction (EF) 30.4±13.6% with angiographically proven NICD and 50 normal individuals (control group).

An echocardiographic study with transmural and pulmonary vein (pv) flow and LV inflow color M-Mode Doppler from the apical 4-chamber view, was performed to all patients and controls.

Delayed relaxation pattern (DRL) was defined if early (E) to late mitral filling wave (A) was <1, isovolumetric relaxation time (IVRT) was >100 ms, deceleration time of E (DTE) was >220 ms and atrial component (AR) of the pulmonary vein ( pv) flow was <35 cm/sec. Pseudonormal pattern (PSN) was recognized if E/A =1-2, DTE=150-200 ms, IVRT=60-100 ms and AR>35 cm/sec or reversed to DLR during the strain phase of Val-salva maneuver.

Results: Fifty-three patients had DLR and 27 PSN filling pattern. Ten patients with restrictive filling pattern were excluded because of no measurable Ap. Patients had reduced Ep (0.31±0.15 vs 0.84±0.20 m/sec; p<0.001) and increased Ap (0.83±0.8 vs 0.51±0.18 m/sec; p=0.007) and Ep/Ap ratio (0.49±0.37 vs 1.81±0.62; p<0.001) compared to control. Patients with PSN pattern had increased Left Atrial diameter (4.4±4.2 vs 4.1±4.1 mm, p=0.01) and reduced Ep (0.28±0.11 vs 0.34±0.13, p<0.03) and Ep/Ap ratio (0.56±0.26 vs 0.42±0.21, p<0.01) compared to DLR.

Binary regression analysis revealed that Ep (p<0.001) and Ep/Ap ratio (p<0.001) were independent predictors for the presence of PSN pattern. Received operator curves that values of Ep >0.45 m/s and Ep/Ap <0.98 had 85% and 92% sensitivity and 84% and 100% specificity respectively in differentiation of PSN from NFP.

Conclusion: Ep/Ap ratio, this novel Color M-mode Doppler echocardiographic index, possesses additive prognostic value in differentiate normal from PSN filling pattern in pts with reduced LV systolic function.

617 Tissue Doppler imaging application for the determination of left ventricular systolic function in patients with congestive heart failure
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Background: Two-dimentional echocardiography ejection fraction (EF) is the most widely used measure of global left ventricular systolic function (LVSF), but is limited by its technical difficulties, inaccuracy and poor reproducibility. In the last years Tissue Doppler Imaging (TDI) is introduced as objective method of assessing LVSF.

Aim: To examine diagnostic value of TDI in quantification of LVSF in patients (pts) with congestive heart failure (CHF).

Method: We studied 110 pts (mean age 69±16) with CHF classified into two groups according EF: group 1 with EF<45% (70 pts) and group 2 with EF >=45 (40 pts). S wave velocities of septal, lateral, inferior and anterior part of mitral annulus and basal segments of left ventricle were measured.

Results: Results are presented in the table below.

Conclusion: S wave velocity of mitral annulus and left ventricular basal segments by Tissue Doppler Imaging correlates positively with global left ventricular systolic function in patients with congestive heart failure.
619 Coronary flow velocity reserve measured by transthoracic echocardiography in patients with chest pain. Usefulness to detect significant stenosis in left anterior descending artery

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Purpose: Usefulness of measurement of coronary flow velocity reserve (CFVR) by transthoracic echocardiography to detect significant stenosis in left anterior descending artery (LAD) has been demonstrated in the general group of patients. Our objective was to assess that in patients admitted with chest pain.

Methods: From 41 patients (58% men, 63% 10 years) admitted with chest pain in our hospital, we studied 35 patients (85%) with Doppler signal in LAD detected. Dipryridamole (0.84 mg/kg) was administered as vasodilator. CFVR was calculated as the ratio of hyperemic to basal peak diastolic flow velocities. Normal CFVR was defined as >1.7. Quantitative coronary angiography was performed in all patients, during admission. Stenosis was considered significant if there was >70% diameter stenosis.

Results: We detected 12 patients with significant stenosis. CFVR was lower in patients with significant stenoses (1.49±0.73 vs. 2.19±0.41, p=0.001). Sensitivity, specificity, true predictive value and false predictive value of an abnormal CFVR to detect significant stenosis in LAD were 92%, 91%, 85% and 95%, respectively.

Conclusion: Measurement of CFVR in LAD by transthoracic echocardiography in patients with chest pain was feasible, with excellent sensitivity and specificity to detect significant stenosis.

620 Combined assessment of flow reserve by transthoracic Doppler echocardiography in the distal part of left anterior descending and right coronary artery: contribution for vessel patency interrogation

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Introduction: Noninvasive assessment of coronary flow reserve (CFR) by transthoracic Doppler echo is feasible for the distal left anterior descending artery (LAD).

We assessed the feasibility of combined evaluation of CFR for LAD and distal right coronary artery (RCA) as well as diagnostic accuracy for patency of each vessel.

Methods: 56 consecutive pts (age 57±14, ejection fraction 46±10, female=10) were studied for CFR by adenosine infusion after the termination of dobutamine stress echo (DSE). LAD flow was interrogated (nearby the apex) by a 7 MHz transducer (modified 2-ch apical view), whereas RCA flow was interrogated (2.5 MHz fundamental imaging) at mid posterior wall (proximal to posterior papillary muscle artery) corresponding to the postero-descending branch (PDA) (modified 2 chamber apical view for PDA).

Results: Flow for LAD was detected in all pts (3 with use of contrast agent) and for RCA in 46 pts (4 with contrast agent). Two pts had an occluded RCA. Feasibility of RCA flow detection was 46/54 (85%). In all pts maximal flow was detected in less than 2 min of adenosine infusion (140 mg/kg/min). Total time for both CFR estimation was <5 min. 4 pts had significant stenosis (>70%) in LAD and 13 pts in RCA (proximal to PDA). 3 pts had both RCA and LAD stenosis.

RCA compared to LAD had higher diastolic resting velocity profile (time-velocity integral cm: 12.4±4 vs. 8.3) but a lower CFR (1.91±0.6 vs. 2.44±0.8 both p=0.05). Using ROC analysis for significant vessel stenosis, a CFR cut off of 1.8 was found for both LAD and RCA with similar diagnostic performance (sensitivity % 100/100, specificity % 89/85, area under curve 0.97/0.98 respectively).

DSE was negative in 3/13 pts with RCA stenosis, whereas CFR-RCA was <1.8 in 2/3 false negative pts by DSE thus improving sensitivity (DSE 77% vs CFR-RCA 92%). The respective negative predictive value was improved from 87% to 95%. Kappa coefficient between CFR-RCA and angiography was 0.75 (p<0.0001), whereas between CFR-RCA and DSE was 0.53 (p=0.001).

For LAD, using CFR, sensitivity and negative predictive value were improved from 0.67 and 0.94 to 1.

Conclusion: CFR evaluation of both distal LAD and RCA nearby the PDA origin is feasible in 85% of pts during DSE providing incremental diagnostic yield for relevant vessel patency.

621 Evaluation of left anterior descending coronary artery of intermediate severity by using coronary flow reserve and dobutamine stress echocardiography

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Background: the physiological significance of left anterior descending artery (LAD) stenosis of intermediate severity is of clinical importance and dobutamine stress echocardiography (DSE) is routinely performed to assess ischemia in this setting. However, assessment of coronary flow reserve (CFR) with transthoracic Doppler echocardiography (TTE) is a new tool and could provide a non invasive and rapid evaluation of the stenosis severity.

Objective: to evaluate the value of CFR measurement determined by TTE, compared with DSE, in the setting of LAD stenosis of intermediate severity.

Methods: 36 stable patients (mean age: 65±11 years, 26, 30% diabetics, 66% hypertensives, 58% dyslipidemic, 30% smokers, all in sinus rhythm), without previous anterior myocardial infarction and with an angiographic proximal LAD stenosis of intermediate severity (55±5% QCA, one vessel disease) were studied. Coronary flow velocity was measured in the distal part of the LAD by TTE, at rest and during continuous infusion of 0.14 mg/kg/min of adenosine within 2 minutes, using a high frequency transducer under the guidance of color Doppler flow mapping, in the modified parasternal view. CFR was calculated as the ratio of hyperemic to basal mean (mean CFR) and peak (peak CFR) diastolic flow velocity. DSE was performed immediately after the adenosine test to assess ischemia in the LAD territory (% maximum predict heart rate=94±8).

Results: adequate recording of CFR was possible in 31 patients. Of the 23 pts with a CFR<2 (peak CFR=2.7±0.6),DSE was normal. Of the 8 pts with a CFR<2 (peak CFR=1.6±0.5),5 had an abnormal response with DSE, in the LAD territory. In this range of intermediate stenosis there was a poor correlation between % LAD stenosis and CFR. In patients with positive DSE CFR was 1.60±0.2 compared to 2.70±0.6 in patients with normal DSE (p<0.05). The efficacy of CFR in detecting ischemia that was confirmed with DSE was Se=100%, Sp=88%ppv=63%npp=100%

Conclusion: given its high negative predictive value, non invasive CFR could be a useful aid in reaching clinical decisions promptly at bedside, in patients with moderately severe lesion of the proximal LAD.

622 A decreased diastolic to systolic ratio of the basal coronary flow as a powerful Indicator of left anterior descending artery stenosis

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Background: Coronary blood flow presents a biphasic pattern at rest, with a greater diastolic and a smaller systolic component. In the present analysis, we evaluated whether a decreased diastolic to systolic ratio of the basal coronary flow may be useful in the identification of subjects with significant left anterior descending (LAD) stenosis.

Methods: Eighty consecutive patients (44 with unstable angina, 21 with acute myocardial infarction and 15 with stable angina) were included in the present analysis. Blood flow velocities were recorded in the mid-distal portion of the LAD using an ATL 5000 CV HD ultrasound system. All patients underwent coronary angiography and were divided into two groups according to the presence (Group A) or the absence (Group B) of a significant LAD stenosis (lumen narrowing >70%).

Results: Adequate Doppler recordings in the LAD were obtained by transthoracic echocardiography in 76/80 patients (Group A: 54 pts, group B: 22 pts). There were no differences with regard to age, wall motion score index, left ventricular mass and volumes, ejection fraction in the two groups, whereas the diastolic to systolic ratio of the basal coronary flow was significantly lower in group A patients (1.36±0.48 vs 1.97±0.58, p<0.0001).

Receiver-operating characteristic curve showed that a value of ratio <1.5 had a sensitivity of 74%, a specificity of 91%, a positive predictive value of 77% and a negative predictive value of 97% for the presence of significant LAD stenosis. In multivariate logistic regression analysis, the ratio was a strong independent predictor of LAD stenosis >70% (OR 5.25, CI 1.30-9.20).

Conclusion: The present findings suggest that assessment of the basal flow in the LAD may be useful to identify subjects with stenosis >70%.
623 Does flow reserve by transthoracic Doppler echo in the distal left anterior descending artery provide incremental diagnostic yield to T201 SPECT for vessel patency? G. Athanassopoulos, G. Hatzigeorgiou1, A. Motis1, G. Karatasakis1, M. Marinou1, D.V. Cokkinos1. Onassis Cardiac Surgery Center, Athens, Greece, 1 Onassis Cardiac Surgery Center, Athens, Greece, 2 Onassis Cardiac Surgery Center, Athens, Greece

Introduction: Noninvasive assessment of coronary flow reserve (CFR) by transthoracic Doppler echo in the distal part of left anterior descending artery (LAD) provides an alternative means to investigate LAD patency. Accuracy of T201 SPECT has limitations in the presence of left ventricular wall motion abnormalities (WMA).

We investigated the relative diagnostic accuracy of CFR to the T201 SPECT outcome for LAD patency.

Methods: 158 pts were studied for LAD CFR (age 63±10, ejection fraction 44±11, 28 women). All had coronary angiography and 99 pts had a T201 SPECT within 3 months from the echo. LAD distal flow was investigated by a modified 2 chamber apical view (GE 7 MHz transducer). Adenosine was infused at 140 mg/kg/min for 4 min. CFR was estimated from diastolic time velocity integral (TVI) relative change from baseline to adenosine.

Results: 55 pts had significant LAD stenosis (>70%), 52 pts had ischemia in LAD territory by T201. 38% of pts had WMA (25% hypokinesis and 13% akinesia).

Resting TVI was similar in pts with or without T201 ischemia for either stenosed or patent LAD: (TL201 positive/negative: for stenosed LAD: 7.6±3.9 vs 7.6±2.9, for patent LAD: 9.3±5.2 vs 7.2±2.2) CFR did not differ according to T201 for either stenosed or patent LAD: (TL201 positive/negative: for stenosed LAD: 1.45±0.5 vs 1.28±0.35, for patent LAD: 2.56±0.46 vs 2.62±0.46). Using ROC analysis for prediction of significant LAD stenosis, a CFR value of 1.8 was found for all pts as well as for those with an ischemic T201 (sens=0.93, spec=0.92, area under curve=0.96/0.93 respectively). Consideration of CFR value reclassified correctly 7/8 pts with false negative and 21/22 pts with false positive T201.

Incidence of WMA was similar between pts with CFR>1.8 or those with ischemic T201 (56% vs 48%). In the presence of WMA, concordance with LAD patency remained unchanged for CFR (without vs with WMA: 0.91 vs 0.93, kappa coefficient 0.82 vs 0.73), whereas it decreased for T201 (0.69 vs 0.39, kappa coefficient 0.38 vs 0.24 respectively).

Conclusion: CFR evaluation of distal LAD provides an accurate means to evaluate LAD patency with better accuracy than T201 SPECT, providing important incremental yield especially in the presence of resting wall motion abnormalities.

625 Transthoracic Doppler echocardiography assessment of coronary flow velocity reserve in patients with left bundle branch block R. Citro, R. Gottiglia1, A.G. Maione, A. Guarino, M. Santoro, G. Gregorio, San Luca Hospital, Vallo della Lucania, Italy, 1 Cardarelli Hospital, Naples, Italy

Background: False positive results in diagnosis of coronary artery disease (CAD) in patients with left bundle branch block (LBBB) attributed to impaired microvascular function have been reported.

Aim of the study was to evaluate coronary flow velocity reserve (CFVR) in patients with LBBB with and without left anterior descending coronary artery (LAD)stenosis.

Population and methods: 20 pts (13 male; mean age 63.8±9.8) with electrocardiographic evidence of complete LBBB have been enrolled. CFVR measurement by transthoracic Doppler echocardiography in the distal tract of the LAD after adenosine infusion (0.14 mg/kg/min over 90 sec) were performed in all pts within 48 hours of coronary angiography. CFVR was calculated as the ratio of hyperemic to basal peak diastolic flow velocity. Exclusion criteria were anterior myocardial infarction, atrial fibrillation, second or third degree atrio-ventricular block, cardiomyopathy, severe valvular heart disease, and left ventricular ejection fraction <45%.

Patients were divided into two groups according to the absence (Group A) or presence (Group B) of significant (>70%) LAD stenosis at coronary angiography and compared with normal controls. Twelve Group A patients underwent stress thallium 201 myocardial scintigraphy.

Results: no significant differences between group A and controls were documented. CFVR was significantly higher in group A and controls compared to group B (p<0.001). A cut-off value of CFVR >2 had a sensitivity of 83%, a specificity of 86%, a positive predictive value of 71% and a negative predictive value of 92% for the presence of significant LAD stenosis. Perfusion defects in the LAD territory were detected at myocardial scintigraphy in 5 (41%) patients with no significant coronary artery disease and with good CFVR.

Conclusion: CFVR estimated by transthoracic echocardiography might be a promising tool for detection of significant CAD especially in the LAD territory even in LBBB patients. A cut-off value of 2 seems to be adequate for the diagnosis of LAD stenosis in this subgroup of patients.

Diastolic coronary flow velocity data

<table>
<thead>
<tr>
<th>Group A (n=15)</th>
<th>Group B (n=5)</th>
<th>Controls (n=9)</th>
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<tbody>
<tr>
<td>Baseline (cm/s)</td>
<td>21±/−6.6</td>
<td>20.2±/−3.1</td>
</tr>
<tr>
<td>Hyperemia (cm/s)</td>
<td>57.9±/−14</td>
<td>33.2±/−4.5</td>
</tr>
<tr>
<td>CFVR</td>
<td>2.65±/−0.54</td>
<td>1.6±/−0.1</td>
</tr>
</tbody>
</table>


One of the main limitations of cardiac imaging methods in the diagnostic sensitivity of coronary artery disease (CAD) is the presence of left bundle branch block (LBBB). Transthoracic Doppler echocardiography (TDE) has the capability to evaluate coronary blood flow in all segments of the left anterior descending (LAD) coronary artery in a quantitative manner, and to establish its coronary flow reserve (CFR). The aim of our study was to evaluate the clinical utility of TDE as a non invasive approach in the identification of single vessel LAD CAD associated with LBBB. We studied by TDE a sample population of 42 pts with single vessel LAD CAD and LBBB, mean age 56.1±11 vs. 60% male gender. The distal LAD flow was identified after intravenous ultrasound contrast agent infusion, the sample TDE located at the mid portion of the vessel lumen and calculated its peak diastolic blood flow velocity (Vmax-cm/s). CFR was estimated after adenosine intravenous infusion (140 mg/kg/min in 5 min) according to the ratio CFR=Vmax after adenosine/basal. Based on quantitative coronary angiography, our population was divided in 4 groups, no LAD disease with stenosis <50% (Group N; n=25 pts), LAD stenosis between 50-70% (Group I; n= 9 pts). LAD stenosis between 70-90% (Group II; n=5 pts) and LAD stenosis over 90% (Group III; n=3 pts). The mean CFR values and standard deviation for group N was 3.4±0.5, in group I 3.2±0.7, in group II 1.8±0.3 and in group III 1.2±0.1. Using the Anova statistical test, significant differences were detected between group I vs II, vs III, N vs II and III. With a 95% confidence interval, the CFR cut off value of 2.0 could predict LAD stenosis >70%, and CFR>1.3 could predict LAD stenosis <95%.

Conclusion: in our group of CAD pts with LBBB, the TDE non invasive estimation of CFR could identify a significant single vessel LAD disease with a 95% confidence.
Is flow reserve of distal left anterior descending artery by transhoracic Doppler echo accurate for vessel patency interrogation in LBBB?

A. G. Athanassopoulos, E. Petropoulou, G. Hatzigeorgiou, G. Karatakasik, D. V. Kokkinos, Athens, Greece

Introduction: The evaluation of LAD patency in LBBB presents with diagnostic limitations with either scintigraphy or stress echo. The non-invasive assessment of coronary flow reserve (CFR) by transhoracic Doppler echo in the distal part of left anterior descending artery (LAD) provides an alternative means.

Methods: Among 350 consecutive pts studied for LAD CFR, there were 136 pts without LBBB and 29 pts with LBBB (age 63±11 vs 82±9, ejection fraction 48±9 vs 36±10, women 18% vs 34%), who had coronary angiography performed within 3 months. A significant LAD diameter stenosis (>70%) was found in 5 (17%) with LBBB and in 40 (29%) without LBBB pts. The LAD distal flow was investigated by a modified 2 chamber apical view (GE 7 MHz transducer) nearby the apex at the site of intramyocardial branching. CFR was estimated from the diastolic time-velocity integral (TVI). Adenosine was infused at 140 mg/kg/min for 4 min.

Results: Diastolic velocity profile and CFR were similar at rest between LBBB and nonLBBB pts (TVIcm: rest: 7.6±0.5 vs 7.5±0.3, adenosine: 17.4±8 vs 19.2±8, CFR: 2.3±0.7 vs 2.2±0.8). CFR values were similar irrespectively of LBBB presence: (LAD <70% vs <70%: LBBB: 1.4±0.6 vs 1.4±0.6; nonLBBB: 1.24±0.5 vs 2.5±0.5). CFR had a curvilinear regression with % LAD stenosis for both LBBB and nonLBBB pts (LBBB: R²=0.66, p<0.005, vs nonLBBB: R²=0.77, p<0.0001).

Conclusion: In the presence of LBBB, CFR evaluation of distal LAD provides an accurate and convenient means to evaluate LAD patency and it may prove superior to other non-invasive techniques.

Coronary flow velocity (CFV) pattern assessed by transthoracic Doppler echocardiography (TTDE) predict adverse clinical events and myocardial recovery after successful primary angioplasty

F. Agostini, A. Iannone, R. Mazucco, N. Baccaglioni, A. Izzo, M. Romano, C. Brunazzi, R. Zanini, Azienda Ospedaliera, Carlo Poma, Mantova, Italy

Aim: To evaluate CFV non-invasively using transthoracic PW Doppler after successful primary percutaneous coronary intervention (PCI) in patients with acute anterior myocardial infarction (AMI), and to compare results with early and late clinical outcome and echo parameters of myocardial recovery (wall motion score index [WMSI]), over a 2 months follow-up period (T1/T2).

Methods: CFV pattern in the distal left anterior descending coronary artery using transthoracic PW Doppler was recorded in 29 of 31 consecutive patients (2 patients had unsatisfactory Doppler signal, feasibility 93.5%) with a first anterior AMI after successful primary PCI and TIMI 3 flow, after 12 hours and within 48 hours (T 0). Three different flow patterns were recorded: Type A pattern (62%) had normal antegrade flow during both diastolic and systolic phase. Type B pattern (10.3%) had reduced antegrade systolic flow and rapid diastolic deceleration time. Type C pattern (27.7%) had systolic flow reversal and rapid diastolic deceleration time. CFV patterns were compared with early and late complications and myocardial recovery.

Results: Wall motion score index (WMSI) result has shown in Table 1. All the patients with type C pattern were affected by early and late complications (5 Congestive Heart Failure, 1 re-infarction, 1 death, 1 Ventricular Septal Perforation, 2 thrombi) whereas none of the patients with type A pattern had complications.

Conclusion: CFV pattern observed following successful revascularization by primary PCI may be a sensitive non-invasive marker of myocardial recovery and a predictor of early and late complications.

Coronary reserve of the left anterior descending artery in revascularized patients with left internal mammary artery

J. L. Moya, G. Guzman, A. Galaz-Liebana, R. Campoamor, T. Centelles, E. Oliva, I. García Andrade, A. Epeldegui, J. L. Moya Mur, Ramón y Cajal H., Madrid, Spain, 2Gualajara H., Guadalajara, Spain, 3Ramón y Cajal H., Madrid, Spain, 4Galapagar, Spain

It's well known that coronary reserve (CR) can be analyzed with transthoracic echocardiography and high frequency probes. There are only few articles studying CR in the left anterior descending artery (LAD) in patients after revascularization.

Objective: To describe CR in revascularized patients with left internal mammary artery (LIMA) without clinical and gammagralphical data of by-pass dysfunction.

Material and methods: 72 patients were studied; 43 had been revascularized with LIMA to LAD; 20 had cardiovascular risk factors (CVRF) without coronary heart disease and 9 without CVRF. The echocardiographic study was performed 3 months after surgery. All revascularized patients were asymptomatic and had a stress gammagraphic study without isquemia in LAD region. CR was determined by transthoracic echocardiography using a 7.71 MHz probe. CR was defined as the ratio between LAD diastolic velocity after dipiridamol infusion (0.8 mg/Kg in 6 min) and basal LAD diastolic velocity.

Results: CR in the three groups was: controls 4.25±1.18; patients with CVRF 3.01±0.80; revascularized patients 2.0±0.52. A multiple linear regression analysis showed that the CR depends on the severity of the LAD lesion (0.026 (0.003-0.05); p=0.028) and the quality of the distal vessel (less than 2 mm) (0.036 (0.07-0.65); p=0.016. Table 1.

Conclusion: The revascularized patients with LIMA without diabetes and data, shows lows values of CR in LAD, overall in patients with less LAD obstruction severity and worse distal vessel. This data has to be in mind when a revascularization technique is indicated. The patients with better CR result shows less values than controls and patients with CVRF. Probably due to microvascular dysfunction persist after surgery.

Transthoracic Doppler assessment of coronary flow velocity pattern as an early predictor of persistent left ventricular dysfunction after primary angioplasty for acute myocardial infarction

A. Scheuble, E. Brochet, M. Faraggi, P. G. Steg, A. Vahanian, L.J. Feldman, Bichat University Hospital, Paris, France

Background: Intracoronary Doppler guidewire studies have shown that patients with an early systolic retrograde flow (ESRF) and a short diastolic deceleration time (DDT) after primary angioplasty for acute myocardial infarction (AMI) have severely impaired microcirculatory perfusion, resulting in poor recovery of left ventricular (LV) function. Recent advances in transthoracic Doppler echocardiography (TDE) allow non-invasive assessment of coronary flow velocity in the left anterior descending coronary artery. We studied the relationship between LV function recovery and coronary flow velocity parameters obtained with TDE early after primary angioplasty for anterior AMI.

Methods: Twenty-four consecutive patients who underwent successful primary coronary stenting for < 12 hour anterior AMI were studied. Coronary flow velocity pattern and adenosine-induced (140 microgram/kg/min, 5 min iv perfusion) coronary flow velocity reserve (CVR) were measured using a high frequency TDE probe (7 MHz, 7V3C Acuson/Siemens) 24 hours and 3 days after AMI. Patients were divided into 2 groups according to LV function reserve 6 weeks after AMI (group A: 11 patients with LV function recovery; group B: 13 patients without LV function recovery). Radionuclide LV ejection fraction (LVEF) was measured at 8 weeks.

Results: Patients in group B had a lower LVEF (39±9% vs 52±11%, p=0.003), a higher incidence of ESRF (77% vs 23%, p=0.045) and a shorter DDT (341±365 ms vs 942±611 ms, p=0.007) than patients in group A. CVR 3 days after AMI was marginally higher in group A (2.1±0.6 vs 1.8±0.5, p=NS). The presence of an ESRF or a DDT < 600 ms 24 hours after AMI had a sensitivity of 77%, a specificity of 63%, a positive predictive value of 71%, a negative predictive value of 70% and an accuracy of 71% to predict the absence of LV function reserve at 8 weeks.

In conclusion, assessment of coronary flow velocity pattern at the bedside with TDE allows early identification of patients with poor LV function recovery.
Coronary flow velocity reserve and myocardial viability after primary angioplasty. A nonsimulative study


Purpose: Despite blood flow normalization in the culprit vessel by primary angioplasty, damage in microvascular circulation can limit the functional recovery of the infarcted region. Our objective was to study whether coronary flow velocity reserve (CFVR) measured by transthoracic Doppler echocardiography (TDE) can predict myocardial viability (MV) in the infarcted region.

Methods: We studied 49 patients (75% men, 60±13 years) who suffered a first anterior acute myocardial infarction and who underwent a successful primary angioplasty (TIMI 3 flow pattern). Measurement of CFVR in left anterior descending artery was performed before discharge, using as vasoconstrictor acetylcholin (0.56 mg/kg for 4 minutes) using a multifequency transthoracic high resolution and near field focusing transducer was used. CFVR was derived as the ratio of diastolic LAD flow velocity, during administration of acetylcholine (AD) at a rate of 140 mcg/kg/min divided by baseline diastolic flow velocity.

Results: CFVR at discharge, measured by noninvasive means, was significantly higher in patients who had MV in relation to CFVR.

Conclusion: CFVR at discharge, measured by noninvasive means, was significantly higher in patients who had MV.

<p>| Table 1 |
|---------------------|---------------------|</p>
<table>
<thead>
<tr>
<th>Patients with MV (n=30)</th>
<th>Patients without MV (n=19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFVR 1.64</td>
<td>1.40</td>
</tr>
<tr>
<td>p 0.02</td>
<td></td>
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</tbody>
</table>

632 Transthoracic Doppler echocardiographic assessment of coronary flow reserve in patients with drug eluting stents


Introduction: Transthoracic assessment of coronary flow velocity reserve (CFVR) enables evaluation of functional outcome of percutaneous interventions (PCI). The aim of our study is to assess CFVR in pts with previous drug eluting stents placement.

Methods: We studied by transthoracic echocardiography 24 consecutive pts (23 males, 1 female aged 56±20 (36-77) years, 9±2 (7-12) months after PCI with SES placement because of significant, >70% left anterior descending (LAD) stenosis. An apical modified 2-chambers view with a multifrequency transthoracic high resolution and near field focusing transducer was used. CFVR was derived as the ratio of diastolic LAD flow velocity, during administration of adenosine (AD) at a rate of 140 mcg/kg/min divided by baseline diastolic flow velocity.

Results: Diastolic coronary flow signal at the apical region was feasible in all pts both at baseline and during AD infusion. At baseline maximum (MX), mean (MN) and time velocity integral (VTI) were lower than the respective values obtained during adenosine infusion (MX: 21.1±8.2 vs 47.6±11.2 cm/sec, MN: 16.8±5.9 vs 37.8±9.6 cm/sec, VTI 8.3±3.4 vs 17.5±4.7 cm*sec, p<0.0001). CFVR for the study population was MX:4.39±2.47, MN:4±2.46, VTI:3.36±2.4. In 21 cases (87.5%) pts CFVR was ≥2. Of the 3 pts with CFVR≥2, one had severe left ventricular hypertrophy because of aortic stenosis with previous aortic valve replacement and 2 had history of anterior infarction with apical scar. Clinical outcome was favorable without death, new myocardial infarction or need for revascularization, at a follow-up of up to 18 months.

In conclusion: pts with PCI and SES placement have a high probability of vessel patency and normal CFVR at a critical time interval reported for restenosis post PCI. Follow-up of these pts can be performed on the basis of transthoracic echocardiographic assessment of LAD CFVR.

634 Transthoracic Doppler echocardiographic assessment of coronary flow reserve in the coronary sinus as a marker of successful left coronary artery territory bypass grafting

A. Vrublevsky, A. Boshchenko, M. Pekarskaya, V. Shipulin, R. Karpov. Cardiology Research Institute, Tomsk, Russian Federation

Background: Previous studies have revealed that stress transoesophageal echocardiography (TEE) can be used to assess the coronary flow velocity reserve (CFR) in the left anterior descending coronary artery (LAD). The aim of the present study was to examine the long-term prognostic value of CFR evaluated by means of TEE in patients who have undergone LAD-angioplasty and stent-implantation.

Methods and patients: 31 patients with significant LAD stenoses were underwent percutaneous coronary intervention (PCI). In consequence of their clinical signs, 11 of the 31 patients required rePCI or coronary artery bypass graft (CABG) operation within six months (Group 1). The clinical status of the remaining 20 cases improved during the follow-up (Group 2). All 31 patients underwent TEE before LAD-PCI and after it. For the patients with a stable clinical status, a third control examination was also performed. 5-year on average after PCI, all patients were underwent a telephone consultation according to their medical history and clinical signs.

Results: Data are presented on the table.

Conclusions: Most of the patients who displayed an improved CFR after PCI suffered no major clinical events during the 5-year follow-up; in contrast, in those who a priori had a low CFR and did not show any improvement after PCI, major coronary events did occur during this period.

635 Prediction of coronary reinterventions by transoesophageal coronary flow velocity reserve measurement - Results of a 5-year follow-up


Background: Previous studies have revealed that stress transoesophageal echocardiography (TEE) can be used to assess the coronary flow velocity reserve (CFR) in the left anterior descending coronary artery (LAD). The aim of the present study was to examine the long-term prognostic value of CFR evaluated by means of TEE in patients who have undergone LAD-angioplasty and stent-implantation.

Methods and patients: 31 patients with significant LAD stenoses were underwent percutaneous coronary intervention (PCI). In consequence of their clinical signs, 11 of the 31 patients required rePCI or coronary artery bypass graft (CABG) operation within six months (Group 1). The clinical status of the remaining 20 cases improved during the follow-up (Group 2). All 31 patients underwent TEE before LAD-PCI and after it. For the patients with a stable clinical status, a third control examination was also performed. 5-year on average after PCI, all patients were underwent a telephone consultation according to their medical history and clinical signs.

Results: Data are presented on the table.

Conclusions: Most of the patients who displayed an improved CFR after PCI suffered no major clinical events during the 5-year follow-up; in contrast, in those who a priori had a low CFR and did not show any improvement after PCI, major coronary events did occur during this period.

Data of patients

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 weeks before PCI 1.66±0.37</td>
<td>1.73±0.45</td>
</tr>
<tr>
<td>1 month after PCI 1.68±0.42</td>
<td>2.09±0.46</td>
</tr>
<tr>
<td>7 months after PCI -</td>
<td>2.14±0.28</td>
</tr>
<tr>
<td>5-year follow-up after PCI 2 patients died</td>
<td>One patient had a new myocardial infarction during the follow-up</td>
</tr>
<tr>
<td>during the follow-up</td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05 vs 2 weeks before PCI.

633 Coronary flow reserve in the coronary sinus as a marker of successful left coronary artery territory bypass grafting

A. Vrublevsky, A. Boshchenko, M. Pekarskaya, V. Shipulin, R. Karpov. Cardiology Research Institute, Tomsk, Russian Federation

Abstracts

The aim of our study was to elaborate the criteria of successful left coronary artery territory bypass grafting (LCABG) by means of transesophageal Doppler assessment of coronary flow reserve (CFR) in the coronary sinus (CS).

Methods: We studied 15 CAD pts (men, mean age 52±8 years) with angiographically documented stenoses (>50%) of the left anterior descending (LAD) and circumflex artery. Transesophageal Doppler assessment of coronary blood flow in the CS was performed at baseline and after intravenous diprydamole infusion (0.56 mg/kg for 4 minutes) using ultrasonic diagnostic system Phillips HDI 5000 SonoCT (Germany). CFR in the CS was calculated as ratio of hyperemic to baseline volume blood flow velocities (VBF). The level of CFR <2 was diagnosed as reduced. Repeated CFR assessment was performed 3 weeks after successful LCABG. A number of bypass grafts was 3±0.1. At least one arterial graft to the LAD was made in every patient.

Results: Before LCABG CFR <2 was revealed in the majority of CAD pts (11 of 15, 73%). A significant increase of CFR in the CS after successful LCABG was registered (Table). Individual analysis showed that the CFR normalization was achieved in 8 pts and the CFR increase in comparison with the baseline level was registered in 5 pts. In 2 pts with the normal baseline level of CFR the dynamics of CFR after LCABG was not observed.

Conclusion: Thus, a normal level of CFR by VBF in the CS is a marker of successful left coronary artery territory bypass grafting.

| Table |
|---------------------|---------------------|
| Parameters | baseline (before LCABG) | dipyridamole (after LCABG) |
|---------------------|---------------------|
| HR, b/min | 64±8 | 84±10## |
| CS diameter, cm | 0.80±0.13 | 0.85±0.11## | 0.84±0.14 | 0.97±0.14### |
| VBF, ml/min | 351±214 | 525±278### | 426±238 | 1283±911## |

* - p<0.05, ** - p<0.01, *** - p<0.001 – in comparison with baseline parameters; 

* - p<0.05, ** - p<0.01, *** - p<0.001 – in comparison with parameters before LCABG.
Change of coronary flow reserve (CFR), rather than absolute value of CFR, is more associated with restenosis in various clinical settings

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Background: Coronary flow reserve (CFR) decreases in the presence of significant coronary stenosis. Therefore, theoretically, CFR can be used for detection of restenosis after PTCA. However, absolute value of CFR is not routinely used for detection of coronary restenosis, because CFR in the absence of coronary stenosis can be affected by various factors (endothelial dysfunction, microvascular damage and left ventricular hypertrophy).

We hypothesized that change of CFR, rather than absolute value of CFR, is more associated with restenosis in various clinical settings.

Method: We studied 99 patients (71 males, 58–11 years, 37 unstable angina, 35 stable angina, 27 myocardial infarction) who underwent successful PTCA at left anterior descending artery. CFR using transthoracic Doppler was measured at 48 hours after PTCA and at the time of follow-up angiography (duration 6.0–15 months).

Coronary flow velocity was measured at intact left anterior descending artery with 7 MHz transducer (HDI 5000, ATL) at baseline and during intravenous infusion of adenosine (140 mcg.kg⁻¹.min⁻¹). Mean diastolic coronary flow velocities from at least three cardiac cycles were averaged.

Results: CFRs in 69 patients without restenosis were 2.55±0.49 at 48 hours after PTCA and 2.93±1.00 at follow up (p<0.005). CFRs in 30 patients with restenosis (>50%, in diameter stenosis) decreased significantly from 2.70±1.01 to 1.98±0.91 (p<0.001). Like previous study, there was a significant difference of CFR in (i) / 10 study between two groups (p<0.001). There was a significant difference of CFR change (ratio of CFR/CFRinitial) between two groups (p<0.001). In ROC curves for prediction of restenosis absolute CFR and CFR change, CFR change has better ROC curve than absolute CFR (AUC 0.82 vs 0.76).

Conclusion: CFR significantly decreases with restenosis after PTCA even in the presence of variable baseline CFR values. Serial measurements of CFR can be used to detect restenosis after PTCA. Restenosis is better associated with change of CFR rather than with absolute value of CFR.

Coronary flow reserve in dilated cardiomyopathy: relationship with peak oxygen consumption and NYHA class

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Background: It has been demonstrated that the maximal oxygen uptake (VO2max) is strictly related to functional status (NYHA Class) in patients with dilated cardiomyopathy (DC) and therefore represents an important clinical predictor. The VO2max is the physiological trigger to increase the coronary flow velocity reserve (CFVR) in the distal left anterior descending coronary artery (LAD, at baseline and during intravenous infusion of adenosine (HDI 5000, ATL) at rest and during the hyperemic phase induced by 0.84 mg/kg of Dipyridamole for 4 min (16 patients), 0.14 mg/kg/min of Adenosine for 2 min (7 patients)), or by the infusion up to 40 μg/Kg/min of Dobutamine (7 patients). The CFVR was calculated as the ratio between the maximal (MCFV) and the basal velocity (BCFV). The results were also compared with 16 normal controls.

Purpose: To investigate if patients with dilated cardiomyopathy had a lower CFVR than normal controls, in the territory of the LAD that proves very useful to demonstrate noninvasively the ischemic etiology of dilated cardiomyopathy.

Results

GROUP | pts(n) | BCFV(cm/sec) | MCFV(cm/sec) | CFVR | A: (DNIC) | 14 26.8±3.2* | 61.2±15+* | 2.2±0.5 # | p<0.001 | B: (DIC) | 16 37.5±16.1* | 55.9±19.3* | 1.0±0.9 | p:0.001

Conclusion: Despite the fact that patients with dilated cardiomyopathy had a lower CFVR than normal controls, the CFVR in the territory of the LAD proved very useful to demonstrate noninvasively the ischemic etiology of dilated cardiomyopathy.

Coronary flow reserve and idiopathic dilated cardiomyopathy: relations with afterload and left ventricular shape


Purpose: A decrease of coronary flow reserve (CFR) is often observed in idiopathic dilated cardiomyopathy (IDCM) but the mechanisms underlying this reduction are still controversial. Aim of the study was to assess CFR changes in IDCM compared to a normal reference population, in relation to standard Doppler echocardiographic measurements.

Methods: Eleven patients (M/F = 9/2, mean age ±48.2 years) with IDCM and 11 healthy controls, comparable for sex distribution and age, underwent standard Doppler echo and transthoracic Doppler interrogation of coronary velocities of left anterior descending artery (LAD) both at rest and after high-dose dipyridamole (Dip). The (0.84 mg/Kg i.v.) CFR was determined as the Dip/rest ratio of coronary diastolic peak velocities. Sphericity index (SI) was measured as the ratio of short- to long-axis end-diastolic diameters. Circumferential and meridional end-systolic stress (CESS and MESS respectively) were determined by pulsed wave Doppler.

Results: In patients with IDCM, left ventricular (LV) ejection fraction (EF) was 29.2±6.3%, transmural E/A ratio 1.40±0.9 and E velocity deceleration time 175.8±56.1. SI was 0.77±0.08. CESS (p<0.001) and MESS/Cess ratio (p<0.0001) were significantly higher in IDCM than in controls. Doppler assessment of LAD showed no difference of coronary diastolic peak velocity at rest between the 2 groups but lower velocity at high-Dip (p<0.01) in IDCM. Thus, CFR was significantly lower in IDCM (17.9±0.3) in comparison with controls (23.4±0.12) (p<0.001). This difference remained significant even after adjusting resting and Dip coronary diastolic peak velocities for the respective mean blood pressure (p<0.01). In the IDCM group, CFR was related directly to SI (r=0.73, p<0.01) and negatively to SI (r=0.69, p<0.02). CESS (r=0.65, p<0.02) and MESS/Cess ratio (r=0.60, p<0.03). No significant relation was found between CFR and ventricular Doppler diastolic measurements.

Conclusions: In patients with IDCM, the reduction of CFR appears as a marker of impaired coronary microvascular function, mainly associated to hemodynamic mechanisms involving impairment of LV systolic function, abnormal loading conditions and LV remodeling.
640 Coronary flow velocity reserve in patients with combined aortic stenosis and regurgitation
A. Nemes, T. Forster, M. Csanady. University of Szeged, Szeged, Hungary

Background: The coronary flow velocity reserve (CFR) is decreased in patients with significant aortic stenosis (AOS) and normal epicardial coronary arteries. The aim of the present study was to examine CFR in patients with combined aortic stenosis and regurgitation.

Patients and methods: Patients with a negative coronary angiogram without outvalvular heart disease (group 1), patients with significant left anterior descending coronary artery disease (group 2), patients with mild AOS (group 3), patients with mild AOS and grade 3-4 aortic regurgitation (group 4) and patients with significant AOS and a negative coronary angiogram (group 5) were investigated. CFR was measured by stress transoesophageal echocardiography and was calculated by the ratio of average peak diastolic flow velocity (APV) during hyperaemia to resting APV.

Results are presented in the table.

Conclusions: 1. The CFR of patients with AOS and a negative coronary angiogram is decreased as compared to control patients and similar to LAD cases. 2. In patients with mild aortic stenosis and grade 3-4 aortic regurgitation the CFR is similarly reduced.

Data of patients

<table>
<thead>
<tr>
<th>No</th>
<th>peak AOS gradient (mmHg)</th>
<th>CFR</th>
</tr>
</thead>
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<tr>
<td>group 1</td>
<td>22</td>
<td>2.72±1.09</td>
</tr>
<tr>
<td>group 2</td>
<td>31</td>
<td>1.75±0.43</td>
</tr>
<tr>
<td>group 3</td>
<td>43</td>
<td>42±7</td>
</tr>
<tr>
<td>group 4</td>
<td>7</td>
<td>57±17</td>
</tr>
<tr>
<td>group 5</td>
<td>16</td>
<td>91±6.25</td>
</tr>
</tbody>
</table>

*p<0.05 vs group 1; **p<0.005 vs group 5.

641 Dependence of coronary flow velocity reserve on the grade of aortic atherosclerosis in patients with normal epicardial coronary arteries
A. Nemes, T. Forster, M. Csanady. University of Szeged, Szeged, Hungary

Background: The detection of atherosclerotic plaques in the descending aorta by transoesophageal echocardiography (TEE) has been found to be indicative of coronary artery disease (CAD). The aim of the present study was to examine coronary flow reserve (CFR) in patients with different grades of aortic atherosclerosis (AA) and normal epicardial coronary arteries.

Patients and methods: The present study involved 21 consecutive patients (mean age: 56±11 years, range: 22-73) with normal epicardial coronary arteries. All cases underwent stress transoesophageal echocardiography to assess CFR. 12 of them did not show echocardiographic signs of AA (Group 1), while 9 patients had aortic intimal thickness or aortic plaque (Group 2). The CFR was calculated by the ratio of average peak diastolic flow velocity (APV) during hyperaemia to resting APV. The grade of AA in the descending aorta was determined by means of the same TEE examination.

Results are presented on the table.

Conclusions: The CFR of patients with AA without coronary artery disease is reduced as compared to cases without aortic atherosclerosis.

Data of patients

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Dmax (cm/s)</th>
<th>D30 (cm/s)</th>
<th>CFV</th>
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</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>50±4.6</td>
<td>30±5.3</td>
<td>3.07±1.22</td>
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<tr>
<td>Group 2</td>
<td>54±6.5</td>
<td>39±7.5</td>
<td>2.16±0.64</td>
</tr>
</tbody>
</table>

*p<0.05 vs group 1.
643 Preclinical impairment of coronary flow reserve in patients with rheumatoid arthritis

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Introduction: The assessment of coronary flow reserve (CFR), measured by transthoracic echo Doppler examination (TTE), has proven to be useful in the detection of relevant coronary artery disease as well as microcirculation.

Aim of our study was twofold: 1) to investigate whether CFR impairment is present in patients with rheumatoid arthritis with or without clinical evidence of ischaemic heart disease; 2) to assess a relationship between CFR reduction and duration of RA.

Methods: 39 RA patients (mean age 61 ± 12 years, disease duration 6 ± 5 years) were studied to assess CFR performed by TTE and matched for age and sex with 15 control subjects. TTE was performed with an electronic phase array ultrasound system (Phillips 5500 Andover, USA) using a high-frequency transthoracic transducer (S6) with second harmonic capability. Coronary flow in the mid-distal portion of the left anterior descending coronary artery (LAD) was searched under the guidance of color Doppler flow mapping. CFR was evaluated in the LAD before and during dipyramidole infusion (0.56 mg/kg in 4 min 0.28 mg/kg in 2 min). CFR was defined as the ratio of hyperaemic-to-basal peak diastolic coronary flow (three highest measurements were averaged). CFR values were considered as follows: group 1 (CFR less than 2.0) severe reduction; group 2 (CFR between 2.01 and 2.5) mild reduction; group 3 (CFR more than 2.5) normal. Stop frame and clips were digitally recorded and stored on magneto-optical disks.

Results and conclusions: Our study showed that CFR, measured by a new non-invasive method, is significantly reduced in RA patients globally considered in comparison with control group (respectively 2.43 ± 0.59 vs 3.38 ± 0.62, P < 0.01) According to different CFR groups we found: Group 1: 9/39 (23%), CFR =1.67 ± 0.54 and disease duration = 9.9 ± 8 years. Group 2: 14/39 (36%), CFR = 2.94 ± 0.12 and disease duration = 7.6 ± 5 years. Group 3: 16/39 (41%), CFR = 2.93 ± 0.38 and disease duration = 7.5 ± 5 years. A high prevalence (59%) of RA patients revealed CFR involvement. Furthermore, a significant linear correlation was found between CFR and the duration of RA (r=-0.34, P<0.05).

In conclusion, CFR is an important tool to reveal an early preclinical cardiac involvement in RA patients; we need follow-up study to assess therapeutic effects on microcirculation.

644 The effect of biventricular pacing on distal left anterior descending flow reserve by transthoracic Doppler echo

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Introduction: Biventricular pacing (Biv) has been introduced in heart failure treatment with positive results on left ventricular systolic function, amelioration of symptoms and improvement of exercise capacity. However, the underlying mechanisms of Biv effects remain under investigation. There are still scarce data concerning the effect of Biv on myocardial perfusion. Transthoracic Doppler echo provides an accurate means to evaluate distal left anterior descending artery (LAD) flow reserve (CFR). Aim of the study was to interrogate the potential effect of Biv on LAD CFR.

Methods: 11 consecutive pts (all with LBBB, 6 with idiopathic dilated cardiomyopathy, 5 with ischemic cardiomyopathy, 10 males, aged 46-70 years) were studied to assess CFR performed by TTE and matched for age and sex with 15 control subjects. TTE was performed with an electronic phase array ultrasound system (Phillips 5500 Andover, USA) using a high-frequency transthoracic transducer (S6) with second harmonic capability. CFR was evaluated in the LAD before and during dipyramidole infusion (0.56 mg/kg in 4 min 0.28 mg/kg in 2 min). CFR was defined as the ratio of hyperaemic-to-basal peak diastolic coronary flow (three highest measurements were averaged). CFR values were considered as follows: group 1 (CFR less than 2.0) severe reduction; group 2 (CFR between 2.01 and 2.5) mild reduction; group 3 (CFR more than 2.5) normal. Stop frame and clips were digitally recorded and stored on magneto-optical disks.

Results: Group 1: 2/39 (5%), CFR = 1.13 ± 0.08 and disease duration = 9 years. Group 2: 8/39 (23%), CFR = 1.51 ± 0.25 and disease duration = 12.1 ± 4.4 years. Group 3: 16/39 (41%), CFR = 1.67 ± 0.35 and disease duration = 12 years. The observed improvement was affected by the baseline CFR as well as by the degree of LV dilatation.

Thus, an improvement of coronary microvascular hemodynamics in the LAD territory, which is expressed by the respective change in CFR, might be an additional parameter contributing to the beneficial effects exerted by the application of biventricular pacing.

645 Coronary flow velocity and coronary flow reserve in rat left anterior descending coronary artery as assessed by transthoracic high-resolution echocardiography

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Introduction: Coronary artery disease is the major cause leading to cardiovascular death. Coronary flow reserve has recently been identified as a physiological biomarker with relevant prognostic information. Recent technical advances dramatically improved the feasibility of coronary imaging in man, using Color Doppler echocardiography. We have now developed and validated a coronary artery imaging protocol in rats with high-resolution Doppler ultrasound.

Methods: 13 weeks old spontaneously hypertensive rats (SHR) were examined under isoflurane anesthesia. Telemetry probes were implanted using standard surgical procedure two weeks prior to the ultrasound study for on-line in vivo blood pressure measurement. A catheter was introduced into the tail veins for continuous infusion of adenosine with increasing doses ranging from 80 to 160 µg/kg/min. Left anterior descending coronary artery (LAD) can be visualized in all the animals using a modified parasternal long-axis view. The entire main stem of LAD can be visualized in the interventricular groove. LAD was imaged under guidance of Color Doppler and flow velocities in this vessel were measured continuously using pulsed Doppler during Adenosine infusion. To validate usefulness of the technique, an additional group of age-matched SHR, which had undergone intensive voluntary physical exercise during 5 weeks were examined. Peak and mean diastolic coronary flow velocity and diastolic velocity-time integral were measured from at least three consecutive cycles. Coronary flow reserve was calculated based on the ratio between mean diastolic flow velocity during baseline and the hyperemic phase.

Results: Intravenous administration of adenosine during the current dose range does not affect blood pressure and heart rate in anesthetized SHR. The maximum adenosine-induced vasodilatation was reached at a dose of 140 µg/kg/min in both the control and the exercised animals. The baseline flow velocity in the mid LAD was 0.33 ± 0.03 and 0.38 ± 0.07 m/s in the exercised and control animals. Adenosine-induced flow velocity increase was significantly higher in exercised animals than controls (ANOVA, P < 0.002). Maximum coronary flow velocity ratio was 2.8 ± 0.5 and 1.5 ± 0.2 in the exercised animals compared to controls.

Conclusions: Coronary flow reserve in rats can be non-invasively assessed using color Doppler echocardiography with high feasibility. In vivo coronary adenosine sensitivity is similar to that of human. Physical exercise is associated with improved coronary flow reserve in SHR.

646 Non-invasive real-time imaging of left and right coronary arteries in mice using color Doppler echocardiography and ultrasound biomicroscopy

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Introduction: In the post-genomic era, mouse models are prevalently used within cardiovascular research. However, with 600 heart beats per minute and a heart size as small as 4 mm, few imaging modalities have been able to study the in vivo mouse coronary artery physiology and morphology. We have developed protocols to study mouse cardiac morphology using novel ultrasound biomicroscopy as well as coronary flow reserve using color Doppler echocardiography.

Methods: Left coronary artery morphology can be assessed both in a parasternal short-axis and long-axis view while the proximal right coronary artery can be visualized in a right parasternal long-axis view using UBM with a 40 MHz scanhead, giving a resolution of 30 µm. Coronary flow velocity can be recorded in the mid LAD in a modified parasternal long-axis view. Hyperemia can be induced using either hypoxia or adenosine.

Results: LCA and RCA can be assessed in 100% of mice (n = 20). Hypoxia and adenosine induced a 2-fold increase of coronary flow. LCA diameter is around 430 µm while the RCA has a diameter of 350 µm.

Conclusion: Mouse coronaries can be assessed non-invasively in real-time.
Poster Session 4

3 December 2004, 14:00 to 18:00

Location: Poster Hall

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Pre-impulse power mean is determinant in contrast perfusion quantification

In order to improve quantification of perfusion and comparability of results for different equipments, settings, contrast agents, and physiological conditions, is necessary to estimate sources of variability.

Aim: To evaluate under controlled conditions, in a perfusion phantom, the effect of pre-impulse steady-state power (Power pre) on the measurement of beta slope (B).

Methods: Perfusion phantom was built using a dialyzer (capillary radius: 105 µm) connected to a pulsatile-flow pump. Flow range: from 10 to 60 ml/min (capillary velocity: 0.4 to 2.4 mm/s). Infusion rate of contrast was adjusted for optimal enhancement. Power pre was measured, for each level of flow (picture). After impulse, B was measured at curves of contrast replenishment fitted with the exponential function: A (1-(e) ^ (-[B]time)).

Results: Measurements (n=217) of B, at different flow levels, were compared grouping by Power pre: Low Power pre (m±sem): 7-14 dB (11±0.3) versus High Power pre: 14-21 dB (17±0.2) (P<0.001) (table).

Conclusions: In perfusion quantification, Power pre affects the measurement of B, a surrogate of capillary velocity. With high Power pre, B is greater at each level of flow. It seems convenient to describe Power pre when reporting B measurements.

<table>
<thead>
<tr>
<th>Flow (ml/min)</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
</tr>
</thead>
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<tr>
<td>Beta (Low Power pre)</td>
<td>0.2±0.1</td>
<td>0.5±0.1</td>
<td>0.7±0.1</td>
<td>1.5±0.2</td>
<td>1.7±0.4</td>
<td>2.4±0.2</td>
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<tr>
<td>Beta (High Power pre)</td>
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<td>2.7±0.5</td>
<td>2.9±0.3</td>
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<tr>
<td>P</td>
<td>0.002</td>
<td>0.001</td>
<td>0.001</td>
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<td>0.003</td>
<td>&lt;0.001</td>
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</table>

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Prediction of functional improvement of left ventricle after anterior myocardial infarction treated with PCI: myocardial contrast echocardiography and low-dose dobutamine study
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Objective: The relation between myocardial perfusion and contractile reserve of left ventricle of patients (pts) suffered from acute myocardial infarction (AMI) treated by means of primary coronary angioplasty (PCI) is still uncertain. The aim of the study was to establish to what extent myocardial contrast echocardiography (MCE) and low-dose dobutamine echocardiography (LDDE) might predict recovery of left ventricular function in these pts.

Methods: 44 consecutive pts (37 male, 7 female, mean age 56.0±10.4 years) with LAD occlusion (single vessel disease) and subsequent AMI treated successfully with PCI (TIMI 3 flow) were enrolled. They underwent ultraharmonic MCE with Levovist 1-2 days after AMI (exam I). MCE was scored semiquantitatively as: 2--homogenous contrast density, 1 – heterogeneous, 0 – no contrast. LDDE (up to 20 µg/kg/min) was performed 4-5 days after AMI (exam II). One month later 2D echo was repeated (exam III). In each examination wall motion score index (WMSI) and ejection fraction (EF) (bi-plane Simpson’s method) were calculated. Improvement of the LV function was defined as decrease of WMSI and increase of EF between exams I and III.

Results: Functional improvement was observed in 30 pts (68%) at follow-up (recovery group) in whom WMSI and EF changed significantly (1.58±0.23 vs. 1.28±0.22, p<0.0001 respectively, 50.6%±7.2 vs. 56.8%±7.1, p=0.001, respectively). In non-recovery group corresponding values were 1.73±0.19 vs. 1.78±0.15 (NS), and 45.1%±5.4 vs. 43.0%±5.7 (NS), respectively. The sensitivity of MCE for homogenous perfusion (score 2) and LDDE for predicting functional improvement was 63% and 59% respectively with specificity 86% and 93% respectively. Complementary evaluation of MCE and LDDE discovered improvement of LV function in 16 pts with sensitivity 74% and specificity 92%.

Conclusions: After successful PCI for AMI significant improvement for LV function was observed in 68%. MCE and LDDE seem to have similar value in predicting functional recovery of the LV after AMI. For optimal evaluation combination of MCE and LDDE has to be applied.
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Real-time myocardial perfusion imaging for pharmacologic stress testing. Added value to wall motion analysis and single-photon emission computed tomography

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Background: Little is known about the added value of real-time myocardial contrast echocardiography (MCE) as an adjunct to pharmacologic stress testing.

Purpose: This study was performed to evaluate the diagnostic value of MCE to detect abnormal myocardial perfusion by 99Tc-Sestamibi-SPECT and anatomically significant CAD by coronary angiography.

Methods: MCE was performed at rest and during vasodilator stress in consecutive, unselected patients (n=120) undergoing SPECT imaging for known or suspected CAD. Myocardial opacification, wall motion (WM) and tracer uptake were visually analyzed in 12 myocardial segments by two pairs of blinded observers. Concordance between the two methods was assessed using kappa statistics.

Results: Of 1556 segments 1025 (76%) were interpretable by MCE, WM and SPECT. Sensitivity of WM was 75%, specificity 83% and accuracy 81% for detecting functionally abnormal myocardial perfusion by SPECT (kappa=0.53). MCE and WM together yielded significantly higher sensitivity (85% vs. 74%, p<0.05), specificity of 83% and accuracy of 85% (kappa=0.64). In 89 patients undergoing coronary angiography, MCE and WM together yielded improved sensitivity (83% vs. 64%, p<0.05) and accuracy (77% versus 68%, p<0.05) but similar specificity (72%) compared with SPECT for detection of high grade (>75%) stenotic coronary lesions. MCE and WM together provided diagnostic information (chi²=51.1) superior to WM alone (chi²=29.7) and to SPECT (chi²= 7.2) for detection of anatomically significant CAD.

Conclusion: Assessment of myocardial perfusion adds value to conventional stress echocardiography by increasing its sensitivity for detection of functionally abnormal myocardial perfusion. MCE and WM together provide improved sensitivity and accuracy for detection of CAD compared with SPECT.

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Comparison of contrast echocardiography with SPECT in the evaluation of coronary artery disease in patients with LBBB

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Purpose: The non-invasive assessment of coronary artery disease (CAD) in patients (pts) with LBBB is troublesome. In this study, we investigated the diagnostic accuracy (dAC) of myocardial contrast echocardiography (CE) with adenosine (AD) to detect CAD in pts with LBBB, and we compared it with SPECT.

Methods: In 45 pts (age 55±5.8 years, 29 men) with LBBB and chest pain underwent SPECT imaging with AD (infusion of AD 140/g/kg/min for 6 min and administration of 3 mCi of TL 201, 3 min after the beginning of AD infusion) and CE with AD within 3 days (using ‘Levoist’, 6-8 g at rest and during infusion of AD at a rate of 140 g/kg/min for 6 minutes). Myocardial perfusion was evaluated by means of the Perfusion Score Index (score 1—homogeneous contrast effect, 0.5—patchy myocardial contrast enhancement, and 0—no visible contrast effect). Perfusion obtained by SPECT in the same segments was evaluated as: 1-normal; 2-reduced/mild ischemia; 3-absent/severe ischemia. Coronary arteriography (CA) was performed within 1 week and was used as the ‘gold standard’ method for CAD detection (>50% reduction in diameter in at least one major epicardial coronary artery).

Results: The K index of concordance of CE and SPECT with CA was 0.37±0.13 and 0.77±0.10 respectively. Their overall sensitivity (SN), specificity (SP), positive predictive value (PPV), negative PV (NPV), and dAC are shown in Table 1. Significant CAD was present in 11 pts (23%). LAD was involved in 8 pts, CX in 2 pts, and RCA in 4 pts. Concerning the LAD disease detection, SPECT had a SN of 75%, a SP of 79%, a PPV of 43%, a NPV of 94%, and a dAC of 79%. Correspondingly, in the case of CE the SN, SP, PPV, NPV, and dAC were 100% for all variables.

Conclusion: CE with AD has a higher global dAC compared to SPECT for the detection of CAD in pts with LBBB. This is mainly due to the poor specificity of SPECT concerning perfusion defects detection in the LAD territory.

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Effect of intravenous adenosine on myocardial salvage in patients with acute MI: measurement of risk area and microvascular reflow with contrast echocardiography


Objectives: Adenosine may enhance microvascular reflow in patients with acute MI although its effect on myocardial salvage relative to the risk area has not been established. Myocardial contrast echocardiography (MCE) can be used to spatially assess the risk area during coronary occlusion and infarct size after reperfusion. We used MCE to test the hypothesis that intravenous adenosine as an adjunct to percutaneous coronary stenting (PCS) acutely improves perfusion within the risk area and reduces infarct size relative to the risk area.

Methods: Thirty patients with acute MI were randomized to IV adenosine (50-70 mg/kg/min) or vehicle for 3 hr after primary PCS. MCE with intravenous adenosine imaging was performed before PCS and 4 weeks later. The risk area during coronary occlusion and infarct size after reflow were determined by an automated threshold program that spatially detects regions lacking contrast-enhancement during MCE. Segmental perfusion based on a 16-segment model was also determined by scores (0, none; 1, partial; 2, normal) assigned by reader blinded to the clinical data. The perfusion score index from the risk area (PSI-RA) was determined by dividing the summed scores by the number of segments.

Results: There were no significant differences in clinical data between patients receiving adenosine (n=14) or placebo (n=16). The infarct area as a percentage of the risk area was smaller in patients treated with adenosine compared to placebo (0.33±0.26 vs 0.60±0.21, p<0.01). This effect was greatest for patients in whom infarct artery patency was achieved <4 hr after onset of pain (0.15±0.15 vs 0.54±0.19, p<0.01), with little effect when patency was achieved >4 hr (0.50±0.22 vs 0.69±0.26, p=0.18). The PSI-RA prior to PCS was not significantly different between the treatment groups. At 4 weeks, patients treated with adenosine compared to placebo had a greater improvement in PSI-RA (0.68±0.70 vs 0.26±0.60, p=0.07).

Conclusions: The adjunctive use of intravenous adenosine at the time of PCS for acute MI improves myocardial salvage within the risk area. This beneficial effect occurs primarily in those undergoing early reflow.
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Real-time myocardial perfusion imaging in the evaluation of patients with chest pain. Added value to clinical and biochemical markers and accurate prediction of functional recovery in patients with non-ST elevation myocardial infarction (NSTEMI).


Background: In patients with acute coronary syndrome (ACS) rapid and accurate risk stratification is crucial. Real-time myocardial contrast echocardiography (MCE) provides information on myocardial perfusion, wall motion and viability. We investigated whether MCE can add diagnostic value to clinical and biochemical markers in identifying patients with ACS and evaluated the relation of myocardial tissue reperfusion to functional recovery in patients with non-ST elevation myocardial infarction (NSTEMI).

Methods: Consecutive patients (n=100) presenting with first occurrence of chest pain serially underwent MCE on admission, 1-4 h after PCI and at 24 h, 4 d and 4 weeks of follow-up. Contrast images were analysed visually and quantitatively measuring peak signal intensity (A) and slope of signal intensity rise (ß) in 16 myocardial segments. Wall motion improvement on follow-up echocardiograms after 4 weeks served as a reference for functional recovery of impaired LV-function.

Results: Thirty-seven of 100 patients had ACS including 25 patients with NSTEMI, 12 with unstable angina and 3 with coronary artery disease (CAD). Multivariate logistic regression analysis showed that MCE was the strongest predictor of ACS (chi2=87.5) adding significant diagnostic value to clinical (chi2=−28.4) and biochemical (chi2=−64.6) markers. Initial perfusion defect size correlated strongly with TDI elevation velocity (Systolic: r=0.72, p<0.001 and with LV-ejection fraction at 4 weeks of follow-up (r=−0.79, p<0.001). MCE differentiated viable from necrotic myocardium in patients with NSTEMI, predicting functional recovery with sensitivity of 81%, specificity of 89% and accuracy of 83%.

Conclusions: Our data suggest that MCE can accurately identify patients with ACS and can detect myocardial viability in patients with NSTEMI showing impaired microvascular integrity. This information may support immediate risk stratification and allow monitoring of the effectiveness of reperfusion therapy in patients with chest pain in the emergency department.

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Prognostic value of myocardial contrast echocardiography for the long-term prediction of cardiac events in patients with confirmed coronary artery disease

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Background: Myocardial contrast echocardiography (MCE) is a reliable method to study the myocardial perfusion by the identification of reversible and/or fixed defects in pts with known or suspected coronary artery disease (CAD). The aim of this study was to assess the long-term (up to 5 years) prognostic significance of reversible perfusion defects in pts with established CAD.

Methods: We examined the outcomes of 165 pts (65±11 years, 123 men) with confirmed MCE and continuous infusion of PESDSA associated with triggered (fixed 1:1) second harmonic imaging, at rest and after a bolus injection of adenosine. A reversible defect was considered positive test while normal perfusion or isolated fixed defect were considered negative tests. The end-points were cardiac death or non-fatal myocardial infarction (hard events) or a revascularization procedure (PTCA and/or CABG).

Results: A positive test was detected in 74 (44.9%) pts. All pts were followed up for 2.9±2.6 years (12-57 months). Sixty-six patients experienced events: 6 non-fatal myocardial infarctions (3.8%), 13 cardiac deaths (7.9%) and 47 pts had a revascularization procedure (28.5%) either by PTCA (n=30) or CABG (n=17). A reversible defect was an independent and powerful predictor of hard cardiac events (hazard ratio = 16.9, CI 14.1-18.2). The cumulative event free survival for hard events (figure) was 88.9% in pts with negative and 75.7% in pts with positive ACE (p<0.0001). When all events were analyzed the cumulative event free survival was 90.1% and 23% for negative and positive ACE respectively (Log-Rank=74.24, p<0.0001).

Conclusions: MCE with adenosine is a very useful predictor of late cardiac events in pts with known CAD and could be used in the clinical scenario.

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Combined use of contrast echocardiography and multislice computed tomography for management of pulmonary arteriovenous malformations in patients with hereditary hemorrhagic telangiectasia

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Previous studies report that pulmonary arteriovenous malformations (PAVM) occur in 20 to 30% of hereditary hemorrhagic telangiectasia (HHT) populations and may result in stroke, brain abscesses, or hemoptysis that affect morbidity and mortality in these patients. Today the multislice computed tomography (MCT) shows a high sensitivity in detecting PAVM. The aim of our study was to evaluate whether a non-invasive approach combined with contrast echocardiography (CE) and MCT is useful for management of PAVM.

Methods: one hundred forty consecutive patients with clinical criteria for HHT diagnosis were prospectively studied. Each patient received CE with a peripheral intravenous injection of a first bolus of saline solution (5 cc) and a second bolus of polygelin solution (3 cc). The related apical 4-chamber echo records were considered as positive when there was: 1. delayed appearance of bubble in the left-sides chambers 3-6 heart cycles after the appearance in the right-sides chambers, 2. confirm of intrapulmonary shunt through assessment of pulmonary vein showing echocast during injection, and 3. different contrast agents converging. MCT of the lungs with contrast media was performed by an independent blind operator. Patients with both MCT and CE positives studies received pulmonary angiography if the MCT measured diameter of the feeding arteries was ~3 mm.

Result: seventytwo patients had PAVM identified by thoracic MCT. CE correctly demonstrated the presence of PAVM in 63/72 (sensitivity: 86%); the false negatives had a single small PAVM. There were four false positive CE (specificity: 97%). Among the patients with identified PAVM 24 were successfully treated with transcatheter coil embolization. Interestingly pa-
tients selected for embolization procedure showed a quickly massive echo-
contract after injection.

Conclusion: our study demonstrated that PAVM occur in 45% of HHT patients. CE has shown high accuracy for PAVM haemodynamically signifi-
cant. We hypothesize that a combined use of CE/MCT could provide a standard reference in screening HHT patients for PAVM management.

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Tissue Doppler imaging does not show intraclinical alteration of myocardial function after contrast echocardiography

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Background: It has been previously suggested that simultaneous expo-
ure of hearts to contrast and ultrasound can damage the myocardium and can produce a transient decrease of the contractility in animals. Tissue doppler imaging (TDI) is a useful tool to quantify the myocardial function with very high temporal resolution. The aim of the present study was to test whether contrast echocardiography (CE) can cause alteration of the myocardial function by using tissue doppler imaging analysis.

Methods: 13 patients without cardiomyopathy (Mean age 48±18) under-
went baseline echocardiography before and after 5 minutes of continuous intravenous infusion of Sonovue from the apical views, using an intermedi-
ate mechanical index (MI=1). High frame rate images (~200/sec) were acquired in tissue doppler mode. Data were averaged over 3 cardiac cycles and analysed offline before and after CE.

Results: There were no significant changes of the different TDI parameters before and after simultaneous exposure to contrast and ultrasound table 1

Conclusion: Our data suggest that CE do not cause infraclinical alteration of the myocardial function. Therefore, an intermediate mechanical index settings, which are usually used for left ventricular opacification, can be used with safety.

Table 1

<table>
<thead>
<tr>
<th>Peak V (cm/s)</th>
<th>Peak V(CE) (cm/s)</th>
<th>Peak SR (CE) (%)</th>
<th>Peak SR (CE) (%)</th>
<th>Peak E (cm/s)</th>
<th>Peak S (cm/s)</th>
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<tr>
<td>Systolic BS</td>
<td>6.4±2.4</td>
<td>6.7±2.5</td>
<td>15±6</td>
<td>16±6</td>
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<td>Diastolic BS</td>
<td>5.7±1.9</td>
<td>5.6±1.9</td>
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<td>Systolic BL</td>
<td>6.0±3.4</td>
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Safety of contrast agents during dobutamine stress echocardiography: a single centre experience
J. Timperley, A.R.J. Mitchell, H. Thibault∗, H. Becher. Oxford, United Kingdom, 1Hospital Louis Pradel, Bordeaux, France

Purpose: Recently there have been safety concerns regarding Sonovue used during echocardiography. We aimed to assess the safety of combined contrast DSE at our institution.

Methods: We retrospectively reviewed the reports of 500 consecutive cases performed since the introduction of routine clinical use of contrast agents for complications. All cases were performed using either no contrast, Optison or Sonovue. Optison was given in each case as 3 ml bolus and Sonovue was given via the Vueject rotating pump as an infusion.

Results: The results are shown in the table below. The number of positive tests were higher with contrast compared to non-contrast. The only significantly haemodynamic difference were a higher peak heart rate in the Sonovue group and a corresponding higher mean dobutamine dose. The number of side effects were similar and occurred in small numbers and there were no allergic events. SVT and VE’s were more common with Optison, and vagal reactions without contrast. VT occurred in 3 patients, 2 with no contrast and 1 with Sonovue. All three survived and there were no deaths.

Conclusion: Combining contrast agents with DSE appears safe in our series with side effects occurring at a similar rate as non-contrast imaging.

Results Table

<table>
<thead>
<tr>
<th></th>
<th>No Contrast</th>
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<th>Sonovue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers (n)</td>
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<td>59</td>
<td>224</td>
</tr>
<tr>
<td>% Male</td>
<td>61.3</td>
<td>55.9</td>
<td>58</td>
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<tr>
<td>Age</td>
<td>63.7±11</td>
<td>63.8±11</td>
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<tr>
<td>Resting Heart Rate</td>
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<tr>
<td>Peak Heart Rate</td>
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<td>124.7±23</td>
<td>129.7±18</td>
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<tr>
<td>Resting BP</td>
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<td>139.69</td>
<td>139.72</td>
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<td>Peak BP</td>
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<td>139.72</td>
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<tr>
<td>Dobutamine mcg/kg/min</td>
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<td>35.7±8.2</td>
<td>37.7±6.1*</td>
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<td>%DSE Positive</td>
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<td>22.3</td>
</tr>
<tr>
<td>%SVT</td>
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<td>3.5</td>
<td>1.8</td>
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<td>% Ventricle Ectopic</td>
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<td>% VT</td>
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<tr>
<td>% Vagal Reactions</td>
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<td>% Esmolol</td>
<td>2.3</td>
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∗ p<0.05 compared to non-contrast imaging.

737
Effect of neutralizing anti-Fas ligand antibody on adriamycin-induced acute and chronic cardiotoxicity in rats

Background and purposes: The precise molecular mechanism of adriamycin-induced cardiomyopathy (ADR-CM) is still unknown. This study was intended to analyze the mechanism of apoptosis induction and the effect of blocking Fas/Fas ligand interaction with neutralizing anti-Fas ligand antibody link with myocardiac performances in acute and chronic ADR-CM in rats.

Methods: Cardiotoxicity was induced in rat by intraperitoneal administration of ADR weekly 2 mg/kg (chronic-IgG group, n=13 and chronic-anti FasL group, n=13) or every other day 5-6 mg/kg (acute-IgG group, n=6, and acute-anti FasL group, n=6) to total amount of 16 mg/kg with (acute and chronic-anti FasL groups) or without (acute and chronic-IgG groups) intravenous neutralizing anti-Fas ligand antibody injection. Same amount of saline and normal mouse IgG serum were injected to the control group. Initial and follow up echocardiographic evaluation was performed after completion of the drug administration. TUNEL assay and immunohistochemical stain for examination of Fas, Bax, and Bcl-2 protein overexpressions were performed. Fas protein overexpression was examined with western blotting.

Results: The systolic thickness of IVS (interventricular septum), LVPW (left ventricular posterior wall) and EF (ejection fraction), FS (fractional shortening) were significantly decreased in chronic-IgG group compared with those parameters of control group or chronic-anti FasL group (p<0.05). Peak mitral E velocity (82.0±11.1 vs 44.0±11.0 cm/sec, p<0.05) and E/A (2.45±0.3 vs 1.1±0.1, p<0.05) in pulsed doppler examinations were diminished in acute-IgG group compared with control group. The TUNEL positive nuclei were dominant in experimental groups compared with control group. In chronic-anti FasL group, the TUNEL positive nuclei were significantly fewer than in chronic IgG group (62.9±14.6 vs 36.6±11.2%, p<0.05).

Conclusion: Apoptosis plays an important role in both acute and chronic ADR-CM. The Fas/Fas ligand interaction is important in the induction of apoptosis in ADR-CM independent of mitochondrial pathway and can be interrupted with neutralizing anti Fas Ligand antibody.
739 Aldosterone antagonism in experimental Chagas’ disease cardiomyopathy

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Purpose: Chagas’ disease is one of the main causes of dilated cardiomyopathy in Latin America, with high rates of morbidity and mortality. Previous studies in patients with heart failure of several etiologies have shown that aldosterone antagonist leads to decrease on mortality and morbidity. The aim of this study was to evaluate whether aldosterone antagonism could prevent myocardial remodeling in Chagas’ disease cardiomyopathy model.

Methods: We studied 60 Syrian hamsters divided in three groups (20 animals each): A) control, B) T. cruzi-infected and, C) T. cruzi-infected treated with spironolactone (40 mg/kg/day) given by gavage. The infected animals were peritoneally inoculated with T. cruzi Y strain blood trypomastigotes. High-resolution transthoracic echocardiogram was performed before infection, 4, 8 and 11 months after infection. We analyzed left ventricular (LV) end-diastolic dimension (LVDD), LV end-systolic dimension (LVESD), fractional shortening (FS) and isovolumic relaxation time corrected by heart rate (IVRTc). The animals were euthanized 11 months after infection and the heart was weighed.

Results: The ratio of LVDD/body weight was greater in the infected group compared to other groups (p < 0.001). TRIVc was longer in infected animals compared to control and treated group (p < 0.001), suggesting an impaired relaxation in the first group. There was a better survival rate after 100 days of infection in animals treated with spironolactone than the infected untreated group (p < 0.05). The ratio of heart weight/body weight was greater in the infected group compared with other groups (p < 0.001).

Conclusions: Aldosterone antagonism could be helpful in preventing cardiac remodeling in chronic Chagas’ disease cardiomyopathy.

740 Transthoracic echocardiography assessment of small animal model of nonischemic cardiomyopathy

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Imaging techniques that can be used for assessment of small animal models of cardiac failure, drug therapy effect and other interventions have not been widely established. The purpose of study was to determine the feasibility of echocardiography in rat model of low dose long term catecholamine induced cardiomyopathy by high transverse echocardiography two dimensional and M modal echocardiography.

Methods: Adrenaline hydrochloride was administered at a dose of 0.01 mg/kg intraperitoneally every other day over 8 weeks in 58 rats. Transthoracic echocardiography by use of 10 MHz transducer on ATL Ultramark 9 machine was performed in 24 rats at baseline and after 10 weeks of beginning therapy with adrenaline. Left ventricular end diastolic and end systolic dimensions and fractional shortening were determined from parasternal long and short axis view. All experiments were conducted in accordance with institutional guidelines for use and care of laboratory animals.

Results: The mortality rate after treatment was 48%. Transthoracic echocardiography provided adequate visualization of left ventricular dimensions and cardiac function in a parasternal short and long axis views. Compared to baseline end diastolic diameters increased from 0.54 ± 0.06 to 0.65 ± 0.08 mm (p < 0.001), end systolic diameters increased from 0.24 ± 0.03 to 0.39 ± 0.07 mm (p < 0.001). Fractional shortening decreased from 55.5 ± 4.1 to 40.6 ± 6.9% (p < 0.001) at 10 weeks. In follow up echocardiography, pericardial effusion was found in 5/24 (21%) rats. Myocardial histological examination in a subset of rats revealed extensive areas of myocardial necrosis with interstitial and perivascular fibrosis development at 10th week of treatment. Ultrastructurally, heart muscle showed myofibrillar disorganisation distorsion of Z and A bands.

Conclusions: Transthoracic echocardiography by use of two-dimensional and M-mode imaging in small animal model represents an accurate reliable diagnostic technique for noninvasive follow up studies of left ventricular structure and function in the cardiomyopathy rat model. The use of echocardiography may be helpful to study new therapeutic strategies in experimental cardiac failure.

741 Feasibility and normal values of tissue doppler imaging in adult male rats

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Purpose: Transthoracic echocardiography can be used to assess cardiac anatomy and function in rats. Tissue Doppler Imaging (TDI) has become an important tool in the quantification of regional function. Few data are available about normal values of strain and strain rate in small rodents. We intend to study the feasibility of strain and strainrate imaging in rats.

Methods: A total of 14 male Wistar rats (332 ± 17 g) underwent baseline transthoracic echocardiography with M-Mode analysis of the left ventricle (LV) and TDI analysis of the inferior wall in short-axis view using a 10 MHz spectral probe.

Results: Mean heart rate was 316 ± 40 min. M-Mode parameters of the LV in short axis are given in the table. A mean of 3 consecutive cycles was calculated. LV end-diastolic (ED) end-end-systolic (ES) volumes (V) were measured by a modified Teicholz formula: [P/4] x LVED(V)². Mean LVEF measured by the modified Teicholz formula was 83 ± 8%. Systolic strain of the inferior wall derived from the M-Mode was 62 ± 13%. Adequate TDI measurements could be obtained in 11 rats. At least 4 consecutive cycles were studied in post-processing with an adapted program (SPEGLE-Software Package for Echocardiographic Quantification LUEven). Mean radial peak systolic velocity of the inferior wall was 3.3 ± 0.5 cm/sec. Mean radial peak systolic strain and strain rate were 51% ± 9% and 14.2 ± 2.6 /sec respectively.

Conclusion: TDI analysis is feasible in rats. Together with M-Mode, B-Mode and Doppler measurements, TDI analysis permits a complete characterisation of LV function in normal rats.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean</th>
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<tr>
<td>Strain IV (%)</td>
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<tr>
<td>LVDD (cm)</td>
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<td>0.08</td>
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<tr>
<td>LVESD (cm)</td>
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<tr>
<td>LVFS (%)</td>
<td>45.6</td>
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<tr>
<td>LVEDV (ml)</td>
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<tr>
<td>LVEV (ml)</td>
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<td>0.02</td>
</tr>
<tr>
<td>LVEF (%)</td>
<td>83.0</td>
<td>7.8</td>
</tr>
</tbody>
</table>

M-mode mean and standard deviation (SD) values in parasatal short-axis of the LV. (LV=Inferior wall, LVEF=LV fractional shortening).

742 Non-invasive assessment of regional function in Wistar rats by strain rate imaging


Background: Rodents play an outstanding role in basic cardiovascular research. Detailed non-invasive regional function assessment by echocardiography would be desirable, but is currently limited to 2D and m-mode measurements. Tissue Doppler derived strain (S) and strain rate (SR) are new echocardiographic parameters of tissue deformation. This study evaluated the feasibility of strain rate imaging in small animals.

Methods: 8 healthy (NORM) and 3 laterally infarcted (INF) male Wistar rats were anaesthetised (2.5 - 5.0% isoflurane) and scanned in left lateral decubitus position (GE Veinmed Vivid7; 8.9 MHz sector transducer) at 173 ± 2 frames/sec. Tissue Doppler loops of parasternal short axis were stored digitally. Peak systolic SR (SPsys) and maximal, systolic and postsystolic S (Smx, Ssys, Sps) were measured off-line as parameters of circumferential function in lateral and septal segments (SEGlat, SEGsep) with a dedicated MATLAB based analysis software.

Results: In NORM, measurements in SEGsep and SEGlat were similar (SPsys: -3.0 ± 1.6/seg, Smx: -10.4 ± 1.4/seg, Ssys: 9.6 ± 1.4 vs. -9.0 ± 3.8/seg, Sps: 0.50 ± 0.4 vs. 0.9 ± 1.3/seg, all n.s.), All INF had visual akinesia in SEGlat. Heart rate was 347 ± 18 bpm (vs. 312 ± 38 bpm in NORM, p < 0.05). SEGsep parameters were similar to NORM, Infarcted SEGlat, Ssys was reduced by 32% (±6.2 ± 2.7 vs. -9.6 ± 1.3%, p < 0.05). Moreover, sign. postsystolic shortening was found (Sps: -1.5 ± 1.8 vs. -0.5 ± 0.4%, p < 0.05).

Conclusion: Strain and strain rate measurements were applicable in Wistar rats. Recordings demonstrated significant differences in regional circumferential function of normal and infarcted myocardium. We conclude that echocardiographic strain rate imaging may be used to routinely analyse regional myocardial function non-invasively in small animals.
Feasibility and accuracy of echocardiographic assessment of left ventricular mass in developing mice

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Recently, the non-invasive assessment of left ventricular mass (LVM) in mice has become feasible by high resolution ultrasound. We therefore evaluated the feasibility and accuracy of LVM in mice of different postnatal stages (p3 - p11).

Methods: High resolution echocardiography was performed during shallow volatile anaesthesia in 42 C57/BL6 mice using a prototype ultrasound system equipped with a new linear array transducer operating at an emission frequency of 15 MHz allowing frame rates up to 280 Hz (HDI-5000, Philips Medical Systems, Bothell, WA, USA). 2D-guided M-mode echocardiography and B-mode echocardiography parastrahl short- and long-axis views were obtained. LVM was calculated by three different algorithms (Penn-convention (P), Area-Length (AL) and Truncated Ellipsoid (TE)).

Results: Echo-imaging was feasible in all mice at p3. Linear regression analysis of all mice revealed good correlation of 2-dimensional echocardiographic assessment of LVM with LVM-histo (AL: y = 1.21 x - 12.1, r = 0.98, p < 0.0001; TE: y = 1.38 x - 2.89, r = 0.98, p < 0.0001). LVM assessed with M-Mode revealed lower correlation coefficient (P: y = 0.6 x - 12.0, r = 0.71, p > 0.0001); Bland-Altman plots revealed bias-values which were lowest for LVM-AL under the golden standard only about 3%. In newborn hearts (LVM-histo: 16 - 31.4 mg) AL revealed closest correlation (y = 0.77x - 2.1, r = 0.88, P < 0.008) bias-plots revealed a mean absolute underestimation of 5.8 mg (30%). Small hearts ( < 50 mg) correlated best with AL at systole (y = 0.78x + 7.9, r = 0.62, p < 0.001). Hearts of adolescent (50 - 75 mg) and adult (75 - 100 mg) mice revealed close linear relationship with AL and TE at diastole. In concordance with the pooled data (above), P revealed lowest regression coefficient and maximal underestimation in all four subgroups.

Conclusions: High resolution echocardiography allows the assessment of LVM even in neonatal and is highly accurate in adolescent and adult mice using B-mode imaging. Mouse-echocardiography thereby might be a valuable tool for the assessment of LVM in different developmental stages.

A new model for dilated cardiomyopathy studied with ultrasonic strain and strain rate imaging

J. D’Hooge, D. Thijs1, K.R. Sipido1, P. Clauss1, B. Bijnens2, J. Thoen1, F. Van de Wey, G.R. Sutherland1, P. Santens1, 1Catholic University Leuven, Leuven, Belgium, 2University Hospital Gasthuisberg, Leuven, Belgium, 3Department of Cardiology, Leuven, Belgium, 4Catholic University Leuven, Leuven, Belgium

Functional imaging of the murine heart has attracted increasing interest. Previously, standard gray scale imaging has been used to characterize cardiac morphology and function both during normal development as well as in pathophysiological settings such as myocardial infarction and heart failure. The aims of this study were to evaluate the effects of selective cerebral overexpression of GH results in marked alterations of cardiac function, morphology and energy metabolism in transgenic mice.

Methods: Male rats -20 g were used. Two groups were studied: the rats treated with creatine analogue beta-guanidinopropionic acid (GPA) (n = 10) and controls (n = 6), GPA (1 M) was administered by subcutaneously implanted osmotic minipumps during 4 weeks. The rats were examined in vivo by 31P magnetic resonance spectroscopy (MRS) for evaluation of myocardial energy status. Transthoracic echocardiography was performed at basal and at stress conditions induced by transesophageal pacing. HPLC was used for measurement of creatine.

Results: BW was lower (p < 0.01) while LV/BW was higher (p < 0.01) in the GPA group indicating myocardial hypertrophy. In the GPA treated rats, total myocardial creatine pool was ~40% lower (p < 0.01) while total nucleotide pool was 30% lower (p < 0.01) compared to the controls. Phosphocreatine-to-ATP ratio was lower in the BGP group (1.6 ± 0.04 v. 2.6 ± 0.07, p < 0.01). LV systolic function was decreased during rest and deteriorated further during stress (p < 0.05). Similarly, LV dimensions were increased in the GPA group (p < 0.05).

Conclusions: Creatine depletion results in functional and structural LV alterations associated with lower myocardial energy reserve. Intact myocardial creatine metabolism is important for normal LV function during resting and stress conditions. This simple model may be valuable for studies of myocardial energy metabolism in small animal models of heart diseases.
747 Perfusion analysis of healthy and LAD-infarcted Wistar rats by high resolution myocardial contrast echocardiography

Background: Myocardial Contrast Echocardiography (MCE) is experimentally established in men and big animals. MCE has not been applied to small animals so far because of technical problems (extreme near field, local resolution, high heart rate, contrast agent application). However, small animals are ideally suited to realize studies with great number (easy handling, low costs) and differentiated questions (knock-outs). Aim of this study was if MCE enables perfusion analysis in healthy and injured myocardium of rodents.

Methods: 23 of 38 male Wistar rats were LAD ligated (LIG), 15 not (NORM). 14 days later, we examined all animals by conventional echocardiography (cECHO) and by real-time MCE (15 MHz linear, Sonos 7500, Philips) under volatile anesthesia (2.5 - 5.0% isoflurane). Settings were adapted to optimal temporal and spatial resolution. For MCE, a 0.3 ml bolus of contrast agent (CA) (Sonovue, Bracco) was injected in a tongue vein and CA enhancement was recorded. Digitally loops of short axis view were analysed off-line (Q-Lab, Philips) and signal intensity (SI) increase was measured in 6 segments (SEG). In cECHO, endystolic and enddiastolic left ventricular diameter (LVEDD), fractional shortening (FS) as well as area shortening (AS) were determined.

Results: 14 of 23 LIG rats had an akinesia in anterior SEG, 9 had hypokinesia, FS (18.6 ± 7.0% vs. 38.3 ± 9.3%, p < 0.001) as well as AS (35.0 ± 9.2% vs. 59.5 ± 4.1%, p < 0.001) decreased in comparison to NORM, LVEDD increased (9.1 ± 0.6 mm vs. 7.6 ± 0.6 mm, p < 0.001). Heart rate of LIG and NORM was comparable (342±26 bpm vs. 334±24 bpm, n.s.). Anterior SEG of LIG animals showed less SI increase in akinetik (0.5 ± 0.6 dB vs. 16.7 ± 17.2 dB, p < 0.01) and hypokinetic SEG (2.3 ± 3.3 dB vs. 16.7 ± 17.2 dB, p < 0.01). SI in inferior SEG increased less than in anterior because of left ventricular shadowing (7.1 ± 10.2 dB vs. 16.7 ± 17.2 dB, NORMT, p < 0.05).

Conclusion: High resolution myocardial contrast echocardiography enables detection of myocardial perfusion and perfusion defects in small animals like Wistar rats. However, CA shadowing deteriorates assessment of inferior segments.

750 The prognostic value of myocardial contrast echocardiography to predict left ventricular function recovery in patients after acute myocardial infarction and primary percutaneous coronary intervention
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Left ventricular dysfunction after recent myocardial infarction may be secondary to stunning or necrosis. Real time myocardial contrast echocardiography (MCE) allows myocardial perfusion assessment from intravenous administration of contrast agent. The aim of the study was to evaluate the feasibility and accuracy of MCE using Optison® and real time imaging (Coherent Contrast Imaging-CCI) for its ability to predict recovery of left ventricular (LV) function in patients with acute myocardial infarction (AMI) successfully treated (TIMI 3) with primary percutaneous coronary intervention.

Methods: Fifty patients with AMI underwent baseline echocardiographic assessment and MCE three to five days after admission. Follow up echocardiography was performed eight weeks later.

Results: 84% of fully perfused segments improved in follow up, while 70% of non-perfused and pathy segments remained unchanged. MCE predicted functional recovery (on a segmental basis) with a sensitivity of 73%, specificity of 82%, positive predictive value of 84%, negative predictive value of 70% and accuracy of 77%. Perfusion of more than one asynergic segment predicted improvement in wall motion score index with a sensitivity of 83%, specificity of 71%, positive predictive value of 94%, negative predictive value of 42% and accuracy of 81% (AUC = 0.848).

Conclusions: Real time MCE using an intravenous fluorocarbon-based contrast agent and CCI is an accurate measure of reperfusion at a microvascular level and a very good predictor of LV function recovery in patients with recent AMI.

749 Myocardial contrast echocardiography is a powerful long-term (up to 66 months) predictor for hard cardiac events in patients at low, intermediate and high risk for coronary artery disease
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Background: Myocardial contrast echocardiography (MCE) is a useful imaging technique for the diagnosis of coronary artery disease (CAD). However its prognostic value has not been studied yet. The aim was to evaluate the long-term prognostic value of MCE in pts at risk for CAD.

Methods: We examined the outcomes of 322 pts (Table) who underwent myocardial contrast echocardiography (MCE) and were classified into 3 groups: Group A: 87 pts at low-risk, Group B: 94 pts with intermediate risk and Group C: 141 pts at high risk. MCE was performed by real time CPS and i.v. contrast agent (Sonovue (Bracco) (5 ml at 2 ml/min). Length of no-reflow (NR) at MCE was calculated in each apical view, averaged and expressed as % of wall motion abnormality (WMA) and of LV length.

Results: In the study population, the length of NR was 4.5±3.1 cm, 23.2±16.3% of LV and 59.1±37.2% of WMA. Thus, according to the mean value of NR length, the number of NR pts was 15 (48%) if NR > 25% of LV or 18 pts (58%) if NR > 60% of WMA.

Conclusions: Thanks to the extremely high signal to noise ratio, MCE performed by real time CPS provided sensitive data on the extent of postInfarct no-reflow. Based on this information, no-reflow could be documented in about 50% of post PCI patients with the damage involving >25% of LV and >60% of the risk dysfunctioning area. This novel classification of no-reflow based on sensitive detection of the phenomenon might improve risk stratification of post-MI patients.
The incremental value of contrast echocardiography for left ventricular opacification and myocardial perfusion during dobutamine stress echocardiography

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Purpose: Dobutamine-atropine stress echocardiography (DASE) is an established tool for diagnosing and risk stratifying patients with coronary artery disease. Use of an ultrasound contrast agent for left ventricular opacification (LVO) has been shown to facilitate endocardial border delineation thus minimising the number of non-interpretable segments. The most recent technical development of real time perfusion contrast echocardiography (RTP) has allowed us to carry out combined perfusion and wall motion analysis. The aim of this study was to investigate the additional value of contrast ultrasound agent for LVO and RTP in DASE in the clinical setting.

Methods: We included 30 consecutive patients admitted to our echo lab for DASE on clinical grounds. The patients were examined using one of three different techniques: either without contrast enhancement, or using bolus doses of second-generation ultrasound contrast agent (Sonovue®) for LVO, or with RTP technique Power modulation Philips Sonos 5500/7500. A segmental analysis was made using a 16 segment model. Wall motion was interpreted on a five-grade scale (hyperkinesia-0, normal wall motion-1, hypokinesia-2, akinesia-3, dyskinesia-4) for every segment at baseline, low dose, peak dose and after the dobutamine infusion was terminated. All 480 segments were analysed in a blinded fashion by two experienced readers in the four different stages. Each reader thus performed an analysis of 1920 segments.

Results: The visualisation of the endocardial border increased markedly when contrast enhancement was used. 319 of 1280 segments (75%) were considered non-interpretable without contrast, compared to 90% (130/1280) in LVO. Using the RTP technique, the visualisation of the endocardial border increased up to 96% (50/1280).

The agreement in assessment of no ischemia, ischemia, scar with ischemia and scar without ischemia, increased from 76% without contrast, to 76% with LVO and up to 81% using the RTP technique. Agreement in diagnosing ischemia/no ischemia at myocardial segmental level increased from 81% (no contrast) to 83% (LVO) and 92% (RTP).

Conclusions: Left ventricular opacification using a second-generation ultrasound contrast agent increases the number of interpretable myocardial segments and decreases inter-observer variability in the assessment of stress echocardiography. A combined perfusion and wall motion analysis using the real time perfusion technique decreases the inter-observer variability further compared to left ventricular opacification alone.

Interobserver agreement on assessment of left ventricular function is not improved by endocardial border tracking but significantly improved by contrast-enhanced echocardiography - A multicenter study

R. Hoffmann, A. Borges1, J. Kasprzak2, C. Firschke3, S. Lafitte4, N. Al-Saadi1, F. Ten Cate5 on behalf the SonoVue LVO-Study Group, University Aachen, Aachen, Germany, 1 University Chantilly, Berin, Germany, 2 Bieganski Hospital, Lodz, Poland, 3 Deutsches Herzcentrum Munich, Munich, Germany, 4 Hospital due Haut Leveque, Pessec Cedex, France, 5 Academic Hospital Dijkzigt, Rotterdam, Netherlands

This study though to define the impact of different echocardiographic reading techniques of left ventricular ejection fraction (EF) and of contrast enhanced echocardiography (CE) in comparison with unenhanced echocardiography (UE) on the correlation between EF defined by echocardiography with EF defined by cineangiography (Cine) and on the interobserver agreement between two readers.

Methods: In 115 pts, with evenly distributed EF-groups (<55%, 35-55%, <35%), UE with second harmonic imaging, CE at low Mechanical Index with i.v. administration of Sonovue and Cine were performed. EF using echocardiography was determined by subjective visual assessment of biplanal apical views (visual), manual tracking of systolic and diastolic bpline apical views (track-bi) and manual tracking of monoplane (4CH) views (track-mo) using UE and CE. EF was determined by two independent off-site readers (OIfR). Interobserver variability (IOV) between the two readers was expressed by mean percentage of error (MPE).

Results: EF defined by OIfR was 46±14% (Visual), 51±15% (Track-bi) and 51±15% (Track-mo) using UE. With CE EF defined by OIfR was 52±16% (Visual), 55±17% (Track-bi) and 55±16% (Track-mo). Using UE correlation on EF defined by Cine was r=0.67; r=0.72 and r=0.68 with Visual, Track-bi and Track-mo, respectively. With CE correlation on EF defined by Cine was r=0.84; r=0.83 and r=0.81 with Visual, Track-bi and Track-mo, respectively. Using UE interobserver agreement on EF was only moderate, independent of the echocardiographic reading technique. IOV was significantly improved with CE independent of the echocardiographic reading technique.

Conclusions: Endocardial border tracking techniques do not improve correlation with Cine on EF or the interobserver agreement on EF. Contrast application significantly improves interobserver agreement on EF independent of the applied echocardiographic reading technique and results in higher correlation with EF defined by Cine.

Table 1

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754 Can we use low mechanical index myocardial contrast echocardiography during dobutamine stress echocardiography to improve the detection of ischemia in non-selected patients?

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Background: Left ventricular opacification with contrast echo (LVO) is well recognized for improving the diagnostic value of dobutamine stress echocardiography (DASE), especially in difficult to image patients. It is now recommended to use the lowest mechanical index (MI), recommended to use MCE modality during stress echocardiography in clinical practice, even in a non-selected population.

Methods: 28 patients with documented coronary artery disease (CAD) were prospectively included in the study (age: 66±14). All the patients underwent tissue harmonic (TH), MCE and LVO at rest and during DASE. A continuous infusion of Sonovue at rest and under high dose of dobutamine was used. Bad quality imaging was not an exclusion criterion. The WM and MP analyses were performed offline in a blinded fashion by 2 independent observers. The segments were classified as impossible to evaluate, normal, or abnormal for WM, qualitative MP. Sensitivity, specificity and agreement of the different techniques for CAD were assessed. A stenosis >50% was considered significant.

Results: Among the 416 segments, at rest, it was not possible to evaluate WM in 55 segments without contrast and at peak dose in 69, compared to 2 and 5 respectively with LVO (p<0.001); 8 and 15 respectively with MCE (p<0.001); (LVO vs MCE, NS). The qualitative perfusion analysis was possible, at rest, in 92% of the segments and at peak dose, in 78%. Comparison with coronary angiography: analysis by patients: table 1.

Conclusions: Looking at the WM, MCE and LVO provide the same improvement for detection of CAD during DASE compared to harmonic imaging without contrast. Moreover, MCE has permitted to get additional information on MP, improving the detection of CAD. Therefore, we recommend to use MCE modality during stress echocardiography in clinical practice, even in a non-selected population.
Combined use of myocardial contrast echocardiography and Doppler myocardial imaging for predicting functional recovery after acute myocardial infarction treated with primary or rescue PTCA


Background: The relation between myocardial perfusion and contractile reserve after restoration of coronary antegrade flow in acute myocardial infarction (AMI) is still controversial. Aim of the study was to assess prognostic role of both Myocardial Contrast Echocardiography (MCE) and Doppler Myocardial Imaging (DMI) parameters in predicting recovery of akinetic left ventricular (LV) segments after AMI treated with PTCA.

Methods: 35 patients (pts) with anterior AMI successfully treated with either primary (25 pts) or rescue PTCA (10 pts) of descending anterior coronary artery underwent standard echo (Acuson Sequoia), DMI and MCE 24-48 hours after AMI. LV ejection fraction (EF), wall motion score index (WMSI), DMI systolic (Sm) and early-diastolic (Em) longitudinal peak velocities of septal mid annulus were calculated at baseline and after 3 months. Functional recovery was defined as improvement >50% of LV EF, reduction of WMSI>0.7, and improvement from akinetic to normal wall motion at the follow-up. Real-time perfusion at low mechanical index (Pulse Sequencing) was performed during i.v. infusion of Sonovue. MCE visual analysis was done using a semi-quantitative score (0: no opacification; 1: heterogeneous; 2: homogeneous). Perfusion was considered normal if >50% of asinergic segments within the risk area.

Results: at baseline, by MCE analysis, among 175 akinetic LV segments, 102 (58.2%) showed normal perfusion, 66 (37.7%) patchy perfusion and 92 (52.3%) normal perfusion. After 3 months, functional recovery was observed in 85 segments (46.8%); most of them (82; 96.4%) had either normal or patchy perfusion at baseline. However, only 83/158 segments perfused at baseline showed functional recovery at follow-up (Positive predictive value - PPV: 52.5%).

Conclusion: MCE enhancement shortly after recanalization of AMI does not necessarily imply a late functional improvement. DMI analysis of myocardial systolic velocity may improve accuracy of MCE for prediction of functional recovery in repertused anterior AMI.

Assessment of coronary microcirculation by real-time myocardial contrast echocardiography after direct PCI in patients with acute myocardial infarction

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Purpose: Akinesia after acute myocardial infarction (AMI) may be reversible (stunning) or irreversible (necrosis). Distinguishing these 2 entities soon after AMI is difficult. One of the prerequisites for viable myocardium is an intact microcirculation integrity. Real-time myocardial contrast echocardiography (RT-MCE) is a modern technique, which allows the assessment of myocardial perfusion. The aim of our study was verify, wether RT-MCE could predict functional recovery of myocardium after AMI.

Methods: A total of 40 patients were studied 2 (±1 days) after AMI. MCE was performed using machine Sonos 5500(Phillips) with power modulation and low mechanical index (MI=0.1). A slow bolus of 0.3 to 0.5 ml contrast agent (Sonovue) was given intravenously. Perfusion was scored on a 3-point scale: 0—normal (homogeneous), 1—patchy (heterogenous), and 0—absent. A detailed assessment of regional wall motion (incl.WMSI) was performed soon after AMI and 6 weeks later.

Results: Normal perfusion predicted functional recovery with a positive predictive value (PPV) of 68% and negative predictive value (NPV) of 82%. The accuracy of the technique was superior in myocardial segments supplied by the LAD coronary artery (PPV 72%, NPV 90%). The mean perfusion score for akinetic segments that exhibited recovery of function was 1.75 (±0.5), compared with 1.1 (±0.8) in those that remained akinetic (p<0.001).

Conclusions: Real-time MCE is a modern and non-radioactive bedside method, which allows the assessment of myocardial perfusion. RT-MCE is a useful predictor of functional recovery of myocardium after AMI.

Infarct related artery flow reserve after primary coronary intervention is significantly impaired, independently from the extent of microvascular damage

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Background: The value of non-invasive infarct related artery (IRA) coronary flow reserve (CFR) after primary coronary intervention (PCI) and its correlation with post-infarct microvascular damage by myocardial contrast echocardiography (MCE) remains to be determined.

Materials: Five days after first anterior myocardial infarction (MI) and successful primary PCI, 20 patients (16 males) underwent transthoracic Doppler echo of mid left anterior descending (LAD) coronary artery (7 MHz probe) at rest and during adenosine test (140 μg/kg/min in 90 sec). Rest and peak adenosine Doppler velocity were measured and their ratio (CFR) was calculated. MCE was performed by real time Cadence Pulse Sequencing (CPS, Sequoia, Siemens) and i.v. Sonovue® (Bracco) (5 ml at 2 ml/ min). The length of perfusion defect (PD) was measured in 3 apical views, averaged and expressed as % of LV. Patients with PD>25% of LV were considered no-reflow (10 pts). 10 subjects with chest pain and angiographically normal coronary arteries were used as controls.

Results: 10 pts showed no-reflow (PD of 33.4±7.5% of LV, p<0.001 vs reflow). LAD CFR was significantly lower in post-MI pts (1.73±0.5) than controls (2.6±0.3 p<0.0001), although it was only slightly lower in no-reflow patients (1.6±0.5 vs 1.9±0.5, p=ns).

Conclusions: After successful PCI, post-infarct CFR is significantly reduced compared to controls, although it is not significantly different between reflow and no-reflow patients. Reduced post-PCI CFR, independently from the extent of microvascular damage, has to be taken into account when adenosine test is used to screen for possible IRA re-oclusion.

Relationship between Q-wave formation, myocardial contractile function and myocardial perfusion assessed by real-time contrast echocardiography in patients with previous myocardial infarction

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The identification of dysfunctional, but viable myocardium after myocardial infarction (MI) is important for prediction of patient prognosis. Assessment of myocardial perfusion as a sign of viable myocardium using myocardial contrast echocardiography (MCE) and its relation to myocardial contractile function and Q-wave formation on ECG was the main aim of this study.

Methods and Results: 47 patients presented with the first MI and treated by direct PCI were enrolled. Patients were divided into 3 groups according the presence and number of abnormal Q waves (group A - no abnormal Q wave; group B - 1 or 2 abnormal Q wave; group C - 3 and more abnormal Q wave). Left ventricle function was assessed using ejection fraction (EF) and wall motion score index (WMSI). Myocardial perfusion was assessed by perfusion score index (PSI).

Patients in group A had significantly better LV function than patients in other groups [EF 57±5 vs 48±11 (group B) and 47±10 (group C); p<0.05]. Also, WMSI was the best in this group [1.34±0.22 vs 1.56±0.39 (group B) and 1.68±0.31 (group C); p<0.01].

Perfusion assessed by PSI was the best in group A (1.2±0.3, p<0.05). There was a significant difference in PSI between group B and C (1.41±0.21 vs 1.56±0.29, p<0.05), eventhough the EF and WMSI in these groups did not differ. Preserved perfusion (MCE scores 1 or 2) were detected in 95 (93%) from 102 hypokinetic segments, whereas only 35 (35%) from 99 segments had preserved perfusion. Amount of perfused segments with severe wall motion abnormality was higher in group B comparing to group C (47% vs 25%, p<0.05).

Conclusion: In patients after MI, the extent of Q wave formation could be a helpful predictor of the amount of preserved myocardial perfusion.
759 Real-time perfusion adenosine stress echocardiography in comparison with myocardial perfusion adenosine scintigraphy for the detection of myocardial ischemia

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Purpose: Myocardial contrast stress echocardiography (MCSE) at a low mechanical index, using power modulation technique, with intrinsic inflow of a myocardial contrast agent, allows for simultaneous analysis of myocardial perfusion and wall motion in real-time (real-time perfusion-RTP). Adenosine (A) SE is better tolerated by the patients than dobutamine SE, but is less accurate. Combining function and perfusion using RTP ASE could therefore be an appealing alternative to dobutamine SE: better tolerated by the patients and possibly more accurate. We aimed to investigate the ability of RTP ASE to detect myocardial ischemia compared to 99mTc-sestamibi single-photon emission computed tomography (SPECT), in an unselected, consecutive patient population.

Methods: 35 consecutive patients, admitted to SPECT due to suspected myocardial ischemia, were asked to participate in the study. One patient chose not to participate and one was excluded due to poor echocardiographic image quality. 33 patients underwent RTP ASE (SONOS 5500) with a pharmacologic protocol of adenosine 2 mg/kg/min. The average of three single-photon emission computed tomography (SPECT) images of normal (score 0), non-valuable, score 1 and perfusion defects can improve in the follow up. Microvascular integrity could improve in evaluating infarct size and regional perfusion at day 1 and 3 months after successful PCI (TIMI 3) in AMI and to assess if MCE may predict recovery of contractility in segments with preserved microvascular integrity.

Conclusion: MCE and 99mTc-sestamibi SPECT images in evaluating infarct size and regional perfusion at day 1 and 3 months after successful PCI (TIMI 3) in AMI and to assess if MCE may predict recovery of contractility in segments with preserved microvascular integrity.

Microcirculation integrity after successful primary coronary angioplasty (PCI) in acute myocardial infarction can be detected with real-time myocardial contrast echocardiography (MCE) and can predict recovery of contractility. A visual semi-quantitative score analysis for MCE was made for each segment by two independent observers, mean segmental count rates were obtained for perfusion and contractility: score 0= non-valuable, score 1= normal perfusion/no defect/normokinetic, score 2= patchy/non transmural defect/hypokinetic, score 3= no-reflow/transmural defect/akinetick segment.

Results: of 256 segments, 244 (95%) were suitable for analysis. 208 segments score 1 at MCE and 209 at G-SPECT, 36 vs 35 respectively had perfusion defects (score 2-3). Total agreement of normal vs abnormal perfused segments was 94% (K=0.75). Sensibility of MCE was 0.96. (IC 95% -0.96-0.98) and specificity 0.8 (IC 95%-0.73-0.88). Functional and perfusion improvement was observed at step 2 with reduction of total contractility score from 169 to 157 and total perfusion MCEscore from 153 to 134 and G-SPECTscore from 157 to 137. At step 1 we had 18 akinetic segments, 7 with MCEscore 3 and 11 with MCEscore 2. At step 2 5/7 MCEscore 3 improved perfusion at score 2 without improvement of kinetic, 2 normalized perfusion and improved in kinetic (kinetic score 2). 8/11 MCEscore 2 defect became MCEscore 1, 6 with improvement ok kinetic and 2 without, 3 still remained MCEscore 3 and kinetic score 3.

Conclusion: this preliminary study shows a very good agreement between MCE and G-SPECT images. Both contractility and perfusion microcirculation defects can improve in the follow up. Microvascular integrity could predict recovery in contractility while persistent no-reflow is a bad prognostic marker but sometime we need a longer follow-up to see improvement in kinetic.

760 Use of real-time myocardial contrast echocardiography in AMI to assess risk area prior to primary PCI: comparison with 99mTc-sestamibi G-SPECT and TIMI flow in the infarct-related artery

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Background: intravenous myocardial contrast echocardiography (IVMCE) is a new tool for perfusion evaluation and can be safely performed bedside in Emergency room (E.R.). It could be a decision-making tool in identify patients with acute myocardial infarction (AMI) must be treated with Primary percutaneous coronary intervention (PCI) or thrombolytic therapy in hospitals with difficult access to catheterisation laboratory. Aim to assess if real-time myocardial contrast echocardiography (MCE) have a good agreement with SPECT imaging and TIMI flow at angiography in the infarct-related artery (IRA), in identify risk area (RA) and IRA patency in patients with AMI before treatment.

Methods: in five patients with AMI we performed IVMCE study and injection of 740 MBq 99mTc-sestamibi at admission in E.R., before undergoing angiography. Real-time MCE studies were performed with Sonos 5500 Philips US System and SonoVue® (Bracco) contrast agent in 10’ continuous intravenous infusion (2 vials at 2 ml/min). G-SPECT images referring to pre-rivaroxaban status were acquired just after PCI with a double-head gamma camera. Left ventricle was divided in 16 wall segments in echo and G-SPECT images (American Society of Echocardiography standard) and a visual semi-quantitative score analysis was made for each segment by two independent observers: score 1= MCE normal perfusion and no defect at G-SPECT, score 2= MCE patchy perfusion and G-SPECT non transmural defect, score 3= MCE no perfusion and G-SPECT transmural defect.

TIMI flow score was evaluated at coronary angiography in IRA prior to PCI.

Results: total 73 (91%) of 80 wall segment were available for MCE semi-quantitative analysis. Overall agreement between MCE and G-SPECT images of normal (score 1=55) versus abnormal (score 2-3=18) perfused segments was 96% (κ=0.88). 11 at MCE and 13 at G-SPECT were segments with perfusion score 3. 3 patients showed TIMI 0-1 in IRA and 2 patients showed TIMI II≥2. Agreement between MCE and G-SPECT vs TIMI flow in the areas of interest was 90% for MCE and 100% for SPECT for score 3 and TIMI 0-1:100% and 90% respectively for score =<2 and TIMI II≥2.

Conclusions: MCE and SPECT showed an excellent agreement in identify risk-areas and predicting the patency of the vessel. These preliminary results, collected in few selected pts, suggest that MCE could play a role as a decision-making tool, especially in the Hospitals without cath-Lab.
The value of myocardial contrast echocardiography in detecting myocardial perfusion abnormality in patients with anterior wall acute myocardial infarction

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Background: The microvascular damage after myocardial infarction has crucial implications. There is a range of both non-invasive and invasive parameters facilitating flow assessment at tissue level. Myocardial contrast echocardiography (MCE) offers a promising modality for non-invasive evaluation of myocardial perfusion.

The study aimed to assess the efficacy of intravenous contrast echocardiography (MCE) in detecting myocardial perfusion defects in patients with acute myocardial infarction compared with 99mTc MIBI SPECT study.

Methods: 42 patients (33 M; 9 F; mean age 55.6±9.6) underwent primary percutaneous coronary (PCI) for acute anterior myocardial infarction. TIMI grade flow, myocardial blush grade (TMPG), corrected TIMI frame count (cTFC), wall motion score index (WMSI), ST-segment resolution and segmental perfusion were estimated in real time before and immediately after PCI, using low MI (0.3) after 0.3 ml bolus injections of intravenous Optison. MCE was repeated on the third day after PCI. All patients underwent a rest 99mTc MIBI SPECT study (SPECT) on the third day after PCI.

Results: A MCE perfusion defect size after PCI ≥50% of the MCE perfusion defect size before PCI was used to define myocardial non-reperfusion. Based on MCE, 24 patients had reperfusion and 18 had non-reperfusion. Patients from the non-reperfusion group showed a higher creatine kinase peak (p = 0.006), higher creatine kinase-MB (p = 0.018) and higher troponin level (p = 0.002), longer time span between the onset of pain and reperfusion (0.011), and worse baseline reperfusible contractile function (p = 0.138). All angiographic parameters were worse in this group before as well as after PCI: TIMI before 0.5±1 vs. 1.0±2, TIMI after 2.1±0.8 vs. 3±0.2, TMPG before 0.31±0.7 vs. 2.0±0.7, and WMSI after 1.12±0.2 vs. 2.6±0.4. cTFC before 99:36 vs. 34:9, cTFC after 53:43 vs. 22:9. MCE on the third day revealed further improvement of myocardial perfusion in 18 patients.

The agreement between MCE and SPECT for detecting perfusion abnormality was 86% (κ 0.72).

Conclusions: MCE facilitated identification of myocardial perfusion abnormalities in patients with acute myocardial infarction, whereas serial MCE facilitated identification of patients with early and late improvement of myocardial perfusion. MCE correlated very well with SPECT images in assessing perfusion defect.

Real time myocardial contrast and 2-dimensional echocardiography for the prediction of recovery after acute myocardial infarction

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Real time myocardial contrast echocardiography (RTMCE) has been used after acute myocardial infarction (AMI). We sought to determine: 1) RTMCE predicts recovery of LV function after AMI, and 2) data are comparable to those obtained with 2-dimensional echocardiography (2-DE).

We studied 34 patients (pts) with AMI (anterior AMI, 28 pts; submitted to angioplasty, 25 pts). RTMCE was performed 6–4 days after AMI. Each dysfunctional segment (SG) was scored as 4−normal perfusion, 3−partial perfusion and 0−absence of perfusion. A perfusion score was calculated as the mean of the perfusion score in the dysfunctional SG. Thinning of every dysfunctional SG was also measured at baseline. Wall motion score index (WMSI) was assessed at the time of the RTMCE and 11 days later.

Conclusion: MCE facilitated identification of myocardial perfusion abnormalities in patients with acute myocardial infarction, whereas serial MCE facilitated identification of patients with early and late improvement of myocardial perfusion. MCE correlated very well with SPECT images in assessing perfusion defect.
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The influence of a second generation myocardial contrast agent on measurement of myocardial velocities using Grey scale speckle tracking in comparison to tissue velocity imaging
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Background: The second generation myocardial contrast agents has been shown to significantly increase the measured velocity using doppler based tissue velocity imaging (TVI). This appears to be a result from increasing background noise rather than a physiological effect. The novel grey scale speckle tracking is based on a fundamentally different technique, and contrast agents should not be from a theoretical point of view affect the measured myocardial velocity.

Objectives: To determine whether there is a clinically significant increase of myocardial velocity from myocardial contrast using speckle tracking compared to TVI.

Methods: Six volunteers were examined with and without infusion of SonoVue, using both TVI and speckle tracking. Three complete heart cycles were digitally stored to a dedicated server for later offline analyses. SonoVue was administrated intravenously with the infusion rate set at 0.8 ml/min. Images were digitally recorded in the three standard apical projections. Velocity measurements were performed in all six basal myocardial segments of the left ventricle using visual averaging both using TVI and speckle tracking. Separate measurements of peak systolic (S), early diastolic (Ea) and late diastolic (Aa) velocities was performed in all six segments. Image acquisition was made using standard settings without SonoVue, decreasing the power to a mechanical index of 0.25 when giving the Sonovue infusion. The_Frame_rate was over 100 for TVI, and over 60 for speckle tracking.

Results: The feasibility was lower for both TVI and speckle tracking during contrast infusion. This was even more pronounced for speckle tracking compared to TVI. 11 percent (12 of 108) registrations were non-interpretable using TVI without contrast, compared to 33% (36 of 108) for during contrast infusion. For speckle tracking these figures were 27% (30 of 108) and 55% (60 of 108).

Using a paired t-test there was a non-significant increase of the measured velocity using contrast infusion during TVI, compared to TVI without contrast infusion. The mean TVI velocities for S, Ea and Aa increased from 7.2 cm/s to 7.5 cm/s (p=0.6). Using speckle tracking, the measured velocities decreased from 6.0 cm/s to 5.3 cm/s during contrast infusion. The difference was statistically significant (p<0.02).

Conclusions: The increase of TVI measured myocardial velocity seem to be insignificant in the clinical setting. There seem to be a decrease in the measured myocardial velocity using the novel speckle tracking technique. The mechanism for the contrast mediated velocity decrease is unclear.

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Reproducibility of quantitative real-time myocardial contrast echocardiography. The importance of measuring at the proper time of cardiac cycle
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Purpose: The time of cardiac cycle to measure signal intensity in quantitative real-time myocardial contrast echocardiography (QRT-MCE) needs to be established. Our objective was to evaluate reproducibility of QRT-MCE at three different times of cardiac cycle.

Methods: We studied 8 patients with a low probability of coronary artery disease (41±16 years, 50% men) who underwent an echocardiography. QRT-MCE was performed with a Philips 5500 (Bothell, USA), using as quantification software QLAB (Philips, Bothell, USA). We administered Sonovue (Bracco, Italy) as contrast agent, in continuous infusion at a rate of 1 ml/min. After a steady state was achieved, we destroyed microbubbles with a run of high-power pulses, fitting the rate of replenishment to a one-minus exponential curve. A (peak intensity), beta (maximal rise of signal intensity) and A x beta parameters were calculated from the curve. We studied distal regions of septal and inferior segments, using a 5-mm square region of interest, in a minimum of 10 cineloops. Measurements were performed by two observers at three different times of cardiac cycle: end-diastole, end-systole and throughout cycle; all over the loops. Correlation between observers was calculated using Spearman’s rank test. Correlation was considered statistically significant if p<0.01.

Results: *: p=0.09; **: p=0.004; ***: p=0.07.

Conclusions: In septal segment, measurements of beta were concordant between observers only at end-systole. In inferior segment, measurements of beta and A x beta were concordant between observers only throughout cycle.
770 Real time contrast echocardiography to assess myocardial perfusion in patients with obstructive hypertrophic cardiomyopathy referred for percutaneous transmural angioplasty
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Background: Microvascular dysfunction is a recognised feature of hypertrophic cardiomyopathy depending on a complex interplay of functional and anatomic mechanisms, including: reduced arteriolar density, fibrosis, myocyte disarray and increased end-diastolic pressure. In the present study we used myocardial contrast echocardiography (MCE) in patients with obstructive hypertrophic cardiomyopathy (HOCM) referred for percutaneous transluminal myocardial ablation (PTSLA) in order to assess myocardial perfusion pattern and its changes after the procedure.

Methods: Sixteen patients with HOCM (mean age 49±13 years, 69% males) referred for PTSLA underwent myocardial-contrast echocardiography (MCE) before and 3 to 6 months after the procedure. MCE was performed with real time imaging during intravenous slow injection of Sonovue®. Myocardial blood velocity and semi-quantitative of blood volume (homogenous, reduced or "patchy" and absent myocardial opacification) were assessed in four chambers view in mid-apical septum (distal to area to be treated) and results were compared to eleven controls.

Results: In patients with HOCM myocardial blood velocity was significantly lower either before (0.17±0.04 vs. 0.50±0.34, p=0.006) or after PTSLA (0.23±0.07 vs. 0.50±0.34, p=0.02) compared with control group. A partial ("patchy") perfusion was present in all the HOCM patients and in none of controls. After PTSLA left outflow tract decreased from 86±19 to 18±21 (p<0.0001) and a significant symptomatic improvement was obtained consisting in reducing of NYHA class (2.5±1.1 to 1.1±0.3; p<0.0001) and resolution of angina. Myocardial blood velocity increased significantly after procedure (0.17±0.04 vs. 0.23±0.07 p=0.004); amount of change was not related to gradient decrease. Perfusion remained "patchy" after procedure in all the HOCM patients.

Conclusions: In patients with HOCM underwent PTSLA myocardial flow velocity, as assessed by MCE, is significantly slower compared to controls but it significantly increases after a successful procedure. The last finding might represent the effect of microvascular function of PTSLA-related morpho-functional changes.

771 LK 565 enables the simultaneous analysis of regional kinetics with contrast echocardiography and of tissue velocity imaging, and improves the endocardial border detection by the anatomical M-mode
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Ultrasound contrast agents are mainly destroyed using conventional 2D-scanning techniques. Under these conditions in the near field and the left ventricular (LV) outflow tract endocardial border detection is impaired. In addition, the combination of tissue velocity imaging (TVI) and contrast echocardiography is often not possible due to aliasing phenomena. Thus, the combination of the analysis of regional kinetics by the anatomical M-mode using echo contrast and TVI can be performed by consecutive data acquisition of contrast echocardiography with low mechanical index techniques and TVI mode. LK 565 enables the data acquisition of TVI during contrast administration because of its high stability and ist characteristics. In 10 patients (pts) TVI before and after LK 565 administration were performed during dobutamine stress. The endocardial border detection using anatomical M-modes as well as TVI data were also performed during dobutamine stress by consecutive data acquisition after SonoVue or Optison administration in 10 additional pts. Using LK 565 90% of the TVI data were acquired without artefacts. Systolic and diastolic maximum velocities did not significantly differ before and after LK 565 administration. The anatomical M-mode enabled endocardial border detection in 90% of the apical, mid and basal LV regions (without contrast in only 55%). Contrast echocardiography with low mechanical index technique in combination with intermittent TVI data acquisition showed in only 75% of all LV regions a distinct endocardial border delination using the anatomical M-mode majorly due to high opacification of the septum and shadowing in the posterolateral regions.

Conclusions: LK 565 enables the TVI data acquisition during contrast administration with the possibility of simultaneous longitudinal and radial wall motion analysis. The endocardial border detection with low mechanical index techniques using conventional contrast agents is comparable to endocardial border detection with LK 565 using conventional 2D scanning techniques. Thus LK 565 is an interesting new agent which enables a better analysis of regional myocardial kinetics and the simultaneous combination of TI and contrast echocardiography.

772 Abnormal capillary density in hypertrophic cardiomyopathy can be detected using myocardial contrast echocardiography
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Background: Microbubble resides only in intravascular space, whereas nuclear tracer migrates to interstitial or intracellular space. Therefore, microbubble concentration (videointensity in contrast-enhanced ultrasound) represents relative blood volume in tissue. It has been known that capillary density is reduced in hypertrophic cardiomyopathy (HCMP), however conventional radionuclide imaging could not demonstrate perfusion abnormality in HCMP. We hypothesized that abnormal capillary density (volume) in HCMC can be demonstrated using myocardial contrast echocardiography (MCE).

Method: We studied 23 patients (13 apical HCMC, 5 hypertensive left ventricular hypertrophy (LVH), 5 normal left ventricle) with no evidence of coronary artery disease. MCE was performed at rest, with low mechanical index Power Modulation Imaging (Sono 5500, Agilent) during continuous infusion of microbubbles. 99mTc-MIBI SPECT was performed for comparison.

Results: In all patients with apical HCMC, MCE showed markedly reduced contrast-enhancement in apical hypertrophic segment especially during systole, whereas SPECT showed normal or rather increased perfusion of apical segments. In normal segments without hypertrophy in patients with apical HCMC, normal contrast enhancement was observed in MCE. In patients with LVH or normal left ventricle, both MCE and SPECT showed normal perfusion. Reduction in myocardial videointensity during systole was significantly greater in apical HCMC than LVH and normal groups. (endystolic videointensity 29.8±13.9%, 73.6±14.7% and 72.3±18.5% of enddiastolic videointensity, respectively, p<0.05).

Conclusion: Resting perfusion defect during systole at apex was observed in patients with apical HCMC using MCE. MCE may be useful for the diagnosis and evaluation of abnormal myocardium in HCMC.
Abstracts

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High-resolution grey scale power modulation or angio mode power modulation? Head to head comparisons of two modalities of real-time perfusion adenosine stress echocardiography with simultaneous SPECT

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Purpose: The new low mechanical index contrast echocardiographic modality of power modulation has allowed for assessment of myocardial perfusion in real-time (RTP). The high-resolution grey scale modality of power modulation (HR-RTP) offers a better spatial resolution compared to the earlier angio mode of power modulation (A-RTP). It is however not clear whether this technical improvement can be transferred into a better clinical result. To address this question we compared these two RTP techniques with 99mTc-sestamibi single-photon emission computed tomography (SPECT).

Methods: We included 46 consecutive patients, referred to adenosine SPECT due to suspected coronary artery disease. All patients underwent RTP imaging (SONOS 5500) with infusion of the second generation contrast agent Sonovue at a rate of 1.0 ml/min, before and during adenosine stress, in conjunction with injection of the isotope preceding the SPECT image acquisition. Analysis of myocardial perfusion and wall motion was performed off-line, at later time points, on separate occasions for each RTP modality. The two separate readings were performed at least two weeks apart, blinded to SPECT results and RTP modality. Myocardial ischaemia was visually evaluated comparing rest and hyperaemia images. Replenishment was considered complete after three beats at peak stress, and four beats at rest. A new or larger perfusion defect at peak stress, compared to the resting image, was interpreted as ischaemia. We analysed the sensitivity, specificity and predictive values for both HR-RTP and A-RTP, compared to SPECT, in three pre-specified areas of interest (AOI) from the schematic distribution area of the three main coronary vessels; the left anterior descending (LAD); the circumflex (Cx); and the right posterior descending (RPD).

Results: A total of 138 AOI were analysed separately using HR-RTP and A-RTP mode of power modulation. A-RTP had consistently better accuracy and predictive values than HR-RTP in comparison with SPECT: accuracy 82 vs 74%; sensitivity 84 vs 42%; specificity 85 vs 79%; positive predictive value 40 vs 24%; and negative predictive value 94 vs 90%.

Conclusion: The A-RTP was superior to HR-RTP for the detection of myocardial ischaemia during adenosine stress echocardiography, using SPECT as the reference method. However, both modalities demonstrated high NPV, which is important in order to exclude ischemic heart disease.

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Triggered replenishment imaging and real-time perfusion imaging differ in replenishment characteristics

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Myocardial contrast echocardiography (MCE) allows quantification of myocardial blood flow at low emission power using a mono-exponential fitting function, with parameter B describing mean blood flow velocity and A representing myocardial blood volume. Real-time perfusion imaging (RTPI) allows continuous MCE, whereas triggered replenishment imaging (TRI) is ECG-triggered. Aim of the study was to compare replenishment parameters (RP) of both modalities with additional respect to day-to-day-variability.

Methods: Quantitative MCE was performed using a HDI-5000 (Philips, Bothell, WA, USA) during continuous infusion of Optison™ in six healthy volunteers. RTPI and TRI were performed four times. Replenishment sequences of both modalities were acquired in random order. RP and their coefficients of variation (CV) were calculated in transmural regions of interest placed in standard myocardial segments.

Results: Two-sided t-tests revealed significantly lower B values using TRI: A was found to be significantly higher (see figure). Values of B*A showed no difference between the modalities. Mean CV of parameter B was 29.1%±14.1 for RTPI and 36.8%±14.3 for TRI (p<0.05, ns). CV of parameter A were 11%±4 (RTPI) and 9.8%±7 (TRI), (p<0.05, ns). Between segments no significant differences of RP and CV were obtained in both imaging modalities.

Conclusion: Significant differences of RP can be explained with maximal efficacy of initial bubble destruction using TRI; absolute values of B*A, representing myocardial blood flow, are similar and show no dependence on imaging modality. Reproducibility of MCE ranges within the scope of spatial heterogeneity of myocardial perfusion.
Relation of increased left atrium volume and left ventricular fibrotic mass in patients with endomyocardial fibrosis

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Purpose: Endomyocardial fibrosis (EMF) is a rare restrictive cardiomyopathy characterized by fibrous tissue apical obliteration. Atrial volumes are usually increased and ventricular volumes are normal or decreased. Myocardial delayed enhancement (MDE) magnetic resonance imaging (MRI) with gadolinium-based contrast allows the quantification of myocardial injury and fibrosis. The aim of this study was to evaluate the relation of the increased left atrium volume (LA) with other left ventricular (LV) function echocardiographic indices, and with LV fibrous tissue deposition by MRI.

Methods: We studied prospectively 19 pts (17 females, 61 ±9 years) with EMF: 11 with predominant LV involvement and 8 with biventricular involvement. MDE was performed in a 1.5 T GE CV/i magnetic. Images were acquired after 10-20 min of 0.2 mmol/kg of gadolinium bolus. We measured by echocardiography LA and LV bivplane volumes, LV ejection fraction (LVEF), ratio of peak early mitral flow (E) and early mitral annulus velocity (E′), grade of mitral regurgitation (MR) and myocardial performance index (MPI).

Results: Left atrium bivplane volume was 82 ±64 ml. Results are shown in table 1. The best correlation was found between LA volume with LV fibrotic mass by MDE.

Conclusions: LV fibrotic mass is the best index related to LA volume, reflecting the direct correlation of LV fibrotic mass with the chronic diastolic dysfunction.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD</th>
<th>Pearson correlation</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>E/E′ septum</td>
<td>10±5</td>
<td>0.46 ± 0.01</td>
<td></td>
</tr>
<tr>
<td>MPI</td>
<td>0.08±0.4</td>
<td>0.41 ± 0.03</td>
<td></td>
</tr>
<tr>
<td>MR (1-3)</td>
<td>1.3±0.9</td>
<td>0.27 ± 0.14</td>
<td></td>
</tr>
<tr>
<td>LV end-diastolic mass (ml)</td>
<td>81±27</td>
<td>0.41 ± 0.02</td>
<td></td>
</tr>
<tr>
<td>LV mass (g)</td>
<td>204±105</td>
<td>0.45 ± 0.01</td>
<td></td>
</tr>
<tr>
<td>LV EF (%)</td>
<td>57±11</td>
<td>-0.24 ± 0.18</td>
<td></td>
</tr>
<tr>
<td>LV fibrotic mass (g)</td>
<td>19±11</td>
<td>0.7 ± 0.0008</td>
<td></td>
</tr>
</tbody>
</table>

Relation between left atrium bivplane volume with left ventricular echocardiographic indices and with left ventricular fibrotic mass by magnetic resonance imaging.

778 “Acromegalic cardiomyopathy”: diagnostic and prognostic usefulness of ultrasonic tissue characterization (integrated backscatter)

V. Di Bello, F. Bogazzi1, D. Giorgi2, C. Palagi2, M.G. Della Donne2, E. Talini2, B. Rizzon2, A. Di Cori2, S. Gavioli2, M. Mariani2, Dipartimento Cardio Toracico, Pisa, Italy, 1 Pisa, Italy, 2University of Pisa, Pisa, Italy

Aim of present study was to evaluate real capability of ultrasonic backscatter analysis (IBS) in diagnosis and prognosis of “acromegalic cardiomyopathy”. Neither previous acromegalic patients (A) (age: 51.3 years: ±5.26) and 25 healthy subjects (C) of comparable age, sex and body mass index were studied. Group A was divided into three subgroups: untreated active disease (ANT =15), active disease treated with somatostatin analogues (AT=4), with and without active disease treated with surgery. All subjects underwent conventional 2D-Color Doppler echocardiography and IBS. Patients with untreated active disease had higher serum GH and IGF-I levels than those with cured acromegaly or treated with somatostatin analogues (p<0.001). Left ventricular mass was significantly higher in ANT (161±27 gm/m2) and at AT (122±15 gm/m2) than in AC and controls (C) (101.6±12 gm/m2) (p<0.001). Left ventricular Ejection Fraction was not different among the studied groups; on the contrary, left ventricular diastolic function reduced mainly in ANT subgroup (E/A ratio: 0.96 ±0.3 vs. C: 1.6 ±0.3, p<0.002).

ANT subgroup patients had a higher IBS reflectivity at septum level: 56.2±5% less than (C): (44±5%; p<0.0001), suggesting an increase in myocardial collagen content. Intramyocardic contractility was affected in untreated acromegalic patients (p<0.001) and in those treated with somatostatin analogues, as assessed by Cyclic Variation Index (CVI).

Main results:

. IBS functional (CVI) and structural (IBS reflectivity) alterations were present even when conventional indices of left ventricular function were within the normal range;
. we found a cross- point of increase in IBS myocardial reflectivity due to collagen deposition and myocardy hypertrophy (IBS reflectivity higher than 45% at septum level and 45% at posterior wall level), which could be considered the beginning of acromegalic cardiomyopathy.
. IBS allows a better diagnostic and prognostic stratification of patients with acromegalic cardiomyopathy.
Prediction of successful cardioversion and maintenance of sinus rhythm in patients with lone atrial fibrillation

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Objective: We aimed to prospectively investigate the predictive value of echocardiographic parameters for prediction of successful cardioversion and long-term sinus rhythm maintenance in patients with lone AF.

Methods and results: Clinical and echocardiographic data, including mean left atrial appendage (LAA) peak flow velocity and mitral annulus motion, were analyzed in 78 consecutive patients (mean age 59±3.9 years) with AF lasting >48 hours and <6 months. Sixty-one patients (78%) underwent successful external electrical cardioversion, while the remaining remained in AF. At one-year follow-up, of the 61 patients successfully converted to SR, 24 (39.3%) remained in SR. For predicting the success of the cardioversion, a model consisting of two variables: LAA flow velocity only marginally enters the model and if removed, little predictive value is lost (dropping to 83.3%). Removing the early systolic abnormal mitral annulus motion variable, the prediction value drops significantly to 70.3%.

Conclusion: LAA flow velocity combined with left ventricular fractional shortening, can predict the success of conversion of AF to SR. Additionally, LAA flow velocity, combined with the analysis of mitral annulus motion before cardioversion, can predict the long term maintenance of SR.

Transcatheter flow propagation velocity: new parameter of left atrial reservoir function

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Background: Left atrial (LA) function is an important determinant of the overall heart performance. The number of noninvasive parameters has been used to assess LA booster pump. However, the evaluation of LA reservoir function still remains a diagnostic challenge. Flow propagation velocity of systolic transatrial flow (FVP) assessed by colour M-Mode can serve as a new parameter of LA reservoir function.

The aim of the study: To assess the feasibility of FVP measurement using transthoracic approach and to evaluate its load-dependence compared to traditional echocardiographic parameters of LA reservoir function.

Methods: 15 healthy males (27±4 years) were examined at rest, after passive leg lifting and after sublingual administration of nitroglycerine (NTG). FVP, the velocity-time integral of systolic pulmonary vein flow velocity (VTI-PVC), appears to be quite strong, yielding 84.6% correct results. LAA flow velocity only marginally enters the model and if removed, little predictive value is lost (dropping to 83.3%). Removing the early systolic abnormal mitral annulus motion variable, the prediction value drops significantly to 70.3%.

Conclusion: LAA flow velocity combined with left ventricular fractional shortening, can predict the success of conversion of AF to SR. Additionally, LAA flow velocity, combined with the analysis of mitral annulus motion before cardioversion, can predict the long term maintenance of SR.

A novel method for two-dimensional myocardial deformation estimation by ultrasound: an in vivo comparison with sonomicrometry


One-dimensional strain (S) and strain rate (SR) imaging have been shown to be angle dependent. Fully resolved two-dimensional (2D) strain would solve this problem. Therefore, a new methodology for estimation of 2D strain based on 2D radio frequency (RF) processing has been developed in our lab. It has earlier been shown to give accurate angle independent strain values in an in-vivo setup.

Aim: To validate this new methodology in the in-vivo setting.

Methods: In 5 open chest sheep, ultrasound (US) RF data were acquired in a parasternal long axis view using a Toshiba PowerVision 6000 equipped with an RF interface for research purposes. Myocardial radial (R) and longitudinal (L) strains were simultaneously estimated in the inferolateral wall using the new methodology from single RF data sets. Four segment-length sonomicrometry crystals (SM) were placed in a tetrahedral configuration just lateral to the imaging plane giving a continuous reference for the L and R strains. After baseline (BL) acquisitions, the deformation was modulated by 1) esmolol infusion (ES), 2) dobutamine infusion (DOB) and 3) inducing ischemia by occlusion of a distal branch of the circumflex coronary artery. Peak systolic strains (Smax) were compared by means of linear regression and the correlation coefficient.

Results: For both the R and L Smax strong correlations were found between the US and the SM measurements (r = 0.95 and r = 0.96 respectively, p < 0.001). Example strain curves are given in FIG 1 (a) and (b) for BL and ISC respectively.

Conclusion: Simultaneous estimation of 2D myocardial L and R strain using US RF tracking showed to be a robust method in an in-vivo setting. Myocardial strain could thus be assessed independent of insonation angle.
Ultrasound speckle tracking reduces angle dependency of myocardial strain estimates - Validation by sonomicrometry

B.H. Amundsen, T. Helle-Valle1, H. Torp2, J. Crosby2, A. Støylen2, H. Ihlen1, O. Smiseth1, S.A. Strandhås2, NNTU, Trondheim, Norway, 1Rikshospitalet University Hospital, Oslo, Norway, 2NTNU, Trondheim, Norway

**Purpose:** Ultrasound tissue Doppler based estimates of myocardial strain in the left ventricle are limited by angle dependency. We have developed a new ultrasound Speckle Tracking application (ST) which estimates the two-dimensional motion of the grey-scale pattern in small areas of myocardium, and thus allows calculation of myocardial strain. Our aim was to validate this application against sonomicrometry.

**Methods:** In three anaesthetised dogs four ultrasonic crystals were implanted subepicardially in the left ventricle. Peak systolic myocardial strain (%) in the midwall segments and maximal relative short axis apical and mid-ventricular diameter changes (%) were measured simultaneously (Fig). Apical four-chamber ultrasound B-mode images were recorded immediately following sonomicrometry recordings. Four "regions of interest" for ST were placed in the same areas as the ultrasonic crystals. Values from three consecutive beats were averaged.

**Results:** Strain in the long-axis (LX) segments (n=20) was not different between the two methods (-4.4±3.9 vs. -4.6±4.0%, p=NS), neither was there any difference between the two methods for the short-axis diameter changes (n=20) (-8.7±4.1 vs. -8.6±3.3%, p=NS). The 95% limits of agreement (Bland-Altman) for strain and diameter change were -5.4 to 4.9% and -4.5 to 4.3%, resp (fig). The correlation between the two methods was 0.79 and 0.85 for long axis and short axis measurements, resp (p<0.001).

**Conclusions:** Ultrasound speckle tracking shows good agreement with sonomicrometry for motion both along and transverse to the ultrasound beam. The application seems to have potential in reducing angle dependency of ultrasound myocardial strain estimates.

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Difficulties in diagnosis of primary cardiac tumors

A. Tomaszewski, E. Czekajska-Chehab1, M. Wójcik, A. Drop1, Skubiszewski Medical University of, Lublin, Poland, 1Skubiszewski Medical University of, Lublin, Poland

Primary cardiac tumors (PCT) are very rare (0.01%-0.03% in autopsy series). Diagnosis of these intracardiac masses is mostly connected with echocardiography (ECHO CG), CT and MRI. Diagnostic difficulties appear not only with the nature of these pathological masses but also with its dynamics. The aim of this study was to perform the comparative analysis of ECHO CG and MSCT in patients (pts) with PCT. The analyzed group:14 pts (7 women and 6 men, age range 30-73 years) out of 496 pts (2.6%) underwent heart MSCT (08.2002-05.2004), with the diagnosis of benign PCT. Both ECHO CG and MSCT evaluate tumors localization, size, and its structure. MSCT provides easier and more accurate evaluation of the tumor in relation to adjacent cardiac structures. In doubtful cases not only both methods but also a follow-up gives the proper answer. MSCT gives additional information concerning the coronary vessels and revealed additional pathology.

The results are presented in the table.

<table>
<thead>
<tr>
<th>Patients</th>
<th>TTE</th>
<th>MSCT</th>
<th>TTE after MSCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fibroma</td>
<td>Fibroma</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>Myxoma</td>
<td>Myxoma</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>Myxoma</td>
<td>Myxoma</td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>Myxoma</td>
<td>Myxoma</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>Myxoma</td>
<td>Myxoma, PE</td>
<td>X</td>
</tr>
<tr>
<td>6</td>
<td>Myxoma</td>
<td>Myxoma, PE</td>
<td>X</td>
</tr>
<tr>
<td>7</td>
<td>Myxoma</td>
<td>Lipoma, x</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>X</td>
<td>Lipoma, LN</td>
<td>Lipoma</td>
</tr>
<tr>
<td>9</td>
<td>X</td>
<td>Fibroelastoma +</td>
<td>Fibroelastoma</td>
</tr>
<tr>
<td>10</td>
<td>Y</td>
<td>Apical Thrombus</td>
<td>Apical Thrombus</td>
</tr>
<tr>
<td>11</td>
<td>2 highly mobile inferior wall masses</td>
<td>No masses after 3 weeks anticoagulation</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Myxoma</td>
<td>Mitral annulus calcification and cusps thickening</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Oval TU connected with aortic cusp</td>
<td>Not confirmed aortic cusp aneurysm</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>LV midseptal mobile mass in patient with neurological deficits and big ischemic focus</td>
<td>Not confirmed (one day later)</td>
<td>The mass decreased (TTE and TEE 2 days after MSCT), no new clinical symptoms</td>
</tr>
</tbody>
</table>

Conclusions: Preliminary findings from the present study suggest that in patients with concentric mild-to-moderate LVH the occurrence of high LV-MWS affects the BFV in intramyocardial, but not epicardial, coronary circulation, independently on the absolute value of the LV mass.
Abstracts

788 Current role of transesophageal echocardiography in of hydatide heart disease determination
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The frequency of hydatide heart disease is about 0.3% among all heart problems (Transoesophageal Echocardiography; Yasu Oka, Paul L. Golinger. p. 99-100).

We couldn’t find any information about ways of different diagnostic between mixomas and hydatide heart cysts. So, actuality of this problem in our region is still significant.

The aim of this study was to clarify of diagnostic value of TEE in cases of hydatide heart diseases.

Methods: 24 patients referred to us from villages were underwent usual routine two-dimensional transthoracal echocardiography. Initially they were diagnosed to have left atrium mixomas. 2DEcho also showed absence of valve deformation. Examination was performed on Sonoline Omnia Echo machine from Siemens. However, on preoperative diagnostic cardiac catheterization was conducted under general anesthesia.

Results: in 18 cases (75%) we revealed cysts covered by capsule with liquid inside. According TEE data, diameter of cyst was 2.5-0.08 cm. Hydatide cyst prolapsed in LV chamber and cause mitral regurgitation of MV. In these cases MR was about 35.6-4.4 mm Hg. Among this group in 15 patients (62%) main pulmonary artery was dilated and pulmonary valve regurgitation was 20.3-276 mm Hg. In this group all patients were underwent of preventive treatment, including captopril, natrium nitroprusside, spironolactone, ventoline in nebulaiser. In 3 patients we didn’t find any signs of pulmonary hypertension and they were referred for operation directly.

In 6 patients (25%) cyst had no so significant size. Its diameters were about 1,7+0,97 cm. The root of cyst was connected with atrial septum, MV was intact. These patients were referred for surgery as soon as it possible without any preventive therapy.

Conclusion: TEE has a definite role in patients undergoing cardiac hydaside cystectomy, because it is likely to beneficially after biopsy. Depending upon the clinical settings and the ability of TE resources, TEE may be the most appropriate diagnostic technique to use for hydatide cells wide spreading with blood flow.

789 Incremental diagnostic value of left ventricular diastolic indexes by tissue Doppler imaging in chemotherapy-induced cardiomyopathy. Its relationship with serial plasma BNP determinations
G.M. Benvenuto, A. Fontanelli, A. Fortunato, L. Merlini, L. Nicoletti, P. Morandi. B. Bortolto Hospital Cardiology Dept., Vicenza, Italy, Vicenza, Italy, Vicenza, Italy, Vicenza, Italy, Italy

Objectives: To investigate potential value of left ventricular function indexes by Tissue Doppler (TD) vs standard echo-Doppler (ED) indexes during chemotherapy-induced cardiomyopathy (CM). Also to investigate the diagnostic value of contemporary plasma BNP samplings.

Methods: We performed ED exams and plasma BNP samplings (by 3-steps follow-up (FU) 1. Baseline 2. End-therapy 3. 1 year-FU) to 40 consecutive patients with chemotherapy-induced cardiomyopathy (CM). From the cluster of the 4 CM-BNP, TD exams and BNP samplings. p = p-value for FU vs baseline data. See text for abbreviations.

Results: The frequency of hydatide heart disease is about 0.3% among all heart problems (Transoesophageal Echocardiography; Yasu Oka, Paul L. Golinger. p. 99-100).

We couldn’t find any information about ways of different diagnostic between mixomas and hydatide heart cysts. So, actuality of this problem in our region is still significant.

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Results: in 18 cases (75%) we revealed cysts covered by capsule with liquid inside. According TEE data, diameter of cyst was 2.5-0.08 cm. Hydatide cyst prolapsed in LV chamber and cause mitral regurgitation of MV. In these cases MR was about 35.6-4.4 mm Hg. Among this group in 15 patients (62%) main pulmonary artery was dilated and pulmonary valve regurgitation was 20.3-276 mm Hg. In this group all patients were underwent of preventive treatment, including captopril, natrium nitroprusside, spironolactone, ventoline in nebulaiser. In 3 patients we didn’t find any signs of pulmonary hypertension and they were referred for operation directly.

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Conclusion: TEE has a definite role in patients undergoing cardiac hydaside cystectomy, because it is likely to beneficially after biopsy. Depending upon the clinical settings and the ability of TE resources, TEE may be the most appropriate diagnostic technique to use for hydatide cells wide spreading with blood flow.

790 Genetic haemochromatosis influences exercise capacity
E.S. Davidsen, E. Gerdts, P. Omvik. Haukeland university hospital, Bergen, Norway

Background: Untreated patients with genetic haemochromatosis (HC) may develop dilated cardiomyopathy. Today HC patients are treated with repeated phlebotomy, but it is unknown if phlebotomy prevents development of cardiomyopathy.

Methods: To assess left ventricular function in asymptomatic HC we performed exercise echocardiography in 152 treated patients and 50 healthy blood donors matched for sex and age. All subjects were exercised in semi-upright position on a chair bicycle, starting from 20 W, increasing by 20 W/min.

Transmural early (E) and atrial (A) velocity and isovolumetric relaxation time (IVRT) were measured at each step.

Results: Exercise results are given in Table 1.

Conclusion: Our study shows that HC patients have lower peak exercise oxygen consumption than controls. In multivariate analysis, higher peak exercise oxygen consumption was associated with male gender, lower age, shorter peak exercise IVRT, higher exercise blood pressure and absence of haemochromatosis (multiple R2=0.7, p<0.001). In subsequent models adding genotype and s-ferritin, the results were not changed. Thus, HC affects the myocardium and reduces exercise capacity even in asymptomatic patients, but our study does not clarify the importance of genotype and of iron overload on the cardiac involvement in genetic haemochromatosis.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>HC patients</th>
<th>Controls</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak exercise load (W)</td>
<td>188</td>
<td>206</td>
<td>p&lt;0.02</td>
</tr>
<tr>
<td>E at peak exercise (m/s)</td>
<td>1.43</td>
<td>1.56</td>
<td>p&lt;0.02</td>
</tr>
<tr>
<td>A at peak exercise (m/s)</td>
<td>1.25</td>
<td>0.95</td>
<td>p&lt;0.09</td>
</tr>
<tr>
<td>IVRT at peak exercise (ms)</td>
<td>27</td>
<td>20</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Aerobic threshold (m/min)</td>
<td>1742</td>
<td>2080</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Respiratory Quotient at peak exercise</td>
<td>1.16</td>
<td>1.10</td>
<td>p&lt;0.003</td>
</tr>
<tr>
<td>O2-consumption at peak (m/min)</td>
<td>2409</td>
<td>2674</td>
<td>p&lt;0.001</td>
</tr>
</tbody>
</table>

Exercise and echocardiographic data.
Pericardial involvement in malignant lymphoma in child
A. Dimitriu, C. Jitareanu, V. Streanga, I. Miron. University of Medicine and Pharmacy, Iasi, Romania

Aim of the study: to reveal the major role of echocardiography for the diagnose and follow up the pericardial involvement in malignant lymphoma in children.

Methods: Patients: 21 children aged between 2 and 18 years with malignant lymphoma with cardiac manifestations (90% non hodgkin lymphoma); All patients were investigated: clinical exam, electrocardiography, chest X-ray and echocardiography.

Results: Clinical signs present in most of our patients: dyspnea, tachypnea, thoracic pain often attributed to malignant lymphoma. Clinical signs of cardiac involvement: cardiac failure (3), cardiac tamponade (4), rarely revealed. ECG revealed: low voltage of QRS complexes and T waves. Chest X-ray: cardiomegaly (most cases) and mediastinal adenopathy. Eco aspects of cardiac involvement were: pericardial effusion (20 cases) to cardiac tamponade (4 cases); pericardial tumors (4 cases); intracardiac primitive (1) or secondary (2) masses. Echocardiographic findings were the principal reason for pericardiotenesis or surgical drainage, revealing the malignant lymphomatous cells in pericardial effusion often haemorrhagic. Systolic and diastolic functions of left ventricle were normal in all cases.

Echocardiography was repeated until pericardial involvement disappears under cytostatic therapy, after 2-4 weeks.

Conclusions: Because of high incidence of pericardial involvement in malignant lymphoma in children, echocardiography is necessary in all cases, even if pericardial involvement signs are missing, in order to prevent the evolution to cardiac tamponade. Echocardiography is the most important investigation to diagnose and follow up the pericardial involvement in malignant lymphoma in child.
795
Is echocardiography of any value in young with ischemic stroke?
I. Asmussen. Central hospital in Sogn and Fjordane, Ferde, Norway

Introduction: Stroke is a rare event in the young population and therefore offers a diagnostic challenge. We have gathered data on our investigational prosthesis and activity during a four year period at the County Hospital Sogn & Fjordane in West Norway in young patients presenting with either Transient Ischemic Attack (TIA) or Ischemic Stroke

Material and methods: Sogn & Fjordane County - the old Viking land - has 110,000 inhabitants. The hospital offers specialized service in Neurology and Cardiology and the three small local hospitals refer their young stroke patients to the neurology centre. During a 48 month period (2000-2003) 65 patients (< 50 years of age) had stroke (31) or TIA (34), (25 females/ 40 males).

We performed CT, MRI and MRA. 42/65 patients had CT (64.6%), positive in 12. MRI 49/65 (75.4%), positive in 30. MRA 32/65 (49.2%) positive in 7.

Medical history: Previous stroke (11/60), hypertension (26/65), diabetes (4/65), previous or recent myocardial infarct (12/61), heavy smokers (29/ 43). Family history of heart disease (29/48), or of Stroke (29/51).

Results: We performed Ultrasound of carotis arterie, transthoracic and transesophageal echo. 56/65 had Doppler of carotid arteries (86.1%) positive in 3 (two dissections males 48 and 49 of age). 38/65 had TTE (58.5%), positive in 6 (ASA, ASD, floppy mitral valve), 22/65 had TEE (33.9%) positive in 7 (two Takayasu, one vasculitis). In 13/65 we had no findings (20%).

Conclusion: Ultrasound of carotid arteries is a quick noninvasive method that can pick up rare events such as carotid dissection. However the method as such is of little value. Echocardiography seems to pick up more abnormalities that can be treated and thus prevent a future ischemic episode.

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Effects of patent foramen ovale on oxygen desaturation in obstructive sleep apnea
M. Johansson, P. Eriksson1, J. Hedner2, Y. Peker3, L. Råstam4, U. Lindblad5, Östra university hospital, Göteborg, Sweden, 1Östra University Hospital, Gothenburg, Sweden, 2Sahlgrenska university hospital, Gothenburg, Sweden, 3Lund University, Malmö, Sweden, 4Skåne University Hospital, Sweden.

Purpose: Oxygen desaturations in obstructive sleep apnoea appears to be in part dissociated from factors such as apnea length, intensity and predicted tissue oxygenation. Hypothesizing that inspiratory pressure swings caused by upper airway occlusion may introduce a dynamic interatrial right to left shunt in subjects with a patent foramen ovale (PFO) we investigated the occurrence of PFO in a matched and controlled sub sample of a population cohort previously subjected to an extensive sleep investigation.

Population and methods: In a community-based cross-sectional sample of 142 patients in primary health care and 180 healthy controls subjected to full night polysomnographical examination 217 were diagnosed with OSAS (> 10 apneas-hypopneas per hour of sleep, AHI). The contribution of respiratory events to deoxygenation was defined by an ODI (Oxygen Desaturation Index)/AHI ratio. Fifteen OSAs cases with OD/AHI ratio > 66 (82.9 : 10.2%) were individually matched with 15 OSAs cases with ratio < 33 (18.9 : 10.2%). Other matching criteria were age and Body-Mass-Index and hypertension. All study participants underwent transesophageal echocardiography comprising 16 to 20 contrast injections in arm and foot during simultaneous provocations with valsalva manoeuvers, coughing and bed tilt. A significant PFO was defined as a maximum of > 20 accumulated bubbles passing through the PFO channel into the left atrium after a single injection with the first bubbles in left atrium within 3 beats after contrastfilling of right atrium.

Results: PFO was found in 9 of the 15 desaturating cases (60%) but only in 2 of the non-desaturating cases (13.3%) (p = 0.021, Fischer’s exact test, two-tailed). The OD/AHI ratio value, but not minimal oxygen saturation and OD/per se, correlated significantly with PFO (r = 0.59, p < 0.020) in these individually matched OSAs cases. An OD/AHI cut off limit of 80% yielded a diagnostic accuracy of 83% for PFO. Considering the known prevalence of PFO in the general population of 27% the 80% limit had a positive predictive value of 72%.

Conclusion: PFO contributes to desaturations during obstructive sleep apnea.

Table 1

Table 1

<table>
<thead>
<tr>
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<th>no PFO</th>
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<tbody>
<tr>
<td>High OD/AHI</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Low OD/AHI</td>
<td>2</td>
<td>13</td>
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</table>

Number of patients with and without PFO according to desaturation ratio.

797
Demonstration of a two-dimensional echocardiographic simulator
M. Weidenbach, K. Scheer, F. Wild, S. Kreutler1, G. Grunst1, P. Schneider, T. Berlage2, Leipzig, Germany, 2Fraunhofer Gesellschaft, St Augustin, Germany

Echocardiography requires visual-perceptive (interpretation of the echocardiographic images) and sensorimotor (steering of the ultrasound probe) skills, both of which cannot be taught adequately to beginners by lectures or textbooks. To achieve these skills a rather ineffective (since time-consuming) one-on-one training by an expert is necessary. New learning media like high-end computer simulators might overcome this problem. We have designed a Java-based echocardiography simulator that addresses these. We would like to give a live demonstration with hands-on opportunity of the simulator used at our institution for the initial training in echocardiography.

1. On a standard computer screen a side-by-side presentation of a three-dimensional (3D) virtual reality scene on the right side (reference window) and a two-dimensional echocardiographic (2DE) view on the left side (echo-cardiography window) is given. The virtual scene consists of a 3D heart model and an animated ultrasound probe with scan plane. The 2DE view is calculated from real 3D echocardiographic data sets that are registered with the heart model to achieve spatial and temporal congruency. The displayed 2DE view is defined and controlled by the orientation of the virtual scan plane. This side-by-side presentation supports the beginner in getting a visual explanation of the spatial relationship between a certain probe position and the corresponding 2DE view. Since the 2DE views are derived from a 3D echocardiographic data set in real time they are not restricted by pre-recorded views but the beginner can interactively explore the heart by manipulating the virtual ultrasound probe.

2. To train the hand-eye-coordination we equipped a plastic dummy transducer with a 3D position sensor and placed it on a plastic torso. Through a calibration the spatial relationship between this dummy transducer and the dummy torso is the same as the relationship between the virtual ultrasound probe and the virtual heart. Any manipulations of the dummy transducer are transferred in real-time to the application showing the 2DE views that would be achieved if a “real” patient is scanned.

The advantage of the simulator in comparison to “just watching” an expert performing a 2DE examination is that the beginner does not need a verbal explanation of the relationship between ultrasound probe, thorax, heart and resulting echocardiographic view but gets a visual presentation of these complex spatial relationships. He is able to experience and understand the results of his own probe manipulations.

798
Echocardiographic investigations in patients with ankylosing spondylitis
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Introduction: Cardiovascular lesion in ankylosing spondylitis (AS) occurs with various incidence rates and grades. Atrial incompetence (AI) is believed to be the typical cardiologic abnormality. The aim of the study was to evaluate the anatomical and functional abnormalities in the group of patients with AS.

Material and methods: The study enrolled 38 patients with ankylosing spondylitis. The age of our patients ranged from 26 to 70 years (mean age 51 ± 11 years). The duration of the disease ranged from 2 to 32 years (mean duration time 16 ± 9 years). The control group enrolled 25 healthy individuals with mean age of 47 ± 12 years. Echocardiographic evaluation (ECHO) included: left atrial diameter (LA), aortic width (Ao), leaflets and cusps of valves, valvular insufficiency (score 0-4+), contractility, ejection fraction (EF) of the left ventricle (LV), right ventricular dimensions, mitral valve prolapse (MVP), interatral septum mobility, pericardium and LV diastolic function (E/A ratio, IVRT, DEC Time).

Results: Echocardiographic abnormalities were found in 85% patients from the studied group and 32% from the control group. AI was found in 13/38 (34%) studied patients and 2/25 (8%) control patients (p = 0.01). The highest score of AI did not exceed grade 2+ in all patients. The increased aortic width was found in 6 patients (16%); the width did not exceed 5 cm in none of them. Mitral valve regurgitation occurred in 38% patients from the studied group. Contractility and EF did not differ between the both groups of studied individuals. Abnormal diastolic function in the form of relaxation was found statistically more frequently in the studied group (P < 0.001). Small volumes of pericardial fluid was found in 13 (34%) patients from the studied group. In the studied group the following abnormalities were found statistically more frequently: MVP (p < 0.005) and interatral septal aneurysm (p < 0.05).

Conclusions: Anatomical and functional abnormalities occur frequently in the course of AS, but they are not significant hemodynamically. There is a statistically significant correlation between the occurrence of cardiovascular abnormalities and duration of the disease in AS patients.
Echocardiographic abnormalities in patients with dermatomyositis and polymyositis

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Introduction: Clinical observations indicate that more than 70% of patients with polymyositis (PM) and dermatomyositis (DM) develop inflammatory changes within the cardiac muscle frequently leading to congestive heart failure. The aim of the study was to evaluate the incidence of cardiovascular abnormalities in patients with DM and PM.

Patients and methods: The study group enrolled 25 patients aged 26-70 years with mean age of 52±11 years treated due to DM and PM. The duration of the disease ranged from 1 year to 30 years (mean 7 years). Echocardiographic evaluation (ECHO) included: left atrial diameter (LA), aortic width (Ao), leaflets and cusps of valves, valvular insufficiency (scored 0-4+), contractility, ejection fraction (EF) of the left ventricle (LV), right ventricular dimensions, mitral valve prolapse (MVP), interatrial septum mobility (IAS), pericardium and LV diastolic function (E/A ratio, IVRT, DEC Time).

Results: Atrial valve abnormalities occurred in 8 patients (32%). Hemodynamically significant valvular insufficiency was found in 5 (20%) patients including 2+ in four patients and 3+ grade in one patient. Ten patients (40%) revealed increased dimensions of left atrium with maximal dimension of 5.3 cm. Hemodynamically significant mitral valve incompetence occurred in 8 patients (32%) including grade 2+ in 7 and grade 3+ in one of them. Interradial septal aneurysm was found in 5 (20%) patients. MVP was found in 13 patients (52%). Left ventricle was enlarged in one patient, with maximal dimension of 62 mm. Hypokinesis was found in 3 patients. Mean EF in the studied group was 57±6%, in 2 patients EF was 45%. Four patients revealed pericardial fluid and one patient had thickened pericardium. Hemodynamically significant tricuspid valve insufficiency occurred in 7 (28%) patients including grade 2+in five patients and grade 3+ in two patients. Fourteen (56%) patients revealed abnormal diastolic function 1 left ventricle including 12 cases of relaxation and 2 cases of restrictive inflow.

Conclusions: 1. Abnormal anatomy and function of heart occur in most of DM and PM patients; however, the changes rarely show high grades of severity. 2. Abnormal diastolic function dominates in the studied group of patients.

Left atrial remodeling and exercise capacity in athletes

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Objective: The left atrium (LA) also reflects left ventricular filling pressure and capable of remodeling in response to its elevation. The aim of this study was to evaluate LA volume and its changes with the phases of atrial filling, and to examine the effect of exercise capacity on these parameters.

Methods: LA volumes in 60 volunteers, of whom 30 were male runners, and age matched 30 sedentary men were measured by two-dimensional echocardiography. Maximal exercise capacity was measured with a metabolic cart during exercise.

Results: LA reservoir, pump, conduit functions, kinetic energy, and force were calculated. LA volume and volume index except the conduit volume, LA passive emptying fraction (Vpef) and LA total emptying fraction were significantly larger than those of non-athletes subjects. There were significantly positive correlation among maximal oxygen consumption (VO2max) and Vpef (r=-0.49, p<0.05), VO2max and LA kinetic energy (r=-0.61, p<0.05), and VO2max and LA force (r=-0.57, p<0.05).

Conclusion: These finding suggest that atrial function is changed parallel with exercise capacity in athletes. LA functional parameters, as a routine follow-up, may provide information about changes in exercise capacity as a sign of increasing cardiac function due to regular aerobic exercise in athletes.

Automated method for spectral Doppler echocardiography analysis in patients with atrial fibrillation

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Background: The process of parameter extraction from Doppler tracings is time consuming and subjected to inter and intra observer variability. More so in Doppler tracings taken from patients with atrial fibrillation (AF), where an average of multiple beats is needed in order to obtain meaningful information.

Objective: to develop and validate an automated software for parameter extraction from Doppler tracings of the mitral valve (MV) and tricuspid valve (TV) flow velocity.

Methods: Using image processing and computer vision tools, such as segmentation, thresholding and edge detection, the envelope of the Doppler signal is obtained. Using provided ECG signal which is synchronized with the Doppler data, each beat is fitted into a parameter model, and parameters of interest are extracted from it.

In order to validate our scheme, we compared the manually-extracted parameters with the automatically extracted ones. Pearson correlation was used to compare between automated and manual data. Numbers are mean±SD.

Results: We examined 24 patients, and divided them to 2 groups: Patients with normal heart rate and patients with AF. The results were compared beat-by-beat on 224 measured beats.

Normal heart rate (MV: 11 patients, 74 beats) Parameter Automatic Manual Correlation (r) MV: Peak Velocity cm/s 107.38±56.93 104.55±57.312 0.9826 MV: VT1 cm 38.79±21.34 33.69±28.082 0.9800 AF (MV: 9 patients, 66 beats ; TV: 8 patients, 84 beats) Parameter Automatic Manual Correlation (r) MV: Peak Velocity cm/s 145.98±72.83 139.12±71.02 0.9923 MV: VT1 cm 24.50±19.06 20.56±14.17 0.9852 TV: Peak gradient mmHg 29.16±9.24 26.89±8.94 0.942665

Conclusion: High correlation was found between the manually obtained parameters and the automatically obtained ones. The automatic scheme may be a powerful tool for accurate measurements of Doppler parameters for patients with irregular heart rate.

Left atrial function using automatic border detection in patients with paroxysmal atrial fibrillation and structurally normal heart

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Hemodynamic parameters in patients (pts) with drug-resistant paroxysmal atrial fibrillation (pAF) have not been completely investigated.

Aim: to evaluate left atrial (LA) volume and its changes with the phases (active and passive) of atrial filling in pAF pts compared to controls.

Methods: 39 consecutive pts without structural heart disease, aged 52±10 years with pAF, were compared with 36 control-matched pts aged 48±18 years. The following parameters were assessed in all pts: left atrial dimensions (LAd=mode, parasternal, LAt and LAV are the measurements of short- and long-axis in apical four chamber view), volume (LAV) calculated using the ellipse formula 0.52(LAdxLAlxLAt) in the changes in LA volume were determined by automatic border detection echocardiography. LA systolic function was assessed using LA active emptying fraction (LA AEF=volume at onset of atrial systole-minimal volume/volume at onset of atrial systole100) and LA total ejection fraction (LATEF=volume maximal-minimal/volume maximal100).

Results: There was no difference between the 2 groups concerning LA volume (62.8±7.8 vs 65.8±8.2 ml, p=0.23), LAd (4.2±0.3 vs 3.95±0.4, p=0.08) and LAt (4.1±0.4 vs 3.9±0.4, p=0.1) while the rest of the parameters were significantly higher in pAF pts: LAV: 5.4±0.5 vs 4.5±0.3 cm3, p=0.001; LAv: 51.6±10.4 vs 37.2±9.3 ml, p=0.0001; LAEF: 36.2±9.7 vs 27.1±8.3%, p=0.0001.

Conclusions: Although without structural heart disease, pts with pAF present echocardiographic evidences of LA dilation and increased LA active contraction, with upward shift of the volume variation curves suggesting pseudonormal pattern. These results show that automatic border detection echocardiographic measurement of LA volume can be valuable in assessing LA function in pAF pts.
803** Improvement on left ventricular diastolic function during enzyme replacement therapy in patients with Fabry disease**

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A common feature of the Fabry cardiomyopathy is left ventricular (LV) hypertrophy in presence of a diastolic dysfunction and a preserved systolic function. We investigated the impact of enzyme replacement therapy (ERT) on LV mass and diastolic function by Doppler-echocardiography in a group of patients with Fabry cardiomyopathy and no or mild symptoms. We studied eleven patients with Fabry disease (mean age 43.1±12.8 years) who were treated in an open label study with 1mg/Kg/body weight of beta- galactosidase (Fabrazyme®) and followed up for 12 months. Data were compared with those of 12 age and gender matched healthy controls. Interpretable Doppler recordings of transmural flow and pulmonary flow velocity curves were obtained from all patients and control subjects. Concentric hypertrophy or remodeling was present in Fabry patients. At baseline the mean values of mitral E/A ratio, E deceleration time (DT) and IRV were similar in the two groups; patients with Fabry disease, however, had greater peak velocity and time-velocity integral (TVI) of pulmonary vein flow at atrial systole (PVa), and a duration of PVa exceeding that of mitral A (D duration=15±8ms Fabry patients, 18±7ms controls; p<0.001). After 12 months of ERT LV mass index significantly reduced from 89.7±2.2 g/m² height^2 to 70 (p<0.001). As regarding echo-Doppler derived variables, E/A ratio resulted significantly (p<0.05) reduced (from 1.3±0.2 to 0.9±0.16) while IRT and DT did not change. There was a decrease in PVa TVI (p<0.001) and in D duration (45±4 ms, after ERT; p<0.001). At one year follow up only one patient exhibited a PVa longer than mitral A value. According to the current results it is possible to conclude that, in spite of the lack of changes in Doppler parameters of early LV filling, the presence of diastolic dysfunction could be detected in patients with Fabry cardiomyopathy and without symptoms of heart failure. Noteworthy, one year of ERT was able to reduce LV hypertrophy and to improve LV stiffness, as indicated by changes in Doppler parameters of late diastole.

804** Echocardiography in cardiac Fabry disease: investigations in the definition of the cardiac phenotype**

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Fabry disease (FD) is a lysosomal X-linked recessive storage disorder which is characterized by the progressive intracellular accumulation of glycosphingolipids in various tissues, especially in the cardiovascular system. Preliminary data indicate that in a substantial part of pts with FD cardiac involvement can be the sole manifestation mimicking the clinical features of HCM. Based on recent reported progress in enzyme replacement therapy major attention has been focused on cardiac FD. Systematic clinical and echocardiographic studies in pts with unequivocal cardiac FD based on morphological evaluation of cardiac biopsy tissue are lacking and the cardiac phenotype has still to be defined precisely.

**Methods:** We investigated for the first time in a systematic study 25 consecutive non related symptomatic pts (mean age 54 years, range 19 to 75 years; 18 male and 7 female pts) who were referred to our clinic for cardiac diagnostic evaluation. In all pts evaluation of cardiac biopsy tissue revealed cardiac FD. In all pts transthoracic echocardiography (TTE) and invasive investigation (left ventricular angiography, coronary angiography) were performed and correlated to morphological and clinical data.

**Results:** Echocardiography in cardiac FD disease revealed in all pts (100%) left ventricular hypertrophy (septal thickness 18 mm, range 13 to 35 mm; posterior wall 14 mm, range 11 to 20 mm) mimicking the clinical features of HCM. In 48% (12 of 25 pts) symmetric left ventricular hypertrophy (LVH) and in 52% (13 of 25 pts) asymmetric septal hypertrophy was present. Only in 2 of 25 pts (8%) systolic dysfunction was diagnosed by TTE. In 23 of 25 pts (92%) left ventricular systolic function and in 16 of 25 pts (64%) left ventricular diastolic function were preserved. No significant differences were observed between male and female pts regarding the clinical manifestation of cardiac FD.

**Conclusion:** In our study TTE revealed in all pts with cardiac FD significant LVH. This holds true for male and female pts. In the majority of pts with cardiac FD the disease completely mimics the clinical and echocardiographic features of HCM. The definition of the phenotype of cardiac FD regarding cardiac mass, pattern and extent of LVH is mandatory for a differentiation of pts with HCM and cardiac Fabry disease. Especially echocardiographic non invasive diagnostic markers of disease manifestation and progression of cardiac FD. Doppler echocardiography are mandatory because of enzyme replacement therapy which for the first time offers a causal therapeutic option in a subgroup of pts with HCM.

805** Time course of cardiac manifestation in Fabry disease: functional and morphological implications**

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**Background:** Left ventricular (LV) hypertrophy associated with myocardial fibrosis is the most common cardiac finding in patients with Fabry disease. The interrelation of these morphological changes with functional abnorma- lities has yet to be demonstrated.

**Methods:** 51 patients with Fabry disease (5-78 years) were included and compared to 25 age matched controls. End-diastolic thickness of the LV interventricular wall was measured by echocardiographic M-mode. Magnetic Resonance Imaging (MRI) was performed to assess ejection fraction and potential late-enhancement for the detection of myocardial fibrosis. In addition, ultrasonic peak systolic Strain Rate (SR) was extracted to assess regional myocardial function.

**Results:** Women younger than 20 years had no hypertrophy, no late- enhancement and normal LV radial and longitudinal function (SR longitudinal=1.7±0.5±s-1). Ten women older than 20 years had LV hypertrophy, no late-enhancement, normal radial function and normal longitudinal function in the septal wall but reduced longitudinal function in the LV lateral wall (SR=1.4±0.5±s-1). All male patients without LV hypertrophy and no late-enhancement had normal radial function but longitudinal function was reduced in both the septal and lateral wall (SR=1.3±0.5±s-1). Patients with LV hypertrophy but without late-enhancement (n=13) had reduced radial and longitudinal function. Twelve patients displaying LV hypertrophy and late-enhancement had severely reduced radial and longitudinal function (SR=1.1±0.5±s-1). Two of them with the worst impairment of regional function (SR=0.8±0.5±s-1) died in the follow-up period. LV ejection fraction was normal in all groups described.

**Conclusions:** These results illustrate the progression of morphological changes of the LV and it’s potential functional consequences in Fabry cardiomyopathy.

806** Differentiation of Fabry disease from other heart diseases causing left ventricular hypertrophy**

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**Background:** Fabry disease (X-linked disorder of glycosphinogolipid metabolism) may mimick hypertropic nonobstructive cardiomyopathy (HNCM), hypertensive heart disease (HHD) or even amyloid heart disease (AAD). Typical cardiac signs of Fabry’s disease are left ventricular hypertrophy, thickening of aortic and mitral valves, and a short PR interval and ST segment abnormalities in the ECG.

**Methods:** ECGs, videotapes or digital stored images of echocardiograms and clinical data were retrospectively completely reviewed and compared in 21 patients with Fabry’s disease, 17 patients with HNCM, 22 patients with HHD, and 16 patients with AHD to find the best parameter to discriminate left ventricular hypertrophy of unknown etiology.

**Results:** No single clinical characteristic or findings of ECG or echocardiog- raphy could reliably differentiate between the various etiologies of left ventricular hypertrophy. A summary of the best discriminators for differentiation of left ventricular hypertrophy of unknown etiology is shown in the Table.

A normal QTc time has a better area under the curve (ROC curve, 0.81 versus 0.72) compared to a shortened PR interval (not significant). Two of the three signs (acroparesthesias/polyneuropathy, anhydrosis or a normal QTc time) identified Fabry disease with a sensitivity of 71% and a specificity of 89%.

**Conclusions:** Using a combination of symptoms, echocardiographic findings and the novel sign of a normal QTc time, Fabry disease can be differentiated reliably from other heart disease causing left ventricular hypertrophy.

**Table.**

<table>
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<th>HHD</th>
<th>Fabry</th>
<th>HNCM</th>
<th>AHD</th>
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<td>Hypertension</td>
<td>100%</td>
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<td>12%</td>
<td>31%</td>
</tr>
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<td>Orthostasis</td>
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<td>0%</td>
<td>12%</td>
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<td>Acroparesthesia or PNP</td>
<td>14%</td>
<td>81%</td>
<td>0%</td>
<td>31%</td>
</tr>
<tr>
<td>Hypo-Arhidrosis</td>
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<td>52%</td>
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<td>0%</td>
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<tr>
<td>Sokolow criteria LVH</td>
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<tr>
<td>Pericardial effusion</td>
<td>5%</td>
<td>0%</td>
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</table>

PNP = polyneuropathy; LVH = left ventricular hypertrophy.
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The development of more aggressive cardiomyopathy in young asymptomatic Duchenne muscular dystrophy boys can be predicted by strain rate values. A three year follow up study.
N. Giatrakos, M. Kinali1, D. Stephens2, F. Muntoni1, P. Nihoyannopoulos3, On behalf of NHLI, ICSM Hammersmith Hospital, London, United Kingdom.

**Background:** Patients with Duchenne muscular dystrophy (DMD) frequently develop dilated cardiomyopathy at the later stages of the disease. Strain rate (SR) and the time to onset of relaxation (TRC) by SR imaging have been used to study myocardial function in ischaemia and cardiomyopathies. The aim of this study was to investigate the usefulness of SR and TRC to predict the adverse outcome in young, asymptomatic patients with DMD.

**Methods:** Thirty-three DMD boys (mean age 8.6±2.7 years) were initially scanned using the HDI 5000 (Philips Medical Systems) to acquire from the parasternal long axis the colour M-mode tissue Doppler (TDI) of the posterior wall of the LV. We calculated the SR and TRC. All patients were without clinical symptoms from the cardiovascular system and had normal conventional echocardiographic studies.

**Results:** They all completed a 70±4 months follow-up with repeated echocardiographic studies. Seven boys showed deterioration in LV function with reduced FS. Three of them died during that time at ages 17.4, 18.5 and 19.4 years. Our findings of SR at end diastole and TRC at the onset of the study could be used with 84.85% accuracy to correctly predict the adverse outcome (Figure). The right panel of the figure shows the predictive boundary between good and poor outcome in terms of deterioration of the cardiac function.

**Conclusion:** Using SR and TR we can accurately classify DMD boys as high or low risk in developing cardiomyopathy in the near future. The predictive boundary line between good and poor outcome (figure), could be used in clinical trials as well as in clinical practice to identify which are of greater risk to develop a more aggressive cardiomyopathy.

-5.02±1.5/s, p=NS) and late diastole (-1.54±0.8/s vs. -1.6±0.6/s, p=NS) as well as in TRC values (384.7±40.2 ms vs. 381.4±33.43 ms, p=NS).

**Conclusion:** SR and TRC values were not significantly different in regards to low intermittent treatment with prednisolone in asymptomatic DMD boys. These results might indicate that the short exposure in low dose prednisolone does not have a significant effect on the cardiac function.

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Prednisolone and SR in DMD

**Prednisolone and SR in DMD**

**DMD**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR peak Systole</td>
<td>1.78±0.75/s</td>
<td>1.82±0.3/s</td>
<td>NS</td>
</tr>
<tr>
<td>SR early Diastole</td>
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<td>-5.02±1.5/s</td>
<td>NS</td>
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<tr>
<td>SR late Diastole</td>
<td>-1.54±0.8/s</td>
<td>1.6±0.6/s</td>
<td>NS</td>
</tr>
<tr>
<td>TRC</td>
<td>384.7±40.2 ms</td>
<td>381.4±33.43 ms</td>
<td>NS</td>
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</tbody>
</table>

809
Validation of motion pictures expert group-4 (MPEG-4) algorithms used to compress echocardiographic video clips: a multicenter study

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Digital imaging is not routinely used in echocardiography, also because of large storage requirements and lengthy transmission times associated with MPEG-2 lossy compression algorithms. We sought to validate the newer MPEG-4 lossy algorithms, to further reduce image size, through human expert assessment, the gold standard method to assess video quality.

**Methods:** 7 cardiologists experts in echocardiography from 4 tertiary referral centers performed blinded readings of 165 randomized uncompressed and compressed 2D (fundamental and II harmonics) and color Doppler, motion images (1 cardiac cycle normal and pathologic clips) in 3 separate sessions. One Digital Video (Adaptec DVSoft) and 3 MPEG-4 (Microsoft Media Video 9 and Video V2; DivX Networks 4.11) compression algorithms were used, the latter at 3 compression levels (0%, 35% and 60%). Text was eliminated and image format (24 bit color, 720x576 pixel, 25 fps) maintained. Mean scores on a 5 point scale across experts were computed for combined diagnostic content and image quality, and compared across the 3 compression levels with ANOVA (uncompressed files as controls). Repeated scoring of uncompressed images was used to test inter- and intra-observer variability (Bland Altman). Based on mean score of uncompressed data, images were also subdivided into “optimal” and “sub-optimal” detail resolution.

**Results:** File dimensions decreased from 12-83 MB (uncompressed) to 0.03-2.3 MB using MPEG-4 algorithms (1:1051-1:26 reduction ratios). The SD of differences ranged 0.6-1.3 for both intra- and inter-observer variability.

The DV algorithm was undistinguishable from uncompressed data. Mean scores for Video 9, V2 and DivX algorithms were not different from uncompressed files at 0% and 35% compression settings. At 60% compression, DivX mean score was significantly reduced compared to uncompressed data (p=0.002). At sub-category analysis, the difference was still significant for gray-scale and fundamental imaging and for optimal resolution, but not for color or II harmonics imaging or sub-optimal resolution. At regression analysis (whole database), session sequence, detail resolution, compression grade, algorithm, image bitrate, echocardiographic view and hertz used all influenced independently the mean score.

**Conclusion:** These preliminary data support the use of MPEG-4 algorithms in the digital laboratory to greatly reduce file sizes to the purpose of cost reduction and ease of image management (archiving and transmission). Quality evaluation studies should account for the many independent variables that affect image quality grading.
810 Prevalence of work related muscular skeletal disorders (WRMSD) across UK based echocardiographers
R. Hare, R. Salter. University of Birmingham, Birmingham, United Kingdom
Purpose: Occupational injury amongst echocardiographers is becoming increasingly prevalent, as advancement in ultrasound technology has resulted in increases in both the number of ultrasounds requested, and the duration of each scanning session.
Research has shown that increased workloads, poorly designed scanning environments and equipment, and lack of ergonomic awareness by management and staff all contribute towards the pressure exerted upon the echocardiographers body. As a result musculoskeletal pain and injuries are being reported as concerns in many hospital departments. This study assesses the prevalence of these symptoms (Work Related Musculoskeletal Disorders - WRMSD) encountered by today's workforce.
Method: 1250 members of the British Society of Echocardiography (BSE) resident in the UK were forwarded a 36-item self-completed questionnaire.
Results: 518 echocardiographers returned the questionnaire (41% response rate).
It was found that the following people were shown to be at an increased risk of suffering pain. Those who were younger in age, shorter in stature than 5 ft 5 inches, female, a technician, less experienced in years of scanning, worked more hours a week, had longer patient examination times, had poor or average work satisfaction, had received manual handling training, and used a mixture of sitting and standing to scan. It was also noted that there was no difference in occurrence of pain, in the use of the left or right handed scanning position.
Conclusion: Despite evidence and recommendations from research over the last two decades, the prevalence of pain suffered by echocardiographers remains high. Longer rest periods in between scans, and shorter scanning periods, may help alleviate pain suffered by the echocardiographer. Ideally more ergonomically friendly equipment should be introduced to each department, to help reduce the amount of symptoms produced. Implementation of these changes could help produce a better working environment, and therefore as a result work satisfaction may also rise.
811 Time to renew the reference values for echocardiographic dimensions in children
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Purpose of the study: To evaluate whether the echocardiographic reference values of the heart dimensions in healthy children are still representative nowadays.
Patients and methods: In total 624 children were included, of which 382 boys and 242 girls in the age from birth to 23 years, body weight over 2.500 grams. The echocardiographic measures were taken from conventional M-mode recordings of the left ventricle parasternal long axis view. End diastolic septal (IVS) and LV posterior wall thickness (LVPW) and end diastolic and end systolic LV dimensions were retrospectively analysed. A linear regression analysis was applied to the logarithmic thickness data versus the logarithm of body weight.
Results: The regression lines from all measured sizes are significantly different from those collected in the early eighties. Especially the thicknesses of the IVS and LVPW are smaller. The regression lines are independent of gender (p-value ranges from 0.18 to 1.00). The spread of data around the regression lines is independent of body weight.
Conclusions: New reference values are found. The new ones should replace those from the past. Gender has no significant impact on these measures. Why the muscular wall thicknesses are thinner than found 20 years ago needs to be further explored.
812 Differences in digital picture and film documentation for various ultrasound methods
K. Kronberg, M.S. Claus1, G.-H. Reil. Klinikum Oldenburg, Oldenburg, Germany, 1OFFIS, Oldenburg, Germany
Background: With todays computer technology the routine use of a complete digital echocardiography laboratory with recording of still images and video loops is feasible. The storage of uncompressed video data would be too voluminous. We report our experience using a digital documentation for various ultrasound procedures applying the MPEG-4 compression standard of the international Moving Picture Experts Group (MPEG).
Methods: In addition to the documentation on videotape and videoprinter a digital acquisition of pictures and films was made possible on the three ultrasound machines in our department. This was done either with a frame grabber card via a computer mounted on the ultrasound machine or using the DICOM (Digital Imaging and Communications in Medicine) interface of the ultrasound system. All still images were converted in the JPEG (Joint Photographic Experts Group) format and all films in the MPEG-4 standard. The reports of the examinations were documented with a structured report system using an ORACLE database.
Results: From 1 January 2001 to 31 December 2002 the opportunity of an additional digital recording of still images and loops was used with 16674 of 22474 examinations (74%). With 14654 transhocracic echo examinations a mean of 5.5 still images and 3.9 loops were digital recorded, with 1053 transoesophageal examinations 2.7 still images and 10.4 loops, with 217 stressechoc 3.7 still images and 12.3 loops and with 6162 angio-logic doppler exams 4.8 still images and 2.8 loops. The mean compression rate compared to uncompressed data was 14:1 with still images (90 kibytes), 102:1 with loops (2 seconds, 422 kibytes) and 24:1 for the finger-print images (36 kibytes) of the loops. The storage volume for the 202600 images and loops would be uncompressed 2628 gigabytes, with JPEG and MPEG-4 compression we needed 33 gigabytes, adequate to an overall compression rate of 79:1.
Conclusion: The freely available opportunity of digital picture and film recording was used in a different extend for each ultrasound modality. Transhocracic echo uses more still images than loops due to M-mode measurements. For transoesophageal and stress echo mainly film recordings were applied. In angio-logic Doppler twice as much still images than films were taken. The design of a digital report and picture archiving system should take the different requirements into account.
The digital documents were frequently used in conferences, for planning of invasive procedures, on the ward as part of the electronic patient record and in teaching sessions.
813 Integration of cardiac magnetic resonance images and reports in a structured cardiologic information system
K. Kronberg, T. Wilkens1, M.S. Claus1, G.-H. Reil. Klinikum Oldenburg, Oldenburg, Germany, 1OFFIS, Oldenburg, Germany
Background: Cardiac magnetic resonance imaging (MRI) is a new and increasingly used method for the cardiologist. We integrated images, films and reports in our cardiology information system for better comparison with echocardiographic and angiographic results.
Methods: The software includes the following features: - Structured report generation for left and right ventricle, atria, cardiac valves, pre- and postcontrast (late enhancement) including reports for stress MRI. - Structured report generation for aortic and pulmonary vessels including suprasternal, intracranial, abdominal and peripheral vessels. - Receiving of MRI images in DICOM (Digital Imaging and Communications in Medicine) format. - Converting and structuring the DICOM images to fingerprint pictures for each series with appending the respective DICOM series and a corresponding film in the Moving Picture Experts Group (MPEG) format. - Integrating a viewer for DICOM and MPEG films in the report software. - Adjusting the framerate of the MPEG films to the heart rate for real time viewing.
Results: In one year all 286 cardiac MRI studies could be integrated in the software system. For each study a mean of 1094 single images in 46 series was taken. The DICOM images required 145 megabyte per study and the fingerprint and MPEG films together 4 megabyte (compression of 48:1). The films were used on all 40 workstations of the department for reviewing and the postprocessing modalities of the DICOM viewer for treatment planning (e.g. aortic stents).
Conclusion: The integration of cardiac MRI reports and films with feasibility of direct comparison with echo and angio films makes it easy to gain access and knowledge of this new imaging modality for all colleagues in the department.

MRI reviewing (non compaction ventricle)
815
Comparaison de echocardiography and right heart catheterization before cardiac surgery
B. Magdelaine, A. Srinelli, C. Barbye, B. Charbonniet. Tours, France
Purpose: The goal of this study was to assess the accuracy of a doppler echocardiographic hemodynamic evaluation with new doppler indexes of left ventricular filling pressures and pulmonary vascular resistance measurement, compared with right heart catheterization data before cardiac surgery in patients with severe heart failure.
Method: Right heart catheterization and doppler echocardiography (DE) were performed in the same hour in 24 patients with dilated cardiomyopathy (ischemic or not) before cardiac surgery or transplantation. Invasive measurements: pulmonary artery systolic pressure (PASP), pulmonary artery diastolic pressure (PADP), mean pulmonary artery pressure (MPAP), pulmonary capillary wedge pressure (PCWP) were measured using a Swan-Ganz catheter. Cardiac output was determined by thermodilution. The pulmonary vascular resistance (PVR) were calculated using the equation PVR=(MPAP-PCWP)/Cardiac output. Left ventricular ejection fraction (LVEF) was evaluated by radionuclide angiography. DE measurements included: LVEF using Simpson's method, cardiac output, PASP, PADP, mitral inflow (E/A ratio) and PVR using the equation PVR=(TRV-10/ TVI-RVT)/0.16 (TRV: tricuspid regurgitation velocity, TVI: time velocity integral).
Results: We found a good correlation between the two methods fo PASP (r=0.86, p=0.014) and PADP (r=-0.72, p=0.02). LVEF assessed by Simpson's method correlated (r=0.98, p<0.0001) with the radionuclide angiography results. For cardiac output measurements the correlation were poor (r=0.51, p=0.16). E/A ratio (r=0.89, p=0.0004) and E/Ea ratio (r=0.73, p<0.001) were well correlated with PCWP. E/Ea >15 was always associated with a PCWP>15 mmHg. There were no correlation between the two methods for PVR (r=0.0, p=0.17) and for the comparison of PCWP and TE-Ea (r=0.48, p=0.19).
Conclusion: Echocardiography is a reliable method before cardiac surgery in order to assess FVF, PASP, PADP and PVR. But right heart catheterization before heart transplantation is still necessary due to the poor correlation between the two methods for PVR measurement.

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Intraoperative transesophageal echocardiography in patients with infective endocarditis
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Purpose: The role of intraoperative transesophageal echocardiography (IOTEE) in patients with infective endocarditis (IE) is usually reserved to cases of inadequate preoperative testing or suspected extension to perivalvular tissue. We aimed to explore the impact of the routine IOTEE to have good surgical results had satisfactorily post-operative course.
Methods: The database of the IOTEE was screened for operations for perivalvular tissue. We aimed to explore the impact of the routine IOTEE in patients with IE.
Results: The study group contained 48 patients (33 male, 15 female, age 56.8±17.3 years, range 20-82 years). There were 18 cases of prothetic valve endocarditis (PVE), 25 with IE on native valves, and 5 who eventually had no vegetations (4 flail mitral valve, 1 ruptured papillary muscle). The operative procedures included aortic valve replacement in 31 cases, mitral valve replacement in 22 cases, tricuspid valve replacement - 2, mitral valve repair - 4, tricuspid annuloplasty - 5, and tricuspid valvectomy - 1. There were 11 cases (%) of perivalvular abscess/fistula, 9 of which were noted in patients with PVE. Pre-pump IOTEE was available in 45 patients (93.8%), and changed the operative plan in 6 (13.3%): avoidance of additional procedure - 3, identification of additional site of IE, attempting valve repair, and replacing another diseased valve - in 1 patient each. Post-pump IOTEE was available in 47 (97.9%) patients, and accounted for second pump-run in 5 patients (10.6%); perivalvular leak (3 cases), immolated leaflet (1 case) and significant mitral regurgitation following vegetectomy (1 case).
Prolonged de-airing was necessary in 5 patients (10.8%). In 4 cases (8.5%) the postoperative IOTEE aided in the evaluation and treatment of difficult weaning from the bypass.
Conclusions: IOTEE has an important role in surgery for IE even when TEE was already performed before, and should be widely implemented.

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Intraoperative echocardiography in pediatric cardiac surgery: King Abdulaziz Cardiac Center experience
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Purpose: To review our experience with IOTEE in pediatric cardiac surgery patients and determine its impact in surgical outcome.
Methods: The impact of IOTEE was assessed in pediatric (<14 years) patients who underwent cardiac surgery at KACC and who had IOTEE before and after surgical repair. A mini-multiplane probe was used on the last 76 patients. The surgical records, and echo reports were reviewed to determine: preoperative diagnosis and indication for IOTEE, accuracy of pre-op diagnosis, IOTEE safety and complications, IOTEE inspired surgical revision, and surgical outcome.
Results: From July 2001 to December 2003 there were 705 pediatric cardiac patients operated at our center. Of these 242 (34%) had pre and post repair IOTEE and are reported here. The median age was 8 months (range 5 days to 14 years); there were 114 females. The most common diagnoses were: AVSD (17%), VSD (14%), TOF (14%), DTAQ (9%), mitral valve disease (6%) and DORV (5%). The IOTEE provided a minor revised diagnosis in 9 patients. Intubation was not possible in 2 patients and the TEE probe was withdrawn in one patient who developed respiratory distress. No other complications were noted. There was surgical agreement with the pre-op IOTEE in all cases. Twenty patients (8%) underwent surgical revision inspired by the post pump IOTEE. All patients determined by IOTEE to have good surgical results had satisfactorily post-operative course.
Conclusions: IOTEE during pediatric cardiac surgery is a safe and valuable procedure that helps in improving surgical outcomes; we currently use it in most heart lesions that require cardiopulmonary bypass in children.

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Follow-up data on 100 PFO-patients after interventional occlusion with 5 different devices - A single center study based on transesophageal echocardiography
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Introduction: From 1998 to 2003 one hundred consecutive patients at the German Heart Center underwent successful interventional PFO-occlusion with 5 different devices (Helix (Hx) 43/100, Cardiose (Ca) 30/100, Starlex (Sx) 16/100, Amplatzer ASD Occluder (Aa) 11/100, Amplatzer PFO Occluder (Ap) 8/100).
Aim: Purpose of this study was to evaluate the success of the PFO occlusion by means of transesophageal echocardiography and look for patients neurological and cutaneous sequelae with a standardized questionnaire.
Patients and methods: 100 patients (50 male and 50 female) were included in the study. Mean age at the intervention was 46 years (±14.5 y), mean age at follow-up was 47 years (±13.2 y). All patient records and questionnaires were included in the study.
Results: 35 patients had a simple PFO, 59 a combination of PFO and atrial septal aneurysm and n=6 an ASD II. All patients had a cryptocytic cerebral stroke prior to occlusion. 1 patient died for non cardiac reason during follow up. 52/99 patients sent their questionnaire back to the clinic. Before device implantation 54 patients were on oral anticoagulation, 25 on antiplatelet therapy. After the procedure at follow-up 10 patients were still on oral anticoagulation, 30 patients were treated with antiplalets. Cardiac dysrhythmia (atrial flutter or fibrillation) were documented in 6/100 cases. In 5/100 patients thrombotic formation on the device was suspected on TTE and proven by TEE. In all cases the therapy with oral anticoagulation/antiplatelets was proceeded. 80/99 patients had a follow-up TEE with a median of 7 month (mean 11±10 m). Residual shunts could be demonstrated in 14/99 patients, right to left shunt in 5 of them. Surgical device explantation with patch closure was done in 5/100: n=2 due to recurrent stroke and residual shunt on TEE (1 Cs, 1 Hx); n=2 due to thrombotic formation on the LA side of the device (2 Cs) and in 1 due to multiple fractures of the LA device (Cs).
Conclusion: Follow-up of our patients with cerebral events after interventional PFO/ASD-occlusion was complicated in few cases by recurrence of neurologic events (2%), thrombotic formation (3%) and dysrhythmia in 6%. Surgical device removal was done in 5/100. The question when interventional PFO occlusion is indicated still remains open.
Non-invasive determination of cardiac output by tissue doppler in cardiac surgery

K. Knoblock, A. Lichtenberg1, M. Winterhalter2, D. Rossmann3, M. Pichtl1, M. Phillips1, M. Karck1, A. M. Kock1, A. Haverich1, Hannover, Germany, 1Medical School Hannover, Hannover, Germany, 2Medical School Hannover, Hannover, Germany, 3Medical School Hannover, Hannover, Germany, USCOM, Sydney, Australia

Introduction: Determination of cardiac output (CO) during and after cardiac surgery on the intensive care unit enables to administer optimal catecholamine therapy especially in critical compromised patients with hemodynamic instability. Invasive determination of CO is possible via a Swan-Ganz-catheter with its associated risk of implantation, such as venous oxygen saturation (CVS%) as reference. Non-invasive CO was determined by the USCOM system using the Doppler principle via a transthoracic approach. Intraoperatively, three measurements were performed directly on the pulmonary outflow tract vs. invasive CO. Additional 80 measurements under different hemodynamic situations were performed on the ICU. Data are expressed as mean±SD.

Non-invasive determined CO via the USCOM system was 5.15±1.98 l/min (95% CI 4.85-5.44) with a cardiac index of 2.6±0.2 l/min. Invasive CO assessed by the Swan-Ganz catheter was 4.92±2 l/min (95% CI 4.63-5.22; n.s.). This findings were significant associated with a correlation index of 0.998 (p<0.001). Spearman-Rho coefficient, both direct and invasive CO were identical. Corresponding central venous saturation was 72.9% correlating with both, non-invasive and invasive CO (0.474 and 0.606, p<0.01). Furthermore, stroke volume was significantly correlated with non-invasive CO, invasive CO, and CVS% (0.946; 0.803; 0.474, all p<0.01).

Using the USCOM system it is possible to determine the beat-to-beat cardiac output in critical ill patients both, in the operating room and on the cardiac intensive care unit non-invasively with a high correlation to invasive determined cardiac output via a Swan-Ganz catheter, CVS%, and stroke volume, without the possible complications associated with invasive right heart catheterisation.

820 Pulmonary vein stenosis after radiofrequency ablation of atrial fibrillation

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National Institute of Cardiology, Warsaw, Poland, 1National Institute of Cardiology, Warsaw, Poland

Aims: Pulmonary vein (PV) ablation offers the potential to cure patients with atrial fibrillation (AF). However, progressional venous/occlusive pulmonary syndrome with pulmonary hypertension as a consequence of pulmonary vein stenosis was reported to be a major complication of this procedure. In this study, we investigated the incidence of pulmonary vein stenosis after radiofrequency catheter ablation of refluxary atrial fibrillation by systematic long-term follow-up. Methods and results: PV isolation was performed in 47 patients with refractory and highly symptomatic episodes of atrial fibrillation (AF), underwent RF catheter ablation by circumferential pulmonary vein isolation (CPVI), according to Pappert technique. Electroanatomical CARTO system was used. Clinical assessment of arrhythmic episodes occurrence as well as transesophageal echocardiographic examination (TEE) was retrospectively performed 13±4.9 months after procedure. Following echocardiographic data were analyzed: left ventricular ejection fraction (LVEF, %), left atrium end-systolic area, E/A diastolic mitral flow ratio, isovolumetric relaxation time (IVRT, ms), E wave deceleration time (DT,ms), PV ostial diameter (mm), PV doppler flow velocities (m/s), regarding left and right superior and inferior PV (LSPV, RSPV, LIPV, RIPv). 8 pts (40%), reported symptoms of arrhythmia, AF episodes of mean duration times 37.2±29.7 hrs were noted in 16 pts using TEE monitoring. Mean LVEF was 63±6%. Results of TEE parameters assessment are shown in Table 1. Although, we found 2 pts with elevated systolic maximal doppler velocity in LSPV, (110 cm/s), one with corresponding turbulence of the flow signal (no adequate difference between systolic and diastolic flow), none of these pts had clinical manifestation of PV stenosis.

Conclusions: 1. Transesophageal echocardiographic follow-up of pts referred for catheter ablation of AF, should show good clinical results with no evident signs of PV flow impairment.

Table 1

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821 Transesophageal doppler-echo evaluation of pulmonary vein flow and left ventricular function after circumferential RF catheter ablation of pulmonary veins due to paroxysmal atrial fibrillation

A. Gerber, A. Rybicka-Musialik1, J. Krauze1, C. Czerwinski2, A.-M. Wnuk-Wojnar1, K. Wita1, A. Hoffmann1, S. Nowak1, I. Wozniak-Sokowska1, M. Trusz-Gluzia1, Slaska Akademia Medyczna, Katowice, Poland, 1Silesian University School of Medicine, Katowice, Poland

Aim of the study: To assess whether successful RF catheter ablation of PV influences left ventricular function and pulmonary vein flow long-term follow-up with transesophageal echocardiographic assessment.

Methods and results: Twenty-five pts, age 53±11.3 years, with refractory to antiarrhythmic drugs and highly symptomatic episodes of atrial fibrillation (AF), underwent RF catheter ablation by circumferential pulmonary vein isolation (CPVI), according to Pappert technique. Electroanatomical CARTO system was used. Clinical assessment of arrhythmic episodes occurrence as well as transesophageal echocardiographic examination (TEE) was retrospectively performed 13±4.9 months after procedure. Following echocardiographic data were analyzed: left ventricular ejection fraction (LVEF, %), left atrium end-systolic area, E/A diastolic mitral flow ratio, isovolumetric relaxation time (IVRT, ms), E wave deceleration time (DT,ms), PV ostial diameter (mm), PV doppler flow velocities (m/s), regarding left and right superior and inferior PV (LSPV, RSPV, LIPV, RIPv), 8 pts (40%), reported symptoms of arrhythmia, AF episodes of mean duration times 37.2±29.7 hrs were noted in 16 pts using TEE monitoring. Mean LVEF was 63±6%. Results of TEE parameters assessment are shown in Table 1. Although, we found 2 pts with elevated systolic maximal doppler velocity in LSPV, (110 cm/s), one with corresponding turbulence of the flow signal (no adequate difference between systolic and diastolic flow), none of these pts had clinical manifestation of PV stenosis.

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822 FRC-TEE - Ultrasound in coronary diagnostics

Klinikum Schwalmstadt, Schwalmstadt, Germany

Purpose: Ultrasound is an interesting approach for noninvasive coronary visualization and diagnostics as its procedure characteristics differ from the established methods of MRI and EBT. We sought to investigate the fragment reconstruction of coronary arteries by transesophageal echocardiography - FRC-TEE - in a patient population being evaluated for coronary angiography.

Methods: We studied 50 patients (33 men, 17 women) with FRC-TEE being admitted for coronary angiography. For fragment reconstruction the newly developed software USIP was used. FRC-TEE angiography findings were compared visually and by quantitative measurements.

Results: All transesophageal studies were performed without any complications and provided evaluable results. In total 171 vessels (right coronary artery 42, left circumflex artery 49, left anterior descending artery 28, ramus intermedius 3, left main coronary artery 49) were examined by FRC-TEE. The total lengths visualized were 9.6±1.7 cm for right coronary artery, 7.0±1.1 cm for left circumflex artery, 3.9±1.2 cm for left anterior descending artery, 4.9±1.3 cm for ramus intermedius and 1.5±0.8 cm for left main coronary artery. There was a high concordance between coronary angiography and FRC-TEE. The mean difference in stenosis degree was 51.6±18.7% using FRC-TEE and 51.3±19.5% using angiography. The mean difference in stenosis degree was 0.2±5.1%. In 19 segments stents could be visualized. A limitation of the method is the detection of distal stenosis of the coronary arteries. Thus 14 stenosis, predominantly in the left anterior descending artery (n=11) and 2 stents (left anterior descending artery) could not be examined by FRC-TEE.

Conclusions: FRC-TEE is a safe and efficacious noninvasive method for diagnosis of coronary artery disease. This method allows follow-up examinations of implanted stents and stenoses and provides additional information to angiographic findings. With improvement in visualization of the left anterior descending artery and distal parts of coronary vessels, with reduction of examination time as well as further automation, it might be useful as a screening method for patients with suspected coronary artery disease.
824 Tissue Doppler imaging predicts sinus rhythm maintenance in patients with atrial fibrillation
I. Paraskevaidis, V. Vartele, D. Tsiapas, P. Kokkinos, S. Kyrzopoulos, K. Papadopoulou, D. Kremastinos. Onassis Cardiac Surgery Center, Athens, Greece

Background: Atrial fibrillation (AF) is the most common arrhythmia. Although the role of rate control versus rhythm control is questionable, DC cardioversion remains a challenge.

Purpose: We aimed to investigate whether pulsatile tissue Doppler imaging (TDI) could be potentially useful to detect patients in whom sinus rhythm can be maintained after DC cardioversion.

Methods: We studied 25 patients (mean age 63 ± 11) with AF of duration (34.7 ± 28.4 days duration). Twenty out of 25 patients were cardioverted. Five out of 20 patients had coronary artery disease, 1 patient dilated cardiomyopathy, 6 arterial hypertension, 4 valvulopathy, and 4 were classified as lone AF. Transthoracic echocardiography was performed before DC cardioversion and the standard echocardiographic parameters were calculated. The TDI sample volume was placed at the basal lateral wall of the mitral annulus and each wave velocity was measured.

Results: Three months after cardioversion, 15 patients (75%) were maintained in sinus rhythm (group I), whereas in the remaining 5 patients AF recurred (group II). Both groups had similar AF duration (32.3 ± 19.8 days in group I vs 42.8 ± 18.8 days in group II, p = NS). Before cardioversion, left atrium diameter (44.7 ± 5.7 mm in group I vs 45 ± 5.1 mm in group II), left ventricular end-diastolic diameter (56.2 ± 9.7 mm in group I vs 56.8 ± 5.9 mm in group II), end-systolic diameter (38.9 ± 10.5 mm in group I vs 40.2 ± 5.2 mm in group II) and ejection fraction were similar between groups (11.6 ± 4.4% in group I vs 47.2 ± 9.2% in group II). In group I p = NS. However, differences were detected in TDI waves. The Ea velocity was higher in group I (Ea = 13.6 ± 4.2 cm/sec) than in group II (Ea = 8.4 ± 2 cm/sec, p = 0.001). The first negative systolic wave velocity was higher in group II (Ea = 4.0 ± 0.8 cm/sec) than in group I (11.6 ± 4.4 cm/sec, p = 0.006). Multivariate analysis showed that patients who presented with peak velocity of the first negative systolic wave >5 cm/sec, AF recurred. The higher the velocity, the faster AF occurred. In those patients with a first negative systolic wave of >5 cm/sec, AF recurred within 10 days after DC cardioversion.

Conclusion: Tissue Doppler imaging (TDI) might help to differentiate those patients who will maintain sinus rhythm 3 months following electrical cardioversion.

825 Improved left atrial and left ventricular function after 30-days sinus rhythm in patients with non-valvular atrial fibrillation

Aim of study: Prospective follow-up of patients with successful cardioversion (CV) of non-valvular atrial fibrillation (AF) to evaluate left atrial, left ventricular function and to assess the role of various clinical and echocardiographic predictors of the preservation of SR.

Methods: Clinical, transthoracic echocardiographic (TTE) and transesophageal echocardiographic (TEE) data of 62 consecutive patients (35 men, mean age: 70.2 ± 10.7 years) with nonvalvular AF (14 persistent, 18 ischaemic, 3 lone), lasting >48 h who had sinus rhythm at Day 1 after successful electrical CV were analyzed.

Results: At one-month follow-up, 46 of 62 (74%) patients had SR (Group A), in 16 patients AF recurred (Group B). The duration of AF <7 days (Group A: 73% vs Group B: 40%), the left atrial appendage (LAA) peak emptying flow velocity (Group A: 35.64 ± 15.85 vs Group B: 25.92 ± 5.89 cm/sec, p = 0.05) measured by TEE before CV, the mitral inflow "A" wave measured on Day 1 (Group A: 57.03 ± 20.27 vs Group B: 53.41 ± 28.66 cm/sec, p = 0.0001) predicted the maintenance of SR. Successful cardioversion resulted in improvement of left ventricular function in Group A (EF%: 50.3 ± 10.78 vs 56.2 ± 9.88, p = 0.02) already at Day 1. Further increase of EF was detected at Day 30 (58.41 ± 7.4%, p < 0.002). In Group B a not significant increase in EF was seen after cardioversion (51.17 ± 11.68 vs 54.73 ± 12.46%, but at Day 30, with AF the baseline EF was detected again (51.92 ± 11.37%). There was significant difference in EF (58.41 ± 7.4 vs 51.92 ± 11.37%, p = 0.04) between patients with SR and AF at Day 30 after CV. At Day 30 the A wave increased significantly compared to Day 1 (58.02 ± 20.61 vs 70.73 ± 23.68 cm/sec, p = 0.0001) in patients with SR, indicating an improvement in left atrial function.

Conclusions: Echocardiographic variables, as LA peak emptying flow velocity before CV, mitral A' wave velocity after CV and the duration of AF - can identify patients with greater likelihood to remain in SR at one month after successful CV. The left ventricular function at Day 30 improved only in patients with SR, together with the improvement of the left atrial function.

826 Left atrial enlargement improves long term outcome of cardioversion of persistent atrial fibrillation
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Long term maintenance of sinus rhythm (SR) post cardioversion (CV) from persistent atrial fibrillation (AF) carries lower risk of stroke and may avoid the risks associated with anticoagulation. HOT CAFE Polish Study is going to estimate the clinical outcome of SR restoration and maintenance in a long term follow-up in comparison with ventricular rate control and anticoagulation in pts left with arrhythmia. We sought to determine echocardiographic predictors of maintained SR during one year follow-up period.

Methods: Our study population comprised 205 pts (F/M 71:134; mean age 61.4 ± 17.6); 104 of them (F/M 33:71; mean age 60.7 ± 9.6) were randomized to SR restoration and maintenance with serial antiarrhythmic drug usage, for whom transthoracic echocardiographic (TTE) variables were recorded prior to CV. Generalized additive logistic regression was used to investigate impact of selected variables on long-term SR maintenance.

Results: SR was presented in 64.4% pts at one year. For considered quantities variables series of generalized additive logistic regression models with one parameter of interest adjusted for age and sex were fitted. Linearity of dependence of echocardiographic parameters of interest with ID success was tested. Increased left atrium area >28 cm (RR 1.72; 1.09-2.71; p = 0.02) and increase of FS value in ranges 28-40% (1.2; 1.01-1.44; p = 0.05) were significantly associated with SR maintenance after one year. In order to determine the influence of the LA diameter on the probability of SR maintenance we analyzed mean LAar values, prior to and after CV. Patients with large LAar values (>28 cm2) presented a significant decrease (31.45 ± 3.07 cm2 vs 28.94 ± 3.81 cm2; p < 0.008) Differences observed in the dynamism of mean LAar values, prior to and 30 days after CV are statistically significant. In the group of patients with LAar >28 cm2 we noted atrial decrease by 2.57 ± 3.2 cm2, while in patients with a smaller left atrium volume: 0.47 ± 2.9 cm2 (p < 0.004).

Conclusion: left atrium area and left ventricle shortening fraction seem to be good predictors of SR maintenance after successful CV. LA enlargement improves long term outcome of CV.

827 Left atrial and left atrial appendage prolonged dysfunction after electric DC shock for atrial fibrillation: evidence of atrial appendage dissociation
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Background: After electric DC shock (ES) for atrial fibrillation (AF) the sinus rhythm (SR) restoration is not always associated to a mechanical recovery of left atrial appendage (LAA) mechanical function. The aim of this study is to evaluate with transesophageal echocardiography (TEE) the left atrium (LA) and LAA functional behaviour 7 days after ES for AF.

Methods: In 80 patients (pts) with non-valvular AF or atrial flutter lasting >48 hours we performed a pre- cardioversion and a 7-days post-cardioversion TEE study. Left atrial dysfunction was considered when transmural Doppler A wave velocity (LAv) was <45 cm/sec (age corrected value) and when LA emptying velocity (LAAv) reduction (see Table). One of the 3 pts with isolated LAAv reduction showed a persistence of a fibrillation-type LAA flow profile, despite a SR restoration and a normal LA. Serial TEE controls reported a LAA flow profile normalization 3 months after ES.

Conclusion: In some patients undergoing ES for AF (4.7% of our cases) a persistent LAA isolated dysfunction may occur. Such a dysfunction can last even for a prolonged period of time (3 months). This observation can importantly affect the diagnostic-therapeutic strategy in pts with AF undergoing ES.

Cases of LAA or left atrial dysfunction

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828
Left atrial function in patients with intraventricular conduction disturbances
Specialistic District Hospital in Łódź, Łódź, Poland

Harmful influence of distal bundle branches blocks (BBB) on left ventricular function, prognosis, occurrence of complications and life expectancy is widely discussed currently in scientific literature. There are few data on atrial function in intraventricular conduction disturbances however we know much about left ventricle function in such cases.

The aim of the study was to evaluate left atrial function in patients with left bundle branch bloc (LBBB) or with right bundle branch bloc (RBBB) by means of echocardiography. BBBs were of ischaemic etiology. All patients had MI no sooner than 3 months prior to inclusion into the study.

Study group I consisted of 23 patients with LBBB (aged 58.3±9.6), study group II of 21 patients with RBBB (aged 64.47±7).

The patients of study group were hospitalized due to cardiac events (angina pectoris, exacerbation of chronic heart failure). Acute MI was excluded in all patients by means of myocardial necrosis markers measured after admission.

Control group consisted of 20 patients with MI in the past (no sooner than 3 months before inclusion into the study) and without BBB (aged 64.4±8.2).

Left atrial systolic function was determined by the forward -mitral flow parameters: PEP LA- pre-ejection period, ET LA - ejection time, A - peak atrial velocity and by the backward pulmonary venous flow parameter - AR- peak atrial reversal velocity.LA - maximal LA diastolic, EF - left ventricle ejection fraction

Conclusions: 1. Left atrial systolic function is significantly enhanced in patients with BBB as compared with the controls. The enhancement is more expressed in patients with LBBB than with RBBB.

2. The enhancement of left atrial systolic function may be the compensatory mechanism as a response to LV impairment, which takes place in the case of BBB.

829
Left atrial appendage flow velocity correlates with propagation velocity of early diastolic flow in patients with atrial arrhythmias

Introduction: Left atrial appendage (LAA) flow velocity has been studied basically in patients with atrial arrhythmias because of its relationship with the presence of intraatrial thrombus. The determinants of this flow are subject of investigation and controversy. Propagation velocity (PV) of early diastolic flow is a useful index for the assessment of left ventricle (LV) diastolic function which is independent from preload and afterload.

Objectives: We sought to analyze the determinants of LAA flow velocity in patients with atrial arrhythmias, concretely those related to LV diastolic function.

Patients and methods: We analyzed prospectively the transeosophageal echocardiograms (TEE) made to 18 consecutive patients, all of them with atrial arrhythmias. Twelve patients had atrial fibrillation, 4 had common atrial flutter and only 2 had uncomfluent flutter. Ten patients were women, mean age 63±13 years. All patients had mild or moderate cardiopathy except in four cases: a severe aortic stenosis with systolic dysfunction, 2 patients with severe ventricular hypertrophy and one severe systolic dysfunction. There was one case of moderate mitral stenosis. All of them had LAA flow velocity (using TEE) and the PV of early diastolic flow propagation velocity using transthoracic echocardiography.

Results: We obtained a mean LAA flow velocity of 0.31±0.16 m/s, and a mean of PV of 457±140 mm/s. We obtained a good correlation between PV and LAA flow velocity. (Pearson’s 0.616, p<0.006), so that, lower LAA flow velocities correspond to lower PV of early diastolic flow. Patients with a "worse" diastolic function (lower PV) had lower LAA flow velocities.

Conclusions: In patients with atrial arrhythmias, LAA flow velocity correlates well with PV of early diastolic flow. Since PV is an independent index from preload and afterload of LV diastolic function we can assess that, in patients with atrial arrhythmias, LAA flow velocity depends on the diastolic function of the left ventricle.

830
Left atrial appendage function in patients with bundle branch blocks
Specialistic District Hospital in Łódź, Łódź, Poland

Bundle branch blocks (BBB) affects the function of heart ventricles. Few data exists on the BBB influence on heart atria function let alone there were no investigations on the BBB influence on left atrial appendage (LAA) function. Impaired LAA function predispose to thrombotic events. We tried to investigate the LAA function in patients (pts) with LBBB or RBBB.

Study group I consisted of 25 pts with LBBB (aged 58.3±9.6) and study group II consisted of 24 pts with RBBB (aged 64.4±7.7). All patients had MI no sooner than 3 months prior to inclusion into the study. Acute MI was excluded in all patients by means of myocardial necrosis markers determined after admission.

Control group consisted of 20 patients with MI in the past (no sooner than 3 months before inclusion into the study) and without BBB (aged 64.4±8.2). To evaluate systolic LAA function the following parameters were determined by means of TEE: LAA - LAA transverse dimension , LAAng - LAA longitudinal dimension EF LAA - LAA ejection function, LAAE - LAA peak emptying velocity, LAAP- peak filling velocity.

Conclusions: LAA systolic function was significantly enhanced in patients with MI and LBBB in comparison to pts with MI and RBBB and with MI and no BBB.

There were no significant differences of LAA function between pts with MI and RBBB and pts with MI and no BBB.

Parameters of LAA determined by TEE

<table>
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<th>parameter</th>
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<th>Group II</th>
<th>Group III</th>
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</thead>
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<tr>
<td>LAAtr [cm]</td>
<td>1.98±0.57*</td>
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<td>LAAng [cm]</td>
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<td>3.4±0.87</td>
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<td>EF [m/s]</td>
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<td>LAAE [m/s]</td>
<td>0.68±0.09*</td>
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<td>0.55±0.05*</td>
<td>0.42±0.04</td>
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</table>

* - statistical significance between group I and III** - statistical significance between group II and III*** - statistical significance between group I and III**** - statistical significance between group II and III, p<0.05 - level of statistical significance.

831
Progressive changes in regional left atrial function in patients with either normal or impaired left ventricular diastolic function: a Doppler myocardial imaging analysis
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Background: atrial wall velocity profiles can be easily assessed from the atrial roof by use of Doppler Myocardial Imaging (DMI). However, a detailed evaluation of regional left atrial (LA) function has not been performed in patients with left ventricular (LV) diastolic dysfunction. Aim of the present study was to analyze changes in regional LA function with progressive impairment of LV diastolic function.

Methods and results: 80 healthy subjects (group A: 35.5±9.8 y; 53 males) and 86 patients with impaired LV diastolic function (group B: 78.9±18.2 y; 56 males) were enrolled into the study. All the patients underwent standard Doppler echo and pulsed DMI. Patients with diastolic dysfunction were classified as having either abnormal relaxation (group B: 46 patients) or restrictive (group C: 40 patients) mitral inflow pattern. Exclusion criteria were: unstable angina, severe valvular or congenital heart disease, cardiomyopathies, atrial fibrillation. As indexes of LA function were measured: mitral inflow peak A velocity, DMI Am wave velocity of mitral annulus, DMI A’ velocity of LA roof. Patients with impaired global diastolic function had advanced age, increased LA diameter, atrial emptying fraction and mitral inflow peak A (0.73±0.21 vs 0.56±18.2 m/s; p<0.0001). DMI analysis detected from normal subjects to patients with abnormal mitral inflow pattern a progressive increase in atrial contribution to LV filling, both at the level of mitral annulus (Am Peak: 0.11±03 in A vs 0.18±2.3 m/s in B; p<0.001) and of the left atrial roof (A’ Peak: 0.05±0.02 in group A vs 0.12±3.2 m/s in group B; p<0.001). Conversely, in patients with mitral inflow restrictive pattern a decrease of LA velocities was detected (Group C: mitral Am Peak: 0.10±0.02; atrial A’ Peak: 0.06±0.03 m/s; both p<0.001 vs Group B). Linear regression models pointed out in group B independent positive association of atrial A peak velocity with age (p<0.0001) and mitral inflow peak A (p<0.0001), as well as independent correlation of the same atrial A with both mitral dp/dt (p<0.0001) and left atrial diameter (p<0.0001) in group C. In the overall population, mitral Am wave and atrial A’ peak were strongly related each other (r: 0.73; p<0.001).

Conclusions: pulsed DMI may represent a useful tool providing readily obtained parameters about LA regional contraction. Changes in regional LA contraction are consistent with increased atrial contribution to filling in patients with abnormal mitral inflow pattern, and with a progressive decrease of atrial peak velocities in patients with restrictive diastolic function.
832
Normal or “pseudonormal” diastolic flow pattern in ischaemic cardiomyopathy? Increased left atrial volume as a simple marker for diastolic dysfunction
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Background: Diastolic dysfunction, frequently manifesting as abnormal mitral inflow indexes, is present in ischaemic cardiomyopathy (ICM). However, mitral E/A ratio and deceleration time (DT) are sensitive to loading conditions, and frequently is difficult to distinguish the normal to “pseudonormal” diastolic flow pattern. The purpose of this study was to verify the hypothesis that increased left atrial volume (LAV) correlates with diastolic dysfunction.
Methods: We studied Echo data in 86 patients (mean age 46±4 years, 47 males) with ischaemic cardiomyopathy without history of hypertension, atrial fibrillation/flutter, valvular heart disease, admitted to our clinic between 2002-2003. Biplane LAV was measured by area-length method. Pts. were divided into 4 groups according to the mitral inflow parameters: Group A: E/A>1.5; Group B: abnormal relaxation with E/A 0.5-1.5; Group C: “pseudonormal” pattern with E/A 1.5-2 and >0.5 decrease on Valsalva and DT 150-230 ms; and group D, restrictive pattern with E/A<2 and DT<150 ms.
Results: In symptomatic pts. (II-III NYHA class) with ICM, LAV increased, in form of pts. with abnormal relaxation, to those with “pseudonormal” pattern, to those with restrictive pattern with statistical significant differences (<0.05) Echo data in 86 pts with ICM. LAV: 49.8±21.7(gr.A) vs. 32.9±18.6 (gr.B); Mitral E/A: 0.9±0.3(A) vs. 0.6±0.1(B); Mitral DT(ms): 119±31 (A) vs. 144±34 (B); Vertical length between annulus center and posterior LA wall: 39.2±17.5 vs. 28.6±14.2(D); LA Valsalva, b/m±227.3±10.7(A)/32.5±10.5(B)/12.8(C)/50±14.9(D).
Conclusion: Increased LAV appears to reflect worsening diastolic dysfunction, and may serve as a simple but important marker for differential diagnosis between normal and “pseudonormal” diastolic flow pattern in ICM.

833
Echographic assessment of left atrial volume. Simultaneous validation by electron beam computed tomography
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Background: Left atrial (LA) volume is an important measure of cardiac remodeling with severe outcome implications but methodological concerns cause uncertainty regarding the impact of this measurement and its variability. Electro Beam Computed Tomography (EBCT) provides a reference to which echocardiography can be compared to.
Methods: First, in 33 patients (validation set), LA volume was measured by 4 different echocardiographic methods: 1) cubed M-mode diameter, 2) 3 two-dimensional diameters using an ellipsoid assumption, 3) biplane method of disks and 4) biplane area-length method and compared to simultaneous (within one hour) EBCT. For the 2 biplane methods, 3 three longitudinal lengths were also tested a) major length (maximal length between annulus center and posterior LA wall) and c) vertical length (vertical length between annulus and posterior LA wall). Second, in 100 normal subjects we defined the normalcy range of LA volume using the method providing accurate measurements.
Results: In the validation set, the 4 echocardiographic methods of LA volume measurement showed good correlations with EBCT (143±55 ml, range 55 to 324) (all r =0.80, p<0.001) (see table) but the area-length method (method 4) had the best correlation with EBCT and underestimated LA volume (p=0.57). In the normal population, LA index (27±6 vs. ml/m²) was not associated with age or gender. LA enlargement, defined as >95% upper confidence interval, was ~40 ml/m². Conclusion: LA remodeling is easily and accurately measured by the area-length method using a vertical longitudinal length and LA-index >40 ml/m² should be considered abnormal. Therefore, LA volume should be part of routine echocardiographic evaluation.

834
Left atrial volume in patients with atrial fibrillation - Comparison of three methods of measurement: transthoracic echocardiography, endocardial catheter mapping and computed tomography
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Abstract background: It was previously observed that high left atrial volumes (LAV) was associated with increased frequency of atrial fibrillation (AF). Echocardiography is the most popular method used to assess left atrial dimensions and volume. Endocardial catheter mapping (ECM) of left atrium (LA) during CARTO ablation of AF is a valuable method to create detailed model of endocardial anatomy in three-dimensional space. Multislice spiral computed tomography (MSCT) can be used to evaluate the anatomy of pulmonary veins (PVs) and LA in patients with AF.
Aim: To compare three methods of LA volume measurement: transthoracic echocardiography, ECM during CARTO ablation of AF and MSCT.
Methods: 30 patients (7 women and 23 men) underwent transthoracic 2-D and M-mode echocardiography and ECM of LA during CARTO ablation of AF. 11 patients from the whole group underwent MSCT to assess pulmonary veins morphology and LA before ablation. LAV was calculated during echocardiography, CARTO system calculated LAV after ECM of the entire LA during atrial end-diastole. All measurements were performed during sinus rhythm.
Results: LAV measured by echocardiography was 61±18 ml vs 111±29 ml obtained during ECM and vs 108±34 ml calculated during MSCT. The average value of LA volume obtained by echocardiography was about 40% lower than that calculated during ECM and MSCT.
Conclusions: Transthoracic echocardiography underestimates LAV as compared to ECM and MSCT measurements by about 40%.

835
Left atrial function assessed by strain and strain rate imaging
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Background: In heart hemodynamic performance the atria play an important role by their reservoir, conduit and contractile function. The assessment of regional atrial wall motion and deformation is feasible using ultrasonic Strain (s) and Strain rate (SR) Imaging.
Aims: To investigate which SR/s deformation parameter best describes left atrial (LA) longitudinal function by correlating different longitudinal deformation parameters to established echocardiographic methods for the assessment of LA function.
Methods: Myocardial Velocity Imaging (MV) data were obtained from 15 young healthy subjects (25 to 38 years). Using standard echocardiography, we measured LA maximal and minimal volumes and the volume at onset of atrial systole. LA filling, active and passive emptying volumes and ejection fractions were calculated. For the reservoir and conduit function we studied the relationships between mitral annulus motion (MAM) and LA and LV filling by M-mode recordings obtained from the apical 4 chamber view throughout the cardiac cycle. Longitudinal SR/s were measured for the mid portion of the lateral LA wall (from the apical four chamber view) and the peak values of SR and s for contractile, reservoir and conduit periods of the LA as well as the value of s at the end of each of these periods were calculated using dedicated software (SPEQLE). To evaluate s as an indicator of LA contractile performance we correlated peak s values during the contractile period with LA ejection fraction. We defined two reservoir phases:early and late and we studied the correlations between peak SR during LA contraction and early LA reservoir and between MAM and peak s during the late LA reservoir.
Results: Consistent patterns of free wall deformation for the LA were obtained in all 15 subjects. The peak value of SR for early reservoir period (4.55±2.04 s-1) was significantly correlated (p<0.001) with the peak SR value for the contractile period (~4.5±1.08 s-1) and therefore, may be an index of atrial relaxation. Peak systolic s (~2.95±0.46%) and end systolic s (~20.24±7.06%) correlated significantly (p<0.001) with LA ejection fraction. Thus, they may be indicators of atrial ejection performance. The late reservoir phase as well as the passive LA emptying during the LA conduit period were related to the displacement of the mitral ring (p<0.02), pointing to a significant influence of LV deformation.
Conclusion: SRI imaging can be considered a robust technique for the assessment and understanding of LA function and should enhance the evaluation of different pathological states.
837 Cardiovascular ultrasound above and below age 50 in embolic stroke

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Introduction: The diagnostic strategy in embolic stroke still varies due to insufficient evidence of the relative usefulness of various techniques, particularly in relation to age at index event. Some guidelines suggest that TEE is particularly indicated in younger patients and is of limited value in patients >50 years old. We therefore studied the prevalence of echocardiographic findings and the yield of relevant findings from CDU, TTE and TEE in patients below and above age 50.

Hypothesis: TEE has a high yield of relevant findings in all age-groups and age >50 years is not a valid reason to exclude a patient from TEE.

Methods: We therefore evaluated the diagnostic yield in relation to age below or above 50 from transcatheter echocardiography (TEE) and transesophageal echocardiography in consecutive patients referred for evaluation of possible embolization from the heart as a cause of ischemic stroke.

Results: In all, 867 patients (196 below age 50) were investigated by CDU and TTE, 453 of these (130 below age 50) also by TEE. Most common relevant findings on TEE were complex plaques in the aortic arch (22.1%) and PFO (18.1%). Patent foramen ovale as well as atrial septal aneurysm were more common in younger subjects. On the other hand, left atrial thrombus and spontaneous contrast, a low ejection fraction and presence of complex plaques in the aortic arch were essentially limited to the patients above age 50. In all 60.7% of the patients above 50 years of age had relevant findings compared with 49.2 of the patients below 50 years. Relevant findings on TEE were rare, in patients without known ischemic heart disease only 1.4%.

Conclusion: Relevant TEE findings in patients with ischemic stroke are considerably more prevalent in patients above than below age 50. A strategy that excludes patients above age 50 from TEE is not recommended. TEE has a low diagnostic yield in all age groups, especially in patients without history of ischemic heart disease.

838 Integrated backscatter in analysis of the spontaneous echo contrast left atrial appendage in patients with nonvalvular atrial fibrillation

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The left atrial (LA) appendage is the most common site of thrombus formation in patients with atrial fibrillation (AF). LA spontaneous echo contrast (SEC) in AF is associated with increased risk of thromboembolism. Integrated backscatter allows the quantitative assessment of LA SEC. Integrated backscatter was used to examine the significance of appendage and LA SEC in patients with and without LA appendage thrombus.

Methods: We performed transesophageal echocardiography with integrated backscatter analysis in 89 patients (66 men, 23 women, mean age 65 +/- 9 years) with AF. The LA and LA appendage integrated backscatter intensity were measured with the regions of interest placed in the LA cavity and the appendage, respectively. The integrated backscatter intensity values for these two chambers were corrected using values from the left ventricular cavity. The LA and appendage were inspected for thrombus and SEC, which was graded from 0 (none) to 4+ (severe). Outflow velocity profiles were obtained by pulsed wave Doppler at the orifice of the LA appendage. All the patients were examined for LA appendage maximal area.

Results: The LA appendage integrated backscatter intensity values were available in 74 patients (83%). Overall, the corrected LA appendage integrated backscatter intensity was significantly increased compared with the corrected LA integrated backscatter intensity (7.4 +/- 3.1 vs 5.8 +/- 4.1 dB, p < 0.05). Outflow velocity at the orifice of the LA appendage was lower (20 +/- 6 vs 39 +/- 15 cm/s, p < 0.001) and LA appendage maximal area was higher (5.4 +/- 1.3 vs 4.2 +/- 1.3 cm2, p < 0.01) in patients who had LA appendage thrombus (n=16) than those who did not. SEC graded 2-4 was more frequent (87.5 vs 34%, p < 0.01) in patients with LA appendage thrombus. The corrected appendage integrated backscatter intensity (7.8 +/- 3.7 vs 7.3 +/- 2.9 dB, p < 0.05) and LA integrated backscatter intensity (5.7 +/- 4 vs 5.9 +/- 4.4 dB, p < 0.05) were not significantly different between the groups. The corrected LA appendage integrated backscatter intensity was not correlated with the LA appendage velocity and appendage size.

Conclusions: Patients with nonvalvular AF had a denser SEC in the LA appendage compared with SEC in the main LA cavity. Outflow velocity at the orifice of the LA appendage, LA appendage maximal area and SEC, but not the corrected appendage and LA integrated backscatter intensity were significantly different between the groups of patients with and without LA appendage thrombus.

839 Real-time visualization and quantification of acute thrombus formation by 13 MHz extravascular ultrasound in porcine arterial anastomosis

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Objective: Thrombus formation on the coronary anastomosis suture line may lead to early flow limitation, graft occlusion and/or loss of myocardium due to generation of thrombotic emboli. We used extravascular ultrasound to visualize acute thrombus formation and dislodgement in the anastomosis in real-time.

Methods: In 5 pigs (75-92 Kg) without anticoagulant or antiplatelet medication, a section of the right carotid artery was excised and anastomosed end-to-side to the left carotid artery to bridge subsequent ligation in between the two anastomoses. The proximal anastomosis was made conventionally with a 4.0 mm punch. For the distal anastomosis, in contrast, a 2.7 mm punch was used to allow construction of pro-thrombogenic intima-advenditia (I-A) apposition with a 0.5 mm adventitia rim exposed to the bloodstream. For three hours, graft flow was measured and the I-A anastomosis was visualized continuously with 13 MHz ultrasound.

Results: In each animal, on the I-A anastomosis repetitive cycles of progressive thrombus formation followed by abrupt (partial) thrombus dislodgement were observed with corresponding flow changes (see Figure). Median thrombus formation and dislodgement cycle length per animal averaged 13.5 +/- 5 minutes (mean +/- SD) (overall range, 2 - 57 minutes). The median thrombus surface area measured in the longitudinal image increased by 0.32 +/- 0.14 mm2 per minute. The median size of the embolized thrombus (longitudinal image) was 7.2 +/- 2 mm2.

Conclusions: In the porcine prothrombotic anastomosis model, extravascular 13 MHz ultrasound allowed quantifiable visualization of acute thrombus formation and embolus generation in real-time.
840 Left atrial appendage dysfunction studied with transthoracic echocardiography for thromboembolic risk: correlation with transoesophageal velocities
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In patients undergoing cardioversion for atrial fibrillation, the left atrial appendage (LAA) dysfunction is an important thromboembolic risk. LAA emptying velocity (LAA eV) obtained with transesophageal echocardiography (TEE) is the most feasible, accurate and reproducible echocardiographic parameter clinically useful to study LAA function.

Aim of this study is to correlate TEE LAA eV to other echocardiographic parameters for thromboembolic risk obtained with transthoracic echocardiography (TTE), in order to find a more easily obtainable measurement with a comparable accuracy.

Method: We studied 92 patients (56 with sinus rhythm and 36 with atrial fibrillation), with preserved EF (53±11%) with clinical indication to TEE. All patients received a II harmonic TTE performed immediately prior to TEE by a different cardiologist, with a complete LAA study. The following TTE measurements were performed: 1) the TTE LAA eV, 2) the thickness change of medial LAA wall related to emptying and filling LAA phases (TTE LAA Delta) with a M-mode tracing in 2-chamber modified view, 3) the maximal LAA area, 4) the parasternal left atrial diameter (LA diam), and 5) the left ventricular ejection fraction (EF).

Results: The following table shows the feasibility of echocardiographic parameters and their correlation (r) versus the TEE LAA eV, considered as gold standard.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Feasibility (%)</th>
<th>Correlation (r) versus TEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTE LAA eV</td>
<td>80/92</td>
<td>0.77</td>
</tr>
<tr>
<td>TTE LAA Delta</td>
<td>87/92</td>
<td>0.71</td>
</tr>
<tr>
<td>TTE LAA area</td>
<td>66/92</td>
<td>0.21</td>
</tr>
<tr>
<td>LAA diam</td>
<td>92/92</td>
<td>0.26</td>
</tr>
<tr>
<td>LAEF</td>
<td>92/92</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Conclusions: Among those parameters obtainable with TTE predictors of thromboembolic risk, only the TTE variables of LAA function show a good correlation with the gold standard TEE LAA eV. Among these TTE variables of LAA function, the new monodimensional index TTE LAA Delta, expression of LAA contractility, showed the best feasibility.

841 Contrast transoesophageal echocardiography systematically underscores right-to-left shunting in patients with patent foramen ovale
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Background: Percutaneous closure of patent foramen ovale (PFO) is emerging as the treatment of choice for young patients (pts) who suffer cryptogenic stroke or paradoxical embolism. Contrast echocardiography (CE) is the method of choice for PFO diagnosis and right-to-left shunt quantification during and after percutaneous closure.

Methods: We prospectively collected data of 37 patients (females: 27%, age: 23-71 years, mean: 42.9 years) who underwent percutaneous closure of PFO after cryptogenic stroke (n=35) or peripheral embolism (n=2). Three different devices were used: 12 PFO-Star (Cardia Inc, Burnsville, MN), 24 Starflex (NMT Medical Inc, Boston, MA) and 1 Amplatzer (AGA Medical, Golden Valley, MInn). Right-to-left shunting (grade 3=important, grade 2=moderate, grade 1=minor, grade 0=absent) was controlled at rest and during a Valsalva maneuver during the intervention by transoesophageal CE and the day after by transthoracic CE. CE was performed by the femoral route during TEE and by the antecubital route during TTE.

Results: Before implantation, the degree of right-to-left interatrial shunting was 2 or 3 in all pts. Percutaneous closure of PFO significantly diminished the degree of shunt. Transoesophageal CE was discordant with transthoracic CE in 65 (24%). The importance of shunting was particularly significantly underscored, as no or minimal residual shunt, in 38% (14 pts).

Conclusions: Our data regarding echocardiographic evaluation of right-to-left interatrial shunting in pts with PFO confirm that this procedure is effective. Our results underline the key role of transthoracic CE in the evaluation of a successful intervention, probably because of the quality of the Valsalva maneuver. Despite femoral access during CE, transoesophageal CE tends to underscore the degree of residual shunting after procedure. TEE emerges as the gold standard for morphological evaluation of percutaneous closure of PFO.

842 About the necessity of the anticoagulant therapy after cardioversion of atrial fibrillation and flutter
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Background: Thromboembolic events after cardioversion are supposed to be the consequence of the slow recovery of left atrial mechanical function. Thereby - according to the ACC/AHA/ESC guideline - to avoid the thromboembolic complications after successful cardioversion oral anticoagulant therapy is recommended for four weeks.

Aim: To assess the feasibility and usefulness of transanial A-wave measurement studied by transesophageal echocardiography as the predictor of recovery of left atrial mechanical function after successful cardioversion.

Methods: From 1996-2002 301 pts. (65.9±8.9 years, 192 male) admitted with atrial fibrillation or flutter underwent electrical or pharmacological cardioversion after excluding left atrial appendage thrombi with transesophageal echocardiography when needed. The left atrial mechanical activity defined to be the consequence if the transaarial A-wave was >0.35 m/s immediately after cardioversion (within 3 hours) and <0.45 m/s 24 hours after the cardioversion (Group A) and insufficient if the A-wave did not reach these criteria (Group B). At group A pts. were administered only LMWH therapy for 48 hours after cardioversion and in group B oral anticoagulation for 4 weeks. The follow-up period was 6 months, physical examination, ECG was performed at the 1st, 3rd and 6th months, and echocardiography at the 1st and 8th months.

Results: altogether 78 pts. were in Group B, 33 underwent electrical cardioversion and 45 pharmacological cardioversion. We detected 4 systemic embolization during the follow-up period - with an ineffective anticoagulant state at the time of the event. In group A 142 pts. underwent electrical and 131 pharmaceutical cardioversion of whom 1 patient with sick sinus syndrome developed stroke during pacemaker implantation.

Conclusions: Early assessment of transmoral A-wave after cardioversion is feasible and useful in identifying pts. for low risk of thromboembolism hereby to avoid the oral anticoagulation but this statement needs to be supported by studies involving higher number of participants.

843 Effectiveness of thrombolytic treatment by using low dose, slow infusion of r-tPA for mechanical prosthesis valve thrombosis under the guidance of transesophageal echocardiography
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Thrombolytic treatment (TT) by the use of several thrombolytic agents for prothetic valve thrombosis (PVT) is gradually increasing. However the use of appropriate agent and dose has not been well defined to achieve a successful, safe and cost-effective TT in PVT.

The purpose of this study is to analyze the results of intravenous TT by using low dose tissue plaminogen activator (r-tPA) under serial transesophageal echocardiographic (TEE) guidance in PVT. In a two year period 13 symptomatic pts (8 F, 5 M) with PVT underwent 17 TT sessions. All pts have low INR levels at the presentation. Nine of the 13 pts had obstructive (7 mitral, 1 aortic, 1 tricuspid) and remaining 4 had nonobstructive large PVT. TT was performed at baseline and repeated after each TT sessions. Fifty mg r-tPA by infusion was given in six hours. In 5 out of 13 pts, complete lysis and 8 out of 13 pts (4 patients received more than one successive doses due to partial thrombolysis), nearly complete lysis, which was defined as persistancy of less than 1 cm of thrombus, was achieved. No major complications were observed for those 12 pts. After TT, in 7 pts with obstructive mitral PVT, the mean value of mitral valve mean gradient decreased from 15.6 ± 7.9 mmHg to 5.1 ± 2.6 mmHg (p<0.006); the mitral valve area increased from 1.18 ± 0.25 cm² to 2.16 ± 1.41 cm² (p<0.0002) and in one patient with aortic valve PVT the aortic mean gradient decreased from 27 mmHg to 13 mmHg; in one patient with tricuspid PVT, tricuspid mean gradient decreased from 10 mmHg to 3 mmHg. In one patient (%7.6), only partial thrombolysis was achieved despite two successive doses were given and furthermore, as a major complication, embolic stroke was occured.

In conclusion: this preliminary report suggests that low dose slow infusion of r-tPA may safe, successful, rapid in response and relatively cost-effective thrombolytic treatment modality in pts with PVT under the guidance of TEE.
Large PFO with atrial septal aneurysm

844

Patent foramen ovale and atrial septum aneurysm as cardioembolic source for cryptogenic stroke in young patients

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Background: Patent foramen ovale (PFO), with or without atrial septal aneurysm (ASA), is a risk factor for stroke of undetermined origin. In young patients presenting with stroke, without any other obvious causes, transoesophageal echo (TEE) may reveal PFO and/or ASA, which could be the source of unexpected stroke as a result of paradoxical embolism.

Patients: During the last five years, six young patients (five women) with unexpected stroke, which was diagnosed clinically and confirmed by MRI, were referred, to our hospital for TEE. Two of them had more than one stroke. Mean age was 39.5 ± 9.5 years. All of them were thoroughly investigated to exclude other possible causes for stroke. One patient, however, was found to be compound heterozygosity for the MTHFR variant, C677T and A1298C. All underwent TEE, using an ALOKA 870 biplane TEE probe. 10 ml of vigorously agitated saline solution was given intravenously as contrast, during a serious of coughs or Valsalva manoeuvre. TEE is the diagnostic modality of choice in such patients.

Results: All of them had large PFO (> 4 mm) and ASA, with either predominant left or right bulging. Contrast study showed in all cases a large quantity of microbubbles crossing PFO and entering the left atrium, during the first three heart beats of opacification of the right atrium. The patients were afterwards formally anticoagulated and referred in a later stage for closure of PFO, surgically (three patients) with concomitant correction of the ASA or with occluding device (three patients). No complications were noted and patients remain asymptomatic until now.

Conclusion: PFO associated with ASA is a possible cause of paradoxical embolism and unexpected stroke in young persons, without other known risk factors for stroke. TEE is the diagnostic modality of choice in such patients.

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Quantitative analysis of left atrial appendage spontaneous echo contrast in atrial fibrillation using echo contrast and tissue Doppler imaging

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Background: Although left atrial appendage spontaneous echo contrast (LAA-SEC) is a marker of increased thromboembolic risk in atrial fibrillation (AF), it has only been evaluated qualitatively. We sought to determine if the use of an echo contrast agent combined with tissue Doppler imaging (TDI) of the LAA could quantitatively describe LAA-SEC in patients with AF.

Methods: We identified 55 patients with AF (mean age 63 ± 12 years) who underwent a clinically indicated TEE prior to cardioversion. All patients had LAA-SEC on TEE. TDI was performed on the LA following a 0.5 ml intravenous bolus injection of Optison®. LAA-SEC was qualitatively graded by a blinded-reader as mild (n = 29) or severe (n = 26), and compared to a quantitative TDI velocity index. In addition, off-line analysis of backscatter index (BI) and shear rate (SR) was performed.

Results: Patients with AF and severe LAA-SEC had significantly decreased LAA emptying velocity, LAA TDI index and LAA SR, compared to those with mild LAA-SEC (Table 1). In the entire group, the mean maximal velocity of the LAA correlated with LAA emptying velocity (r = 0.59; p < 0.0001), SR (r = 0.55; p < 0.0001) and LAA area (r = 0.34; p = 0.014). ROC analysis revealed that a TDI cut-off of 6.13 cm/sec was 72% sensitive and 82% specific for predicting severe LAA-SEC. On logistic regression analysis, LAA TDI was the only predictor of qualitative LAA-SEC grade.

Conclusions: TDI evaluation of the LAA combined with the use of echo contrast is useful in quantitatively grading the severity of LAA-SEC. This new index may help to decrease or eliminate the subjectivity seen in the qualitative evaluation of LAA-SEC.

<table>
<thead>
<tr>
<th></th>
<th>Mild LAA-SEC (n = 29)</th>
<th>Severe LAA-SEC (n = 26)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>63 ± 12</td>
<td>67 ± 15</td>
<td>0.17</td>
</tr>
<tr>
<td>LVEF(%)</td>
<td>40 ± 13</td>
<td>39 ± 13</td>
<td>0.44</td>
</tr>
<tr>
<td>LAA area (cm²)</td>
<td>4.7 ± 1.5</td>
<td>6.1 ± 1.4</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>LAA emptying velocity</td>
<td>37 ± 10</td>
<td>20 ± 7</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>LAA TDI index (cm/s)</td>
<td>7.5 ± 2.2</td>
<td>3.6 ± 1.7</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Backscatter index (dB)</td>
<td>1.54 ± 0.92</td>
<td>2.81 ± 1.57</td>
<td>0.001</td>
</tr>
<tr>
<td>Shear rate (s⁻¹)</td>
<td>0.86 ± 0.38</td>
<td>0.45 ± 0.22</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>
504 Circulating microparticles are increased in patients with atrial fibrillation: transesophageal echocardiography correlations


Background: Non-valvular atrial fibrillation (NVAF) is associated with an increased risk of thromboembolism (TE) mainly through left atrial (LA) stasis and thrombosis. We have shown that circulating platelet microparticles (MPs) levels were increased in patients with AF, as compared to controls. We investigated the relationship between MPs and transesophageal echocardiographic (TEE) markers of TE.

Methods: TEE parameters included LA area, LA appendage (LAA) emptying velocities and presence of LAA/LAA spontaneous echocardiographic contrast (SEC). MPs levels were assessed by a prothrombinase assay on a platelet depleted plasma and results were expressed as nmol/L phosphatidylinerine equivalent. Annexin V immobilized MPS were captured by specific antibodies to determine their cells origin, platelet (anti-GP 1b) or endothelial (anti CD 31) origin.

Results: Among 66 patients (Pts) with NVAF (33 men, mean age: 66±13 years) without any chronic anticoagulant treatment, 14 had lone AF and 52 NVAF. The table summarizes the main results and shows that MPs were significantly increased in AF patients with low LAA velocities, as compared to those with preserved LAA velocities. Platelet (49.6 ±47.3 and 17.1±27.7, respectively, p=0.003) and endothelial (0.59±0.78 vs 0.24±0.25, respectively, p=0.025) MPs were both significantly increased in Pts with low LAA velocities.

Conclusion: Both endothelial and platelet MPs are increased in AF patients with LAA<25 cm/s suggesting that Low LAA velocities could contribute to increased levels of MPS, a potential marker of an hypercoagulable state in AF.

MPS levels and TEE abnormalities

<table>
<thead>
<tr>
<th></th>
<th>NO</th>
<th>YES</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAA Area &gt;5 cm²</td>
<td>16.7±24.0</td>
<td>29.6±36.0</td>
<td>0.139</td>
</tr>
<tr>
<td>LAA velocity &lt;25 cm/s</td>
<td>18.3±21.9</td>
<td>46.2±57.7</td>
<td>0.020</td>
</tr>
<tr>
<td>LAA/LAA SEC</td>
<td>23.1±24.1</td>
<td>24.7±36.0</td>
<td>0.840</td>
</tr>
<tr>
<td>Thrombogenic milieu*</td>
<td>15.8±24.4</td>
<td>25.8±32.5</td>
<td>0.291</td>
</tr>
</tbody>
</table>

MPS: circulating microparticles * any of the above abnormality

505 Pre and post-cardioversion transesophageal echocardiography for brief anticoagulation therapy with enoxaparin in atrial fibrillation patients. A prospective study with a 1-year follow-up. Evaluation: 14 - Source of Embolism

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Background: In patients with atrial fibrillation (AF) and electrical cardioversion (C), the transesophageal echocardiography (TEE) allows to avoid the 3 weeks of pre-cardioversion anticoagulation therapy. However, after sinus rhythm restoration, at least other 4 weeks of oral anticoagulation therapy are indicated due to the post cardioversion thromboembolic risk related to left atrial (LA) and left atrial appendage (LAA) stunning. We prospectively assess the safety of anticoagulation therapy discontinuation 7 days after C using low-molecular-weight-heparins (LMWH) in patients who underwent a pre-C and 7 days post-C TEE evaluation.

Methods: 101 pts with non-valvular AF lasting >48 hours were enrolled into the study. In 99/101 we performed a 1st TEE and, within 24 hours, a C if there were no LAA thrombi, complex aortic plaques or severe spontaneous echocontrast. After C and 7 days of enoxaparin (100 IU antiXa/kg × 2), a second TEE was carried out. In the absence of new thrombi, severe spontaneous echocontrast and/or low emptying velocity of LAA the therapy with enoxaparin was stopped; differently, anticoagulation therapy with enoxaparin was overlapped with oral anticoagulation and continued for at least 3 weeks. All patients were clinically followed at 1, 6 and 12 months after C.

Results: Sinus rhythm was restored in 68/99 patients after successful C. The 2nd TEE was carried out in 53 pts. At 1 month follow-up no thromboembolic events were recorded in pts at risk who had continued the oral anticoagulant therapy for at least 3 weeks or in those who suspended LMWH after 7 days post-C TEE. Between second and 12th month, three ischemic stroke occurred, all in the group of patients who had anticoagulation therapy for at least 3 weeks and had shown LAA velocity<25 cm/sec at I or II TEE. No thromboembolic events were recorded in pts with normal LAA velocity; conversely, among the patients who had shown low LAA velocity at either TEE, three suffered from ischemic stroke. In two of these three patients low LAA velocity was detected only at post-C TEE.

Conclusions: A brief anticoagulation therapy using LMWH appears to be safe and feasible. The 7 days post-C TEE can well define patients without LAA stunning at low thromboembolic risk, who may take advantage of an early interruption of enoxaparin as an alternative to long oral anticoagulation. The LAA stunning, even in the absence of other thromboembolic risk factors, could select a group of patients at high risk who should continue oral anticoagulation indefinitely or until signs of LAA dysfunction disappear.
506  
Diagnosis of left atrial appendage thrombi by multiplane transesophageal echocardiography: interlaboratory comparative study  
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Background: Transesophageal echocardiography (TEE) is regarded the method of choice to visualize left atrial appendage thrombi (LAAT). However, the interobserver variability among 2 independent echocardiographic laboratories (EL) in diagnosing LAAT by multiplex TEE has not yet been assessed.  
Methods: The videorecordings of 50 patients, 25 from each EL (23 f, 27 m, mean age 70 years, range 38–86), were reviewed by one experienced observer from each EL in a blinded manner. LAAT were assessed as present, absent or questionable. The indications for TEE were: before cardioversion (n=17), valvular disease (n=13), endocarditis (n=12), embolic source (n=8). All patients were in atrial fibrillation, and in 11 patients the diagnosis of LAAT had been regarded difficult in one EL.  
Results: The prevalence of LAAT was 10% (OB1) vs 12% (OB2). A questionable LAAT was assessed in 6% (OB1) vs 12% (OB2). By head-to-head comparison, disagreement was found in 11 cases (22%). In 2 cases, one OB diagnosed a LAAT which was not confirmed by the other OB. In 3 cases, one OB diagnosed a LAAT whereas only a questionable LAAT was diagnosed by the other OB.  
Conclusion: Even with multiplex TEE probes, interobserver variability among 2 independent EL for the diagnosis of LAAT is high due to problems in differentiating LAAT from severe spontaneous echocardiographic contrast and reverberation artifacts.

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Transesophageal echocardiography for the detection of a potential embolic source in patients with single versus multi-vessel territory acute ischemic stroke  
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In pts with acute ischemic stroke, the finding of multiple vascular territory infarcts is considered indicative of an embolic event, and transesophageal echocardiography (TEE) is frequently performed for indentification of a potential cardiac or aortic source of embolism (SOE).  
Hypothesis: The incidence of SOE on TEE is higher in pts with multiple vessel territory (MVT) infarcts than in those with single vessel territory stroke (SVT).  
162 consecutive pts with an acute neurologic deficit consistency with stroke and evidence of acute ischemic CNS infarct on MRI/CT undergoing TEE were included. We excluded pts with ICA-stenosis >=50%, lacunar syndromes, recent (<4 weeks) heart surgery, AFIB/Flutter or peripheral embolization. Pts were divided into two groups according to SVT or MVT. The incidence of SOE on TEE in both groups was compared.  
Results: Of 162 pts considered, 109 pts suffered from an SVT; 53 pts had acute ischemic strokes in MVT. Mean age was 59±13 years, 62% were male. HTN, DM, total cholesterol, smoking and BMI were equally distributed among the two groups. The incidence of SOE on TEE in both groups are listed in the Table. There was no difference in the incidence of cardioembolic risk factors on TEE between the two groups.  
Conclusions: The incidence of SOE strokes is high, regardless of the number and distribution of vascular territories involved on brain imaging. Potential sources of proximal embolism on TEE are present in a significant number of pts a finding that may influence further treatment decisions.

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Transcatheter closure of interatrial defects in patients with paradoxical embolism: echocardiographic closure time curves of three different occluder devices  
R.S. Von Bardeleben, C. Halcour, M. Ries, R. Schnabel, M. Eicke1, C. Kampmann2, H.J. Rupprecht, G. Horstick. Johannes-Gutenberg-Universität, Mainz, Germany, University Mainz Medical Center, Mainz, Germany. 1University Mainz Medical Center, Mainz, Germany. 2University Mainz Medical Center, Mainz, Germany.  
Abstracts S141  
Introduction: Interventional PFO and ASD closure procedures in patients with and without additional interatrial septum aneurysm (IASA) have been reported to significantly reduce the risk of recurrent thromboembolic events. The aim of the present study was to evaluate four different occluder devices in respect of time to definite closure on mid-term follow up.  
Methods: Since 1999 until 2003 246 consecutive patients were included in the study. Non-randomized, prospective study (101 women, 145 men, mean age 50 years, mean BMI of 25.7). All patients had a history of symptomatic PFO or ASD with cerebral (n=243) or peripheral (n=3) embolism and underwent a defect closure using the Amplatzer PFO occluder (AP) (n=184), CardioSeal/Starflex (CS) (n=39) and Gore Hexx (GH) device (n=20). Primary implantation was successful in all patients. Two patients underwent surgery within one year after closure (one stenosis of the coronary sinus by the occluder, one imperfect closure of an ASD II with small rim).  
During a median follow up of 19 months transesophageal and transthoracic echocardiographic controls were performed at day one, one month and three/six months, in case of residual shunts one and two years after intervention. The closure rates at day one were 77% for AP and 70% for both CS and GH devices. At 1 and 6 months the closure rate for Amplatzer PFO reached 88/92%, 86/88% for CardioSeal/Starflex and 84/92% for Hexx devices. These values peaked at one year with 95% for AP, 90% for CS and 84% for GH. Age and BMI did not differ between the groups. However the higher rate of women (58% (GH) vs. 37% (AP) and 43% (CS)) and IASA (47% vs. 18% and 27%) were statistically significant (p<0.01).  
Conclusion: Interventional PFO closure is a new and promising technique in symptomatic PFO patients. There were no conversions to surgery during the procedure and only 0.7% of late removals on follow up. 70% of all functional closures already occurred within 20 hours after the procedure. Closures in Amplatzer and CardioSeal/Starflex devices reached almost 90% in 1 month while Hexex devices showed a different closure peak at 6 month in part due to the high number of IASA. These results demonstrate the importance of the closure time curves for each device in the clinical evaluation of residual shunts during follow-up.

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Transesophageal echocardiographic identification of embolic risk markers in patients with lone atrial fibrillation  
Objectives: This study describes transesophageal echocardiographic findings and identifies clinical predictors of spontaneous echo contrast (SEC) in the left atrium (LA) or left atrial appendage (LAA) in a cohort of patients with lone atrial fibrillation (LAF).  
Background: Although transesophageal echocardiography-derived parameters, notably SEC in the LA or LAA, are known predictors of embolism in AF, their value is less well known in LAF.  
Methods: Transthoracic and transesophageal echocardiography was performed in prospectively enrolled patients with non-valvular AF.  
Conclusions: A total of 82 patients with LAF and 289 patients with non--lone AF (LAF) were enrolled from July 1998 to March 2002. LA/LAA abnormalities, defined as the presence of any of the following characteristics, LAA area of more than 5 cm2, emptying or filling LAA velocities of less than 25 cm/s or the presence of SEC or thrombus in the LA or LAA, were significantly less frequent in LAF than in NLAF. SEC in the LA or LAA was significantly less frequent in LAF (29.3% vs. 49.8%, respectively, p<0.001). In LAF patients, SEC in the LA or LAA was significantly (p<0.05) less frequent in patients aged 60 years or less (17.9%) than in patients aged over 60 years (39.5%) and in patients with paroxysmal LAF (5.9%) than in patients with persistent LAF (45.6%). On multivariate analysis, age and persistent LAF were the only clinical variables independently associated with SEC.  
Conclusions: Transesophageal echocardiography detects thromboembolic risk markers in LAF patients. These abnormalities are less frequent in LAF than in low-risk NLAF patients, but in patients with LAF, older age and persistent AF were associated with these risk markers.

Abstracts
ORAL SESSIONS

New methods and applications for Doppler myocardial imaging

3 December 2004, 11:00 to 12:30
Location: Room 2

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New non-invasive method for assessment of LV rotation - Speckle tracking echocardiography
T. Helle-Valle, T. Edvardsen, J. Crosby1, B. Amundsen1, B. Rosen2, H-J. Smith3, H. Torp1, A. Støylen1, H. Ihlen, O.A. Smiseth. Rikshospitalet University Hospital, Oslo, Norway, 1NTNU, Trondheim, Norway, 2Johns Hopkins University, Baltimore, United States of America, 3Rikshospitalet University Hospital, Oslo, Norway

Background: Clinical and experimental studies have shown that LV rotation is a sensitive marker of changes in LV function. So far, non-invasive assessment of LV rotation has only been possible by magnetic resonance (MR) tagging. In the present study we introduced and validated speckle tracking echocardiography to measure regional LV rotation. As reference method we used MR tagging.

Methods: In 15 healthy volunteers, LV apical cross-sectional images were obtained by echocardiography and MR tagging. The echocardiographic recordings were analyzed by software that utilized the speckle patterns in the gray scale images. The algorithm allowed speckle tracking from frame to frame throughout one heart beat. Nine regions of interests were selected from each cross-section. The rotation was estimated as the average angular displacement of these regions relative to the center of a best fitted circle through the same regions. MR tagging was performed using SPAMM technique.

Results: Mean peak rotation by MRI and echo was 12.5°±1.2° and 11.4°±0.9°, respectively (Fig.1, a representative case). Regression analyses demonstrated a linear relationship between the two methods, r=0.93, p<0.0001 (Fig 2). Difference in time to peak rotation was 39±20 ms (ns).

Conclusions: Regional LV rotation measured by echocardiography correlated well with rotation measured by MR tagging. This suggests that speckle tracking echocardiography may represent a new powerful non-invasive tool for quantifying left ventricular function.

Figures

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An in-vivo validation of a new tool (2D strain) to assess angle independent strain by ultrasound: a comparison with sonomicrometry

One-dimensional strain (S) imaging have been shown to be angle dependent. To address this problem, a new application has been developed (GE Echopac 2D Strain). This method determines myocardial deformation via frame to frame tracking of unique acoustic grey scale (GS) patterns in the image. Automatic tracking of the region of interest (ROI) ensures evaluation of the same myocardium throughout the cardiac cycle.

Aim: To validate this new methodology in the in-vivo setting.

Methods: In 4 open chest sheep, ultrasound (US) grey scale images (60 fps) were acquired in an apical 2-chamber view using a GE Vivid 7. Two pairs of sonomicrometry crystals (SM) were placed to give a continuous reference for the longitudinal (L) and radial (R) S at the ROI. After baseline (BL) acquisitions, the deformation was modulated by 1) esmolol infusion (ES), 2) dobutamine infusion (DOB) and 3) inducing ischemia by occlusion of a distal branch of the circumflex coronary artery. Myocardial L and R S were analysed in the inferolateral wall using the novel 2D strain methodology. Peak systolic S measured with the two methods were compared by linear regression.

Results: For the L S a good correlation was found between the two methods (R=0.75, p<0.005). An example curve is given in Fig 1. However, for the R S, a poor correlation was found (R=0.36, p>NS).

Conclusion: L myocardial S estimation based on acoustic GS tracking is feasible in an in-vivo setting. The method introduces automatic tracking of the region of interest, compensating for overall motion and significantly decreasing the time needed for analysis. However, the method still needs some improvements to fully estimate the S component perpendicular to the US beam. Still, it is a promising tool to improve the currently available methods.
Background: Tissue Doppler based strain rate (SR) data of the left ventricle (LV) can be post processed and displayed as a 3D colour surface figure. The aim of this study was to evaluate if such a 3D reconstruction could be useful diagnosing myocardial infarction (MI).

Methods: Tissue Doppler data (mean frame rate 152) from standard apical LV views were acquired from 28 patients with acute MI, diagnosed by standard ECG and biochemical criteria, and 25 patients with normal coronary angiograms. The recordings were post processed in customized software into a 3D surface model that could be scrolled in time and rotated in space, showing colour coded strain rate data. Myocardial velocities of the model were captured from five different angles and presented to two physicians experienced and two less experienced in SR imaging. The observers received an additional note illustrating typical 3D figures of normal and infarcted LVs, and the appearance of reverberation noise. For each patient the observers had to decide if an MI was present, and in case the location (anterior or inferior). The observers did not have access to grey scale cine loops.

Results: The observers found the model to be "intuitive", but nevertheless expressed difficulties in separating reverberations from MI. The mean sensitivity, specificity and accuracy in diagnosing MI for the four observers were 44%, 83% and 62%, and the mean correct location was 58%. There were 17 false positive and 83 false negative diagnoses; in 94% and 81% of these, respectively, reverberations or drop-outs could be noticed in the corresponding grey scale 2D images. Overall, reverberations or drop-outs were found in 87% of patients.

Conclusions: The 3D reconstruction alone was not useful for diagnosing MI. The success of this was the original quality of the data. 3D-surface display nicely illustrated the presence and location of reverberations, artefacts and noise in the SR data. Various displays may further improve the recognition of artefacts, potentially being a guide for performing more reliable quantitative SR measurements. Further filtration of the tissue Doppler and SR data might also improve the sensitivity.

A bull's eye representation of end-systolic longitudinal myocardial strain allows for the assessment of the area at risk in acute myocardial infarction


Strain (S) and Strain Rate (SR) Imaging have been used for the assessment of regional myocardial function. Typically, S and SR are extracted from a particular segment of the LV and displayed as a function of the cardiac cycle. This allows an accurate analysis of the temporal deformation characteristics. Although this procedure can be repeated for several cardiac segments, it has the disadvantage that the spatial deformation characteristics are not optimally exploited. Bull’s eye representations have been used for this purpose in other imaging modalities.

Aim: To investigate the feasibility of using a Bull’s eye representation for the display of the spatial distribution of the longitudinal deformation characteristics of the LV.

Methods: 15 pts with acute myocardial infarction (AMI) enrolled in this study. Myocardial Velocity Imaging (MI) data sets were taken after primary PTCA using a GE Vivid 7. Data from 6 LV walls were analyzed using dedicated software (SPEQLE) to extract end-systolic strain and contract a 16-segment bull’s eye model. All segments were assigned to the presumed perfusion territory using coronary angiography. A blinded reader, without medical background, was asked to score each segment as being normal or abnormal based on the colour coding in the bull’s eye. Sensitivity and specificity were defined using the angiography data as a reference.

Results: A Bull’s eye representation of end-systolic strain is shown in the figure. A sensitivity and specificity of 75% and 80% were obtained respectively.

Conclusions: A Bull’s eye representation gives a good assessment of the spatial differences in end-systolic longitudinal strain. Based on this methodology, a reader without medical background could accurately identify areas at risk in pts with AMI.

Ultrasonic strain rate imaging can predict the recovery of function after acute myocardial infarction and assess the transmurality of scar in chronic infarctions

F. Weidemann, C. Wacker, A. Rauch, F. Fidler, W. Bauer, B. Bijnen1, G.R. Sutherland2, W. Voeger, G. Ertl, J.M. Stratmann. University Hospital Wuerzburg, Wuerzburg, Germany, 1 University Hospital Gasthuisberg, Leuven, Belgium, 2 St George Hospital, London, United Kingdom

Background: In a prospective clinical study we sought to follow patients with acute myocardial infarction from the ischemic event, over the primary coronary intervention (PCI) up to the chronic phase after survived myocardial infarction by non-invasive Strain Rate Imaging.

Methods: 41 patients with first acute ST-Elevation infarction were examined immediately before PCI, three days after and 5 months after PCI. At every stage regional myocardial function was assessed by the use of ultrasonic Strain Rate Imaging and peak systolic Strain Rate and systolic Strain were extracted. In addition, late enhancement imaging with Magnetic Resonance Tomography (MRT) was done after 5 months to assess the transmurality of residual scar distribution.

Results: MRT study showed that 8 of the patients had no late enhancement (complete recovery = no-scar-group), 16 patients had subendocardial late enhancement (non-transmural infarction=NT-group) and 17 patients had a transmural late enhancement (transmural infarction=T-group) in the region of interest. Before PCI both Strain Rate and Strain were markedly reduced in the ischemic segments compared to the remote region (Strain Rate: ischemia=0.6±0.3 vs 1.5 ± 0.5, p<0.001). Three days after PCI systolic Strain Rate and Strain increased significantly only in the regions which were viable (no-scar- vs NT-group).

After 5 months the measurement of systolic Strain could accurately distinguish the different groups (Figure).

Conclusions: This clinical study shows that by the use of Strain Rate Imaging: a) the ischemic segment can be precisely detected, b) the recovery after coronary intervention can be predicted and c) the transmurality of scar distribution can be assessed.

Ultrasonic strain rate imaging can predict the recovery of function after acute myocardial infarction and assess the transmurality of scar in chronic infarctions

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After 5 months the measurement of systolic Strain could accurately distinguish the different groups (Figure).

Conclusions: This clinical study shows that by the use of Strain Rate Imaging: a) the ischemic segment can be precisely detected, b) the recovery after coronary intervention can be predicted and c) the transmurality of scar distribution can be assessed.
New and revisited applications of myocardial perfusion imaging

3 December 2004, 14:00 to 15:30
Location: Room 2

702 Contrast echocardiography using a new calibration method for assessing myocardial viability in patients with myocardial infarction: comparison with contrast-enhanced magnetic resonance imaging
K. Sakata, K. Nakamura, S. Yamane, N. Mizuno, S. Tsuji, K. Satou, H. Yoshino, Kyorin University School of Medicine, Tokyo, Japan

Background: Delayed-enhancement magnetic resonance imaging (DE-MRI) has been shown to identify necrotic tissue. Myocardial contrast echocardiography (MCE) is used for assessment of myocardial blood volume and myocardial viability.

Objective: We compared DE-MRI with MCE to evaluate the association between extent of myocardial necrosis by DE-MRI and myocardial perfusion by MCE in patients with myocardial infarction (MI).

Methods: Twenty-four patients with anterior MI underwent DE-MRI and MCE. All patients were treated with angioplasty and stenting in the acute phase. DE-MRI was examined 15 minutes after injection of Gd-DTPA. The ratio of transmural extent of hyperenhancement (%DE) was calculated. MCE was performed by ultraharmonic imaging and intravenous Levovist. We divided the LV wall into 6 segments in apical four-chamber view. The calibrated contrast intensity (CI) of regional myocardium was calculated in infarct myocardium using the VoluMap-445 system. We measured calibrated CI (dB) by subtracting the left ventricular (LV) cavity CI from myocardial CI.

Results: A total of 144 segments in 24 patients were divided into 69 infarct segments and 75 non-infarct segments. Twenty-six of 69 infarct segments had transmural extent of hyperenhancement (%DE = 100%; Group A), 11 segments had 75-99% (%DE = 75-99%; Group B), 15 segments had 50-74% (%DE = 50-74%; Group C), 10 segments had 25-49% (%DE = 25-49%; Group D), 7 segments had <25% subendocardial extent of myocardium (%DE <25%; Group E). Calibrated CI was -20.7 ± 1.2 dB in Group A, -17.3 ± 2.4 dB in Group B, -15.0 ± 1.8 dB in Group C, -12.2 ± 2.3 dB in Group D, and -9.8 ± 1.6 dB in Group E. There were significant differences in calibrated CI between each group.

Conclusions: DE-MRI and MCE could predict myocardial viability. Extent of myocardial necrosis by DE-MRI and myocardial perfusion by MCE have a good correlation in evaluating the degree of myocardial viability.

703 Microvascular damage at myocardial contrast echocardiography is a better predictor of lack of viability and left ventricular remodeling as compared to regional contractile dysfunction
F.A. Gabrielli, D. Lomaglio, A. Scarà, A. Lombardo, F. Pennestri, A.G. Rebuzzi, F. Crea, L. Galuito, Catholic Univ. of the Sacred Heart, Rome, Italy

Background: Whether myocardial contrast echocardiography (MCE) has an adjunctive value in the early identification of regional contractile recovery and left ventricular (LV) remodeling after acute myocardial infarction (AMI) is still controversial.

Methods: 40 patients (33 males, mean age 64 years) presenting with their first AMI (34 anterior) and successfully treated by primary coronary intervention (PCI) underwent MCE at 24 hours after MI, by real-time Cadence Pulse Sequencing (GPS, Sequoia, Siemens) and i.v. Sonovue® (Bracco) (5 ml at 2 ml/min). Regional wall motion was evaluated by 2D echo at 24 hours and 3 months later. Contrast and wall motion (WM) were scored in each segment (3 = akinesia and absent perfusion, 2 = hypokinesia and hypoperfusion, 1 = normokinesia and normoperfusion) and a regional MCE and WM score were calculated as the sum of segmental scores divided by the number of dysfunctioning segments. End-diastolic (EDV) and end-systolic (ESV) LV volumes were measured using the Simpson biplane method and A EDV, ESV and WM ((3 months -- 24 hours)/ 24 hours)*100 were calculated. Pts with >20% A EDV, ESV were considered remodeled (REM) and <20% AWM were considered viable (V), respectively.

Results: at 24 hours, REM pts had higher MCE score (2.6 ± 0.6 vs 1.7 ± 0.7, p<0.005), but identical WM score (2.8 ± 0.3 vs 2.8 ± 0.3, p=ns) compared to non-REM pts, while V pts had lower MCE score (1.6 ± 0.8 vs 2.4 ± 0.7, p<0.005) and similar WM score (2.6 ± 0.3 vs 2.7 ± 0.3, p=ns). MCE score, but not WM score, showed a significant linear relation with AEDV, ESV (r=0.5, p<.0001) and AWMS (r=0.7, p<.0001).

Conclusions: After AMI, the demonstration of the presence and the quantitation of the extent of microvascular damage is able to identify pts that will undergo LV remodeling and lack of spontaneous contractile recovery. Thus, as compared to regional wall motion by 2D echo, 24 hours MCE has an adjunctive value in the correct prognostic stratification of post-MI patients.
704 Impact of infarct transmurality on transmural blood flow in patients with chronic left ventricular ischemic dysfunction
P. Lim, A. Pasquier1, D. Vancraeynest1, A.M. D’Hondt2, B. Gerber2, J.L. Vanoverschelde2.
1Paris, France, 2Saint Luc Hospital, Bruxelles, Belgium

Background: Real-time myocardial contrast echocardiography (RT-MCE) offers the unique opportunity to measure myocardial blood velocity (ß) and blood volume (MBV) quantitatively and therefore to address complex pathophysiological issues, such as myocardial viability. In this study we used this novel approach to examine how the transmural extent of necrosis, as delineated by contrast-enhanced MR (CE-MR), impacts on the evaluation of MBV in patients with chronic LV ischemic dysfunction.

Methods: 10 coronary pts (69±9 years) with an ejection fraction of 34±4% underwent Gd-DTPA CE-MR and RT-MCE, for the measurement of the transmural extent of necrosis (%), ß (s-1) and MBV (dB) in remote and dysfunctional segments (16-segment model). Myocardial perfusion was also graded visually as normal, heterogeneous or absent.

Results: 99/160 segments (62%) were dysfunctional on 2D-echo. RT-MCE quantification was possible in 88% (141/160) segments. Compared to remote, dysfunctional segments had lower ß velocities (0.19±0.20 vs. 0.42±0.20 s-1, p<0.0001), MBV (3±3 vs. 5±3 dB, p<0.0005) and visual scores (0.7±0.9 vs. 1.5±0.7, p<0.0001). In dysfunctional segments, the visual perfusion analysis accurately predicted infarct transmurality (23±18% in normal, 36±22%, in heterogeneous and 58±25% in absent perfusion, p<0.001). Quantitatively, ß was significantly correlated to infarct transmurality (r=-0.72, p<0.0001, Figure).

Conclusion: The measurement of myocardial blood velocity by RT-MCE is closely related to infarct transmurality by CE-MR. These results indicate that the presence of myocardial viability closely depends on the maintenance of residual myocardial blood flow.

705 Myocardial contrast echocardiography can evaluate cardioprotective effects of atorvastatin in acute ischemia-reperfusion injury
University of Heidelberg, Heidelberg, Germany

Background: The 3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitor (statins) have been shown to reduce the infarct size by increasing the bioavailability of nitric oxide. The purpose of the study was to compare the myocardial contrast echocardiography (MCE) can be used to evaluate cardioprotective effects of atorvastatin in acute ischemia-reperfusion injury.

Methods: Male Wistar rats underwent 20 min of mechanical LAD occlusion followed by 180 min of reperfusion. The animals were randomized to receive atorvastatin (10 mg/kg/d, orally, starting 3 days before intervention, followed by 180 min of reperfusion. The animals were randomized to reperfusion injury of activated PMN and these effects can further be amplified by insonation. Phospholipids-microbubbles seem to be the preferred target for microbubble-activated PMN via insonation and function to a smaller extent and only after insonation with high mechanical index.

706 Insolation of human neutrophil granulocytes in the presence of ultrasound contrast agents reduces apoptosis and membrane injury, reducing their inflammatory activity
University of Heidelberg, Heidelberg, Germany

Objective: Activated polymorphonuclear neutrophil granulocytes (PMN) can bind and subsequently phagocytose microbubbles that are used as ultrasound contrast agents.

Purpose: To assess insonation effects on cell membrane integrity and inflammatory activity of PMN containing phagocytosed microbubbles.

Methods: PMN isolated from healthy volunteers were activated with phorbol-myristate-acetate (PMA) for 15 min to allow phagocytosis of albumin- and phospholipid-microbubbles and were subsequently exposed to ultrasound bursts with mechanical index of 0.1 to 1.6. Membrane injury was assessed by measurement of lactate dehydrogenase (LDH) and apoptosis was evaluated by double staining with annexin V and propidium iodide, using flow cytometry. Neutrophil superoxide anion generation was measured photometrical.

Results: Incubation of albumin- but not phospholipids-microbubbles with activated PMN induced LDH leakage (**, p<0.001 16±10% versus 62±14%) and apoptosis (10±3% versus 29±5%, p<0.001). Insolation of PMN in the presence of albumin-microbubbles amplified LDH-leakage with increasing acoustic pressure (**, p<0.001 non-sonified versus sonified albumin-microbubbles, MI=0.8 to 1.6) and reduced superoxide anion generation (Figure). In the presence of phospholipid-microbubbles, LDH-leakage was induced only by insonation with high mechanical index (#, p<0.001 non-sonified versus sonified phospholipids-microbubbles, MI=1.8) and neutrophil function remained unchanged (Figure).

Conclusions: Albumin-microbubbles induce apoptosis and membrane injury of activated PMN and these effects can further be amplified by insonation. Phospholipids-microbubbles seem to be the preferred target for microbubble-activated PMN via insonation and function to a smaller extent and only after insonation with high mechanical index.
Familial amyloidotic polyneuropathy (FAP) is an uncommon genetic systemic disease with limited cardiac involvement. There is today about 200 patients alive in Northern Sweden with this diagnosis. Morphologic heart abnormalities, above all myocardial hypertrophy, is a salient feature in advanced stages of the disease. Our hypothesis was that myocardial tissue Doppler imaging (TDI) and strain echocardiography might disclose functional cardiac abnormalities before traditional echocardiographic ones.

Methods: Including it in this study was 24 patients (mean age 60±13 years, 12 females) with biopsy verified FAP considered for OLT and 36 healthy controls. (mean age 61±13 years, 21 females) Standard M-mode and Doppler echocardiography was performed to assess global left and right ventricular (LV, RV) function where TDI and strain echocardiography was used to assess the regional longitudinal lateral, septal and right free wall function. The time intervals were corrected for heart rate.

Results: We found increased LV and RV wall thickness and by using TDI we found a prolonged isovolumic (IV) relaxation time at septal segment (12.7±4.2 vs 10.1±3.3%, p<0.05) and prolonged IV contraction time at LV lateral (12.7±4.2 vs 10.1±3.3%, p<0.001) and RV (11.7±3.9 vs 8.3±2.1%, p<0.001). Finally, strain was reduced at all three basal segment but at both the septal segment (1.48±9.9 vs -12.6±15.8%, p<0.001, -7.1±11.2 vs -18.0±14.0%, p<0.001).

Conclusion: Myocardial tissue Doppler imaging and strain echocardiography discloses functional abnormalities early in the course of FAP before evident morphological signs. The findings shows regional myocardial disturbance in all three basal segments, but most related to the septal segment even in absence of hypertrophy. The results may be used as a model for functional disturbances in cardiac hypertrophy and infiltration. Furthermore, is should be considered a biventricular disease.

ORAL SESSION

Doppler myocardial imaging in specific heart muscle diseases

3 December 2004, 16:30 to 18:00
Location: Room 2

ORAL SESSION

Doppler myocardial imaging in specific heart muscle diseases

3 December 2004, 16:30 to 18:00
Location: Room 2

854 Regional myocardial deformation disturbances in familial amyloidotic polyneuropathy. A strain and tissue Doppler imaging study
P. Lindqvist, C. Backman, B.-O.Olofsson, O. Suhr, A. Waldenström, Umeå University Hospital, Umeå, Sweden, 1 University Hospital, Umeå, Sweden

Background: Familial amyloidotic polyneuropathy (FAP) is an uncommon genetic systemic disease with limited cardiac involvement. There is today about 200 patients alive in Northern Sweden with this diagnosis. Morphologic heart abnormalities, above all myocardial hypertrophy, is a salient feature in advanced stages of the disease. Our hypothesis was that myocardial tissue Doppler imaging (TDI) and strain echocardiography might disclose functional cardiac abnormalities before traditional echocardiographic ones.

Methods: Including in this study was 24 patients (mean age 60±13 years, 12 females) with biopsy verified FAP considered for OLT and 36 healthy controls. (mean age 61±13 years, 21 females) Standard M-mode and Doppler echocardiography was performed to assess global left and right ventricular (LV, RV) function where TDI and strain echocardiography was used to assess the regional longitudinal lateral, septal and right free wall function. The time intervals were corrected for heart rate.

Results: We found increased LV and RV wall thickness and by using TDI we found a prolonged isovolumic (IV) relaxation time at septal segment (12.7±4.2 vs 10.1±3.3%, p<0.05) and prolonged IV contraction time at LV lateral (12.7±4.2 vs 10.1±3.3%, p<0.001), septal (12.4±3.4 vs 8.9±1.9%, p<0.001) and RV free wall (11.7±3.9 vs 8.3±2.1%, p<0.001). Finally, strain was reduced at all three basal segment but at both the septal segment (1.48±9.9 vs -12.6±15.8%, p<0.001, -7.1±11.2 vs -18.0±14.0%, p<0.001).

Conclusion: Myocardial tissue Doppler imaging and strain echocardiography discloses functional abnormalities early in the course of FAP before evident morphological signs. The findings shows regional myocardial disturbance in all three basal segments, but most related to the septal segment even in absence of hypertrophy. The results may be used as a model for functional disturbances in cardiac hypertrophy and infiltration. Furthermore, is should be considered a biventricular disease.

855 The three year follow-up of Idebenone therapy for Friedreich’s ataxia
J. Ganame, G. Di Salvo, G. Buyse, P. Claus, J. D’Hooge, B. Bijnens, G.R. Sutherland, L. Mertens, University Hospital Gasthuisberg, Leuven, Belgium, 1 University Hospital Gasthuisberg, Leuven, Belgium

Purpose: Friedreich ataxia (FA) is associated with a progressive hypertrophic cardiomyopathy. Idebenone, a free radical scavenger, has been shown to improve myocardial deformation parameters and reduce left ventricular mass index (LVMI) after one year of therapy. The long-term effects remain to be described. We aimed at determining whether the beneficial effect of idebenone on myocardial function and whether the regression in LVMI persisted over a three years period.

Methods: LVMI was calculated using the Devereux formula. Myocardial deformation was assessed measuring longitudinal peak systolic strain and strain rate at the basal, mid and apical segments of the interventricular septum and LV lateral wall in seven FA patients with hypertrophic cardiomyopathy and normal fractional shortening (age: 8.5-27.6 years, before the start of treatment). They were studied at baseline, at 12 months, at 24 months and at 36 months after starting Idebenone (5 mg/kg/day).

Results: Table. Averaged peak systolic longitudinal strain rate and strain values are shown. There was a reduction in LVMI after one year of therapy, which remained virtually unchanged after three years. An improvement in myocardial function at 12 months, which persisted throughout the second year, was seen. However, deterioration was noticed at 36 months.

Conclusions: The beneficial effect on myocardial function does not seem to be sustained beyond two years of therapy. On the other hand, LVMI decreases and remains unchanged throughout the three years follow-up. Based on these findings, the beneficial effects of idebenone beyond two years of therapy remain to be demonstrated.

Table

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<th>Peak systolic strain rate</th>
<th>Peak systolic strain</th>
<th>LVMI</th>
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<tr>
<td>Baseline</td>
<td>-1.02±0.21</td>
<td>-12.3±3.4</td>
<td>127.8±28.6</td>
</tr>
<tr>
<td>12 months</td>
<td>-1.50±0.51 *</td>
<td>-16.4±5.2 *</td>
<td>110.3±26.3 *</td>
</tr>
<tr>
<td>24 months</td>
<td>-1.38±0.31</td>
<td>-17.3±4.4</td>
<td>111.3±29.2 *</td>
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<tr>
<td>36 months</td>
<td>-1.10±0.16 ⩾1</td>
<td>-14.3±3.7 ⩾†</td>
<td>116.1±28.0</td>
</tr>
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* p<0.05 vs. Baseline; § p<0.05 vs. 12 months; † p<0.05 vs. 24 months
Results: Cardiac involvement and left ventricular (LV) diastolic dysfunction are frequent findings in patients with Fabry disease (FD). Early diastolic mitral annular velocity (Em) determined by pulsed wave Doppler echocardiography (PW-TDE) and flow propagation velocity (FPV) measured by colour M-mode (CMM) represent new Doppler indices of LV diastolic function which have been suggested to be less load-dependent. The aim of the study: To determine the utility of Em and FPV in the assessment of LV diastolic function in patients with FD and to compare the discriminating power of these parameters against standard Doppler indices of LV filling.

Methods: We analyzed 81 echocardiographic examinations performed in 35 patients with FD (63% males, 41 ± 12 years) from 1993 to 2003. In all, PW-TDE of the lateral mitral annulus with measurement of Em and CMM of mitral inflow with the assessment of FPV were performed. The subjects were classified into 2 groups based on standard Doppler indices of LV filling: Group N comprised patients with normal LV diastolic function (36 examinations) and group A consisted of patients with abnormal LV diastolic function (45 examinations; impaired relaxation in 16 cases, pseudonormalization in 27 cases and restrictive filling pattern in 2 cases). The receiver operating characteristics (ROC) curves method was used to determine the summary measure of relative accuracy for Em and FPV in detection of LV diastolic dysfunction.

Results: The mean values of Em were 0.16 ± 0.03 m/s in group N and 0.10 ± 0.03 m/s in group A (p < 0.001). The mean values of FPV were 0.69 ± 0.15 m/s in group N and 0.60 ± 0.19 m/s in group A (p < 0.05). ROC curves analysis showed significant difference (p < 0.001) between the areas under the curve on behalf of Em (0.90, 95% CI 0.82-0.96 vs. 0.67, 95% CI 0.55-0.77). The optimal cutoff values were 0.13 m/s for Em (80% specificity, 81% specificity) and 0.53 m/s for FPV (44% sensitivity, 90% specificity). Incorrect diagnosis of normal LV diastolic function based on the measurement of Em was more often present (p < 0.001) in patients with pseudonormalization, pseudonormalization with higher LV mass index and higher relative wall thickness, larger LA diameter and higher age.

Conclusions: In patients with Fabry disease, Em is a more reliable index of LV diastolic function than Em. Em appears to be relatively insensitive in detecting abnormal LV diastolic function in affected subjects of older age with pronounced concentric LV hypertrophy and pseudonormal filling pattern.

Pulsed tissue Doppler imaging detects early myocardial dysfunction in patients with b-thalassaemia major

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Purpose: In patients with b-thalassaemia major the greatest challenge so far was the early detection of myocardial dysfunction due to myocardial iron overload. The purpose of this study was to assess whether pulsed Tissue Doppler Imaging (TDI) indices can early detect cardiomyopathy in patients with b-thalassaemia major before development of overt heart failure.

Methods: We examined 45 patients with b-thalassaemia major with no symptoms and signs of heart failure, whose myocardial iron overload was evaluated with the magnetic resonance imaging (MRI) method of T2* (T2*). All these patients were asymptomatic and had normal left ventricular (LV) ejection fraction, assessed by MRI and echocardiography. By using the well-accepted cut-off point of T2* <20 ms, we found that 32 (71%) of patients had significant myocardial iron overload (T2* <20 ms), while the rest 13 of them had not. All thalassemic patients, as well as 30 age-matched controls, underwent pulsed TDI. Myocardial velocities were measured along the long axis, in the apical 4-chamber view, by using 2 sites at the mitral annulus (septal and lateral) and 1 site at the tricuspid annulus (lateral).

Results: Systolic mitral annular velocity (s-wave) was significantly lower in patients with b-thalassaemia major (7.3 ± 2.3 cm/sec), than in normal controls (10.5 ± 1.8 cm/sec, p < 0.0001). At the RV free wall the systolic velocities were 10.4 ± 2.9 cm/sec in thalassemic patients versus 11.3 ± 2.4 cm/sec in normal controls (p < 0.05). Furthermore, when thalassemic patients were divided into two groups according to myocardial iron overload as assessed by MRI, systolic mitral annular velocity was lower in the group of patients with significant myocardial iron overload (n=32) (LV s-wave 6.9 ± 1.8 cm/sec) than in the group of patients without (n=13) (LV s-wave 7.8 ± 2.9 cm/sec). However, this difference did not reach statistical significance (p = 0.07), possibly because of the small number of patients without significant myocardial iron overload.

Conclusions: Tissue Doppler Echocardiography seems to be a sensitive tool in the early diagnosis of myocardial dysfunction due to myocardial iron overload, in patients with b-thalassaemia major. Low myocardial systolic velocities that are detected by this method may represent an early sign of cardiomyopathy in these patients, despite their preserved ejection fraction.

858 Pulsed Doppler tissue imaging - Sensitive marker for early detection of anthracycline-induced myocardial dysfunction

I. Majerová, J. Popelová, J. Malíš, P. Telekés, Nemocnice E řesku Tisín, a.s., E řesku Tisín, Czech Republic, 1Faculty Hospital Motol, Prague, Czech Republic, 2Faculty Hospital Motol, Prague, Czech Republic

Background: The long-term anthracline - induced cardiotoxity depends on the cumulative dose and is usually found in doses exceeding 240 mg/m2.

Purpose: To evaluate, if pulsed tissue doppler echocardiography is more sensitive for early detection of anthracycline myocardial toxicity than standard echocardiographic parameters.

Methods and patients: We evaluated 17 adults (age 21-31 years, median 27 years) surviving 11 years (5-18, median 10 years) after the anthracycline therapy, 35% underwent radiotherapy of the mediastinum. The cumulative doses of the anthracycline therapy were between 141 and 564 mg/m2 (median 450 mg/m2). Echocardiographic examination was performed using standardized conventional and pulsed tissue doppler echocardiographic parameters (ejection fraction, fractional shortening, E/A, E/Ea, Doppler tissue imaging - Sensitive marker for early detection of anthracycline-induced myocardial dysfunction)

859 Early detection of acromegalic cardiomyopathy: a Doppler Tissue Imaging Study

V. Di Bello, F. Bogazzi1, D. Giorgi2, C. Palagi2, M.G. Delle Donne3, E. Talini1, B. Rizzon1, A. Di Cori1, C. Sardella1, M. Marian1, Dipartimento Cardio Toracico, Pisa, Italy, 1Pisa, Italy, 2University of Pisa, Pisa, Italy

Purpose of present study was to analyze early functional effects on the heart induced by acromegaly, through the PW Doppler Tissue Imaging (DTI) at mitral annular level. Acromegalic patients (A) were carefully selected in the Endocrinologic Department; 25 patients (A) (9 female), mean age 48.5 ± 5.3 and 25 healthy subjects (C) of comparable age, sex and body mass index were index. The diagnosis of acromegaly was established by high mean serum GH levels and by high plasma IGF-I levels for age. All study subjects are normotensive, no diabetic and have a negative maximal exercise stress test to avoid confounding effects of coronary artery disease. All subjects underwent conventional 2D-Color Doppler echocardiography, PW DTI was performed in apical 4-chamber view, with sample volume placed at mitral annular level in correspondence both with basal posterior septum and lateral wall. The following parameters were considered: both the diastolic waves: early Em and late Am, their ratio, the isovolumic relaxation period (IRrM), and the ratio between the E velocity (derived by transmural flow analysis) and Em at lateral level (related with capillary wedge pulmonary pressure). Left ventricular mass indexed by body surface was significantly higher in group A in comparison with controls (C) (150.1 ± 35 vs 101.6 ± 12 g/m2; p < 0.001) while left ventricular systolic function was comparable in both groups. Ejection Fraction (EF): 62 ± 5% in A vs. 63 ± 7% in C (n.s.). Left ventricular diastolic function showed a slightly but significant impairment in A group (E/A ratio of mitral flow pattern: 0.4 ± 0.3 vs. C: 1.1 ± 0.3, p < 0.009). The isovolumic relaxation period (mitral flow-derived) overlapped in both groups, while mitral deceleration time was significantly higher in group A (p < 0.01). The Em both at septum and lateral wall was significantly lower in group A (p < 0.05), while Am was significantly higher in group A (p < 0.001). The DTI was performed at 6 months from the last dose of therapy, 3 patients of group A (6%) and 2 patients of group C (8%) were excluded due to a significant higher Am. Also E/Ea was significantly higher in A vs. C (p < 0.01).

In Acromegaly we have observed: 1) left ventricular hypertrophy and, 2) through PW DTI, a global left ventricular diastolic dysfunction (in some, for an impairment of late diastolic period essentially due to an increase of myocardial stiffness (interstitial fibrosis augmentation).
Poster Session 5

4 December 2004, 8:30 to 12:30
Location: Poster Hall

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Reduced regional systolic and diastolic functional reserve of the venous left ventricle in patients with transposition of the great arteries by atrial switch: a strain rate imaging study
T. Poerner, B. Goebel, K.K. Haase, H.E. Ulmer, R. Arnold, University Hospital of Mannheim, Mannheim, Germany, 1 University Children’s Hospital, Heidelberg, Germany

Purpose of this study was to investigate regional myocardial function at rest and under exercise in patients with transposition of the great arteries corrected by atrial switch operation (cTGA).

Methods: Twenty-four patients with cTGA aged 12-33 years and 17 matched healthy young subjects underwent high frame rate tissue Doppler echocardiography including strain rate imaging (TDE/SRI) at rest and during submaximal bicycle exercise at 1 W/kg body weight. Longitudinal systolic (Vs) and diastolic (Ve) velocities, peak systolic strain rate (SR) and peak strain were determined in the basal, mid-wall and apical segments of the free wall of the systemic right ventricle (RV), respectively in the interventricular septum and in the lateral wall of the venous left ventricle (LV) from apical 4-chamber-views using a dedicated software.

Results: Quantitative echocardiographic data are displayed in Table 1.

Conclusions: (1) The septum and especially the free RV wall of patients with cTGA showed markedly lower regional systolic and diastolic performance indices compared to the control group both at rest and under exercise. (2) Venous left ventricle of cTGA patients presented at rest with reduced diastolic velocities, while contractility parameters were comparable to those of the control group. (3) Under submaximal exercise TDE/SRI revealed in patients with cTGA significantly lower values for strain rate, strain and peak velocities in the lateral LV wall compared to healthy subjects, demonstrating a reduced functional reserve of the venous LV after correction of TGA.

Table 1 (mean±SD)

<table>
<thead>
<tr>
<th></th>
<th>Strain (%)</th>
<th>Strain SR (1/s)</th>
<th>Strain SR (1/s)</th>
<th>Strain Vs (mm/s)</th>
<th>Strain Ve (mm/s)</th>
<th>Strain Ve (mm/s)</th>
</tr>
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<tbody>
<tr>
<td>TGA</td>
<td>cTGA Controls</td>
<td>cTGA Controls</td>
<td>cTGA Controls</td>
<td>cTGA Controls</td>
<td>cTGA Controls</td>
<td>cTGA Controls</td>
</tr>
<tr>
<td>RV: rest</td>
<td>15±8 *</td>
<td>10.1±0.61 *</td>
<td>2.2±0.69 *</td>
<td>2.1±0.74 *</td>
<td>1.8±0.59 *</td>
<td>0.8±0.42 *</td>
</tr>
<tr>
<td>RV: exercise</td>
<td>13±6 *</td>
<td>14.9±1.1 *</td>
<td>2.6±1.89 *</td>
<td>2.9±2.93 *</td>
<td>2.7±2.74 *</td>
<td>1.8±1.42 *</td>
</tr>
<tr>
<td>Septum: rest</td>
<td>20±9 *</td>
<td>12.4±0.63 *</td>
<td>1.9±0.69 *</td>
<td>23±12 *</td>
<td>2.8±1.18 *</td>
<td>1.6±0.83 *</td>
</tr>
<tr>
<td>Septum: exercise</td>
<td>23±10</td>
<td>18.1±1.1 *</td>
<td>3.1±0.81 *</td>
<td>34±16 *</td>
<td>4.2±2.22 *</td>
<td>3.2±1.18 *</td>
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<tr>
<td>LV: rest</td>
<td>19±9</td>
<td>1.64±0.7 *</td>
<td>1.8±1.1 *</td>
<td>53±36 *</td>
<td>55±37 *</td>
<td>94±41 *</td>
</tr>
<tr>
<td>LV: exercise</td>
<td>18±8 *</td>
<td>2.09±0.86 **</td>
<td>2.59±1.32 *</td>
<td>76±44 *</td>
<td>86±42 *</td>
<td>60±23 *</td>
</tr>
</tbody>
</table>

p<0.05; * vs. controls, ** vs. rest.

916
Different right ventricular adaptation to increased afterload in patients with Mustard repair for transposition of great arteries (TGA) and in primary pulmonary hypertension (PPHT)
J.L. Tan, M.A. Gatzoulis, M.Y. Herein, W. Li, Royal Brompton Hospital, London, United Kingdom, 1 London, United Kingdom

Background: Mustard repair for TGA in infancy results in the right ventricle being subjected to systemic pressure overload from birth. In contrast the right ventricle in PPHT faces progressive increase in afterload later in life.

Hypothesis: The right ventricle has different adaptive mechanisms to postnatal versus late progressive increase in afterload.

Methods: Twenty patients (age 28±8 years, 9 male) who had Mustard operation in infancy for TGA were compared with 19 patients (age 40±3 years, 6 male) with PPHT and twenty age matched normal controls. All patients were in sinusrhythm and clinical stable condition. The mean systolic pulmonary artery pressure was 85±30 mmHg derived from tricuspid regurgitation velocity in the PPHT patients. Right ventricular long axis function was studied using M-mode and Tissue Doppler velocities of the tricuspid ring movement. Ventricular asynchrony was indirectly assessed from total isovolumic time and presented in second per minute (sec/min).

Results: Table: RV long axis motion and systolic velocity were significantly impaired only in Mustard patients, but early diastolic velocity was maintained in the two patient groups. Total RV isovolumic time was significantly prolonged in all patients compared to controls, and to a greater extent in PPHT.

Conclusion: Right ventricular systolic function is significantly compromised in Mustard patients. It is only the asynchrony that features the main disturbance in facing increased afterload in PPHT. These findings warrant further evaluation.

Table

<table>
<thead>
<tr>
<th></th>
<th>Normal (N=20)</th>
<th>PPHT (N=19)</th>
<th>Mustard (N=20)</th>
<th>P Value (Mustard vs PPHT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RV measurement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-axis amplitude (mm)</td>
<td>23.7±4.2</td>
<td>19.5±4.1</td>
<td>11.7±3.6*</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Systolic velocity (cm/sec)</td>
<td>11.5±2.6</td>
<td>10±2.1</td>
<td>7.1±2.8*</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Early diastolic velocity (cm/sec)</td>
<td>9.3±2.5</td>
<td>7.6±2.2</td>
<td>7.4±2.8</td>
<td>NS</td>
</tr>
<tr>
<td>Total isovolumic time (sec/min)</td>
<td>4.2±1.3</td>
<td>11.4±2.3#</td>
<td>8±3.8*</td>
<td>P&lt;0.01</td>
</tr>
</tbody>
</table>

P<0.0001, ** P<0.001, Normal vs Mustard patients. #P<0.0001, Normal vs PPHT patients.
917 Evaluation of right ventricular function in patients with repaired tetralogy of Fallot with the use of tissue Doppler imaging and brain natriuretic peptide
S. Brill, G. Latsios, N. Alexopoulos, C. Aggelii, J. Barbetseas, C. Pitsavos, G. Vysoulis, C. Stefanadis. Athens Medical School, Athens, Greece

Purpose: Patients with repaired tetralogy of Fallot (RTOF) present with pulmonary regurgitation of varying severity, which results in right ventricular dilatation and dysfunction. Accurate estimation of right ventricular function is difficult in these cases. Tissue Doppler Imaging (TDI) is an echocardiographic method relatively volume independent, which estimates both systolic and diastolic function. Brain natriuretic peptide (BNP) is a hormone produced in predominately by the ventricles in cases of pressure and volume overload. The aim of the present study was the evaluation of right ventricular function of adult asymptomatic patients with RTOF by means of TDI and BNP values.

Methods: 22 adult patients with RTOF and 22 age and sex matched healthy controls were studied by means of 2D, Doppler and TDI echo. The following measurements were obtained: Right ventricular diameter, Left ventricular diameter (RVD/LVD) at the 4-chamber view as well as systolic (Sa) and diastolic (Ea, Aa) velocities at the right ventricular free wall tricuspid annulus site. Serum BNP levels were measured in both groups.

Results: Patients with RTOF showed statistically significant (p<0.001 for all) reduced TDI velocities compared to controls (left figure): Sa (8.19 vs. 12.10 sec velocity and or 16.26 vs. 11.10), Ea (10.66 vs. 19.04, 0.014), Aa (5.24 vs. 16.6 vs. 13.76 0.3). The BNP levels were increased in patients compared to controls (47.6 vs. 0.41 pg/ml, p<0.001). The increased BNP concentration of RTOF correlated to the RVD/LVD ratio (r=0.72, p<0.001, right figure).

Conclusions: Our results indicate that although our cohort of patients was asymptomatic, the use of TDI and BNP easily discriminated them from the healthy controls. Moreover, right ventricular dilatation is correlated to BNP levels.

919 Intracardiac echocardiography for percutaneous closure of atrial septal defects in adult patients

Transesophageal echocardiography (TEE) has been routinely used during percutaneous closure of atrial septal defects (ASD) as a guiding tool before deploying closure devices. In adult patients this technique requires profound sedation or general anesthesia with orotracheal intubation, prolongs the proceedings and involves more skilled staff in the cath-lab.

Methods: From April 2002 to April 2004 we have treated 16 patients with ASD (10 ostium secundum, 1 patient foramen ovale) with the Amplatzer® device. Intracardiac echocardiography (ICE) was used in all procedures (Ultra ICE 9 F 9 Mhz, Boston Scientific). Bilateral femoral venous access was obtained, and all patients received heparin (1 mg/kg), antibiotic prophylaxis, and aspirin for 6 months.

Results: The Amplatzer® device was deployed and detached successfully in 15 patients (94%), with a mean diameter of 24 mm (18-34 mm). No patient required general anesthesia or orotracheal intubation, and neither TEE nor sizing balloons were needed to perform the procedure. Mean duration of the intervention was 60±18 minutes and the fluoro time was 11.8±8 minutes. A transthoracic echocardiogram (TTE) was done the next morning to confirm the correct position of the device, and all patients were discharged before 24 hours. Clinical and TTE follow-up at 6 months was uneventful, with normal position of the device and absence of intracardiac shunts. No vascular complications or embolic events were found.

Conclusions: ICE is a safe and useful technique during percutaneous closure of ASD in adult patients, and avoids the need for general anesthesia and orotracheal intubation. The procedure duration is probably decreased when using ICE instead of TEE, as well as the need of other skilled staff in the cath-lab.

920 Doppler tissue imaging analysis of right ventricular function in adult patients before and after transcatheter closure of atrial septal defect
C.V. Laskari, P. Bonou, S. Rammos. Onassis Cardiac Surgery Center, Athens, Greece

Adult patients with an atrial septal defect (ASD) have long-standing right ventricular dilatation and dysfunction. We used Doppler Tissue Imaging (DTI) to assess right ventricular systolic and diastolic function in adults with ASD before and after closure with the Amplatzer septal occluder.

Methods: 42 pts with ASD secundum, mean age 35 years (18-63), 15 men and 27 women underwent transcatheter closure of their ASD with an Amplatzer septal occluder. ASD size was 8-34 mm by echocardiography and mean Amplatzer size was 22 mm (15-40). After conventional echocardiographic assessment, pulsed DTI was obtained from the apical 4-chamber view.

Results: Mean fluoroscopy time was 18 minutes and the fluoro time was 11.8±8 minutes. A transthoracic echocardiogram (TTE) was done the next morning to confirm the correct position of the device, and all patients were discharged before 24 hours. Clinical and TTE follow-up at 6 months was uneventful, with normal position of the device and absence of intracardiac shunts. No vascular complications or embolic events were found.

Conclusions: ICE is a safe and useful technique during percutaneous closure of ASD in adult patients, and avoids the need for general anesthesia and orotracheal intubation. The procedure duration is probably decreased when using ICE instead of TEE, as well as the need of other skilled staff in the cath-lab.

Abstracts
921

Right ventricular performance in Ebstein’s disease by transesophageal strain Doppler echocardiography: A morpho-functional study in adult patients

A. Vitarrelli, Y. Conde1, E. Cinino1, I. D’Angeli1, S. D’Orazio1, S. Stellato1, V. Padella1, D. Battaglia1, G. Continanza1, F. Caranci1.
Rome, Italy, 1Rome, Italy

Background: Ebstein’s anomaly of the tricuspid valve is a complex and fascinating congenital heart defect characterized by a spectrum of anatomical abnormalities that can involve the atrium and right ventricle. The purpose of the present study was to assess right ventricular function using tissue Doppler imaging (TDI) and strain echocardiography in Ebstein’s patients (pts) to better understand the relationship between functional severity and anatomic derangement.

Methods: Transesophageal echocardiography with TDI and strain capabilities (Applio, Toshiba corp, Tokyo, Japan) was performed in 9 pts aged 12-39 years. 10 age- and sex-matched subjects with no signs of heart disease were selected as normal controls (CTR). Right ventricular ejection fraction (EF), fractional shortening (FS), and tricuspid flow filling parameters (E/A ratio, DT) were determined. Offline analysis of the myocardial velocity data sets was performed using dedicated software. Velocity and strain traces from the right ventricular free wall were processed in the esophageal 4-chamber view. Systolic and diastolic TDI values (Sw, Ew, Aw), peak systolic strain and systolic and diastolic strain rate values were determined.

Results: Measurements of TDI/SR parameters were rapidly obtained with a low inter- and intra-observer variability. E/Aw ratio was significantly reduced in pts compared to CTR (p<0.005). Peak systolic strain and systolic and diastolic strain rate at apical and mid level were also lower in pts in comparison with CTR (p<0.001). Right ventricular EF, FS, E/A ratio, and DT were not significantly different among the two groups. No correlation was found between EF, FS, E/A ratio, DT, and anatomic derangement. A significant relationship was shown between peak systolic strain and apical displacement of septal/posterior leaflet (r=-0.67, p<0.001) and between peak systolic strain and the ratio of proximal to distal right ventricle (r=-0.72, p<0.001).

Conclusion: Thus, Ebstein’s pts may present with systo-diastolic ventricular function that can be early assessed by strain Doppler echocardiography. This may lead to better decision-making regarding the indications for and timing of surgery.

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Tetralogy of Fallot: prognostic factors after surgical repair

S. Amorim, C. Cruz, F. Macedo, P. Bastos1, F. Rocha-Gonçalves.
Hospital São João, Porto, Portugal, 1Hospital de São João, Porto, Portugal

Corrective surgery for tetralogy of Fallot (TOF) has allowed excellent survival. However, several years after surgery, the majority of pts has right ventricular (RV) dilation, and +/-10% will need a reoperation on their RV outflow tract due to limited exercise capacity, ventricular arrhythmias or symptoms of heart failure (HF). Our aim was to identify predictive factors of adverse outcome: moderate-to-severe RV dilatation, HF, reoperation of the RV outflow tract and cardiac death.

All pts admitted to our clinic between January 1971 and July 2001, 22 were lost and 66 were followed through 18.6 years. We analysed clinical, electrocardiographic and echocardiographic variables, existing RV dilation when the inlet measurement made at end-diastole from 4-chamber apical view was more than 35 mm, being moderate when it was between 50 and 60 mm and severe when it was >60 mm. From 66 pts, 25 (37.9%) were submitted to previous palliative shunt (PS) at the age of 4.0±5.2 years. Mean age at surgical correction was 10.8 years (range 1.1 to 38 years; median, 6.5 years). Transmural patching was used in 65% of pts, patch closure of a right ventricular incontinuity in 91% of pts and in 53% of pts a pulmonary comissurotomy was performed. At the end of follow-up, 3 pts were in NYHA class II-III and only one patient was successfully reoperated with implantation of a biological pulmonary valve. Frequency of RV dilation was 97% (n=57/59), being moderate-to-severe in 69% (n=36/52). In pts with moderate-to-severe RV dilation we found to be more frequent the performance of a previous SP (18.5±8.5% in pts vs. 15.0±3.5% in CTR, p=0.03) and the use of transmural patching (37.5 vs 75.0%, p=0.01). Those pts felt more palpitations (0 vs 22.2%; p=0.05), but there weren’t more arrhythmic events (18.8 vs 33.3%; p=0.28), maximal heart rate at exercise was inferior (86.2±10.9 vs 93.9±6.8; p=0.04), but the time of exercise and functional capacity was similar between groups. Follow up time and the use of RV patching was similar.

The use of transmural patching was associated with a previous PS at a latter age (0.9±1.7 vs 4.9±5.7 years; p=0.01), higher grade of pulmonary insufficiency (47.7 vs 57.5%, p=0.01) and higher QRS duration (136.8±28.9 vs 149.2±24.7 ms; p=0.03), besides larger RV dilation. Mortality was 0%.

Transmural patching and the performance of a previous PS were predictive factors of important RV dilatation, appearing pulmonary insufficiency to be its physiological mechanism. Despite this, at long-term, the prognosis is favourable and pts have good functional capacity.

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Correlations between echocardiographic parameters and concentrations of the natriuretic peptides in adults with ostium secundum atrial septal defect prior and after percutaneous closure

T. Lasawa, M. Demkow1, A. Kliśiewicz, J. Janas2, P. Hoffman. Institute of Cardiology, Warsaw, Poland, 1Institute of Cardiology, Warsaw, Poland

Objectives: There are no data on correlations between echocardiographic parameters and natriuretic peptide concentrations (NP) in adults with ostium secundum atrial septal defect (ASD II) treated with Amplatzer Septal Occluder (ASO).

Methods: 16 consecutive adult patients (pts) with ASD II with the pulmonary-to-systemic flow ratio > 1.5, at the age of 35±12 years were studied. Final diagnosis was established by transthoracic echocardiography (TTE). All pts underwent successful closure of ASD II with ASO. TTE was performed one day before and one month after transcatheter procedure as well as blood samples collection. Afterwards, serum concentration of atrial natriuretic peptide (ANP) and brain natriuretic peptide (BNP) was analyzed (Shionoria-ANP, BNP). Every TTE was performed by meticulous systolic and diastolic measurements of both right atrial and ventricular dimensions and areas. Achieved data were compared and correlated with serum concentrations of BNP and ANP.

Results: Closure of the ASD resulted in significant decrease of right ventricular transverse diastolic diameter (RVTdd, p=0.003), right atrial transverse systolic diameter (RATsd, p=0.003), right atrial diastolic area (RAda, p=0.004), right atrial systolic area (RAsa, p=0.003) and right atrial diastolic areas (RAda, p=0.005). The higher concentrations of BNP was before the ASO procedure (22.6±14.9 pg/ml, median 20.0 pg/ml) the higher RATsd (39.5±6.0 mm, median 40.0 mm, p=0.038) and higher right atrial longitudinal systolic diameter (RLSd, 43.5±6.6 mm, median 44.0 mm, p=0.006). Also the ANP concentrations before the procedure (42.4±25.1 pg/ml, median 39.0 pg/ml) correlated with RATsd (p=0.005) and RLSd (p=0.029). The increased concentrations of BNP, one month after, correlated with tricuspid annulus diastolic diameter (TAdDd) 28.9±3.5 mm, median 28.0 mm (p=0.008).

Conclusions: The enhanced release of ANP and BNP is associated with enlarged systolic RA dimensions. Persisted high concentration of the BNP indicates pts with enlarged tricuspid annulus. One month after ASD II closer by the use of ASO we observed significant reduction of the right atrial and the right ventricle dimensions.

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Echocardiographic assessment of the right heart chambers in different types of Ebstein anomaly in adult population

S. Trajać, S. Popović1, L. Jovović1, B. Vujčić-Tesić1. Dedine Cardiovascular Institute, Belgrade, Serbia and Montenegro, 1Dedine Cardiovascular Institute, Belgrade, Serbia and Montenegro, 1Institute of Cardiovascular Disease, Belgrade, Serbia and Montenegro

Introduction: Atrialisation of right ventricle (RV) due to dislocation of tricuspid leaflets (TV) is a mandatory characteristic of Ebstein anomaly (EA). Degree of the RV dysfunction depends of the level of RV atrialisation and severity of tricuspid regurgitation (TR).

Purpose: to assess morphologic characteristics of right atrium (RA) and RV in patients (pts) with type A and B EA as well as relations between these two chambers in purpose to determine the anatomic severity of the anomaly and hemodynamics consequence.

Methodology: In 28/32 pts with EA confirmed by echocardiography (mean age 41.75±15.2) the following parameters were measured: inferior to superior distance (d2), lateral to medial distance (d3) of RA, area of RA (ARA), area of anatomic RV (ARV) as well as index of their areas (ARA/ARV). Severity of TR was assessed semiquantitative and degree of TR was correlated with ARA.

Results: Pts with correlation between ARA/ARV and ARA were found in both examined types and it was more prominent in type B (r=0.584, p<0.05 vs. r=0.7517, p<0.01). There was no difference in d2 (61.8±13.52 mm vs. 54.91±22.83 mm) and d3 (65.93±25.04 vs. 69.21±36.74 mm) as well as in ARA and ARV between two examined groups. Index ARA/ARV was significantly different (1.68±0.75 vs. 3.0±2.12, p<0.05). Positive correlation was noted between severity of TR and ARA (r=0.3734, p<0.05) in all pts independently of EA type.

Conclusion: Index ARA/ARV as well as relation between ARA/ARV and ARA are the most reliable parameters of EA severity. Degree of TR depends of ARA independently of EA type.
926 Strain rate values based on tissue Doppler velocity or speckle tracking are different
C. Bjork Ingul, H. Torp, A. Stoylen, S.A. Slordahl. NTNU, Trondheim, Norway

Background: New scanner technology gives high quality 2D images simultaneously with tissue Doppler, making it possible to utilise the grey scale information (speckle tracking) in strain rate (SR) measurement. Tracking the motion of the region of interest (ROI) might increase the precision compared to a stationary ROI. The aim of the study was to compare mean values and feasibility of different methods for analysing peak systolic SR (SRs) and end-systolic strain (Ses). Methods: 30 patients with myocardial infarction and 30 patients with normal coronary angiography were examined. SRs and Ses were measured in 16 segments from 3 apical views. Method 1; a stationary ROI was placed automatically in the centre of the segment at end-diastole. SR was calculated from velocity gradient along the ultrasound beam. Method 2; a dynamical ROI was placed automatically in the centre of the segment at end-diastole, tracking the lateral motion of the ROI by speckle tracking and longitudinal motion by tissue Doppler velocity. SR was calculated as in method 1. Method 3; strain was calculated automatically from the segment length variation through the cardiac cycle by tracking the end points of each segment in the two described directions. SR was calculated as the time derivative of strain. Method 1-3 are automatic using a customised analyse software. Method 4; manual analysis using EchopAC PC and a stationary ROI. Results: 988 segments were analysed per method. Method 3 showed significantly lowest absolute mean value of SRs in normal segments and manual method lowest in infarcted segments. Feasibility was highest for manual method (Table 1). Conclusions: Velocity gradient based SR gives 25% higher absolute peak systolic mean values compared to speckle tracking based SR. Ses did not differ. A stationary or dynamical ROI showed similar results.

<table>
<thead>
<tr>
<th>Method</th>
<th>Normal segments SRs 1/s</th>
<th>Normal segments Ses%</th>
<th>Infarcted segments SRs 1/s</th>
<th>Infarcted segments Ses%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n=24)</td>
<td>(n=9)</td>
<td>(n=21)</td>
<td>(n=13)</td>
</tr>
<tr>
<td>Mean values</td>
<td></td>
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<tr>
<td>Normal segments</td>
<td>-1.45 (0.53)</td>
<td>-1.48 (0.52)</td>
<td>-1.15 (0.32)***</td>
<td>-1.32 (0.44)</td>
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<tr>
<td>SRs 1/s</td>
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<td></td>
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<tr>
<td>Normal segments</td>
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<td>-18.9 (7.6)</td>
<td>-16.9 (4.9)*</td>
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<td>Ses%</td>
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<td></td>
<td></td>
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<tr>
<td>Infarcted segments</td>
<td>-0.60 (0.42)</td>
<td>-0.61 (0.45)</td>
<td>-0.61 (0.37)</td>
<td>-0.46 (0.27)**</td>
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<tr>
<td>SRs 1/s</td>
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<tr>
<td>Infarcted segments</td>
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<td>-3.3 (8.7)</td>
<td>-4.5 (6.1)</td>
<td>-4.0 (5.8)</td>
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<tr>
<td>Ses%</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Percentage of SRs analyzable segments</td>
<td>75.2%</td>
<td>75.5%</td>
<td>81.5%</td>
<td>92.3%</td>
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</table>

Mean values (SD) for normal and infarcted segments for peak systolic strain rate (SRs) and end-systolic strain (Ses), *p<0.05 ***p<0.001.**p<0.001.

927 The influence of temporal filtering on strain values calculated from tissue Doppler measurements
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Background: We have in earlier studies shown that rectangular temporal averaging filters compromises the measured velocities already when using filters exceeding 20 ms of averaging time especially when applied to velocity calculations during the iso-volumetric phases. The pure systolic and diastolic velocities are more robust allowing filter functions up to 50 ms of averaging time in systole. Diastole is somewhat less robust limiting the recommended filter functions to be kept under 30 ms averaging time especially during the atrial contraction. Strain is basically calculated as the integral of strain rate and should therefore be less disturbed by filtering. On the other hand, strain rate is calculated from velocity data, a variable with an unfavourable signal to noise ratio. The aim of the present study is to estimate the influence of different time averaging filters on calculated strain data.

Method: 14 individuals 7 normals and 7 with different forms of cardiac disease including relaxation disturbances and some with delayed contractions during iso-volumetric relaxation. A fixed sample volume with a strain length of 12 mm was applied in base of the septal wall. The sample was selected to minimise the angle error. The measured values were set to 100% when calculation was performed on unfiltered data. The relative values applying temporal filters from 20 ms up to 80 ms were then calculated as relative % values against the unfiltered data. Strain during the iso-volumetric contraction (IVCS) and during isovolumetric relaxation (IVRS) as the maximum systolic and diastolic E and A values were calculated.

Result: Systolic strain is not changed of filters below 70 ms. E strain is also fairly unchanged using filters below 70 ms. The A strain is decreased when filter functions over 50 ms are applied. Strain during the isovolumetric phases has a trend towards overestimation of measured values when applying strain averaging filters below 40 ms and underestimate when filter factors exceeding 60 ms.

Conclusion: Strain calculations are more tolerant than velocity calculations when applying temporal filtering which could be performed with filters up to 40 ms averaging time in systole even up to 70 ms. Strain during the isovolumetric phases should even be filtered with filters with averaging times of 40-60 ms.

928 Longitudinal and radial regional strain obtained from Gray-scale conventional echocardiography
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Background: Strain measurements using echocardiography are obtained as the spatial gradient of Doppler velocities, inheriting its limitations due to the angular dependency. Our work presents a preliminary validation of a new method to compute the longitudinal (Sl) and axial (Sr) strain components from conventional gray scale echocardiographic images using non-rigid spatio-temporal registration based on semilocal parametric models of the deformation.

Methods: A total number of 46 echocardiographic basal and mid segments from the septum and inferior wall were analysed. These segments were qualitatively classified into three different contractility patterns. Cardiac motion field was obtained for each pixel in the regions of interest extracting Sr and Sl. Results were assessed by means of a one-way analysis of variance (ANOVA) with Sheffe post-hoc correction for multiple comparisons.

Results: (Table 1) Strain components Slong and Sax showed significant differences (p<0.05) between segments with normal contractility and hypokinetic and akinetic ones. Slong showed also significant differences between akinetic and hypokinetic segments.

Conclusion: Obtaining Sr and Sl from echocardiographic conventional imaging using spatio-temporal non-rigid registration techniques allows us to quantify regional systolic function, overcoming the limitations of the Doppler based techniques.

<table>
<thead>
<tr>
<th>Mean values</th>
<th>Normal (n=24)</th>
<th>Hypokinetic (n=9)</th>
<th>Akinetic (n=13)</th>
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<tr>
<td>Normal segments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sr</td>
<td>55.8±21.8</td>
<td>20.8±7.7</td>
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</tr>
<tr>
<td>Sl</td>
<td>-15.2±6.0</td>
<td>-8.5±6.8</td>
<td>0.5±7.6</td>
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</tbody>
</table>
929
Radial and longitudinal myocardial velocity estimation from grayscale conventional echocardiography. Validation against Doppler velocities

M.J. Ledesma Carbayo, M. Desco 1, N. Malpica, P. Mahia 1, E. Pérez David 1, A. Santos, M.A. García Fernández 1. Universidad Politécnica de Madrid, Madrid, Spain, 2HGU Gregorio Marañón, Madrid, Spain

Background: Measurements of myocardial velocity (V) using Tissue Doppler Imaging (TDI) has the intrinsic limitation of the angular dependency. This work presents a new method to obtain radial and longitudinal myocardial velocities from 2D grayscale echocardiographic sequences and its validation against Tissue Doppler Imaging (TDI) velocities.

Methods: TDI and grayscale sequences of the septum (apical view) were acquired simultaneously from normal volunteers with an Acuson Sequoia at a frame rate of 110 fps, and analyzing V with both methods. The 2D velocity vector, that enclose the radial and longitudinal components, was obtained by means of an automatic motion detection method based on non-rigid registration of consecutive frames. Linear regression analysis was applied to assess the relationship between the V calculated with the proposed method (Vr) and Doppler velocities (Vd).

Results: Linear regression results showed a good correlation between Vr and Vd (slope = 0.846 ± 0.003, R2 = 0.782). Figure shows a standard TDI image (A), the equivalent image obtained with the proposed method (B), and the corresponding velocity time curves from a ROI.

Conclusions: Non-rigid registration techniques allow obtaining radial and longitudinal components of V from conventional grayscale imaging, overcoming the limitations of Doppler techniques.

Figure 1

930
Spatial velocity distribution for visualising velocity gradients. Feasibility and preliminary experience

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Background: Strain rate (SR) is the longitudinal velocity gradient. The data are susceptible to drop-outs and reverberations, mimicking pathology. The velocity gradient at a specified time of the heart cycle can be shown as spatial velocity curves. Utility of this visualisation method in identification of artefacts was tested in this clinical study.

Methods: Tissue Doppler data from standard apical left ventricle (LV) views were recorded in 26 normal subjects and 16 patients with myocardial infarction (MI). Mean frame rate was 152. Tissue velocity imaging (TVI) values where extracted along a line following the wall from base to base through the apex in mid systole. Velocity was plotted vs. localisation in a diagram applying no smoothing.

Results: In 18 of 26 normals there were reverberations. Six of eight anterior Mls and eight out of 10 inferior Mls were visible. Eleven of the normals could mistakenly be classified with anterior Mls due to drop outs, and one with inferior MI.

Figure 1 shows some examples of infarctions and reverberations: a: Good quality 4ch view, b: 2ch view with inferior reverberations and anterior drop outs. c: 2ch view with anterior MI. d: inferior MI. Reverberations and drop outs indicate that the SR values might be less reliable.

Conclusions: Spatial Velocity Distribution is a method for visualising the velocity gradient, without post processing the data to secondary parameters. This approach is less susceptible to artefacts and may reduce the impact of reverberations. The Spatial Velocity Distribution may be an aid in detecting reverberations, but it seems less useful in discerning drop outs from infarctions.

Figure 1

931
Impact of exercise training on regional myocardial function assessed by Doppler myocardial imaging

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Objective: To assess the effects of exercise training (ET) on exercise capacity (EC), left ventricular ejection fraction (EF), and regional systolic and diastolic myocardial function in patients (pts) with left ventricular (LV) dysfunction.

Methods: In the group of fifty-three male pts (mean age 58.6 ± 8.3 years) with 40% of LV dysfunction, 15 four weeks later bicycle ergometric test and four weeks later echocardiography studies were performed. In order to evaluate regional myocardial function, myocardial velocities (m.v.) were obtained from apical approach, with pulsed wave Doppler myocardial imaging (PW DMI) sample volume placed in each LV segment at basal and medium level. In each adequately visualized segment we calculated m.v. of systolic (Vs), early (Ve) and late (Va) diastolic waves and their ratio Ve/Va - index of regional diastolic function. After the initial study, pts were randomized to trained (T, n = 33) and control (C, n = 20) groups. Patients in T group exercise daily about 40 minutes over a period of four weeks at a residential rehabilitation center while pts in C group received usual community care.

Results: After four weeks, significant increased in EC (from 58.6 ± 17.2 to 72.6 ± 18.3 W; P < 0.05) and duration of test (from 8.3 ± 3.2 to 10.9 ± 4.1 min; P < 0.01) were observed only in T group. EF increased slightly in the T group but was not changes in the C group. After exercise training in the T group regional systolic and diastolic myocardial function of basal and medium segments showed: increased Vs by 11.7% and 12.6% (P < 0.05 both), and ratio Ve/Va by 11.4% (P < 0.05) and 14.8% (P < 0.01) compared with baseline values. In the C group evaluation of regional myocardial function of basal and medium segments showed slightly changes: increased Vs by 4.4% and 6.6% (NS both), and ratio Ve/Va by 5.8% and 3.6% (NS both) compared with baseline values.

Conclusion: Residential short-term exercise training in pts with LV dysfunction, has a positive influence on regional myocardial function, which can be estimated by PW DMI before significant changes in left ventricular ejection fraction.

932
Contractile function in dynamic exercise trained athletes, measured with the non-invasive ultrasound indices strain rate and strain, is normal at rest

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Background: Dynamic exercise trained athletes have an increase in LV end diastolic diameter and a proportional increase in wall thickness. This way the enlarged LV can, according to Laplace’s law, maintain a normal end systolic wall stress. Because of the increased end diastolic volume and the resulting increase in stroke volume the athlete can maintain a normal cardiac output at a lower heart rate. Whether this increase in preload is associated with an alteration in myocardial contractile function at rest has not clearly been established yet. The relation between end systolic wall stress and the fractional shortening index was shown to be similar in cyclists and controls. From these data, a normal systolic myocardial function at rest in athletes can be expected. However, using Myocardial Velocity Imaging (MVI), Strain Rate (SR) and Strain (S) can be derived as more sensitive markers for the non-invasive study of myocardial contractile function.

Aim: To evaluate whether dynamic exercise trained athletes that have altered cardiac dimensions, have a different contractile function compared to matched control subjects using the new ultrasound parameters SR and S.

Methods: MVI data (GE, System 7), obtained at >150 frames/s from 40 duration trained athletes (31 bicyclists, 9 triathletes) (n=29; y, BMI 23.2, VO2max 4.7 ± 0.7 l/min) and 40 matched controls (n=29; y, BMI 23.3, VO2max 3.3 ± 0.7 l/min) was post processed to determine radial and longitudinal myocardial deformation (basal posterior and basal septal segments respectively).

Analysis was performed on custom made software enabling tracking of the cardiac wall throughout the cardiac cycle and exact timing of global cardiac events.

Results: Heart rate was significantly decreased in athletes compared to controls (52 ± 9/min vs 67 ± 12/min). End diastolic diameter, posterior wall thickness and stroke volume were significantly increased in the group of athletes compared to controls (56.7 ± 4.4 mm vs 51.8 ± 4.1 mm; 11.6 ± 1.4 mm vs 9.4 ± 1.1 mm and 107 ± 24 vs 87 ± 19 ml respectively; p < 0.0001). This resulted in a normal end systolic wall stress (3.75 ± 0.72) vs 3.96 ± 1.02). Moreover, radial and longitudinal Smax and SRmax at rest did not differ significantly between athletes and controls (Radial Smax: 68 ± 14% vs. 65 ± 15%; Radial SRmax: 4.22 ± 1.03 l/s vs. 4.33 ± 1.26 l/s, Lmax Smax: -24 ± 11% vs. -20 ± 14%. Long SRmax: -1.38 ± 0.69 l/s vs. -1.88 ± 0.61 l/s for athletes and controls respectively.)

Conclusions: In dynamic exercise-trained athletes, myocardial contractile function, measured with the sensitive ultrasound parameters SR and S, was normal at rest.
Dynamic left ventricular obstruction without hypertrophy: undescribed phenomena

N. Liel, N. Liel-Cohen1, A. Wolak1, Y. Henkin1, M. Gueron1, S. Soroka University Medical Center, Beer Sheva, Israel

Background: Left ventricular dynamic obstruction (LVDO) is a well described phenomenon and associated with several clinical conditions: hypertrophic obstructive cardiomyopathy (HOCM), left ventricular hypertrophy (LVH), acute coronary syndromes (ACS), complication of left sided prosthetic valve and in hyperadrenergic states. However, we have occasionally seen this phenomenon in echocardiographic studies of patients with none of these states.

Our aim is to describe this unique group of patients, so far not described in the medical literature.

Methods: Computerized database search for all patients with LVDO above 2 meter per second (1995-2002). Exclusion criteria were: HOCM, LVH, ACS, significant valvular diseases and prosthetic valve. Echocardiography reports and videos were reviewed. Patients’ files were reviewed for clinical variables.

Results: Patients characteristics: 22 patients: (12 males/10 females), age 71 ± 10 years, 7 ambulatory/15 hospitalized. Clinical findings: 87% of patients murmurs were described. Heart rate 81±13 BPM. Blood pressure of hospitalized patients, at the morning of the echocardiographic study was 129±7 over 68±9 mmHg. 93% of the patients had hypertension. Mean creatinine 1.2±0.3 and urea 61±38. No patient was on inotropes or drugs. Echocardiographic findings: Left atrium: Anterior–posterior 34±5 mm, superior–inferior 49±9 mm. Wall thickness: septum 10±1 mm, posterior wall 9±1 mm. Left ventricular (LV) diameter: diastole 40±6 mm, systole 20±5 mm. Fractional shortening 50±8%. Global LV systolic function was normal in 19 patients. Dynamic obstruction: in the LVOut flow tract in 19/22 patients, LV peak velocity 3.5±0.8 m/s, LV peak gradient 52±25 m/s. Systolic anterior motion of the mitral valve in 16/22 patients. Mild or more mitral regurgitation was found in 19 patients. In 5 out of 8 patients who had a repeated echocardiogram, LVDO was a repeated finding. 6 (27%) patients died within a year from the echocardiogram. All the patients that died were hospitalized at the time of the echocardiographic study. (6/15 40%). 16 of the patients (72%) were living within 1084±721 days from the echo study.

Conclusions: Finding of LVDO without LVH is a rare phenomenon, found in ambulatory and in hospitalized patients. The high urea creatinine ratio may imply that some of the patients had a degree of prerenal azotemia. In hospitalized patients this finding may imply a poor prognosis. However due to the rarity of this phenomenon and the small number of patients found further studies are needed to clarify its physiology and importance.

Tissue Doppler evaluation of ventricular function in patients with permanent pacemakers

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Background: Altered ventricular function has been described in patients with permanent pacemakers. The aim of this study is to assess the value of tissue Doppler imaging (TDI) in early detection of abnormalities in ventricular function after permanent pacemaker implantation.

Methods: This study included 23 patients in whom right sided permanent pacemakers were implanted (19 VVI mode & 4 DDD mode). Echo-Doppler and TDI measures were obtained just before pacemaker implantation and repeated after a follow-up period of 7.7±3 months. Conventional echo-Doppler measures included LV and RV dimensions and %fractional shortening, LV ejection fraction, early diastolic velocity, deceleration time and peak filling rate of both mitral and tricuspid flow. TDI measures included peak systolic & early diastolic velocities for both mitral and tricuspid annuli. The values of early diastolic mitral and tricuspid annular velocities were lower in the follow-up than the pre-implantation values, however the difference did not reach statistical significance. The values of the corrected time from Q wave to peak systolic and to peak early diastolic annular velocities correlated to cycle length, are early markers of left and right ventricular dysfunction in these patients.

935 Effects of contrast on regional left ventricular strain and strain rate measurements

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Strain rate imaging, quantifying regional myocardial function, and contrast echocardiography (LVO), may decrease operator dependency in interpretation of stress echo. Aim of this study was to evaluate if presence of contrast agent during tissue Doppler echocardiography significantly affects measurements of tissue velocity, regional strain and strain rate.

Method: Recordings of LV tissue velocity data were performed with conventional TVI(150 FPS) and a modified LVO application with increased TVI line density (100 FPS) in 15 healthy volunteers and 21 cardiac patients, without and with iv. contrast. Analysis (EchoPacPCM™) of peak systolic velocity (PSV), peak systolic strain rate (SRs) and end-systolic strain (ess) was performed in ROIs of 3×3 mm in mid septum and mid lateral wall of 4ch view, using offset of 6 mm and maximal temporal smoothing.

Results: Feasibility, determined by the ability to measure a given waveform by its conformity to an expected shape, was better for LVOTVIcon than TVIcon, both for PSV, SRs and ess (Table). Mean PSR values did not vary significantly between applications. Mean SRs and ess for TVIcon was significantly larger(absolutes values)than for TVI, but LVOTVIcon gave no significant change neither in SRs nor ess compared to baseline (Table). Differences were more pronounced in septal than lateral segments, probably due to noise from contrast in cavities and stronger contrast opacification in the septal wall.

Conclusion: Measurements of SRs and ess were neither feasible nor reliable with conventional TVI with simultaneous contrast. The modified LVO application increased feasibility and gave values for contrast PSV, SRs and ess comparable to conventional TVI. However, measurements in septal segments were still prone to noise.

Abstracts
An impaired myocardial dysfunction can be detected late after low anthracycline dose using strain and strain rate imaging

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Purpose: Cardiac toxicity remains as a major limitation for the use of Anthracyclines (Ado). This has lead to developing the cumulative dose modifying protocols. Currently, neither a method of detecting cardiac dysfunction at an early stage nor a predictive parameter for dysfunction are available. Strain (S) and Strain Rate (SR) imaging is a new technique which offers a more sensitive approach to quantifying abnormalities in systolic function and could potentially detect Ad induced changes undetectable by current methods.

Methods: We examined 56 pts aged 12.7 ± 4.8 years. They had all received an Ad dose lower than 300 mg/m². Both, standard echocardiographic measurements as well as colour Doppler myocardial imaging data were obtained. Peak systolic myocardial velocities, SR and S were estimated both, in the radial, from the intero-lateral wall, and in the longitudinal direction from the left ventricular (LV) lateral wall and interventricular septum.

Results: End systolic wall stress was higher; isovolumic relaxation time was prolonged; LV annular motion was reduced in pts compared to controls. All other standard indices of LV function were not different in the patient group compared to controls. A significant reduction in radial peak systolic SR and peak systolic S was found in all LV analysed segments. Conversely, myocardial velocities failed to show any changes in the segments where dysfunction was reduced.

Conclusions: By measuring deformation indices, it can be shown that both, radial and longitudinal function appear to be affected late after a low Ad dose. S/SR imaging could potentially be used to monitor cardiac function since it detects abnormalities at an early subclinical stage.

Table

<table>
<thead>
<tr>
<th></th>
<th>Vel (cm/sec)</th>
<th>Vel</th>
<th>S (s⁻¹)</th>
<th>SR (s⁻²)</th>
<th>Strain (%)</th>
<th>Strain (%)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Ant Controls</td>
<td>Ctr</td>
<td></td>
<td></td>
<td></td>
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<tr>
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<td>54.1±17.9</td>
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</table>

* p<0.05 vs. Controls; †p<0.001 vs. Controls; †p<0.01 vs. Controls.

Abstracts

937 Anthracycline-induced cardiotoxicity: evidence of early changes in Doppler tissue imaging and prediction of late impairment of left ventricular ejection fraction in adults

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Purpose: Anthracycline-induced cardiotoxicity is responsible for definitive impairment of left ventricular ejection fraction (LVEF). It occurs more frequently during the first year following chemotherapy but late-onset cardiomyopathy has been described, especially in children.

We aimed to evaluate prospectively anthracyclines long-term effects on cardiac function, assessed with pulsed Doppler Tissue Imaging (DTI) and conventional echocardiography, and to appreciate the predictive values of early changes regarding late impairment of LVEF.

Methods: 20 patients, 38 ±10 years old, with normal initial echocardiography (TTE1) and who needed first anthracyline chemotherapy for malignant tumours, were enrolled for prolonged follow-up. Two patients died during the treatment course and 2 were lost for follow-up. An echocardiography was performed to survivors 1 to 3 months after chemotherapy (TTE2) and 3.2 ±0.4 years later (TTE3). During each TTE, usual echocardiographic data were recorded together with pulsed DTI spectrum of the mitral annulus and of the basal posterior and lateral walls of the left ventricle.

Results: The mean doxorubicin-dose was 211±82 g/m². TTE2 and TTE3 displayed a marked decrease in peak early diastolic velocities (p<0.02 and p<0.005 respectively), and also a decrease in peak late diastolic velocities and peak systolic velocities on TTE3 (p<0.01). There was no significant change of LVEF between TTE1 and TTE2 (72.6±5.8% vs 71.0±8.1%) and none was below 55%. A significant decrease was observed in TTE3 (56±8%; p<0.005), with 4 patients (25%) having a LVEF<50%.

None of them, however, had clinical signs of heart failure. A DTI isovolumic relaxation time of the mitral annulus below 80 ms during TTE2 could perfectly predict patients with a LVEF<50% at late control.

Conclusion: Late impairment of the LVEF is not rare in adults after anthracycline chemotherapy, and may not be assessed in early controls. It is preceded by, and associated with, changes in the systolic and diastolic DTI measurements. Evaluation of the DTI mitral annular isovolumic relaxation time early after chemotherapy could help to select patients who need specific follow-up.

938 Use of strain and tissue velocity imaging for early detection of regional myocardial dysfunction in patients with beta thalassemia

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Background: Iron overload contributes to cardiac dysfunction in patients with beta thalassemia (Th). Tissue velocity and strain imaging (TVI & SI) might prove useful in early detection of regional myocardial dysfunction in these pts before overt cardiac failure. The aim of this study is to clarify the value of TVI and SI in early detection of regional myocardial dysfunction in thalassemia patients.

Methods: This study included 2 groups; G1: 27 pts with Th and G2: 14 age-matched normal subjects. Conventional echo-Doppler indices of systolic & diastolic function were obtained including end-diastolic and end-systolic dimensions of both LV & RV (LVEDD, LVESD, RVEDD & RVESD), LV ejection fraction (EF), fractional shortening of both LV & RV (LFS & RFS), early and late (E & A) transmural diastolic velocities and E/A ratio. TVI measures included systolic & diastolic myocardial velocities (Sm, Em, Am & Em/Am) of the basal segments of septal (sept), lateral (lat) & RV free walls. Systolic strain values were measured in the same segments and included S-sept, S-lat & S-RV. All measures in G1 pts were compared to those of G2 subjects. Sm and strain values were compared in lat vs sept, RV vs sept and lat vs RV segments in both G1 & G2.

Results: LVEDD, RVEDD & RVESD were higher in G1 compared to G2, while LVEF, EF, LFS & RFS did not significantly differ in the 2 groups. Both E & A were higher in G1 than G2, while E/A was lower in G1 than G2. Lat-Sm & sept-Sm in G1 were not different from those in G2, while RV-Sm was higher in G1 than G2 (-20.9±6.8% vs -27.2±4.3%; p<0.001), S-sept was higher in G1 than G2 (-31.1±8.3% vs -25.1±3.8%; p<0.01) and S-RV was not different in G1 from G2. Lat-Sm was lower than sept-Sm in G1 (5.9±1.2 vs 6.5±0.8; p<0.05) but was not different in G2 (6.2±1.3 vs 6.2±0.8; p=NS). S-lat was lower than S-sept in G1 (p<0.0001) but not in G2 (p=NS). RV-Sm was higher than sept-Sm and higher than lat-Sm in both G1 & G2. Sept-Em was higher, S-sept was lower than S-lat both in G1 and G2. Sept-Em was lower, sept-Am was higher & sept-Em/Am was lower in G1 compared to G2. RV-Am was higher and RV-Em/Am was lower in G1 compared to G2.

Conclusion: thalassemia patients have regional systolic dysfunction in the lateral wall and regional diastolic dysfunction in the septal and RV wall. TVI and the newer modality SI are promising tools for quantitative assessment of regional myocardial function. SI seems more capable of early detection of regional myocardial dysfunction.
Methods: We studied 29 consecutive b-thal patients, with normal LV systolic and diastolic function and 15 age and gender matched controls. Apical 4 & 2 chamber views were used to calculate LA volumes using the formula: (0.85 x AreaAC x L AreaAC x LA length) at end systole (LAVmax), at the end of P wave (LAVp) and end diastole (LAVmin). Total Emptying Volume (TEV: LAVmax-LAVmin), Passive Emptying Volume (PEV: LAVmax-LAVp) and Active Emptying Volume (AEV: LAVp-LAVmin) were calculated as well as Total (TEP:TEV/LAVmax), Passive (PEF-PEV/LAVmax) and Active (AEF-AEV/LAVp) Emptying Fractions. A 24 hours ECG Holter recording was obtained and blood was collected for ANP measurements from all patients and controls.

Results: There was no statistical difference between the 2 groups in age, LV dimensions and LV ejection fraction, mitral inflow E/A wave ratio, pulmonary venous flow S/D wave ratio and systolic and diastolic function, and E mitral/E annulus ratio. LA parameters (b-thal vs controls) are shown below: LAVmax: 57 ± 15 vs 52 ± 11.5 ml/pns, LAVp:35±2.1 vs 12.9 ± 30.3 ± 8.8 ml, pns LAVmin:24.9 ± 8.5 vs 17.5 ± 7.1 ml, p:0.02, TEV:32.1 ± 10.3 vs 34.6 ± 6.9 ml/pns, PEF: 21.9 ± 8.7 vs 21.8 ± 5.6 ml, p, pns: AEF: 10.2 ± 7.4 vs 12.7 ± 5.8 ml, p:ns, PEF: 38.9 ± 10.9 vs 42.4 ± 9.1, p, pns: AEF: 29.0 ± 11.6 vs 41.6 ± 10.4%, p<0.03 ANP levels were higher in b-thal group (2097 ± 888 vs 830 ± 394 mol/ml, p<0.01) In b-thal group short runs of atrial fibrillation detected in 3/29 and frequent premature supraventricular beats in 8/29 vs 0/15 and 2/15 in controls respectively<p<0.01 and p<0.05).

Conclusion: Cardiac hemochromatosis seems to lead in LA mechanical dysfunction and electrical instability even before presentation of ventricular dysfunc­tion.

940 Diastolic mitral annular velocity reflects diastolic abnormalities in young patients with beta-thalassemia major
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Objective: We aimed to evaluate myocardial diastolic function in patients with beta-thalassemia major (b-TM) using tissue Doppler imaging (TDI) and to correlate the findings with brain natriuretic peptide (BNP) levels as indicator of elevated left ventricular enddiastolic pressure.

Methods: During 2003 we enrolled 192 consecutive patients with b-TM that visited our Institution for routine examinations. The Institution is consid­ered the major reference center for b-TM in Greece. Of the 192 patients, 88 were men (25 ± 6 years old) and 104 women (26 ± 6 years old). By TDI, diastolic myocardial velocities were sampled continuously in the RV (Etv, A) and LV (Emv, Avm) free wall. From the apical four-chamber view diastolic transmirtal and transtriscubid velocities were recorded and E/A waves velocities in both sites was measured. Also the ratio E/Emv and E/A velocities were sampled continuously in the RV (Etv, AVTV,

Results: Linear and non-linear multiple regression analysis showed that BNP levels were inversely associated with Em (b = -1.15, p<0.01) and Etv (b = -1.15, p<0.01) velocities. In addition Em/Am, Etv/Avtv ratios showed inverse parabolic associations with BNP levels (b for 2nd order term = 1.2, p = 0.001, and b = 1.1, p = 0.01, respectively), after controlling for age, sex, serum ferritin, heart rate and hemoglobin levels. Particularly, values of both ratios within 1.5 - 2.5 range were associated with higher values of BNP, were lower or higher values of the ratios were related with lower values of BNP. The ratio E/Emv was positively correlated with the levels of BNP (r=0.12, p=0.03), while transmirtal A and E velocities as well as the ratio E/Emv did not have any correlation with BNP levels (r=0.02, p=0.55 and r=0.29, p=0.28, respectively).

Conclusion: Our findings may state a hypothesis about the independent role of mitral annulus motion on the evaluation of progressive diastolic dysfunction in young patients with an infiltrative disease like b-thalassemia major. The parabolic association of E/A ratio of mitral and triscupid annular motion with BNP levels reflect the progress from pseudonormal to restrictive pattern, where the transmirtal and transtriscubid flow being volume-dep­endent are insufficient.
942 Echocardiographic evaluation of the left ventricular function in children with sickle cell disease: effect of long term erythrocytapheresis
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University of Louisville, Louisville, United States of America, 1University of
Louisville, Louisville, KY, United States of America, 2University of
Louisville, Georgetown, United States of America, 3Louisville, KY, United States
of America
Background: Previous studies on cardiac function in patients with sickle
cell disease (SCD) have demonstrated an array of abnormalities of systolic
and diastolic function, including elevated left ventricular myocardial perfor-
ance index (LVMI) in patients on chronic transfusions protocol. Up to
now, there are no reported studies on cardiac function in patients with
SCD maintained on long-term erythrocytapheresis (LTE). Therefore, we
studied the left ventricular (LV) function in children with SCD, including
those on LTE.
Patients and methods: LVMI, which combines Doppler-derived systolic
and diastolic time intervals to generate a combined index of global ventricu-
lar function, was recorded in 22 patients with SCD aged 3-20 years. The
LVMI is defined as the summation of the LV isovolumic contraction
time (IVCT) and LV isovolumic relaxation time (IVRT), divided by LV
ejection time (ET). These time intervals were measured and averaged
for each patient (3 to 6 consecutive cardiac cycles) on the mitral inflow
and LV outflow tract velocity curves. We compared two groups of patients:
10 non-transfused patients (NT-SCD) and 12 patients on long-term eryth-
cytapheresis (T-SCD). The difference in LVMI between the two groups
of patients was evaluated with a two-sample t-test after verification of
Gaussianity. The relationship between LVMI and demographic and clini-
cal variables was investigated through partial correlation and multiple re-
gression analyses.
Results: The two groups of patients were not homogenous with respect
to age, body surface area, and hemoglobin levels. T-SCD had higher mean
LVMI compared to NT-SCD patients (P = 0.0001). Patients with severe
disease (including those on LTE) showed higher LVMI than those with
mild disease (P = 0.02). In partial correlation analyses, hemoglobin levels
were positively associated with LVMI (P = 0.014). Transfusion status
was, however, not significant in the multi-regression analyses (P = 0.091)
and may have been confounded by the inclusion of disease severity as a
variable.
Conclusions: In this exploratory study of ventricular function in patients
with SCD, we observed elevated LVMI in patients on long-term erythro-
cytapheresis, which is consistent with the findings in a recent study on
hypertransfused children with SCD. In contrast to the latter, who were
maintained on regular transfusions and had elevated serum ferritin levels,
none of our transfused patients had elevated ferritin levels. Elevated LVMI
in our patients may be related to transfusion status or be a reflection of the
global severity of disease.

943 Tissue Doppler identifies early cardiac involvement in familial
amyloidotic polyneuropathy, in patients with normal echo-Doppler
study
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Marques3, E.I. Oliveira1, J.C. Cunha1, Lisboa, Portugal, 1Hospital Santa
Maria, Lisbon, Portugal, 2Hospital Santa Maria, Lisbon, Portugal
Familial amyloidotic polyneuropathy (FAP) is a hereditary disease, charac-
terised by amyloid deposition in several organs, including the heart.
Cardiac involvement has prognostic implications. The aim of this study
was to assess the role of Doppler myocardial imaging (DMI) in the
early detection of heart abnormalities in patients (pts) with FAP before other
echo-Doppler changes.
Methods: We studied 54 consecutive patients (pts) with FAP (Group A;
44-14 years-old, 24 men) diagnosed by biopsy and genetics. Exclusion
criteria: nonisinar rhythm, hypertension, ischemic or more than mild valvul-
disease. 20 normal individuals (Group B; 39-8 years-old, 15 men)
were also studied. All were submitted to conventional echo-Doppler and
DMI: 1. Left ventricle (LV): dimensions, ejection fraction (Simpson’s), wall
thickness and echogenicity; 2. Mitral flow - E and A velocity (cm/s) and
Desaceleration time (ms) after Valsalva (Des); 3. DMI - Velocity of Em (early
diastolic), Am (atrial systole), Sm (systolic), in basal and mid segments of
LV walls (16 segments model), from the three apical views. Mitral flow
patterns were classified as: a) normal (E/A < 1 and Des < 140 to 239); b) Relaxation abnormality (E/A < 1 and Des > 240); c) restrictive abnormality (E/A > 2 and Des < 140). DMI patterns were classified as: a) normal: Em/Am; b) Relaxation abnormality: Em/Am < 1; c) Restric-
tive abnormality: Em, Am < 14 cm/sec.
Results: All patients were in NYHA class I or II. Left ventricle (LV) dimen-
sions and ejection fraction were normal in all but one pt. In group A, 22 pts
had increased thickness or echogenicity (Group A1), while the remaining
32 had no structural changes (Group A2). Comparison between Group A1
and A2, showed: a) older age (51±16 vs 38±10, p = 0.003), b) mitral
Doppler flow: more frequent relaxation or restrictive pattern (13 in Group
A1 vs 6 in Group A2); c) DMI: lower Em and Sm in all segments (p = 0.000
vs p = 0.005), regardless of mitral flow pattern. DMI of the 26 pts from
Group A2 with a normal structure and mitral flow pattern, showed: a) “normal” DMI pattern in 19 pts and a relaxation abnormality pattern in some
(2-4) segments, in 7 pts; b) In comparison with Group B, lower Em and
Sm in all basal segments (p = 0.004 and p = 0.06).
Conclusion: In our population of pts with FAP, we found frequent cardiac
involvement, with structural and functional abnormalities of LV. DMI identi-
fied subtle changes of systolic and diastolic function when conventional
was normal. The prognostic meaning of these findings should be assessed.

944 Noninvasive diagnosis of acute cardiac rejection with tissue
Doppler strain and strain rate imaging
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P. Claus, B. Bijnen, J. Vanhaecke, G.R. Sutherland. 1University Hospital
Gasthuisberg, Leuven, Belgium
Endomyocardial biopsies are the standard method for diagnosing cardiac
rejection. However, this invasive procedure is risky for the patients.
We aimed at assessing the value of strain (S) and strain rate (SR) imaging
for the early diagnostic of acute rejection in heart transplant recipients.
Methods: Color myocardial velocity imaging together with endomyocardial
biopsies were acquired in 9 heart transplant recipients (age 48±8 y).
In total, a number of 72 biopsies were taken. In 12 of these, an acute cardiac
rejection grade > = IB was diagnosed (83% grade IB and 17% grade IIa)
according to the International Society of Heart and Lung Transplantation
(ISHLT) criteria. For these 12 biopsies, S and SR data during the rejec-
tion period were compared to the values 1 week before and 1 week
after the event. For longitudinal deformation S and SR data were acquired
from the left ventricular (LV) free wall, septum and right ventricular (RV) free
wall. For radial deformation, the LV posterior wall (LVPW) was analyzed.
S and SR were analyzed using dedicated software (SPECQL).
Results: During rejection (ISHLT > = IB), radial S and SR (parasternal
long axis) were significantly decreased compared to the time before and
after rejection in the same patients (Fig.1 left). Longitudinal deformation
(apical 4 chamber view) was decreased during rejection (without being
statistically significant) (Fig.1 right).
Conclusions: During an episode of acute rejection, S and SR imaging
show a significantly reduced radial deformation of the LVPW. Myocardial
deforation, assessed by S and SR imaging can be useful in monitoring
and diagnosing rejection in heart transplant recipients and may improve
patient management.
945

Myocardial velocities by tissue Doppler echocardiography quantitates improvements in regional cardiac function - A study of perhexiline in heart failure

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Background: In a study looking at the potential benefits of the metabolic drug perhexiline on chronic heart failure (CHF), tissue Doppler echocardiography (TDE) was employed to assess cardiac function at rest and during dobutamine stress (DSE). Perhexiline led to a significant increase in VO2max and stroke volume during exercise. We describe an echocardiographic protocol which enables the objective assessment of regional myocardial function.

Methods: This was a double blind randomised controlled trial. Patients with ischaemic CHF (NYHA II-III, LVEF<45%) were recruited and randomised to either perhexiline (n=11005) or placebo (n=11021). TDE peak systolic velocities (PSV) were measured at rest and during DSE. LVEF (Simpson’s), velocity of lateral mitral valve annulus and E/Ea ratio (reflecting LV end diastolic pressures) were obtained. Investigations were repeated after 8 weeks of treatment. Data are mean±SEM. ANCOVA was used to test for statistical significance. PSV were obtained and averaged over 15 LV segments. 10 μg/kg/min was taken as ‘low dose’.

Results: There was no significant difference in heart rates between groups over 15 LV segments. 10

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group Control</th>
<th>Group Perhexiline</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>E/Ea ratio (ms)</td>
<td>9.1±1.0</td>
<td>8.9±1.5</td>
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</tr>
<tr>
<td>Resting mean PSV (cm/s)</td>
<td>3.5±0.2</td>
<td>3.4±0.2</td>
<td>0.03</td>
</tr>
<tr>
<td>Low dose PSV (cm/s)</td>
<td>4.6±0.3</td>
<td>4.8±0.3</td>
<td>0.05</td>
</tr>
<tr>
<td>Peak stress PSV (cm/s)</td>
<td>6.4±0.4</td>
<td>5.8±0.4</td>
<td>0.72</td>
</tr>
</tbody>
</table>

*p < 0.001

Conclusions: TDE demonstrated significant improvements in CHF following treatment with the metabolic drug perhexiline. DSE measuring PSV were obtained and averaged after 8 weeks of treatment. Data are mean.

Study Endpoints

<table>
<thead>
<tr>
<th>Pre PTCA</th>
<th>Post PTCA</th>
<th>Pre Perhexiline</th>
<th>Post Perhexiline</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVEF (%)</td>
<td>32.9±1.9</td>
<td>32.9±1.9</td>
<td>0.001</td>
</tr>
<tr>
<td>PSV (cm/s)</td>
<td>6.4±0.4</td>
<td>6.4±0.4</td>
<td>0.001</td>
</tr>
<tr>
<td>RFP (ms)</td>
<td>72±1.9</td>
<td>72±1.9</td>
<td>0.001</td>
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</tbody>
</table>

946

Assessment of percutaneous transluminal coronary angioplasty influence on left ventricular myocardial function in patients with coronary artery disease by pulsed tissue Doppler echocardiography


The aim of this study was to evaluate by pulsed wave tissue Doppler (PWTD) the alterations of the regional functions of the left ventricle (LV) after PTCA in patients with CAD.

Methods: 92 patients with CAD (85 men and 7 women, age 51.3±0.8 years) were examined before and two days after PTCA. The following parameters were evaluated using PWTD: the maximum velocities of the systolic wave (S), of the rapid filling wave (E), of the atrial contraction wave (A), and the E/A ratio. During regional myocardial function assessment the volume sample was placed in each segment of LV (16 segments). 1300 segments of LV were estimated in total. All patients were divided into three groups depending on degree of coronary artery stenosis: <75% (A1); >75% (B) and occlusion (group C).

Results: The PWTD indices (S, E, A, E/A) were increased in all groups after PTCA, however in group B tissue Doppler revealed significant changes (Table).

Conclusion: Thus, the increase of the regional left ventricular myocardial function velocity parameters was observed after PTCA. The registration of such alterations by PWTD may be useful as an additional method of assessment of PTCA results.

947

Assessment of regional left ventricular diastolic function in patients with preserved systolic function before and after angioplasty - Tissue Doppler imaging study

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Objective: Distortion of left ventricle diastolic function is an early sign of ischemia. Tissue Doppler Imaging (TDI) allows assessment of regional diastolic function. To assess the influence of coronary angioplasty (CA) on diastolic function we compared changes of regional diastolic parameters in patients before and after angioplasty by means of TDI.

Methods: Studied group comprised 31 males and 9 females (age 49.8±9.6 years), with preserved systolic function, who were qualified for CA. The pts were divided into two groups: group I - artery stenosis <70% (16 pts), group II - artery stenosis >70% (24 pts). Regional wall diastolic function was assessed by TDI one day before (exam 1), 2 – 3 days (exam 2) after successful angioplasty. TDI myocardial diastolic velocities (Em and Am wave, Em/Am ratio) and time intervals (isovolumic relaxation time - IVRT, rapid filling phase - RFP, atrial filling phase - AFP) were measured in the long-axis.

Results: Regional Em was increased between exam 1 and 2 for the whole group (6.4±1.70ms vs 6.9±1.5cm, p<0.05), but in separating groups only for group II (6.0±1.5cm vs 6.8±1.7cm, p<0.01), the same as Em/Am ratio (0.9±0.9 vs 1.3±0.9, p<0.05). There were no significant changes in Am, RFP and AFT. IVRT was shorten for the whole group (103±19ms vs 91±20ms, p<0.05) and for group II (121±20ms vs 97±21ms, p<0.01).

Conclusions: In patients with coronary artery stenosis after successful CA regional diastolic function showed improvement as assessed by TDI. Significant improvement of diastolic function was apparent only for significant stenosis (>70%).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Before PTCA</th>
<th>After PTCA</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (n=257 segments)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S (cm/s)</td>
<td>6.4±0.4</td>
<td>6.9±0.11</td>
<td>0.001</td>
</tr>
<tr>
<td>E (cm/s)</td>
<td>6.47±0.14</td>
<td>6.58±0.13</td>
<td>0.001</td>
</tr>
<tr>
<td>A (cm/s)</td>
<td>6.56±0.15</td>
<td>7.65±0.17</td>
<td>0.001</td>
</tr>
<tr>
<td>E/A</td>
<td>1.06±0.02</td>
<td>0.94±0.02</td>
<td>0.001</td>
</tr>
<tr>
<td>B (n=764 segments)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>S (cm/s)</td>
<td>6.19±0.06</td>
<td>6.64±0.07</td>
<td>0.001</td>
</tr>
<tr>
<td>E (cm/s)</td>
<td>6.08±0.06</td>
<td>6.20±0.07</td>
<td>0.002</td>
</tr>
<tr>
<td>A (cm/s)</td>
<td>6.63±0.08</td>
<td>7.08±0.08</td>
<td>0.001</td>
</tr>
<tr>
<td>E/A</td>
<td>0.97±0.01</td>
<td>0.94±0.01</td>
<td>0.003</td>
</tr>
<tr>
<td>C (n=279 segments)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S (cm/s)</td>
<td>6.13±0.10</td>
<td>6.65±0.10</td>
<td>0.001</td>
</tr>
<tr>
<td>E (cm/s)</td>
<td>5.72±0.12</td>
<td>6.09±0.11</td>
<td>0.001</td>
</tr>
<tr>
<td>A (cm/s)</td>
<td>6.49±0.13</td>
<td>6.71±0.14</td>
<td>ns</td>
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<tr>
<td>E/A</td>
<td>0.94±0.02</td>
<td>0.98±0.02</td>
<td>ns</td>
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</tbody>
</table>
948 The presence of a pre-ejective velocity wave measured with tissue Doppler imaging is a sign of non-transmural necrosis: comparison with contrast-enhanced magnetic resonance

P. Mahia, M.A. García Fernández, E. Pérez David, T. López Fernández, I. Gómez Anta, F. Samago Cebada, M. Moreno, J. Lafuente. HGU Gregorio Marañón, Madrid, Spain

Background: In experimental models, the persistence of pre-ejective velocity wave in reperfused myocardial segments with abnormal contraction implies non-transmural necrosis, but this has not been confirmed in patients with reperfused myocardial infarction (AMI). Methods: The presence of pre-ejective velocity positive wave with Tissue Doppler Imaging (TDI) was analyzed in 24 patients with AMI treated with successful primary angioplasty. The study was performed by an Acuson Sequoia equipment and a total of 197 segments were included. The same day a cardio-magnetic resonance (CMR) study was performed with cine images in standard planes and late enhancement technology, acquiring images in short axis, 4 and 2 chambers views with sequence 3D-T1-TFE after 15 minutes of the administration of 0.2 mmol/kg of Omiscan®. The transmurality of the necrosis was quantified in every segment, defining three groups: Minimum (0-25%), partial (25-75%) and transmural (75-100%), relating it to the presence/absence of the pre-ejective velocity positive wave. (Figure 1)

Results: The location of AMI was confirmed by CRM’s images in all patients (16 anterior and 8 inferior). 178 segments of 197 (90%) showed the presence of the pre-ejective velocity wave. In 95% of the segments with minimal partial necrosis a positive wave was observed, whereas only one of the segments with transmural necrosis presented it (12%, p<0.05).

Conclusions: The absence of the pre-ejective positive wave in TDI implies transmural necrosis in chronic myocardial infarction.

Figure 1

949 Hypothyroidism: myocardial effects and diastolic function.

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Introduction: It is known that hypothyroidism causes myofibrillar swelling, loss of striations and interstitial fibrosis. The aim of this study was to assess the impact of hypothyroidism on cardiac diastolic function and structure. Subjects and method: We studied 46 patients, 22 males and 24 females, 58±12 years old. All cases suffered from hypothyroidism. Exclusion criteria: heart failure, coronary heart disease, myocardial infarction, diabetes mellitus, bundle branch block and atrial fibration. All were submitted to conventional Echo-Doppler evaluation of:1. Intraventricular septum diameter (IVSd);2. Left ventricular posterior wall dimension (LVPWd);3. LV diastolic diameter (LVDd);4. LV systolic diameter (LVSd). Ratio LVPWd/LVDd 6. Isovolumic relaxation time of LV (IVRT LV)7. Isovolumic relaxation time of RV (IVRT RV)8. Mitrall flow E and A velocity, ratio LVPWd/LVPWd, LV mass (g/m²). Ratio LVPWd/LVDd = 1.32 ± 0.06, LV mass = 82.2 ± 23.6. Data were compared using U-test. Conclusion: A significant increase in IVSd, LVPWd and LVPWd/LVDd was observed in hypothyroid patients. Also hypothyroidism causes diastolic dysfunction as it is manifested by prolonged IVRT LV and IVRT RV.

Table 1

<table>
<thead>
<tr>
<th>parameter</th>
<th>hypothyroidism</th>
<th>normal hormones</th>
<th>p (t-test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVSd</td>
<td>1.32 ± 0.06</td>
<td>1.07 ± 0.12</td>
<td>0.006</td>
</tr>
<tr>
<td>LVPWd</td>
<td>1.32 ± 0.06</td>
<td>1.07 ± 0.12</td>
<td>0.006</td>
</tr>
<tr>
<td>LVDd</td>
<td>5.03 ± 0.64</td>
<td>5.01 ± 0.58</td>
<td>0.19</td>
</tr>
<tr>
<td>LVd</td>
<td>3.10 ± 0.35</td>
<td>3.06 ± 0.74</td>
<td>0.43</td>
</tr>
<tr>
<td>LVPWd/LVDd</td>
<td>0.46 ± 0.35</td>
<td>0.42 ± 0.06</td>
<td>0.006</td>
</tr>
<tr>
<td>IVRT LV</td>
<td>28.5 ± 4.2</td>
<td>27.5 ± 5.0</td>
<td>0.33</td>
</tr>
<tr>
<td>IVRT RV</td>
<td>103.6 ± 14.1</td>
<td>98.3 ± 11.5</td>
<td>0.02</td>
</tr>
<tr>
<td>E/A</td>
<td>1.22 ± 0.25</td>
<td>1.24 ± 0.35</td>
<td>0.59</td>
</tr>
</tbody>
</table>

Comparison of mean value during hypothyroidism and three months later, when the hormones were normal.

950 Diastolic dysfunction in non alcoholic fatty liver disease


Introduction: NAFL is the major cause of cryptogenic cirrhosis and is linked to the metabolic syndrome. The aim of this study was to determine if any cardiac abnormalities are present in patients with isolated NAFLD as a model of early metabolic syndrome. Methods: 36 patients with NAFL were included in the study and compared with an age and gender-matched control group. The diagnosis of NAFL was made using US and laboratory standard criteria. 12 patients had a liver biopsy. Patients with diabetes mellitus, hypertension and morbid obesity (BMI ≥ 40) were excluded. All patients had a normal exercise test according to the Bruce protocol and underwent a standard echocardiographic study. The following parameters were assessed by echo Doppler:peak velocities of early (E) and late (A) diastolic filling, E/A ratio, flow propagation velocity (Vp). Using tissue Doppler imaging (TDI) early diastolic velocity Ea, and systolic velocity Sa of mitral annulus were obtained.

Results: There was a significant difference in left ventricular mass (LV mass) and markers of left ventricular diastolic function on echo Doppler including E, E/A ratio, Vp and Ea on TDI. The significant data is presented in the table. On linear regression analysis no significant correlation was seen between LV mass (m²), E/A, Vp and Ea and BMI. On multivariate analysis the Ea on TDI was found to be the only independent index that can distinguish the patients with NAFLD from the control group.

Conclusions: Patients with NAFL in the absence of morbid obesity, hypertension, diabetes and coronary artery disease have increased LV mass and early features of left ventricular diastolic dysfunction.

Table

<table>
<thead>
<tr>
<th>parameter</th>
<th>control (20)</th>
<th>NAFL (36)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>49.8 ± 6.2</td>
<td>45.4 ± 10.5</td>
<td>0.1</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>30.8 ± 4.6</td>
<td>26.0 ± 2.4</td>
<td>0.002</td>
</tr>
<tr>
<td>EF (%)</td>
<td>64.4 ± 8.1</td>
<td>65.6 ± 4.2</td>
<td>0.6</td>
</tr>
<tr>
<td>LV mass (g/m²)</td>
<td>82.2 ± 23</td>
<td>60.1 ± 13.2</td>
<td>0.001</td>
</tr>
<tr>
<td>E (cm/s)</td>
<td>71.6 ± 13.2</td>
<td>82.2 ± 8.3</td>
<td>0.04</td>
</tr>
<tr>
<td>Ea</td>
<td>9.6 ± 1.5</td>
<td>12.7 ± 2.1</td>
<td>0.0004</td>
</tr>
<tr>
<td>E/A</td>
<td>1.9 ± 0.4</td>
<td>2.1 ± 0.4</td>
<td>0.0001</td>
</tr>
<tr>
<td>Vp (cm/s)</td>
<td>51.8 ± 8.0</td>
<td>68.1 ± 13.8</td>
<td>0.001</td>
</tr>
</tbody>
</table>

951 Leg lifting induced changes on Doppler and tissue doppler parameters in patients with severe coronary heart disease and normal coronary arteries

B. Pirat, A. Yildirir1, A. Atar1, V. Simsek1, B. Oznin1, H. Mudderrisoglu1. Baskent University hospital, Ankara, Turkey, 1Baskent University Faculty of Medicine, Ankara, Turkey

Purpose: In this study we aimed to compare the effects of postural changes on echocardiographic parameters in patients with normal coronary arteries and severe coronary artery disease (CAD) in the presence of diabetes mellitus. Methods: Thirty-one patients scheduled for coronary angiography (CA) were studied prospectively. Those with prior coronary artery surgery, severe valvular heart disease, chronic renal failure, rhythm other than sinus rhythm and ejection fraction below 40% were excluded from the study. Left ventricular pulsed Doppler parameters and septal and lateral mitral annulus velocities were measured at baseline and after leg lifting (45 degree leg lifting, 2 min stabilization). Myocardial performance indexes (MPI) were also calculated.

Results: Angiography yielded normal coronaries or non-critical stenosis (<70%) in 14, and severe CHD in 17 patients. The groups were similar for demographic characteristics and ejection fractions. Leg lifting resulted in increased peak early mitral inflow velocity (E), peak early mitral anulus velocity (Ea), and left ventricular ejection time in both groups (p<0.05 for all measurements). After leg lifting, shortening of E wave deceleration time and enhancement of systolic mitral anulus velocity (S) were observed in patients with normal CA (p<0.001 and p=0.036, respectively), but not in those with CHD (p=0.05). In both groups MPI values improved significantly after leg lifting (p<0.05 for both groups). We observed a significant inverse relationship between MPI and E, Ea and E/A ratio both before and after leg lifting in only subjects with normal CA (r=-0.77, p=0.001; r=-0.61, p=0.02; and r=-0.75, p=0.002, respectively). As expected, leg lifting did not affect E/Ea in any group.

Conclusions: Our findings suggest that in severe CHD, leg lifting induced augmentation of myocardial contractility and relaxation are blunted. Also, the relation between MPI and Doppler parameters are impaired in patients with severe CHD.
953 Aortic valve closure can be timed by tissue Doppler
A. Stoylen, S. Malm, S.A. Aase, E. Sagberg. NTNU, Trondheim, Norway
Aims: Aortic valve closure (AVC) is important for timing post ejection events, and in averaging heartbeats and 3D reconstruction. Beat to beat heart rate variation precludes precise timing by other heartbeats. Phonoangiography is filter and gain dependent. AVC causes short oscillations in the base of the left ventricle seen by tissue Doppler (TDI), and the aim of this study was to evaluate the feasibility and reliability of this for timing of AVC.
Methods: 16 normal subjects were examined by simultaneous echo and phonocardiography. AVC of aortic valve (AV) and left ventricle (LV) with TDI, pulsed wave Doppler flow in LVOT and 2D cine loops of three standard apical views (4ch, 2ch and a4ch with colour TDI was acquired, and analysis performed with EchoPAC PC. Mean HR was range 44-84.
First phase was calibrated by Doppler and AVC-M mode in LV M-mode and curved M-mode through the mitral ring and anterior mitral valve in each view and compared with phono. AVC was timed at 9 ms earlier than phono consistent with calibration. Finally AVC was identified by pulsed Doppler in LV M-mode and curved M-mode through the mitral ring and anterior mitral valve in each view and compared to phono. Findings are shown in table 1, showing that AVC can be demonstrated in the whole base of the heart with consistent reliable results.
Conclusion: Aortic valve closure can be reliably identified by TDI in each cine loop.

<table>
<thead>
<tr>
<th>Segment</th>
<th>Velocity</th>
<th>Strain rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS</td>
<td>0 (51 – 44)</td>
<td>-18 (11 – 47)</td>
</tr>
<tr>
<td>AL</td>
<td>3 (68 – 34)</td>
<td>2 (31 – 17)</td>
</tr>
<tr>
<td>LS</td>
<td>26 (18 – 39)</td>
<td>24 (21 – 40)</td>
</tr>
<tr>
<td>DS</td>
<td>14 (15 – 32)</td>
<td>5 (33 – 50)</td>
</tr>
<tr>
<td>BS</td>
<td>24 (18 – 40)</td>
<td>-42 (-66 – 12)</td>
</tr>
<tr>
<td>BL</td>
<td>16 (5 – 32)</td>
<td>-32 (-20 – 17)</td>
</tr>
</tbody>
</table>

Segmental time from first negative velocity resp first elongation to AVC (10 to 90 percentiles).

954 Echocardiographic assessment of the activation sequence and asynchrony in patients with long-term right ventricular outflow tract (RVOT) in comparison to right ventricular apical pacing (RVA)
A. Dabrowska-Kugacka, E. Lewicka-Nowak, S. Tybura, R. Wilczek, J. Staniewicz, G. Swiatecka. Medical University, Gdansk, Poland
The aim was to assess long-term influence of RVA in comparison to RVOT pacing on the activation sequence and asynchrony in patients with RVOA.
Methodology: In 1995-1997 120 pts referred for permanent pacing were randomized to RVA or RVA pacing. This year echo examination and NT-pro BNP analysis was performed in 13 RVOT and 14 RVA pts. By means of M-mode and Doppler several parameters of global asynchrony and activation sequence were evaluated.
Conclusions: 1) Long-term RVOT and RVA have a comparable effect on global asynchrony parameters. 2) RVOA in comparison to RVA pacing diminishes the electromechanical delay in the IVS and RV free wall, 3) Lower BNP levels in the RVOT group may indicate that RVOT activation sequence is more physiological than RVA pacing.

Table 1

<table>
<thead>
<tr>
<th>RVOT</th>
<th>RVA</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR [ms]</td>
<td>852 /-142</td>
<td>852 /-102</td>
</tr>
<tr>
<td>EF [%]</td>
<td>51 /-6</td>
<td>49 /-13</td>
</tr>
<tr>
<td>age</td>
<td>69 /-16</td>
<td>76 /-7</td>
</tr>
<tr>
<td>pacing time [months]</td>
<td>93 /-6</td>
<td>89 /-9</td>
</tr>
<tr>
<td>BNP [mol/L]</td>
<td>428 /-430</td>
<td>1034 /-851</td>
</tr>
<tr>
<td>PEP-LV [ms]</td>
<td>175 /-34</td>
<td>181 /-31</td>
</tr>
<tr>
<td>PEP-RV [ms]</td>
<td>140 /-24</td>
<td>148 /-20</td>
</tr>
<tr>
<td>DFP-LV [ms]</td>
<td>396 /-126</td>
<td>386 /-114</td>
</tr>
<tr>
<td>DFP-T [ms]</td>
<td>441 /-113</td>
<td>386 /-102</td>
</tr>
<tr>
<td>IVD-art [ms]</td>
<td>34 /-21</td>
<td>32 /-27</td>
</tr>
<tr>
<td>IVD-ven [ms]</td>
<td>72 /-44</td>
<td>58 /-41</td>
</tr>
<tr>
<td>Q-IVS</td>
<td>161 /-28</td>
<td>186 /-33</td>
</tr>
<tr>
<td>Q-LW</td>
<td>178 /-20</td>
<td>176 /-43</td>
</tr>
<tr>
<td>Q-MS</td>
<td>175 /-31</td>
<td>190 /-26</td>
</tr>
<tr>
<td>Q-AW</td>
<td>159 /-32</td>
<td>170 /-33</td>
</tr>
<tr>
<td>Q-RV</td>
<td>145 /-35</td>
<td>171 /-35</td>
</tr>
</tbody>
</table>

RVOT/RVA asynchrony, activation pattern

<table>
<thead>
<tr>
<th>RVOT/RVA</th>
<th>p</th>
</tr>
</thead>
</table>
| RR heart rate | EF – ejection fraction; PEP-LV, PEP-RV – LV and RV pre-ejection period; DFP-M, DFP-T – mitral and tricuspid diastolic filling time; IVD-art, IVD-ven – inter-ventricular delay at the arterial and venous level; Q-IVS, Q-LW, Q-MS – time between Qwave and onset of systolic motion (of the mitral valve) in the interventricular septum, lateral, inferior, anterior and right ventricular free wall.

952 Heterogeneity index of the mitral annulus motion assessed by pulsed Doppler imaging
A. Oliveira Anão, J. Monte, L. Bronze Carvalho, J. Galvão, H. Custódio, R. Cordeiro, I. Arrojo, J. Azvedo, A. Aleixo. Hospital São Francisco Xavier, Lisbon, Portugal. 1Hospital São Francisco Xavier, Lisbon, Portugal
The calculation of a heterogeneity index (HI) in the mitral annular dynamics by pulsed Doppler tissue imaging (TDI) can reflect quantitatively the intensity of relative contribution of the different left ventricular (LV) walls. To evaluate the heterogeneity of LV wall motion in several points of the mitral annulus in increasing degrees of LV diastolic dysfunction (DDI), we compared it with a normal group (N). We studied 141 hypertensive patients (pts), 94 male (67%), mean age 63 ± 15 years old with grade I (DDI group, 90 pts 64%) and II (DDI group, 51 pts 36%) DD. Exclusion criteria were the presence of coronary heart disease, bundle branch block, LV regional wall motion abnormalities assessed by 2D echo imaging, and the presence of mitral regurgitation grade II. Differences between these 2 groups for age and sex were NS. We compared these groups with N group, 41 healthy individuals, 21 male (51%), mean age 35 ± 13 years old. Pulsed TDI maximal systolic “s”, rapid “e” and atrial “a” diastolic relaxation velocities (Vm/cm/sec) were measured in 4 points (P) of the mitral annulus: adjacent to the interventricular septum (P1), the lateral (P2), inferior (P3) and anterior (P4) LV walls. The presence and characterization of diastolic dysfunction was assessed with pulsed Doppler calculating the maximal diastolic velocities of the translational flow (E and A waves/cm/sec), the pulmonary venous systo-diastolic forward flow (S, D and A waves/cm-sec) and the first aliasing flow propagation velocity of the LV inflow by M-mode colour Doppler (FP-45 cm/sec for DDI). The transmastoideo echodopplergic apical 4- and 2-chambers views were used. HI was calculated with the formula: sigma (summation)|P1-4 -A|/4 , where P = TDI Vm in points 1-4, and A = average TDI Vm.

Results: HI were in N, DDI and DDII groups, respectively. For DTI “s”: 2.27, 2.36, 2.04 p<0.05, for all groups; For DTI “e”: 2.96, 1.85, 2.50; p<0.003 (DDI-I), p<0.001 (N-DDI); For DTI “a”: 2.80, 3.63, 2.97; p<0.05 for all groups.

Conclusions: The heterogeneity index of grade I diastolic dysfunction is significantly attenuated and limited to the rapid relaxation “e” diastolic phase of the mitral annulus motion, when compared with a normal population or grade II diastolic dysfunction. The calculation of this heterogeneity index can be a useful tool in the pathophysiological characterization of the mitral annulus motion through the different degrees of LV diastolic dysfunction.

955 Initial diastolic deformation occurs before aortic valve closure in mid septum
A. Mykleby, S. Malm, E. Sagberg, S.A. Aase. NTNU, Trondheim, Norway
Aims: M-mode of the left ventricle shows initial thinning before aortic valve closure (AVC). Strain rate of the septum has shown an initial elongation in mid septum, starting before aortic valve closure, followed by elongation in the apex, and finally elongation during early filling propagating from base to apex. The aim of this study was to time these events in relation to AVC, and to compare to the lateral wall.
Methods: 16 normal subjects were examined with tissue Doppler in left ventricular M-mode and apical four – chamber cines loops. Mean HR was 62, range 44 – 84. Aortic valve closure AVC was timed by tissue Doppler. In M-mode, time from onset of thinning to AVC was timed by tissue Doppler. In cine – loops, curved M-mode was placed in the septal and lateral wall. Time from first negative velocity to AVC and from first positive strain rate to AVC was measured in basal, septal and apical segments.

Results: In M-mode, there was a consistent interval of thinning 31 ms before AVC (range 4 to 51). For longitudinal strain rate and velocities, times to AVC are given in table 1, showing initial midwall elongation and negative midwall and basal velocities 15 – 25 ms before AVC.

Conclusion: There is initial elongation in the midwall with negative velocities in the midwall and base, possibly representing initial change in LV shape, before AVC. This is followed by isovolumic relaxation in apex, immediately after AVC. Finally there is elongation in the base, representing early filling. Lateral wall shows the same pattern as septum, but with higher variability due to more noise. There is correspondence between velocities and strain rate, except in the base, where velocities follow the midwall due to tethering.

<table>
<thead>
<tr>
<th>Segment</th>
<th>Velocity</th>
<th>Strain rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS</td>
<td>0 (51 – 44)</td>
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<td>LS</td>
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<tr>
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<td>BS</td>
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</tr>
<tr>
<td>BL</td>
<td>16 (5 – 32)</td>
<td>-20 (-40 – 17)</td>
</tr>
</tbody>
</table>

Segmental time from first negative velocity resp first elongation to AVC (10 to 90 percentiles).
Noninvasive quantification of right and left ventricular function in the fetus with peak systolic strain rate derived from color tissue Doppler imaging

L.B. Paulikis, S. Miller, A. Banerjee.
Tufts New England Medical Center, Boston, United States of America

Background: Strain rate imaging quantitates regional myocardial function. Quantitation of right and left ventricular function has been difficult in the fetus. We tested the feasibility of peak systolic strain rate (SR) measurements on fetal echocardiogram.

Methods: Color tissue Doppler images were recorded in 15 normal fetuses at 26±5 weeks of gestation (range 19-33 weeks) at frame rates >150/ s. 25 healthy children (age 10.6±4.4 y) served as controls. Peak systolic velocities were determined in the basal RV, LV and septum from 4-chamber views. SR was measured using manual frame-by-frame tracking and cine compound.

Results: Fetal SR measurements were most reliable in mid-wall segments in longitudinal direction with a sample size of 6 mm (the septal length was 18±5 mm). SR was more stable than velocities during pregnancy (Figure). Children had higher velocities than fetuses in all walls including the RV (Table). SR was relatively age-independent but still lower in the fetus (Table). At all ages, RV SR was higher than LV SR (P<0.01).

Conclusions: Longitudinal strain rate measurements are feasible on fetal echocardiogram. Peak systolic strain rate is a promising marker of RV and LV systolic function in the fetus because it is less age-dependent than velocities.

Systolic Function Markers in the Fetus

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RV</th>
<th>LV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak systolic</td>
<td>2.0±0.4</td>
<td>2.0±0.5</td>
</tr>
<tr>
<td>SR (1/s)</td>
<td>2.8±0.5</td>
<td>2.4±0.5</td>
</tr>
<tr>
<td>Strain rate</td>
<td>0.9±0.1</td>
<td>0.9±0.1</td>
</tr>
<tr>
<td>Velocity (cm/s)</td>
<td>2.0±0.5</td>
<td>2.4±0.5</td>
</tr>
</tbody>
</table>

LV Peak Systolic Velocity and SR

Harmonic imaging reduces the sample size needed for left ventricular regression trials

Hôpital Européen Georges Pompidou, Paris, France

Background: The poor reproducibility of echocardiographic left ventricular (LV) mass measurement is a major limitation for LV regression trials. The only validated method for LV mass measurement is M-mode fundamental imaging (FI). LV mass is routinely measured by M-mode harmonic imaging (HI) and using a two-dimensional parasternal long axis (2D) LV view with either HI or FI, even though these methods have not been validated. We thus evaluated the reproducibility of the different echocardiographic methods and the consequences on required sample size.

Methods: Forty consecutive hypertensive patients (32 men and 6 women, mean age 51.1±10.3 years) underwent transthoracic echocardiography. In each case, LV mass was measured using M-mode FI, M-mode HI, 2D FI and 2D HI. Two independent observers measured LV parameters applying the ASE convention for the 2D methods and both the ASE and Penn conventions for the M-mode methods. The M-mode LV mass was calculated by applying the Penn and ASE equations, and the 2D LV mass was calculated by applying the M-mode ASE equation.

Results: HI significantly overestimated LV mass compared to FI, whatever the modality used (p<0.05). The prevalence of LV hypertrophy was higher according to HI (15.8% to 18.4%) than according to FI (7.9% to 10.5%). Interobserver variability was assessed by using the intraclass correlation coefficient (ICC). For M-mode Penn: ICC=0.73 in FI and 0.78 in HI; For M-mode ASE ICC=0.68 in FI and 0.72 in HI; For 2D: ICC=0.69 in FI and 0.82 in HI. To evaluate the consequences of the different interobserver reproducibility obtained with HI, we calculated the sample size (n) needed to detect a significant change in LV mass (delta) in a clinical two-group experiment for each technique (Table).

Conclusion: Although HI overestimates LV mass compared to FI, the use of HI improves interobserver reproducibility, particularly in 2D mode. Thus, 2D mode HI should be the method of choice for clinical trials evaluating LV mass regression, as it reduces the required sample size by more than 50% compared to M-mode FI.

Sample size per group(n)

<table>
<thead>
<tr>
<th>Delta</th>
<th>Power (%)</th>
<th>PennFI</th>
<th>PennHI</th>
<th>ASEFI</th>
<th>ASEHI</th>
<th>2DFI</th>
<th>2DHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>90</td>
<td>225</td>
<td>175</td>
<td>181</td>
<td>197</td>
<td>165</td>
<td>106</td>
</tr>
<tr>
<td>20</td>
<td>90</td>
<td>57</td>
<td>45</td>
<td>46</td>
<td>50</td>
<td>42</td>
<td>28</td>
</tr>
</tbody>
</table>

FI= fundamental imaging; HI= harmonic imaging; ICC=intraclass coefficient; LV mass= left ventricular mass; 2D=2-dimensional.
960

Left ventricular circumferential function in hypertensive patients
M. Przewlocka-Kosmala, W. Kosmala, W. Mazurek. Medical University, Wroclaw, Poland

Several lines of evidence suggest that longitudinal myocardial function as assessed by tissue Doppler imaging (TDI) is impaired in hypertensive (HT) pts. Analogous data concerning function of circumferential fibers in these pts are still lacking. The objective of the study was evaluation of the circumferential myocardial function in HT pts.

Material and methods: Studied group consisted of 102 HT pts aged 57.8 ± 12.7 with excluded coronary artery disease. 33 healthy persons served as controls (CG).

Each patient underwent echo study with TDI. Analysis of tissue velocity curves included mean peak systolic velocity (LSm), mean peak early diastolic velocity (LEm) and mean late diastolic velocity (LAm) obtained from six curves included mean peak systolic velocity (LSm), mean peak early diastolic velocity (LEm) and late diastolic velocity (LAm) estimated in mid anteroseptal (AS) and posterior (P) segments in parasternal short axis view.

Results: Higher value of SaxSm-AS and tendency to this in SaxSm-P suggested increased left ventricular (LV) circumferential systolic function in hypertensive pts when compared with CG, whereas lower values of SaxEm-AS, SaxEm-P, SaxEm-Am-AS and SaxEm-Am-P indicate impaired LV circumferential diastolic function in these pts. Decreased LSm as well as decreased LEm and LAm reflect LV longitudinal systolic and diastolic dysfunction, respectively.

Conclusion: Our study demonstrated in HT pts increased LV circumferential systolic function and deteriorated diastolic one. The former may be a compensatory response to the impairment in LV longitudinal systolic performance.

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Differentiation between pathological and physiological left ventricular hypertrophy by timing of the early diastolic mechanism. A novel approach
G. King, J.B. Foley, J. Cosgrave, G. Boyle, M. Hussey1, K. Bennet, P. Crean, M.J. Walsh. St James Hospital, Dublin, Ireland. 1Dublin Institute of Technology, Dublin, Ireland

Background: Sudden death in athletes is one of the worst catastrophes in sport. Identifying athletes at risk of sudden death remains a great challenge because the athlete’s heart undergoes adaptive changes in response to physical exercise that can mask some pathological abnormalities. Current echocardiographic methods of differentiating pathological from physiological hypertrophy are limited.

The aim of this study was to investigate the clinical utility of a novel approach using Doppler tissue imaging and timing the early diastolic mechanism to differentiate pathological from physiological left ventricular hypertrophy.

Methods and results: We compared 60 subjects with different types of LV hypertrophy (group 1: 14 patients with mild hypertrophic cardiomyopathy; group 2: 3 hypertensive athletes (international rowers)) and 30 controls, (group 4). The time interval between Ea (peak early mitral annular velocity from Doppler tissue imaging) and peak mitral opening E (from the M-mode) was measured simultaneously on the same heartbeat. The patient groups had a lower four-site averaged Ea in cm/s, median 9.1 (IQR 6.7, 10), compared with either the athletes’ median, 18.7 (17.3, 20.9), or the control group median, 18.4 (15.3, 19.8), p < 0.0001. In the athlete group Ea preceded the peak mitral opening E by a median 20 ms (IQR 10, 20) and in the control group by a median 15 ms (0, 30), compared with the patient groups where Ea was reversed in time relative to the peak mitral opening E by a median 10 ms (0, 20), p < 0.0001.

Conclusions: Along with the four-site average early diastolic tissue relaxation velocity (Ea), this novel simple measurement of the time interval between peak early diastolic tissue (Ea) and mitral valve opening is useful in differentiating pathological from physiological left ventricular hypertrophy. Phase reversal of the early diastolic mechanism is a strong predictor of pathological hypertrophy.

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Is hypertensive response a more powerful predictor of future hypertension than echocardiographic left ventricular hypertrophy in normotensives undergoing stress echocardiography?
M. Al-Mallah, F. Alqaishi1, A. Arsah1, R. Al-Tamsheh1, K. Ananthusubramaniam1. Dearborn, United States of America. 1Henry Ford Hospital, Detroit, MI, United States of America

Background: Hypertensive response (HRS) during exercise stress echocardiography (SE) in normotensive patients and echocardiographic left ventricular hypertrophy (LVH) have been previously shown to predict future development of hypertension.

Hypothesis: We tested the hypothesis that HRS may be a better predictor of future hypertension in normotensive patients during SE than LVH.

Methods: Retrospective study of consecutive patients referred for SE between 1/97-12/97. HRS was defined as peak systolic blood pressure > 200 mmHg for males and > 190 mmHg for females and/or peak diastolic blood pressure > 100 mmHg regardless of gender. Baseline demographics and SE variables were obtained through medical record review and the SE report which included LVH assessment by standard criteria. Patients were followed up for a median duration of 73 months to identify development of hypertension.

Results: Of 751 patients who had SE, 672 (89.5%) patients had no history of hypertension. 28.1% developed HRS during SE. Only Diabetics had higher incidence of HRS (p < 0.03). LVH was reported in 27.8% of the patient with higher incidence in males and African Americans. Over a median follow-up of 73 months, HRS was a better predictor of developing hypertension (OR 2.8, 95% CI 1.9-4.2, P < 0.0001, Area under the ROC curve 0.623) compared to LVH (OR 1.5, 95% CI 0.98-2.2, P = 0.06, Area under the ROC curve 0.538).

Conclusion: In conclusion, HRS is a better predictor of future incidence of hypertension than echocardiographic LVH. This high risk which is regardless of gender or race emphasizes the importance of close follow-up, risk factor and lifestyle modification in this patient population as a whole.

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Tissue Doppler imaging in the assessment of diastolic function in hypertensive patients with and without left ventricular hypertrophy

Left ventricular hypertrophy (LVH) is a major risk factor of cardiovascular mortality in hypertensive patients. It has been shown that in patients with hypertension tissue Doppler imaging (TDI) is able to detect impairment of diastolic function more accurately than transmitral Doppler. The aim of this study was to evaluate if the assessment of diastolic function by TDI offers any significant information in hypertensive patients without hypertension.

We studied 224 p with hypertension. Left ventricular hypertrophy was diagnosed by cardiac mass index and relative wall thickness. We measured E, A, E/A and TDE from transmitral Doppler and e, e’ from tissue Doppler at the level of the septal and lateral mitral annulus. The results were compared with a control group of 45 age-matched voluntary healthy persons.

Results: In our series, 53% of hypertensive patients had left ventricular hypertrophy diagnosed by cardiac mass index. Transmural pulsed Doppler showed abnormalities only in patients with hypertension. In hypertensive patients without LVH, TDI was able to detect impairment of diastolic function. Our findings suggest that many hypertensive patients with an echocardiogram reported as normal, because they had not hypertension and had normal transmitral Doppler could have impaired diastolic function if studied by TDI.

RESULTS

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>HTA + LVH</th>
<th>HTA without LVH</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTA</td>
<td>45 p</td>
<td>119 p</td>
<td>105 p</td>
</tr>
<tr>
<td>E/A</td>
<td>1.2 ± 0.4</td>
<td>0.76 ± 0.3</td>
<td>1.1 ± 0.2</td>
</tr>
<tr>
<td>TDE</td>
<td>202 ± 20</td>
<td>270 ± 31</td>
<td>245 ± 20</td>
</tr>
<tr>
<td>e’/e</td>
<td>1.3 ± 0.3</td>
<td>0.71 ± 0.2</td>
<td>0.87 ± 0.3</td>
</tr>
</tbody>
</table>

Note: All measurements are in arbitrary units.
964 Regional diastolic dysfunction as early manifestation of hypertensive heart disease
J. Separovic Hanzevacki, M.L.B. Martina Lovric Bencic1, A.E. Aleksander Ernst1, M.C. Maja Cikes. Zagreb, Croatia, 1University Clinic Rebro, Zagreb, Croatia

Background: Global left ventricular diastolic dysfunction measured by Doppler mitral and pulmonary veins inflow is usual in hypertensive patients. In order to better understand the pathophysiologic process and to diagnose subclinical myocardial changes it is necessary to assess regional diastolic function. We sought to analyze segmental myocardial relaxation using Tissue Doppler Imaging (TDI) in hypertensive patients (pts) with and without global diastolic dysfunction by conventional Doppler parameters.

Methods: treated hypertensive pts (48±7.3 years) with normal myocardial thickness and normal systolic function, were randomised in 2 groups according to blood pressure (BP) control from previous 24 h BP monitoring. Group A: 38 pts with well control BP; group B: 30 pts with uncontrolled BP. Pts and 21 healthy age match normals (n.) underwent TDI (E', A' at annulus, base and middle segment (s.) of each wall in longitudinal views and basal posterior segments in short (SAX) and long axis (LAX)) and Doppler echocardiography (IVRT, FPVE, PPVE, DEx, Adur, PVA, PVAAdur). For statistical analysis the non-parametric Mann-Whitney test was used. P value <0.05 vs. control group and vs. B group.

Results: In group A parameters measured by Doppler echocardiography were normal, while TDI revealed regional impairment of relaxation: 1. E'/A' <1 was found in 4/21 s. or 19% (in annular and basal s. of the lateral wall and basal s. in LAX and SAX: mean E'/A' = 0.82 ± 0.07, p < 0.001*). 2. All segments mean was: E/A = 1.03 ± 0.02, n.s. In group B Doppler parameters shown impairment of relaxation: E/A = 0.92 ± 0.33*, DEx = 259.95 ms* # PVAdur/A' = 0.82 ± 0.14*, TDI values were indicated impairment of relaxation in a majority of segments: 1. All segments mean: E'/A' = 0.64 ± 0.12, p < 0.01*, p < 0.059; 2. E/A (mean) was found in 18/21 or 74% of all s. (in basal s. of each wall and middle s. of septum and lateral walls: mean E/A = 0.12 ± 0.09, p < 0.0001*).

Conclusion: In hypertensive pts. with normal standard Doppler parameters of diastolic function and without hypertrophy regional diastolic dysfunction is found. This is the earliest manifestation of hypertensive heart disease revealed by TDI. These might have important clinical value in diagnosis of subclinical hypertensive heart disease and follow up the treatment.

965 Do late diastolic parameters change in mild hypertensive heart disease?
J. Separovic Hanzevacki, M.L.B. Martina Lovric Bencic1, K.P. Kresimir Putarek, A.E. Aleksander Ernst1, M.C. Maja Cikes. Zagreb, Croatia, 1University Clinic Rebro, Zagreb, Croatia

Background: By standard Doppler echocardiography (PWE) relaxation disturbance in hypertensive patients (pts.) is easily measured. It is not clear whether structural changes of the myocardium induce other functional disturbances during diastole apart from the relaxation. Tissue Doppler Imaging enables us to analyze regional myocardial diastolic function. In order to evaluate late diastolic function we sought to measure TDI parameters in hypertensive pts.

Methods: treated hypertensive pts (48±7.3 years, EF2D58±12%)were randomised in 2 groups according to blood pressure (BP) control. Group A -uncontrolled BP (27 pts); group B-well control BP (30 pts). Both groups and 13 healthy age match normals (n.) underwent TDI and PWE at baseline and at 3-month follow-up. Following parameters were measured: 1.TDI: peak early (E') and late diastolic velocity (A'), acceleration time (A'-AcctA'), deceleration time (A'-DIA') from annulus, base and middle s. of each wall and basal posterior s. in short (SAX) and long axis (LAX) 2.PWE Doppler parameters (p).E/A, DEx, Adur, PVA and PVAAdur. For statistical analysis the non-parametric Mann-Whitney test was used. *p < 0.05 vs. n., #p < 0.05 vs. group B, 1p < 0.05 vs. baseline.

Results: At baseline in group A all PWE and TDI p. revealed relaxation disturbances. TDI study revealed significantly higher A' (mean for all s. = 7.37±1.47 cm/s*) and longer AcctA' (mean for all s. = 0.07±0.01 ms*) compared to n. In group B PWE p. were normal but TDI showed relaxation disturbances in 3/21 or 15% of s. along with prolong AcctA' (0.06±0.009 ms*) in the same regions. At follow-up in group A PWE p. have not been changed while TDI p. revealed higher A' velocity (8.86±1.9 cm/s*), longer AcctA' (0.08±0.01 ms*), and longer DIA' (0.08±0.012 ms*) compare to baseline and between groups in majority of segments (73%). In group B at follow up no change in PWE parameters were occurred. TDI parameters of impaired relaxation occurred in more segments compare to baseline (5/21 or 23%) along with higher mean value A' (7.5±2.3 cm/s*/#) and prolong AcctA' (0.09±0.01 ms*), and DIA (0.09±0.01 ms* #) in the same s.

Conclusion: In hypertensive pts. at baseline we found regional late diastolic dysfunction in myocardial segments with impaired relaxation. After a 3-month follow up, late diastolic parameters in those segments became worse. Percentage of segments with early and late diastolic dysfunction after 3 month increased despite the treatment. It seems that along with impaired relaxation other functional disturbances occurs during diastole in hypertensive heart disease even in treated pts.

966 Left ventricular hypertrophy in a patient population referred by the general practitioner for echocardiography, the Parkstad experience
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Introduction: Because a correct diagnosis of heart failure or cardiac murmurs is difficult in general practice, frequently general practitioners (GP's) have gained easy access to echocardiography. This has led to improved diagnostic yield in these pts. However, frequently patients ith dyspnea have a normal systolic left ventricular function, but abnormal diastolic function. Often this is due to left ventricular hypertrophy (LVH).

Methods: GP's participating in the project were able to ask for an echocardiogram form a patient suspected for heart failure or a cardiac murmur. Systolic dysfunction was defined as a left ventricular ejection fraction below 40%.

Results: Twenty two pts (28%) had more than 1 indication (2 pts with dyspnea, cardiac murmur and peripheral edema, 10 pts with dyspnea and a cardiac murmur and 10 pts with dyspnea and peripheral edema. The echocardiographic diagnosis are shown in the table:

Conclusion: In general practice left ventricular hypertrophy accompanied by diastolic dysfunction is a frequent cause of dyspnea. Early detection can be performed with echocardiography.
Effects of long ventricular hypertrophy on transmural flow pattern and aortic stiffness in hypertension

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Purpose: Hypertension causes left ventricular hypertrophy (LVH). LVH can lead to diastolic dysfunction. However, the effects of LVH on aortic stiffness and its relationship to transmural Doppler flow were not fully elucidated. This study was undertaken to investigate the relationship between transmural Doppler flow and aortic stiffness in hypertension patients and effect of LVH on this relationship.

Methods: Eighty-three patients (mean age 46±8 years, 49 males) with untreated essential hypertension were included in this study. LVH was assessed by M-mode echocardiography and we divided patients into two groups based on the presence of LVH. Transmural Doppler flow velocity was measured from the standard four-chamber view. Indices of aortic stiffness were measured by M-mode echocardiography and were calculated from following formula: Stiffness index (SI) = (systolic blood pressure/diastolic blood pressure)/(changes in aortic diameter/diastolic diameter); Distensibility (Di) = (changes in aortic diameter)/(diastolic di- meter) (pulse pressure).

Results: Among all patients, the peak early filling velocity (E) was significantly correlated with SI (r = 0.227; p = 0.039), the peak atrial velocity (A) was significantly correlated with DI (r = 0.229; p = 0.018), and the early filling to atrial velocity ratio (E/A) was significantly correlated with SI (r = 0.233; p = 0.034). There were 21 patients (25%) with LVH. Patients with LVH had higher systolic blood pressure, diastolic blood pressure, blood urea nitrogen, SI and lower DI than patients without LVH. Parameters of transmural Doppler flow pattern were similar in both groups. The correlation between transmural Doppler flow and indices of aortic stiffness were disappeared in patients with LVH.

Conclusion: Our data indicated that transmural Doppler flow pattern was correlated with aortic stiffness. The transmural Doppler flow pattern was not only influenced by diastolic filling but also increased afterload. However, this phenomenon was blunted by the presence of LVH. When assessing transmural Doppler flow pattern in hypertension, aortic stiffness should be taken into account and also the influences of LVH.

Usefulness of brain natriuretic peptide in the identification of left ventricular dysfunction in asymptomatic hypertensive patients

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Background: The role of BNP in the screening of left ventricular dysfunc-
tion is still unclear. Aim of the study is to evaluate the usefulness of BNP measurement in asymptomatic patients at high risk for developing left ventricular dysfunction and heart failure.

Methods: One hundred fifty-four ambulatory consecutive patients with an at least five-year history of hypertension were studied (mean age 56 ± 7 years). Twenty-six patients had a previous myocardial infarction. All the patients were in NYHA class I and underwent blood sample for NT-Pro BNP and 2D-Doppler echocardiography. An ejection fraction < 45% was considered as systolic dysfunction; diastolic dysfunction was evaluated by the pattern of transmural and pulmonary vein flow velocities. Statistical analysis was performed by parametric approach (Student’s t test, ANOVA with Tukey’s post-hoc test) and non-parametric approach (Wilcoxon test, Kruskal-Wallis test), as appropriate. Diagnostic accuracy was evaluated by Receiver Operating Characters (ROC) analysis.

Results: Echocardiography showed a normal left ventricular function in 40 patients, a diastolic dysfunction in 80 pts and a systolic dysfunction in 14 patients. The values of NT-pro-BNP were not different between pts with isolated diastolic dysfunction and pts with normal LV function (92.1 ± 138.2 vs 85.2 ± 85.8 pg/ml), but were significantly higher in pts with systolic dysfunction (365.1 ± 294.8 pg/ml; p < 0.05). However, among the patients with isolated diastolic dysfunction, those with the higher degree of dysfunction, i.e. pseudonormalization pattern, showed higher NT-pro-BNP values than pts with a pattern of abnormal relaxation (160.1 ± 157.9 vs 84.3 ± 133.5 pg/ml; p = n.s.). ROC analysis showed a high value of the area under curve (0.89) for the diagnosis of systolic dysfunction with a sensitivity of 93% and a specificity of 80% for a cut-off of 114 pg/ml and with a negative predictive value of 0.98 (positive predictive value 0.33).

Conclusion: In asymptomatic patients at high-risk for heart failure because of a history of hypertension or myocardial infarction (VIHF), and of B of ACC/AHA heart failure classification, the measurement of NT-pro-BNP may represent a good screening in excluding left ventricular systolic dysfunction and, probably, the higher degrees of isolated diastolic dysfunction. Therefore, in the patients with lower values of NT-pro-BNP more expensive examinations (i.e. Doppler echocardiography) may be avoided.

The influence of the excess body mass on the left ventricular remodelling in patients with atrial hypertension

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Purpose: The aim of this study is to determine the influence of the excess body mass (BM) on the left ventricular hypertrophy (LV) remodelling in patients (pts) with moderate essential hypertension (EH).

Methods: In 38 pts (mean age 51 ± 1.8 year) by means of 2-D guided M-mode Echocardiography and Doppler –Echocardiography were evaluated the LV mass index (LVMI), relative wall thickness (RWT), the peak of velocity of early (E) and late filling (A) ratio (E/A), isovolumetric relaxation time (IVRT) and E wave deceleration time (DT). Systolic function was determined by LV ejection fraction (EF) and midwall fractional shortening (MFS). Pts were randomly divided into two groups 19 in each: 1 – 12 male and 7 female with BM index (BMI) 23.5 kg/m 2 ; II –13 male and 6 female with BMI 29.4 kg/m 2 .

Results: In pts of I group the concentric remodelling was observed by 31.6%, concentric LV hypertrophy - by 47.4% and in the rest ones the LV geometry was normal. In all pts with concentric remodelling LV systolic and diastolic functions were preserved. In pts with concentric LV hypertrophy the systolic function was preserved and diastolic function was disturbed by 44.4% cases. In pts of II group LV hypertrophy was registered in all cases: concentric LV hypertrophy - by 91.5% and eccentric LV hypertrophy - by 8.5%. Independently from type of LV remodelling, the peak velocity of early filling was not correlated in all pts and was more significant in the eccentric LV hypertrophy: A/A ratio 0.83 ± 0.05, IVRT 164.0 ± 6.1 ms and DT 257.8 ± 26.0 ms in pts with isolated diastolic dysfunction. The eccentric LV hypertrophy and significantly lower in eccentric LV hypertrophy (57.7: ± 1.54% and 16.6: ± 1.2%, accordingly, p < 0.05 for each). The EF was significantly lower in eccentric LV hypertrophy and significantly lower in eccentric LV hypertrophy (57.7: ± 1.54% and 16.6: ± 1.2%, accordingly, p < 0.05 for each).

Conclusion: The overweight in EH is the independent risk factor of marked changes of LV hypertrophy, geometry and function. The overweight often produces the eccentric LV hypertrophy, diastolic and systolic dysfunc-
tions compared with hypertensive pts having normal body mass. For the latter ones the concentric LV hypertrophy and preserved systolic function is typical.
971 Left ventricular mass regression and remodeling assessed by echocardiography after percutaneous transliminal renal angioplasty and intravascular brachytherapy guided by intravascular ultrasound

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Purpose: The aim of our study was to evaluate the influence of intravascular brachytherapy (IVBT) procedure performed after percutaneous transliminal renal angioplasty (PTRA) controlled with intravascular ultrasound (IVUS) on left ventricular function, mass regression and type of LV hypertrophy (LVH) in long term observation.

Methods: 59 patients (pts.), aged 51.6±8 years with severe hypertension complicating renal artery atherosclerotic stenosis, were successfully treated with PTRA and randomised to Group I (PTRA alone) and group II (PTRA followed by IVBT). Subsequent IVBT with PARIOS® catheter and Nucletron® system for peripheral arteries was performed and PTRA was optimised with IVUS study. Follow-up effect was assessed with IVUS and quantitative angiography (QCA).

LV mass and functional parameters before PTRA and in 12 months follow up were analyzed in echocardiographic examination with reference to different type of procedure

Results: In both analyzed groups elevated left ventricular mass index (LVMI) was observed (p<0.04). No significant differences in IVS to LVW ratio, relative LV wall thickness, volume parameters and LVEF among both groups were found.

In 12 months follow up the values of LVM and IVS to LVW ratio were significantly lower in Group I (p<0.004) and (p<0.004) in PTRA+IVBT group in comparison to PTRA alone group. Analysis of left ventricular geometry and type of hypertrophy revealed marked reduction of concentric LVH in follow up in IVBT group (before 19 (61.3%) in follow up 13 (41.9%)).

Conclusion: Echocardiographic analysis comparing several LV parameters in PTRA alone and PTRA+IVBT groups revealed, that PTRA and brachytherapy was associated with better control of blood pressure and LV mass regression, especially concentric hypertrophy in long term observation. Intravascular ultrasound data provided that IVBT of renal arteries is safe an effective method in prevention of restenosis in long term observation after PTRA.

972 Hypertension is associated with increased intraventricular dyssynchrony even in the presence of a preserved LV systolic function and normal QRS duration on the surface ECG

J. De Sutter, N. Van de Veire, B. Paelinck1, M. Vaerenberg,2, T. De Backer3, E. Hoffer,4, P. Unger5, P. Vandervort6 on behalf of The Belgian Multicenter Registry on Dysynchrony, University Hospital, Ghent, Belgium, 1University of Antwerp, Belgium, 2AZ Middelheim, Antwerp, Belgium, 3OLV, Aalst, Belgium, 4CHR de la Citadelle, Liège, Belgium, 5Hospital Erasme, Brussels, Belgium, 6ZOL, Genk, Belgium

Aim: To assess potential differences in global parameters for intraventricular dyssynchrony (IVD) in pts with hypertension (HT) compared to controls.

Methods: From a dysynchrony registry we selected 33 pts with normal LV systolic function and quantitative angiography (QCA).

Conclusion: Hypertension is associated with increased intraventricular dyssynchrony even in the presence of a preserved LV systolic function and normal QRS duration.

974 Left Ventricular (LV) Hypertrophy (H) and abnormal ventricular geometry in patients with Obstructive Sleep Apnea (OSA)

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Methods: We studied 233 hypertensive male-patients: 138 with OSA, confirmed by overnight polysomnography (Embla, Island), 95 - without OSA. 46 patients with severe OSA were undergoing CPAP-therapy at list 1 year. Echocardiography examination was performed in all patients. LV mass was calculated using the equation described by Devereux and colleagues. The LV geometry was categorized as normal, concentric remodeling, eccentric hypertrophy, or concenctric hypertrophy on the basis of LV mass and relative wall thickness as described by Ganzau and colleagues.

Results: In patients with OSA only 24 subjects (17.4%) had normal geometry of the LV. The others - in 9 (7.9%) had increased relative wall thickness with normal ventricular mass ("concentric remodeling"). 33(36.9%) had increased mass with normal relative wall thickness (eccentric H) and 72(63.2%) had "typical" hypertensive concentric H (increase in both variables). In patients without OSA 58(60.5%) had abnormal geometry of the LV- concentric H in 34(62.96%), eccentric H in 12 (15.3%) è concentric remodeling in 12 (15.3%) cases. The degree of LV hypertrophy was related to the degree of severity of OSA. After 1 year of CPAP-therapy in 46 patients with severe OSA echocardiography examination revealed significant changes in LV structure- reduction of relative wall thickness and LV mass.

Taken into account the fact that all changes in LV structure were revealed in patients independently of age, body mass, degree of blood pressure we suggest OSA to be risk factor in causing structural changes of LV.
Left atrial volumes and reservoir filling function changes in arterial hypertension

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Left atrial (LA) dimensions are increased in hypertensive heart disease (HHD). Mechanisms of the dilatation and consequences for LA reservoir filling function are unclear.

Aim: To evaluate LA dimension and reservoir function changes in HHD, as related to LV geometry (Gr.1—normal or concentric remodeling; Gr.2—eccentric, and Gr.3—concentric hypertrophy), and duration (short, <1 y.; intermediate, 1-5 y.; prolonged, >5 y.) of HHD.

Methods: In 54 pts with HHD we measured M-mode LV diastolic hypertrophy index (LV wall thickness/radius) and mass index; 2D LV biventricular volumes, ejection fraction, and stroke index and LA biaxial maximum, minimum volumes and normalized reservoir function (LA maximum—minimum)/minimum volumes x 100;% mitral annulus medial and lateral pulsed tissue Doppler (TD) systolic peak velocities; LV filling pressures as estimated by pulsed Doppler mitral and pulmonary venous flow velocities.

Results: In all patients, LV filling pressures were normal and LV systolic function within the normal limits of our database. Maximum LA volume was significantly greater in patients with prolonged, compared to short, duration of HHD (58±15 vs 77±25 ml, p<0.02); the former were elder with a tendency towards increased mass (184±66 vs 160±28 g/m², p<ns) and hypertrophy index (4.7±0.1 vs 41.1±0.1, p<ns). At regression analysis, LA maximum volume was positively related to LV mass index and patient age (p<0.02); minimum volume was related to LV mass index and duration of HHD, and inversely to medial TD velocity (p<0.02); LA reservoir function was directly related to LV mass and inversely related to HHD duration (p<0.02). Compared to both normals and eccentric hypertrophy, in concentric hypertrophy maximum and minimum LA volumes were increased (p<0.05), and reservoir function decreased (Gr.1, 155±35%; Gr.2, 138±40; Gr.3 115±40; p<0.05), whereas LV diastolic parameters were unchanged. Maximum LA volume was the main determinant of stroke index (p<0.001).

Conclusion: Our preliminary data suggest that in HHD increased LV mass determines an adaptive increase in LA maximum volume and reservoir function, the former also related to stroke index. Persistent LV mass elevation in long-standing HHD may decrease reservoir function through an increase in minimum LA volume.

Unfavorable alterations of left ventricular geometry are associated with increased levels of inflammatory markers in essential hypertensive patients with normal left ventricular mass

D. Chatzis, C. Tsoulis, K. Dimitriadis, P. Stougianinos, P. Missiovoulos, I. Vlasseros, C. Stefanadis, I. Kallikazaros. Hippokration Hospital, Athens, Greece

Purpose: To assess the possible relationship between LV concentric remodeling, levels of inflammatory markers, like high sensitivity C-reactive protein (hs-CRP) and serum amyloid A (SAA), in essential hypertensive subjects.

Methods: From a population of 95 consecutively newly diagnosed and untreated hypertensive patients with stage I or II essential hypertension, we selected 57 hypertensives [42 men, mean age 48 years, office blood pressure -result of both normal sensitivity to HHD duration (p<0.02). Compared to both normals and eccentric hypertrophy, in concentric hypertrophy maximum and minimum LA volumes were increased (p<0.05), and reservoir function decreased (Gr.1, 155±35%; Gr.2, 138±40; Gr.3 115±40; p<0.05), whereas LV diastolic parameters were unchanged. Maximum LA volume was the main determinant of stroke index (p<0.001).

Conclusion: Our preliminary data suggest that in HHD increased LV mass determines an adaptive increase in LA maximum volume and reservoir function, the former also related to stroke index. Persistent LV mass elevation in long-standing HHD may decrease reservoir function through an increase in minimum LA volume.

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Purpose: To assess the possible relationship between LV concentric remodeling, levels of inflammatory markers, like high sensitivity C-reactive protein (hs-CRP) and serum amyloid A (SAA), in essential hypertensive subjects.

Methods: From a population of 95 consecutively newly diagnosed and untreated hypertensive patients with stage I or II essential hypertension, we selected 57 hypertensives [42 men, mean age 48 years, office blood pressure 147/95 mmHg], with normal LV mass, that underwent 24 h ambulatory BP monitoring. All participants were divided into two groups, according to relative wall thickness (RWT) values; group A-normal LV geometry (RWT<0.45) and group B-LV concentric remodeling (RWT>0.45). Additionally, UAE was determined in three non-consecutive 24 h urine samples by nephelometric methods and all subjects underwent 24-h BP monitoring.

Results: For the pooled population, body mass index (BMI) was 26.93±2.5 kg/m², total cholesterol was 241±31 mg/dl, triglycerides were 134±63 mg/dl, low density lipoprotein-cholesterol was 153±14 mg/dl and UAE was 20.3±9 mg/24 h. Regarding the echocardiographic data, left ventricular mass index (LVMI) was 104.5±22 g/m², RWT was 0.42±0.07 and left atrial diameter was 3.5±0.31 cm. UAE was correlated with LVMI (r=0.32, p<0.05), BMI (28.2±4 kg/m² vs 27.5±2 kg/m², p<0.05), office systolic BP (154±9 mmHg vs 145±4 mmHg, p<0.05) and higher UAE [21.5±6 mg/24 h vs 19.7±3 mg/24 h, p<0.05].

Conclusions: LV concentric remodeling is accompanied by increased UAE, even in newly diagnosed essential hypertensive patients with normal LV mass. UAE measurement, in conjunction with evaluation of LV geometric adaptations, may contribute to better cardiovascular risk stratification, in this setting.

Patients with systolic dysfunction and hypertension have increased levels of plasma 8-hydroxy-2′-deoxyguanosine

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Purpose: Abundant evidence has been gathered to suggest that mitochondrial DNA sustains many more mutations and greater oxidative damage than does nuclear DNA in humans. Oxidative stress has been reported to be involved not only in ischemic cardiomyopathy but also in hypertension (HT). 8-hydroxy-2′-deoxyguanosine (8-OHdG) has been recognized as a sensitive biomarker of oxidative DNA damage and also oxidative stress. We assessed the hypothesis that 8-OHdG plasma levels may be critically influenced by ventricular pathological changes and patients with heart failure, we have compared the plasma levels of 8-OHdG in subjects with and without systolic dysfunction diagnosed and non-diagnosed of HT.

Methods: We have studied 114 patients (82 males, 32 females), age 64±13, that had been diagnosed of heart failure. A specific questionnaire and echo-Doppler study were performed on these patients. We also collected blood samples and patients were classified according to the NYHA. All blood samples were centrally analyzed and 8-OHdG levels are expressed as ng/mL. Mitral flow propagation velocity (Vp, cm/s), left ventricular mass index (LVMI, g/m²), and ejection fraction (EF) were also calculated.

Results: For the whole population, 8-OHdG was 0.30±0.52 LVM 167±51, EF 36±10 and Vp 35±10. When we compared 8-OHdG, 0.11±0.23, in EF<40 without HT (LVMI 164±51, EF 30±6 and Vp 36±10) with 8-OHdG, 0.40±0.60, in EF<40 with HT (LVMI 165±72, EF 33±5 and Vp 37±12), we found, p<0.05. Stepwise multiple regression analysis identified HT as an independent predictor of increased 8-OHdG. In EF<40, we found NS when compared subjects diagnosed and non-diagnosed of HT.

Conclusions: This multicenter study shows that the marker of oxidative DNA damage 8-hydroxy-2′-deoxyguanosine is found more elevated in patients with systolic dysfunction and hypertension when compared with normotensive patients. In subjects EF<40, we found NS. New studies should be conducted to validate the prognostic and therapeutic consequences of these results.
979 Oxidative stress related parameters in patients with diastolic left ventricular dysfunction

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The role of antioxidative defense mechanism is controversial, especially during exercise. Still less is known about association between diastolic LV function and adequate antioxidative response during exercise.

The aim of the study was to investigate changes of plasma level of most important enzymatic antioxidant parameters, super oxide dismutase (SOD) and glutathione peroxidase (GSH-Px) before and after exercise, in patients with diastolic left ventricular dysfunction (LVDD)

Methods: LVDD was evaluated by Doppler echocardiography by assessment of mitral flow velocities (E,A), left atrial size (LA) and ejection fraction (EF). The activity of SOD (U/gHb) and erythrocyte activity of GSH-Px (U/g/Hb) was evaluated with commercially available kit. Each subject performed a symptom limited bicycle exercise test with standardized 25 Watts increment stress protocol.

Results: There are an increase of antioxidants before and after exercise in all patients (E/A ratio: from 1.76 to 1.86, p = 0.003). Level of increasing was closely related with LV diastolic function. There was a significant correlation between enhancing value of SOD and GxP levels surgery and impaired LV relax and dysfunction. However, in a logistic regression model, age remains the only significant variable (p < 0.001).

Conclusions: The role of antioxidative defense mechanism is controversial, especially during exercise. Still less is known about association between diastolic LV function and adequate antioxidative response during exercise.

982 Evaluation of left ventricular function by myocardial Doppler echocardiography in patients with diabetes and hypertension: the importance of being old.


Aim of the study: To evaluate the impact of arterial hypertension (HPT) and diabetes mellitus (DM) on global systolic and diastolic left ventricular function evaluated by myocardial Doppler echocardiography.

Method: Two hundred thirty-one consecutive patients referred to our echocardiographic laboratory were selected for this study. Patients with shortness of breath, history of myocardial infarction, congestive heart failure, significant valvular disease, atrial fibrillation, or left ventricular ejection fraction <50% (biplane Simpson’s method) were excluded. The population was divided according to the presence or absence of HPT and DM. Myocardial velocities at lateral mitral annulus were assessed in apical 4-chamber view. Systolic (Smitr) and diastolic (Emtr, Aimtr and E/A ratio) velocities were measured averaging three cardiac cycles. Data were analyzed using Kruskal-Wallis test.

Results (see table): Compared to normal subjects, patients with HPT and/ or DM showed a trend toward lower systolic velocities and a significant reduction of E/A ratio, due to progressive lower early diastolic and higher late diastolic velocities. However, in a logistic regression model, age remains the only significant variable (p < 0.001).

Conclusions: Compared to a control group, velocities of mitral annulus evaluated by myocardial Doppler echocardiography are different in patients with HPT and/or DM. However, these changes are significantly more evident in older patients. Thus, in clinical practice all these measures should be considered according to patient’s age.

983 Determinants of exercise capacity in patients with diastolic left ventricular dysfunction

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Exercise presents a physiologic challenge for patients with diastolic dysfunction. An impaired exercise capacity in hypertensive and patients with diabetes mellitus remained exactly recognized.

Aim of the study was to investigate the relationship between diastolic left ventricular dysfunction (LVDD) and objective measures of circulatory, ventilatory and metabolic function during exercise.

Method: All patients underwent comprehensive Doppler echocardiographic assessment and exercise testing with respiratory gas monitoring. Two studied groups consisted of 50 pts with isolated hypertension; 32 male, mean age 50.9 ± 9.2 and 27 pts with isolated diabetes mellitus; 15 male mean age 53.7 ± 6.6.

All patients had preserved systolic function (EF > 58% ± 15%) and impaired LV relaxation (E/A = 0.78 ± 0.15) and between E/A and test duration (RER) tightly dependent of late diastolic wave (A) (r = 0.054) and between E/A and test duration (RER) closely dependent of late diastolic wave (A) (r = 0.054) and between E/A and test duration (RER) closely dependent of late diastolic wave (A) (r = 0.054) and between E/A and test duration (RER) closely dependent of late diastolic wave (A) (r = 0.054).

Conclusion: Kinetics of oxygen consumption and peak exercise capacity are determinate by left ventricular diastolic characteristics. Diastolic dysfunction and not EF is related to aerobic capacity impairment in pts with hypertension and diabetes mellitus.
984 Increased sympathetic drive to the cardiovascular system in middle-aged obese women: new evidence from a wave intensity approach

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Cardiovascular (CV) involvement in obesity remains a still controversial issue. The multifactorial origin of CV disease in obesity, when present, may explain conflicting findings reported in the literature.

To address this clinically relevant issue, we used a wavefront analysis (“Wave Intensity”) to apply to diameter calibrated for blood pressure (P) and flow velocity (F) waveforms estimated at common carotid artery (CCA) level. WI is the product of the time derivatives of P and F spatially averaged across the vessel diameter, and provides information about LV systolic function and ventricular-arterial coupling.

Methods: Fifteen overweight to severely obese women (OB: BMI 33.5±5.6, mean age 45.7±13.6) and 15 lean age- and gender-matched controls (NL, BMI within 25; age 45.5±12.6), without evidence of CV disease, diabetes and significant dyslipidemia (total cholesterol below 240 mg%) were selected. WI study was performed at the right CCA by a new real-time non-invasive system using an Aloka SSD-5500 echocardiographic machine with a 7.5 MHz linear probe, implemented with an echo-tracking system (spatial resolution about 15 μm) for arterial diameter monitoring. Average F is obtained by range-gated color Doppler signals. Pressure waveforms are estimated through arterial diameter change waveforms, as previously validated. From R-wave synchronized waveform analysis we assessed LV pre-ejection and ejection time (PER, LVEF, Augmentation Index (AI), local pulse wave velocity (PWV), and the two characteristic positive WI peaks resulting from forward travelling waves: W1, early-systolic, “compression wave”, related to LV inotropism, and W2, late-systolic, “extension wave”, influenced by peripheral resistance.

Results: Compared to NL, OB had significantly (p<0.05) higher heart rate (79±13 vs 68±13 bpm), blood pressure (136±16/83±10 vs 113±11/72±11 mmHg), AI (19.9±14.5 vs 9.9±9.6%), as well as area under the curve of W1 (1464±456 vs 375±146 mmHg m²/s) and W2 (114±73 vs 69±34 mmHg m²/s). No differences were found in PWV, PER, LVEF. In the overall population, peak W1 was directly related to heart rate (r=0.472, p<0.05).

Conclusions: Our women free of CV disease, a preserved pump function against increased arterial impedance is maintained at espense of an increased LV inotropism supported by enhanced sympathetic drive. The WI approach provides an interesting new tool for noninvasive evaluation of ventricular-arterial coupling in preclinical CV disease.

985 Central obesity is an independent predictor factor for left ventricular diastolic dysfunction in diabetic hypertensive patients

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Purpose: Left ventricular diastolic dysfunction is a common feature of diabetes and hypertension. Diabetes and hypertension are frequently associated with obesity, which may further contribute to diastolic dysfunction. The aim of the present study was to evaluate the influence of obesity on left ventricular (LV) diastolic dysfunction assessed by tissue Doppler imaging - derived indices in diabetic hypertensive patients.

Methods: We studied 41 patients (33 females) with type 2 diabetes and hypertension (systolic/diastolic blood pressure >140/80 mmHg or antihypertensive drugs) without coronary artery or valvular disease and good LV systolic function. All patients underwent transthoracic 2-D, M-mode, conventional Doppler and tissue Doppler echocardiography at rest. The ratio of peak early diastolic filling velocity (E) to septal mitral annular peak early diastolic velocity (Em) was measured; E/Em >10 indicates diastolic abnormality, and is known to correlate well with LV filling pressures. Multiple linear regression analysis was used to evaluate the independent predictor factors for E/Em (dependent variable). Independent variables used in the model were: age, years since diagnosis of diabetes, body mass index, waist circumference, glycated haemoglobin, interventricular septum thickness, systolic and diastolic blood pressure.

Results: The characteristics of the patients studied were: mean (SD): age, 48.4±9.8 years (range 25-71); since diagnosis of diabetes, 8.3±7.2 years (range 1-25); body mass index 31.3±5.2 kg/m²; waist circumference, 106.6±10.8 cm; glycated haemoglobin 7.91±0.97%; interventricular septum, 12.3±2.2 mm; E, 10.5±2.5; systolic blood pressure, 140±7.9 mmHg; diastolic blood pressure 78.8±8 mmHg. There was a weak, but significant, independent positive correlation of E/Em only with waist circumference (r=0.2, p<0.05).

Conclusions: In diabetic hypertensive patients, a non-invasive index of LV filling pressure derived by tissue Doppler echocardiography (E/Em) independently correlates with waist circumference, which indicates central obesity. Whether the co-existence of central obesity and hypertension in these patients is simply an epi-phenomenon or may have an adverse effect on cardiovascular prognosis warrants further research.

986 The dispersion of tissue Doppler myocardial velocities in patients after myocardial infarction with and without diabetes

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Aim: to quantify the left ventricular LV contractility in patients with left ventricular dysfunction after myocardial infarction with and without diabetes using pulsed wave tissue Doppler echocardiography (TDE).

Methods and results: The study group included 30 patients after myocardial infarction with diabetes (aged 62±6 years; LVEF 32%±10%), 30 patients after myocardial infarction without diabetes (aged 64±7 years LVEF 31.6%±8%) and 30 healthy volunteers (aged 57±6 years LVEF 61%±8%). We measured TDE systolic and diastolic velocities using pulsed wave tissue Doppler; TDE velocities dispersion index was calculated as a ratio of standard deviation to the mean value of myocardial velocities of six basal segments.

Systolic myocardial velocities and early diastolic velocities were significantly lower in patients after myocardial infarction with diabetes than in pts without diabetes (respectively; systolic velocities: 3.9±1.0 vs 6.6±1.7 vs 12.9±1.6 cm/s; ANOVA, p<0.05; early diastolic velocities: 5.1±1.0 vs 9.6±1.1 vs 15.3±1.1 cm/s; ANOVA, p<0.05). There were no significant differences between groups in late diastolic velocities. Dispersion index of systolic velocities in patients with diabetes was significantly higher than in patients without diabetes and control subjects (respectively: 38.1±6.0% vs 28.6±3.2% vs 15.8±5.6%; ANOVA, p<0.05).

Conclusions: In patients with left ventricular dysfunction after myocardial infarction and diabetes systolic and early diastolic myocardial velocities are significantly lower than in patients after myocardial infarction without diabetes, with higher dispersion of systolic velocities.
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Isolated type 2 diabetes mellitus causes myocardial dysfunction that becomes worse in presence of cardiovascular diseases; results of the Myocardial Doppler in Diabetes (MYDID) study 1

Purpose: Uncomplicated type 2 diabetes mellitus (DM) have been reported to cause myocardial functional disturbances. It is however not known whether the extent of the disturbances are similar to those seen in coronary artery disease (CAD) and hypertension (HTN) neither is it known whether combination of the illnesses causes additional disturbances. To investigate the issue we have performed tissue Doppler enhanced dobutamine stress echocardiography (DSE) in a group of subjects with these illnesses, isolated or in combinations.

Subjects and methods: 200 subjects, (127 males, 73 females, 56±10 years) including controls (n=23), patients with HTN (n=20), CAD (n=35), isolated DM (n=59), DM+HTN (n=27), DM+CAD (n=16), and DM+HTN+CAD (n=20), underwent DSE. Regional myocardial systolic and early (E') myocardial diastolic velocities (cm/s) were measured off line at rest and during maximal stress (max).

Results: Average LV systolic velocities at rest were significantly lower in CAD compared with controls (5.7±1.2) and in DM+HTN compared with DM (5.3±1.3) (all p<0.05). During exercise, significantly lower systolic velocities also appeared in DM (p<0.01) and HTN group (p<0.01) compared with controls (12.5±2.5), as well as in DM+HTN and DM+CAD compared with isolated DM (11.3±2.6) (all p<0.001). The E' velocity distribution showed a similar response. Pooled data (Fig) showed that DM with cardiovascular diseases (CVD+DM) has significantly lower systolic velocities compared with those without CVD-DM.

Conclusion: The results suggest that isolated DM causes diminished myocardial systolic and diastolic velocity response to dobutamine. The discrete disturbances become more pronounced when concomitant CAD and/or HTN complicate upon DM.

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Diastolic dysfunction is a common feature in patients with diabetes irrespective of the presence of hypertension
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Purpose: Diabetes, hypertension and ageing are frequently associated with left ventricular diastolic dysfunction. The aim of the present study was to evaluate the prevalence and severity of diastolic dysfunction in diabetic patients with and without hypertension.

Methods: We studied 56 patients with type 2 diabetes without coronary artery or valvular disease and good left ventricular systolic function; 41 with hypertension (HT; systolic diastolic arterial pressure >140/90 mmHg or on antihypertensives drugs) and 15 without hypertension (NT). Diastolic function was assessed using conventional Doppler echocardiography at rest (deceleration time, isovolumic relaxation time, peak early diastolic filling velocity (E)/peak atrial filling velocity (A) ratio, peak pulmonary venous atrial reversal (AR) flow velocity and duration) and tissue Doppler echocardiography (septal mitral annular peak early diastolic velocity (E wave), E'/A ratio, tissue Doppler derived parameters (E/A, E/A-T)).

Results: No significant differences were noted between two groups regarding standard assessment of diastolic function (E/A, E/A-T) or TDE parameters. The E/A-T velocity was similar between the groups. TDE measurements: systemic (S-), early (E-), and late (A-) velocities of a mitral annulus were recorded. The ratio E/A-T was calculated.

Conclusion: No significant differences were noted between two groups regarding standard assessment of diastolic function (E/A, E/A-T) or TDE parameters. The E/A-T velocity was similar between the groups. TDE measurements: systemic (S-), early (E-), and late (A-) velocities of a mitral annulus were recorded. The ratio E/A-T was calculated.

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Tissue Doppler echocardiography in the assessment of left ventricular dysfunction in patients with type 1 diabetes mellitus
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Background: Little is known about the early stages of left ventricular dysfunction in patients (pts) with type 1 diabetes mellitus (DM1).

Methods: Tissue Doppler echocardiography (TDE) extends the diagnostic possibility to detect these early changes in diabetic heart.

Results: The study group consisted of 24 pts with DM1 (14 men, mean age 26.2±1.2 years). Mean duration time of diabetes was 15.7±5.5 years. Pts with any history or signs and symptoms of heart diseases and severe diabetic complications were excluded. Microvascular complications (background retinopathy, microalbuminuria or periferal neuropathy) were observed in 72% of pts. 14 healthy volunteers (mean age 25.3±0.9 years) served as a control group.

Conclusions: Tissue Doppler echocardiography was performed using standard approach. TDE measurements: systemic (S-), early (E-) and late (A-) velocities of a mitral annulus were recorded. The ratio E/A-T was calculated.

Results: No significant differences were noted between two groups regarding standard assessment of diastolic function (S-, E/A, E/A-T) or TDE parameters. The E/A-T velocity was similar between the groups. TDE measurements: systemic (S-), early (E-), and late (A-) velocities of a mitral annulus were recorded. The ratio E/A-T was calculated.
991 Strain rate imaging during dobutamine stress identifies reduction of myocardial inotropic reserve in uncomplicated type II diabetes


Strain rate (SR) and Strain (S) derived by color Tissue Doppler are indices which provide information about myocardial performance, both at rest and during stress-echo, in humans. Aim of the study was to evaluate S and SR changes during dobutamine (Dob) stress echocardiography in patients with type II diabetes, free of overt coronary heart disease.

Fifteen type II diabetic patients and 15 healthy controls, without left ventricular (LV) wall motion abnormalities, underwent standard and Dob-stress echocardiography. Longitudinal myocardial tissue-Doppler systolic velocities (Sm, cm/s), SR (1/s) and S (%) of posterior septum were measured by off-line analysis at rest, at low-Dob and high-dose Dob. Reproducibility analysis in 10 subjects showed Bland-Altman inter-observer interval of agreement for high-Dob SR comprised between -4.7% and 7.2%. The 2 groups were comparable for age, sex, body mass index, systolic blood pressure (BP), diastolic BP and heart rate (HR) at rest. Left ventricular mass index and relative wall thickness were higher and midwall shortening lower in diabetics than in controls (all p<0.0001), with difference in endocardial shortening. Transmitral Doppler analysis showed a pattern of LV abnormal relaxation in diabetics (lower E/A ratio, prolonged deceleration and isovolumic relaxation times). Sm and SR were similar between the 2 groups at rest. S was -22.9±3.1% in diabetics and 23.1±2.8% in controls (p=ns). At low and high-dose Dob, Sm, HR and BP were similar in both groups, but both Sm and SR were lower in diabetics at low-Dob (p<0.03 and p<0.01, respectively) and at high-Dob (p<0.005 and p<0.001, respectively). S improved with increasing HR at any level of Dob test (rest, low-Dob, high-Dob) in either group (p<0.0001 in both diabetics and controls). However, plotting together HR at rest, low-Dob and high-Dob with the respective S values, the slope of this association was lower in diabetics (b=-0.07) than in controls (b=-0.15, p=0.04).

In conclusion, patients with type 2 diabetes mellitus have a depressed resting midwall mechanics which is associated with altered strain imaging under Dob stress. The blunted slope of the association between S and HR underscores the alteration of force-frequency relation and highlights a reduced myocardial inotropic reserve in the diabetic heart.

992 The improvement in myocardial performance index (MPI) and LV systolic function after one year of growth hormone (GH) therapy in patients with childhood onset GH deficiency (GHD)

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Objective: There is accumulating evidence that GH has an important role in the maintenance of normal cardiac growth and function.

Patients and methods: Sixteen patients with childhood onset GHD (age 42.3±13.1 years, 10 males) were investigated before and after 12 months of GH treatment at a dose of 0.02 IU/kg/day (7 ug/kg/day). The GH dose resulted in a serum IGF-I level in the normal range in all patient. A complete Doppler-echocardiographic examination, treadmill exercise test, Technetium-99m sestamibi single-photon emission computer tomography (SPECT) imaging at rest and after exercise were performed basally and after 12 months.

Results: Echocardiography showed improvement in left ventricular systolic function after GH treatment. End-systolic volume decreased from 30.0±12.4 ml to 24.4±8.2 ml (between-group comparison, p<0.05) and ejection fraction increased from 55.9±7.0% to 62.2±9.2% (between-group comparison, p<0.01). Left ventricular diameter and wall thickness did not change after GH treatment, although systolic increase in interventricular septum thickness (IVS%) and systolic increase in posterior wall thickness (PWT%) increased significantly (IVS% 52±31.9% vs. 67.3±30.4% and PWT% 48.7±20.2% vs. 58.0±17.7%, p<0.01, p<0.01, respectively). Left ventricular contractile function measured at midwall level improved - left ventricular midwall fractional shortening (MWS) increased (16.1±6.55 vs. 23.30±5.89%, p=0.0068) and stress-correlated MWS increased between examinations performed before and after 12 month of GH treatment (90.97±36.66 vs. 133.10±29.84%, p=0.0049). Diastolic function did not change as assessed by early diastolic flow (E), diastolic flow secondary to atrial contraction (A), or E/A ratio. Myocardial performance index (MPI) which is defined as the sum of isovolumetric relaxation and contraction times divided by ejection time and evaluates diastolic and systolic LV function was subnormal at baseline (0.483±0.146, normal range 0.37±0.05). After 12 months of GH treatment MPI decreased to normal values (0.410±0.086, p=0.0104), LV-mass index increased after GH treatment (103.33±28.4 vs. 108.19±28.1 g/m²), although it did not reach significance (p=0.05). There was a trend for an increase in exercise duration and capacity after GH treatment, but the difference did not reach statistical significance. SPECT imaging showed normal myocardial perfusion at rest and after exercise basally and after 12 months in all patients.

In conclusion, GH replacement therapy in adults with childhood onset GHD demonstrated beneficial effects on cardiac performance.

993 Effect of thyroid hormones on ultrasound myocardial tissue characterization

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Objective: Thyroid hormones influence cardiac performance directly and indirectly via changes in peripheral circulation. Patients with a history of thyroidectomy for thyroid cancer present a unique model to investigate the cardiac effects of hypothyroidism.

Patients and methods: Eighteen patients with a history of thyroidectomy for thyroid cancer (age 45.4±12.0 years, 2 males) in whom thyroid hormone replacement therapy (T4) was withheld for whole body radioiodine scanning, were investigated before restoration of T4 therapy and after 5 months of euthyroid conditions. Cardiac structure and functional indices were measured by echocardiographic techniques including acoustic quantification with cyclic variation (CV) of integrated backscatter (IBS) from the myocardium during the cardiac cycle.

Results: During the first echocardiography study, both levels of free thyroid hormones were below normal range, and TSH was increased, confirming the severe hypothyroid state. T4 medication resulted in a euthyroid state at the time of the second study. Thyroid hormone levels increased significantly to the upper normal range, and TSH concomitantly decreased to the lower normal range. Left ventricular diameter and wall thickness did not change after T4 treatment, although systolic increase in wall thickness increased significantly (IVS% 27.1±10.3% vs. 36.4±12.3% and PWT% 33.5±14.6% vs. 42.9±18.6%, p<0.05, p<0.05, respectively). Ejection fraction calculated by the Teichholz formula increased from 0.57±0.11 to 0.65±0.05 (p<0.001) and cardiac output increased from 3734±655 to 4400±866 ml/min. (p<0.001). LV-mass index did not change significantly after T4 treatment (165.7±42.9 g/m² vs. 159.9±38.5 g/m²). The cyclic variation of integrated backscatter (CV-IBS) increased significantly after 5 month of treatment (p<0.05), in both the interventricular septum and the left ventricular posterior wall (6.43±1.20 vs. 7.82±1.68 dB for the interventricular septum, 7.12±2.44 vs. 8.43±2.37 dB for the left ventricular posterior wall, p<0.01, p<0.001, respectively). The calibrated integrated backscatter (cal-IBS) did not change significantly after T4 treatment (-23.22±7.56 vs. -23.85±7.27 dB for the interventricular septum, -24.63±6.01 vs. -25.61±5.08 dB for the left ventricular posterior wall). Correlation was found between CV-IBS and increase in LV walls thickness.

Conclusion: Hypothyroidism is associated with decreased cyclic variation of IBS and thyroid hormone replacement therapy improves CV-IBS. This finding is in concordance with improvement of LV systolic function by thyroxine therapy.
994 Usefulness of tissue characterization (integrated backscatter) in early detection of structural and functional myocardial alteration in severe obesity

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Obesity is associated with haemodynamic overload (pre-load), so resulting in an haemodynamic circulation with increased blood volume. Aim of the present study was to analyze the functional effects on the heart induced by severe obesity, through the backscatter analysis, which is able to enlighten the structural and functional myocardial alterations, relatively independent by load conditions.

Obese subjects (O) were carefully selected in the Endocrinologic Department: 19 obese (O) (13 female) (mean age: 38.5 ± 5.3 and mean weight: 119.1 ± 18 kg) and 19 healthy, non obese subjects (C) of comparable age and sex were studied. Severe Obesity was defined by BMI > 35 Kg/m² (all study subjects are normotensive, no diabetic and have a negative maximal exercise stress test. All subjects performed conventional 2D-Color Doppler echocardiography and ultrasonic myocardial integrated backscatter analysis (IBS) through Acoustic Densitometry (Philips Sonos 5500 echograph). Left ventricular mass indexed by heart was 2.7 was significantly higher in group O in comparison with controls (C) (60.1 ± 15 vs 41.6 ± 8 g/m²; p < 0.001) due to a slight but significant increase in left ventricular volume (p = 0.05) and in myocardial thickness (septum: p < 0.0001).

So, both higher heart rate (p < 0.001) and cardiac output (p < 0.01) determined in O an increase in preload (left atrium dilation: p < 0.001). Of constant speed, left ventricular systolic function revealed an hyperdynamic status: Ejection Fraction (EF): 78 ± 5% in O vs 63 ± 7% in C; < 0.0001. Left ventricular diastolic function showed a slightly but significant impairment in O group (E/A ratio of mitral flow pattern: 1.6 vs. C: 1.6 ± 0.2; p < 0.005). The IBS values at septum level, indexed by pericardium interface, are significantly higher for septum (A: 50.2 ± 11 vs C: 41.9 ± 9%; p < 0.005). Other IBS measurements in O are present in obese heart if we considered the dynamic variations (Cyclic Variation Index:CVI) both at septum (CVIibs.O: 10.9% vs. 28.7%; p < 0.0001) and at posterior wall level (CVIibs.O: 24 ± 12% vs. 38 ± 13%; p < 0.001).

The Backscatter analysis allows to obtain two fundamental findings in these patients: 1) the detection of an alteration of the level of myocardial echo-reflection, compared with pericardium interface, expression of structural modifications induced by obesity; and 2) the early alteration of myocardial intrinsic contractility showed by CVI also when EF is over normal. The independence by load conditions of IBS parameters, makes them more sure for the serial evaluation of obese patient.

995 The evaluation of the effect of glycemic control in diabetic patients on left ventricular diastolic functions using transmural Doppler echocardiography: a comparison between pre and post hemodialysis


Purpose: The diastolic dysfunction of left ventricle is one of the earliest signs of cardiac involvement in diabetic patients. In this study we planned to investigate the effects of glycemic control on left ventricular diastolic functions. Standard Doppler echocardiography and pulsed tissue Doppler imaging (TDI) from the mitral annular level were used to evaluate the diastolic functions.

Methods: 12 patients followed for type 2 Diabetes Mellitus for at least 1 year in our Endocrinology outpatient clinic who were on oral antidiabetics were included in the study. The patients were grouped according to their mean HbA1c levels in the last 6 months. Patients with a mean HbA1c level > 8.5% were included in Group 1, and those with a HbA1c level 6.7-4% were in Group 2 and those with a HbA1c level > 7.5% were in Group 3. All the participants underwent conventional 2-dimensional echocardiography. For the evaluation of LV diastolic functions transmural early diastolic diastolic wave velocity (E wave), late diastolic wave velocity, E wave deceleration time and isovolumetric relaxation time (IVRT) were measured with TDI. The measured TDI parameters were as follows: early diastolic maximal velocity (e wave), late diastolic maximal velocity, systolic maximal velocity and the duration of s wave, IVRT and isovolumetric contraction time. The measurements were made from the mitral annular level of the lateral wall and interventricular septum.

Results: The clinical and demographic characteristics and the laboratory findings of Group 1 (n = 38, mean age 59.1 ± 7.9, 14 males), Group 2 (n = 40, mean age 59.3 ± 6.8, 14 males) and Group 3 (n = 34, mean age 59.8 ± 1.1, 15 males) were similar (p < 0.05). The patients were equally in all groups and their blood pressures were well regulated. The left ventricular mass was significantly greater in Group 3 than Groups 1 and 2 (Group 3: 260 ± 7 vs Group 1: 253 ± 20 vs Group 2: 225 ± 14 mm; p < 0.007) and lateral side of mitral annulus (Group 1: 253 ± 20 mm vs Group 2: 225 ± 14 mm; p < 0.007) were longer in Group 1 than Group 3. The other TDI parameters failed to demonstrate a significant difference between the groups.

Conclusion: Our findings suggest that patients who have a tight glycemic control have better diastolic functions than diabetic subjects whose glycemic control is poor.

996 Pulmonary venous inflow shows impairment of left ventricle relaxation in young healthy persons with gigantic obesity

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The impairment of left ventricular diastolic function (LV-DF) causing changes of mitral flow (MVF) was shown in obesity. The aim of our study was to examine the pulmonary venous flow (PVF) in young healthy persons with gigantic obesity.

Material and methods: The study group (O) consisted of 20 healthy persons (14 women, 6 men; age 20 – 40, mean 29) with gigantic obesity (BMI > 40). The control group (C) consisted of 20 healthy persons (12 women, 8 men; age 22 – 40, mean 31) with BMI < 25. In ECHO the parameters of LV-DF was measured.

Results: MVF assessment: maximal velocity (Vel max; cm/sec) of early phase (E) was lower in O (without statistic significance; NS) than C (without late phase (A), was higher in O than C (NS) so the MV E/A ratio was significantly lower in obese persons than in control group (1.3 vs 0.2 ± 0.6 vs 1.5 ± 0.2; p < 0.05). The deceleration time of MFV-E and isovolumetric relaxation time did not differ significantly between groups. PVF assessment: Vel max of systolic flow (S) was higher in O group than C (63 ± 8 vs 50 ± 8; p < 0.001). Vel max of diastolic flow (D) was lower in O than C (48 ± 12 vs. 58 ± 7; p < 0.05); so the PVF S/D ratio was significantly higher in obese persons than in control group (1.4 ± 0.3 vs 0.9 ± 0.2; p < 0.0001).

Conclusions: The assessment of PVF is a good method to reflect LV-DF, even when MVF remains normal. 2. The S/D ratio of pulmonary vein inflow in young healthy persons with gigantic obesity shows impairment of LV relaxation, when MVF E/A is normal.

998 Left ventricular and atrial systolic velocities increase following a single hemodialysis session in patients with end-stage renal disease investigated using tissue Doppler echocardiography

S. Govind, L.-A. Brodin, J. Nowak, S. Roumina, B. Lind, S.K. Saha1, Karolinska Univ Hospital, Huddinge, Stockholm, Sweden, 1 Karolinska Universitet Hospital, Huddinge, Stockholm, Sweden

Purpose: Haemodialysis (HD) is known to improve cardiac function in patients with end-stage renal disease (ESRD). However, the mechanism behind such improvement is not entirely known. We propose that tissue Doppler echocardiography (TDE) offers a rapid, bed side choice to follow the changes in regional myocardial functions in patients undergoing HD.

Methods: 23 subjects (55±8 years) with ESRD undergoing HD were investigated prior to and immediately after one randomly chosen HD session using both standard Doppler & TDE. A GE Vivid apparatus equipped with Echopac software was used. Standard 2-D and Doppler measurements were followed by colour TDE estimations of left ventricular (LV) regional myocardial systolic and diastolic velocities as well as strain rate imaging. Longitudinal TDE parameters were calculated from the apical projections whereas radial functions were estimated from parasternal (PLAX) windows. Pre-and post-HD data, expressed as mean± SD, were paired to test the null hypothesis at p<0.05.

Results: Average LV ejection fraction was 61%. LV internal dimensions (mm) were significantly lower post HD (51±6 & 48 ± 8; p<0.002), LV wall thickness, and pulmonary arterial systolic pressure were unchanged. Average (mean of 4 LV bases) LV basal peak systolic velocity (cm/s) was significantly higher post HD compared with pre HD (5.5±2.8 vs 4.9 ±1.4; p < 0.001). Average atrial systolic velocities (cm/s), calculated also from the 4 LV bases, were significantly higher post HD: 6.7±2.6 vs 5.5 ±2.8; p< 0.001. Early regional diastolic velocity was unchanged. Radial strain rate (1/s) measured from PLAX view was significantly higher post dialysis (1.6±0.6 vs 1.8 ±0.96; p<0.05) due to a slight but significant difference in arterial blood pressure. Changes in radial strain rate may indicate that improved regional contractility and LV filling as well as reduced afterload have roles in such improvements.
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Longitudinal diastolic function and functional reserve are reduced in patients with end stage renal disease
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Background: Abnormalities of the left ventricular (LV) diastolic function are common in patients with end-stage renal disease (ESRD). In patients with diastolic dysfunction, the abnormal relaxation velocity-versus-heart rate relationship prevents augmentation of relaxation velocity as heart rate increases during exercise. Doppler tissue imaging (DTI) has been introduced as a method to evaluate diastolic function or myocardial relaxation by measuring mitral annulus velocity during diastole. The purpose of this study was to evaluate resting diastolic function and diastolic functional reserve during exercise in patients with ESRD using conventional Doppler and DTI.

Methods and results: Mitral inflow and septal mitral annular velocities were measured at rest and during supine bicycle exercise (25 W, 3 min increments) in 22 patients (15 male, mean age 53 years) with ESRD and 29 patients (7 male, mean age 58 years) with control. None had echocardiographic evidence of myocardial ischemia. LV end-diastolic and end-systolic dimensions and left atrial volume index were significantly larger in patients with ESRD compared with controls. The ejection fraction was significantly lower in patients of ESRD (68 ± 6 vs 62 ± 9, p = 0.0079).

There were no significant differences in mitral inflow velocities (E, E/A, DT) between the two groups except A velocity, which was significantly higher in patients of ESRD. However, early diastolic mitral annular velocity (E') at rest and change of E' with exercise was significantly lower in patients with ESRD compared with control (figure).

Conclusion: Unlike conventional mitral inflow parameters, longitudinal resting diastolic function and diastolic functional reserve during exercise assessed by DTI were significantly reduced in patients with ESRD.

1000
Reproducibility of thoracic electrical bioimpedance measurements of cardiac output in patients on hemodialysis: comparison with echo-derived cardiac output
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Aim: Thoracic Electrical Bioimpedance (TEB) is a non-invasive method to monitor Cardiac Output (CO). We assessed the short- and long-term reproducibility of TEB in patients on hemodialysis HD and we compared the relationship of CO derived by TEB (TEB-CO) with simultaneous measurements of CO obtained by echocardiography (E-CO).

Methods: Seventy HD patients, 39 with left ventricular Ejection Fraction (LVEF) ≥40% (group A) and 31 LVEF < 40% (group B) participated in the study. TEB-CO was measured with a BioZ System (CDI Corp, Irvine, A, USA) on two consecutive non-HD days (T0 and T1, respectively) and a month later (T2), at the same time for each patient. TEB-CO, on all occasions, was derived as the average of all CO determinations taken over a 10-minute period. At baseline (T0), CO measurements were also obtained by echocardiography [Hewlett-Packard, Sonos 2500] simultaneously with the TEB method. Vasodilatory drugs were not changed during the study period. The short-term (2 days) and long-term (1 month) reproducibility of the TEB-CO measurements were assessed with the intra-individual coefficient of variation (CVi). TEB-CO and E-CO measurements were compared with Bland and Altman analysis.

Results: Table 1 shows the TEB-CO and E-CO measurements in the 2 HD groups.

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Usefulness of Tissue Doppler Imaging(TDI) for evaluation of diastolic function in patients on maintenance hemodialysis: comparison with hypertensive cardiomyopathy

Backgrounds and purposes: It is unknown whether the specific pattern of diastolic dysfunction is exist in patients on maintenance hemodialysis(HD). The aim of this study was to elucidate the condition affect on the LV diastolic function of patients on maintenance HD and the usefulness of TDI for evaluation of LV diastolic function compared with patients of LV hypertrophy(LVH) from hypertensive cardiomyopathy.

Methods: We prospectively examined the medical conditions and echocardiographic parameters mainly centered on representative of diastolic function of 52 patients on maintenance HD(HD group; M:F=24:28, mean age=59±14 years) and 24 patients with hypertensive heart disease(HD group; M:F=13:11, mean age=63±14 years).

Results: LV systolic function was normal in both groups(ejection fraction; 61 ±10% in HD group and 61 ±8% in HD group), LV mass index was 140.4 ±49.7 g/m² in HD group and 120.2 ±36.1 g/m² in HD group(p=NS).

Asymmetrical septal hypertrophy was more frequently noted in HD group(n=28(53.8%) vs n=3(12.5%) respectively, p=0.004). Left atrial(LA) dimension was significantly different between two groups(4.2 ±0.7 cm in HD group vs 2.8 ±0.6 cm in HHD group, p<0.00). In study of mitral septal annular pulsed wave tissue Doppler imaging(TDI), E(a) velocity(0.11 ±0.01 m/sec vs 0.18 ±0.08 m/sec, p=0.008) and E(a) wave VTI(0.013 ±0.012 m vs 0.028 ±0.020 m, p=0.00) were significantly lower in HD group. Mitral inflow to annular tissue Doppler E(a) velocity ratio(8.1 ±3.7 cm in HD group vs 3.9 ±1.6 cm in HHD group, p=0.05) were significantly different between two groups.

Conclusion: In the patients on maintenance HD, the degree of diastolic dysfunction is attenuated because of the increased LA pressure. TDI of mitral septal annulus is useful to evaluate the diastolic function of the patients on maintenance HD.
Load-dependence assessment of ultrasonic tissue characterization and myocardial diastolic and systolic function in patients undergoing hemodialysis

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Ultrasonic tissue characterization with cyclic variation of integrated backscatter (CIVBS) is a noninvasive method for assessment of myocardial performance. Hemodialysis (HD) reduces myocardial hypertrophy and volume and pressure overload.

The aim of the study was to investigate the effect of HD on myocardial tissue characterization and left ventricular function in ESRD patients.

We examined 18 patients with ESRD undergoing routine HD (age 54±16 years, 8 female, 12 male). Routine echocardiographic parameters, tissue Doppler of mitral annulus and CIVBS were measured just before and immediately after HD. For IBS analysis two regions of interest were chosen in the parasternal long-axis view: mid septum and mid posterior wall.

The effect of HD on the echocardiographic parameters and CIVBS. HD significantly reduced left ventricular end-diastolic diameter (LVEDd), left ventricular mass (LVM) and increased relative wall thickness (RWT).

The ratio of transmural E wave to the early diastolic annular velocity (E/Em) was significantly reduced by HD. CIVBS of interventricular septum immediately after HD was lower than before HD.

The present results demonstrated that HD reduced LVM and improved indices of the left ventricular performance. The reduction of myocardial interstitial edema could be responsible for the decrease in CIVBS after HD.

Our results suggest that ultrasonic tissue characterization may be a new diagnostic tool for defining pathological changes in left ventricular hypertrophy in patients with ESRD.

The effect of HD on Echo parameters

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Elevated troponin T is associated with increased left ventricular mass index and predicts mortality in peritoneal dialysis patients

D. Duman, S. Tokay1, O. Unay2, A. Oktay3. Haydarpasa Numune Hospital, Istanbul, Turkey, 1Marmara University Medical School, Istanbul, Turkey, 2Marmara University Medical School, Istanbul, Turkey, 3Marmara University Medical School, Istanbul, Turkey

Background: Patients with end stage renal disease have a high risk of premature death, mainly as the result of cardiovascular (CV) events. It has recently been shown that elevated cardiac troponins (cTnT and cTnI) are related to left ventricular mass index (LVMI) and predict poor outcome in chronic hemodialysis patients.

The aim of this study was to investigate the prognostic value of the cTnT and cTnI in total and CV mortality and their relationship with LVM in CAPD patients.

Methods and results: Sixty-five CAPD patients (mean age 56±12 years; 55 males, 22 diabetic and 15% with known coronary artery disease) without any evidence of acute coronary syndrome in the last 28 days were prospectively included. After 48 months, total and CV mortality were evaluated. During follow-up, 23 pts (35%) died (70% CV cause, 22% non-CV cause).

Conclusion: Elevated cTnT level is a negative ventricular predictor of total and CV mortality in CAPD patients. Furthermore, there was a significant positive correlation between cTnT elevation and increased LVM.

Persistently elevated plasma cardiac troponin T in end stage renal disease: a marker of left ventricular diastolic dysfunction

R. Sharma, D. Pellerin1, D.A. Gaze2, J.S. Shah1, C.P. Streather3, P.O. Collinson3, S.J. Brecker4. London, United Kingdom, 1The Heart Hospital, London, United Kingdom, 2St George’s Hospital, London, United Kingdom, 3St George’s Hospital, London, United Kingdom, 4St George’s Hospital, London, United Kingdom

Plasma Cardiac Troponin T (cTNT) is persistently elevated in a proportion of patients with end-stage renal disease (ESRD) and is associated with increased mortality. The mechanisms for this remain unclear. The aim of this study was to compare baseline characteristics of ESRD patients with and without raised cTNT.

Methods: 118 patients (mean age 52±12 years, 75 male) referred for renal transplantation (mean creatinine 608±272 µmol/l) were prospectively studied over an 18 month period. All had coronary angiography, dobutamine stress echocardiography, exercise testing and baseline biochemical markers. Severe coronary disease was defined as luminal stenosis >70% in at least 1 vessel by visual estimation. For analysis, a baseline cTnT ≥0.1 µg/l was taken as significantly elevated.

Results: 25% of patients studied (n=30) had a raised cTnT. These patients had significantly impaired left ventricular (LV) fractional shortening (30±10% vs 39±9%, p<0.001), higher LV end diastolic diameter (5.2±0.9 cm vs 4.4±0.8 cm, p<0.001), and higher LV end systolic diameter (3.5±0.9 cm vs 2.6±0.7 cm, p<0.001) compared to those without. LV filling pressure was significantly higher in the cTnT positive group (E/A 14±5 vs 10±4, p=0.005, E′/E″ 2.5±0.8 vs 1.6±0.6, p=0.033), as was baseline N Terminal Pro-BRAIN Natriuretic Peptide level (4440±803 pg/ml vs 630±1230 pg/ml, p=0.002). LV wall thickness was similar in the 2 groups.

The proportion of patients with mitral (MV) and aortic (AV) regurgitation with diabetes (68% vs 23%, p<0.001) was significantly higher in the troponin positive group. Age, serum creatinine, the percentage of patients with severe coronary disease, and inducible regional wall motion abnormality was similar in both groups. Stepwise logistic regression identified LV end systolic diameter (odds ratio 4.145, 95%CI 1.9–9.0, p=0.001) and diabetes (odds ratio 10, 95%CI 3.0–34.5, p<0.001) to be independently associated with elevated plasma cTnT.

Conclusions: A significantly elevated plasma cTnT was present in 25% renal transplant candidates. Raised levels were independently associated with diabetes and LV dilatation. There was no association with significant coronary artery disease.

Echocardiographical follow-up of patients on dialysis - The importance of the main pathological findings to cardiovascular risk stratification

V. Vysniauskas, J. Urbanavičienė. Marijampolė Central Hospital, Marijampolė, Lithuania

The aim of the investigation is to analyze the sequence of the appearance as well as the progression of the pathological findings and to estimate cardiovascular risk using the results of echocardiography. Materials and methods: 185 pts (84 [45.4]%m./101[54.6]%f.) have been echocardiographically followed up within 14 years. The average age of the pts was 62 (range16-79). 2D Doppler EchoKG was performed once a year.

Results: Pathological findings have been revealed by the first Echo KG investigation – some degree of MV and AO valve calcification (CV) etc. in all pts. It has recently been shown that elevated cardiac troponins (cTnT and cTnI) are related to left ventricular mass index (LVMI) and predict poor outcome in chronic hemodialysis patients.

The effect of HD on the echocardiographic parameters and CIVBS. HD significantly reduced left ventricular end-diastolic diameter (LVEDd), left ventricular mass (LVM) and increased relative wall thickness (RWT).

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Effect of creation of arterio-venous fistula on left and right ventricular function estimated by tissue Doppler in patients with chronic renal failure

W. Kosmala, W. Weyde, T. Porazko, M. Przewlocka-Kosmala, M. Klinger, W. Mazurek, Medical University, Wroclaw, Poland, 1Medical University, Wroclaw, Poland

Several lines of evidence suggest that arterio-venous fistula (AVF) as an access for hemodialysis therapy may exert adverse influence on the heart. Several lines of evidence suggest that arterio-venous fistula (AVF) as an access for hemodialysis therapy may exert adverse influence on the heart.

Aim: to investigate the effect of creation of AVF on left (LV) and right ventricular (RV) function in patients (pts) with end-stage renal insufficiency.

Material and methods: The study population consisted of 16 pts (mean age 63.9±15.8 years) with chronic renal failure scheduled for creation of AVF. Each patient underwent echo study including color tissue Doppler imaging before, 2 days and 3 months after creation of AVF. Analysis of tissue velocity curves, reconstituted from digitized images acquired in apical views, comprised mean peak systolic velocity (LV Sm), mean early (LV Em) and late diastolic velocity (LV Am) and mean isovolumic relaxation time (LV IRTm) obtained from the 6 basal segments of LV and peak systolic velocity (RV Sm), peak early (RV Em) and late diastolic velocity (RV Am) and isovolumic relaxation time (RV IRTm) from the basal segment of RV free wall.

Results: During follow-up significant decrease in LV Sm and lengthening of RV IRTm were found out already after 2 days. Further evaluation performed after 3 months revealed decrease in LV Sm, LV Em, LV Em/Am ratio, RV Em, RV Em/Am ratio and increase in RV IRTm.

Conclusions: Creation of AVF in pts with chronic renal failure results in an early impairment in RV systolic function and prolongation of RV IRTm, whereas other parameters of RV diastolic function as well as LV systolic and diastolic performance deteriorate later. * p < 0.05 vs baseline

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<td>RV IRTm [ms]</td>
<td>46±13</td>
<td>56±10*</td>
<td>55±14*</td>
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Effect of preload reduction on myocardial energy expenditure

A. Minczykowski, D. Zaremba-Orabink, T. Pietrzak, S. Czekalski, H. Wysocki

University School of Medical Sciences, Poznan, Poland, 1University School of Medical Sciences, Poznan, Poland

Objective: In end-stage renal disease (ESRD) large changes in circulating volume occur during haemodialysis (HD) leading to a reduction in preload.

The relations of preload to myocardial bioenergetic expenditure in ESRD patients have not been previously investigated.

Patients and methods: Twenty one patients (age 53.7±15.7 years, 9 males) on maintenance haemodialysis (4 h three times a week) underwent echocardiography approx. 30 min prior to, and approx. 30 min after, a routine haemodialysis session. A detailed two-dimensional and Doppler examination was made to assess left ventricular (LV) structure and function and to calculate myocardial workload (expressed as energy expenditure) from end-systolic stress, ejection time, and stroke volume.

Results: Haemodialysis resulted in a mean reduction in weight of 1.9±0.5 kg. Following HD, there were significant reduction in left ventricular end-diastolic and end-systolic dimensions and left atrial diameter (LVIDd, 4.6±0.6 vs. 4.4±0.7 cm, p<0.01, LVIDs, 3.3±0.6 vs. 3.1±0.7 cm, p<0.05, LA, 4.2±0.6 vs. 3.6±0.5 cm, p<0.001. Also consistent with a reduction in preload there was a reduction in the peak early transmral flow velocity (E, 85.7±11.2 vs. 63.9±9.8 cm/s, p<0.01) and in the E/A ratio (1.07±0.28 vs. 0.75±0.23, p<0.001). HD decreased E wave deceleration time from 234.2±55.3 to 196.7±31.2 ms (p<0.01). LV wall thickness and systolic increase in wall thickness did not change after haemodialysis (IVSd, 1.5±0.4 vs. 1.5±0.3 cm, PWTd, 1.3±0.3 vs. 1.4±0.3 cm, IVS%, 33.6±20.3 vs. 30.1±10.5% and PWT%, 34.5±19.6 vs. 30.6±12.8%, p<0.05). LV fractional shortening and ejection fraction did not change significantly in comparison with baseline. Doppler stroke volume decreased after HD (74.8±10.9 vs. 70.7±12.7 cm3, p<0.05), however, cardiac output did not change significantly (541±1749 vs. 5524±976 cm3/min). LV mass index did not change after HD (154.8±45.9 vs. 148.7±52.7 g/m3), HD increased significantly circumferential end-systolic stress (eESS, 115.4±44.6 vs. 136.9±56.9 Kdyn/cm², p<0.01) and decreased end-systolic meridional wall stress (mESS), an index of afterload (60.2±25.2 vs. 55.1±25.4 Kdyn/cm², p<0.05). Nonviscously estimated myocardial energy expenditure did not change significantly after HD (1.118±0.543 cal/s=96.6±46.9 Kcal/day at baseline vs. 1.252±0.793 cal/s=105.8±68.5 Kcal/day after HD, p>0.05).

Conclusion: Preload reduction by haemodialysis has an influence on myocardial systolic and diastolic functions. However, the extend of this effect does not change myocardial energy expenditure.

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Prognostic evaluation of echocardiographic changes in hemodialysed patients with End Stage Renal Disease (ESRD) and Renal Transplant Recipients (RTRs)

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Background: A few studies have been done about echocardiographic changes during hemodialysis and after renal transplantation.

Material and methods: In this prospective research project, 76 hemodialysis patients and 32 renal transplant recipients (RTRs) were studied for about 17 months. The systolic and diastolic function of left ventricle and their changes, LV mass index(LVMI) and its changes, pattern of LV hypertrophy and valvular disorders evaluated in each group and compared.

Results: The frequency of regional wall motion abnormality (RWMA) and abnormal ejection fraction (EF<50%) increased in hemodialysis patients. The peak E wave velocity and E/A ratio decreased in RTRs but increased in hemodialysis patients. LVMI elevated in the hemodialysis patients (p<0.0001), but it decreased nonsignificantly in RTRs. Therefore at the end of the study LVMI was much higher in hemodialysis patients (p<0.0001). There was not any significant correlation between LVMI and hemoglobin, creatinine, uremia or albumin. LVMI changes had a significant correlation with the systolic, diastolic and mean blood pressure of hemodialysis patients but not with RTRs.

The most common pattern of ventricular hypertrophy in RTRs was concentric hypertrophy but in hemodialysis patients was mixed hypertrophy. Prevalence and severity of aortic and mitral insufficiency increased in hemodialysis patients but decreased in RTRs.

Conclusion: Probably due to continuous increase of volume and pressure overload and hormonal factors, LVMI increases in hemodialysis patients, whereas in RTRs at least dose not increase. The RWMA and abnormal EF in the hemodialysis patients suggest a progressive left ventricular failure. Due to persistent volume and pressure overload in hemodialysis patients, the frequency of aortic and mitral insufficiency increase. Finally, it can be suggested that in comparison to hemodialysis patients, RTRs have better cardiac function. To approve this theory, more advanced studies are needed.

Key words: Echocardiography-hemodialysis-renal transplantation-systolic function-diastolic function
1009 Acute effects of low intravenous doses of furosemide on left ventricular function in anuric end stage renal disease patients evaluated by color tissue Doppler velocity imaging

S. Yumi Hayashi, L.A. Brodin, B. Lindholm1, B. Lind, S. Gunnnes1, A. Alvestrand1, A. Seeberger1. Huddinge University hospital, Huddinge, Sweden. 1Dept. of Clinical Science, Stockholm, Sweden, 2St Elisabeth Hospital, Tromsøm, Norway.

Color tissue Doppler velocity imaging (TVI), offering objective means to quantify systolic and diastolic function, has improved the sensitivity of echocardiography to detect acute changes in cardiac function. Furosemide (F) has been shown to induce a rapid decrease in left ventricular pressure due to venous dilatation in patients with intact diuresis. In the present study, we used TVI to evaluate the acute vascular effects of small doses of furosemide on left ventricular (LV) longitudinal myocardial function in anuric end stage renal disease (ESRD) patients which has not been studied previously.

Methods: Conventional two dimensional echocardiography and color TVI images were recorded immediately before and 10, 20 and 30 min after an intravenous 40 mg dose of F and 10, 20 and 40 min after a second i.v. 40 mg dose of F given to twelve clinically stable anuric hemodialysis patients (61.6±16 yr, 8 M). The myocardial tissue velocities (v; cm/s) for isovolumetric contraction (IVC), peak systole (PS), isovolumetric relaxation (IVR), early (E) and late (A) myocardial diastolic filling velocities and SR were measured in the left ventricle (LV) at 6 sites (septal, lateral, inferior, anterior and posterior walls) at basal regions. The average of 6 walls was used to evaluate global function.

Results: Heart rate and mean blood pressure were unchanged during the study. Neither the first nor the second dose of F resulted in significant changes in IVC (1.9±0.5 cm/s basally), PSV (4.0±1.2 cm/s basally) and SR (1.1±0.3 cm/s –1basally), indicating that 40 mg and 80 mg of F did not have any effects on myocardial contractility and relaxation. E/A, which is an indicator of diastolic function, decreased significantly after 10 min (1.5±0.5 vs 0.9±0.4 p<0.05) suggesting a change in LV filling dynamics.

Conclusions: In hemodialysis patients, low doses of furosemide, had no netotropic effects but resulted in a change in LV filling indicating increased atrial contribution. This finding indicates that, in contrary to findings in patients with preserved renal function, the vascular effects of low doses of Furosemide are minimal in the presence of end stage renal failure.

1010 Comparison of left ventricular systolic and dyastolic function between patients undergoing chronic dialysis and kidney transplantation in a follow-up study

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Cardiac disease is the leading cause of death among end-stage renal disease patients and it accounts for almost half of deaths. Left ventricular dysfunction has jet well related to poor outcome.

Purpose: To assess and follow-up by annual echocardiogram the systolic and diastolic function in all renal replacement therapy (RRT) pts referred to our institution, investigating any difference between those undergoing chronic dialysis (DIAL) and those transplanted (TX).

Methods and results: 125 pts on RRT (91 DIAL, 34 TX) were enrolled and followed for 2 years. Two expert physicians made off-line analysis of echocardiograms in a blinded fashion and, when significant differences (ie >10%) were found, the results were reviewed together. TX were younger than DIAL (median age 49.3 vs 68.2 years, p <0.0001) but with a longer time on RRT (median time 90 vs 28 months, p <0.0001) and more often suffering from hypertension (88.2% vs 60.7%, p<0.01). A multiple regression Cox’s analysis (including age, sex, time on treatment and heart rate) showed that TX and DIAL differentiated between indexes of systolic function (LVESD, SF, EF), all worse among DIAL. In the follow-up there was no deterioration of these indexes, on the contrary some diastolic parameters worsened (see Table).

Conclusions: DIAL and TX mainly differ over the degree of fluid overload and ureremia, completely resolved in functioning transplanted pts. From our data it’s possible to argue that fluid overload and ureremia might damage the left ventricular systolic function more than hypertension. In a two years follow-up, there was no deterioration of left ventricular pump function, but we found a worsened pattern of dyastolic dysfunction in DIAL and a change from normal to a 1st degree diastolic impairment in TX.

<table>
<thead>
<tr>
<th>Table</th>
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<tbody>
<tr>
<td>DIAL</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>E/e</td>
</tr>
<tr>
<td>LVESD (cm)</td>
</tr>
<tr>
<td>E/A DII (cm)</td>
</tr>
<tr>
<td>TX</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>DT ms</td>
</tr>
<tr>
<td>LVESD (cm)</td>
</tr>
</tbody>
</table>

1011 The effect of the dialysis modality on cardiac morphology and function in patients with chronic renal failure

W. Kosmala, W. Weyde1, M. Krajewska1, M. Przewlocka-Kosma, M. Klenger1, W. Mazurek, Medical University, Wroclaw, Poland, 1Medical University, Wroclaw, Poland.

Alterations in cardiac morphology and function are common findings in patients (pts) with chronic renal insufficiency, especially those treated with chronic dialysis. Data concerning direct comparison of adverse effects of two modalities of dialysis – i.e. continuous ambulatory peritoneal dialysis (CAPD) and hemodialysis (HD) - on myocardial structure and function are still incomplete.

Aim: to compare pts treated with CAPD and HD with respect to the left (LV) and right (RV) ventricular morphology and systolic and diastolic function.

Material and methods: The study population consisted of 16 pts (mean age 67.4±12.6) chronically dialyzed by CAPD and 15 pts (mean age 69.3±8.1) dialyzed by HD with arteriovenous fistula as access for therapy. The clinical characteristics of the CAPD and HD groups were similar in terms of duration of dialysis treatment, blood pressure, hemoglobin values and concomitant pharmacotherapy. There were also no significant differences between both groups in the level of residual renal function, volume status and intensity of inflammatory process assessed by plasma levels of CRP and IL-6.

Each patient underwent standard echocardiographic study with the additional use of tissue Doppler imaging. Analysis of tissue velocity curves included mean peak systolic velocity (LVSv), mean peak early diastolic velocity (LVEv) and mean isovolumetric relaxation time (LVRt) obtained from 6 basal segments of LV and peak systolic and peak early diastolic velocity from basal segments of LV and RV free wall (LVSm, RVSm and RVEv, respectively). According to established criteria all pts were classified into four different groups: normal (NG), concentric remodeling (CR), eccentric hypertrophy (EH) and concentric hypertrophy (CH).

Results: NG was found in 12% of CAPD and 0% of HD pts, CR – in 19% of CAPD and 0% of HD pts, EH – in 44% of CAPD and 40% of HD pts and CH – in 25% of CAPD and 60% of HD pts. There were no significant differences in predicted left and RV function parameters between CAPD and HD pts.

Conclusion: LV and RV systolic and diastolic function are comparable between CAPD and HD pts. In HD pts LV hypertrophy, especially concentric one, is more prevalent than in CAPD ones, which may be related to the presence of arteriovenous fistula.

1012 Assessment of left ventricular diastolic function in patients with chronic renal failure - A thirty months follow-up study

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Objectives: The aim of this study was to evaluate left ventricular diastolic function in patients with chronic renal failure (CRF) during thirty months follow-up.

Background: Left ventricular diastolic dysfunction is well known in CRF patients treated with hemodialysis (HD) and peritoneal dialysis (PD). Changes in diastolic function have not been well characterised in this group of patients.

Methods: Eighty eight patients (M/F: 43/45, age 46.6±12.6 years) with CRF were studied by echocardiography. Pulsed wave Doppler was used to obtain mitral inflow and pulmonary venous flow velocities an grade of diastolic dysfunction. Four mitral inflow patterns were distinguished: normal, impaired relaxation, pseudonormalization an restrictive pattern. Deceleration time of early wave of mitral inflow pattern (DecTE) and isovolumetric relaxation time (IRT) were measured.

Results: According to this grading method we found: 5 pts from HD group and 9 pts from PD group with normal diastolic function, 33 pts from HD group and 32 pts from PD group with impaired relaxation, 0 pts from HD group and 2 pts from PD group with pseudonormalization and 2 pts from HD group and 2 pts from PD group with restrictive mitral inflow pattern during first examination. After thirty months follow-up we found: 4 pts from HD group and 3 pts from PD group with normal diastolic function, 32 pts from HD group and 34 pts from PD group with impaired relaxation, 0 pts from HD group and 2 pts from PD group with pseudonormalization and 4 pts from HD group and 8 pts from PD group with restrictive pattern. There were no significant correlation between IRT and DecTE in both groups of CRF pts.

Conclusion: A wide range of diastolic dysfunction grades was found in patients with CRF on renal replacement therapy. In the majority of CRF patients impaired relaxation was found during first and second examination. Serial Doppler mitral inflow record shows progression of left ventricular diastolic dysfunction in patients with chronic renal failure treated with hemodialysis and with peritoneal dialysis.
We investigated RV function in 10 consecutive pts with FD (9 phenotypes regarding RV involvement differs between both disorders. Ventricle (RV) in FD and HNCM are lacking. No data are at issue, if the clinical features of HNCM has to be excluded. Studies investigating the right ventricle (RV) in FD and HNCM are lacking. No data are at issue, if the clinical phenotype regarding RV involvement differs between both disorders.

Methods: We investigated RV function in 10 consecutive pts with FD (9 men and 1 woman; age 55+/–10 years; septal wall 17+/–3 mm) and matched pts with HNCM by invasive methods including right ventricular angiography (EMCB) and in 50% of pts apparent RV involvement was diagnosed by TTE and/or angiography (in HNCM RV involvement was present in 50% of pts: hypertrabecularization and RV hypertrophy). Additionally, TDI revealed RV cardiomyopathy in 1 pt. Description: This is the first report about clinical apparent RV involvement in pts with cardiac FD which seems to be frequent in pts with pronounced left ventricular hypertrophy as in pts with HNCM. TDI seems to add additional information about concealed RV involvement in both disorders. Further studies using TDI and magnetic resonance imaging are mandatory to elucidate if the cardiac phenotype differs between FD and HNCM. This is of importance because enzyme replacement therapy of FD for the first time offers a causal therapeutic option in a subgroup of pts with the clinical features of HNCM.

Specific for ARVD revealed by echo- Phenomenon of Brugada pts.

Abstracts S175


Methods: Data of 6 individuals with an ECG compatible with Brugada syndrome were randomized to RVA or RVOT pacing. This year echocardiographic examination and NT-pro BNP analysis was performed in 13 RVOT pts (age 69+/–16 years; pacing time 89+/–9 months) and 14 RVA pts (age 76+/–7 years, pacing time 89+/–9 months), LV diastolic function was assessed on the basis of the mitral inflow and pulmonary vein velocities.

Results: NT-pro BNP levels were significantly lower in the RVOT group in the long term follow-up. There were no differences between groups with regard to the mitral inflow parameters in the peri-implantation period or long term follow-up. Decreased VTI-S, increased VTI-D and Adur-pulm in the RVA in comparison to the RVOT group at long term follow-up indicate faster progression of diastolic dysfunction in the RVA group.

Conclusions: Long-term RVOT pacing leads to a lesser degree of diastolic dysfunction than RVA pacing.

1017 Influence of long-term right ventricular apex in comparison to right ventricular outflow tract pacing on left ventricular diastolic function

Permanently right ventricular apex (RVA) pacing leads to adverse changes in myocardial geometry and hemodynamics. Right ventricular outflow tract (RVOT) pacing seems to be more beneficial due to different activation patterns.

Purpose: Assessment of left ventricular (LV) diastolic function in relation to long-term RVOT or RVA pacing.

Methodology: In 1995-1997 123 pts with standard pacing indications were randomized to RVA or RVOT pacing. This year echocardiographic examination and NT-pro BNP analysis was performed in 13 RVOT pts (age 69+/–16 years; pacing time 83+/–6 months) and 14 RVA pts (age 76+/–7 years, pacing time 89+/–9 months), LV diastolic function was assessed on the basis of the mitral inflow and pulmonary vein velocities.

Results: NT-pro BNP levels were significantly lower in the RVOT group in the long term follow-up. There were no differences between groups with regard to the mitral inflow parameters in the peri-implantation period or long term follow-up. Decreased VTI-S, increased VTI-D and Adur-pulm in the RVA in comparison to the RVOT group at long term follow-up indicate faster progression of diastolic dysfunction in the RVA group.

Conclusions: Long-term RVOT pacing leads to a lesser degree of diastolic dysfunction than RVA pacing.

RVOT/RVA - LV diastolic parameters, BNP

Case 1: RV function normal in most FD pts (RV function normal in 9 of 10 pts by TTE and in 9 of 10 pts by TDI). However, RV angiography revealed in 3 of 10 pts (30%) abnormal RV hypertrophycardiac involvement was diagnosed by TTE and/or angiography (in HNCM RV involvement was present in 50% of pts: hypertrabecularization and RV hypertrophy). Additionally, TDI revealed concealed RV involvement in 1 pt. A characteristic of FD patients is an increased PVR, and in patients with a transplanted heart the increased PVR may cause RV dysfunction.

The early survival after cardiac transplantation (Tx) mainly depends on the function of the transplanted heart. A donor heart, not adapted to the mostly elevated pulmonary artery pressure and resistance in the recipient, may cause right ventricular (RV) failure after Tx. Strain (S) and strain rate (SR) imaging are accurate methods for the noninvasive quantification of regional systolic deformation which could be helpful in the early evaluation of RV failure.

Aims: To evaluate systolic deformations of the RV using S and SR imaging early after heart transplantation.

Methods: The study population consisted of 10 recent heart transplant patients, each being studied 10 times during a 4 months follow up after Tx. Right heart catheterization, standard echocardiography, together with S and SR imaging, were performed. Longitudinal deformation was analyzed for the RV free wall (basal and apical segment) and the interventricular septum (basal, mid- and apical segment).

Results: A significant correlation (multivariable analysis) was shown between decreasing Pulmonary Vascular Resistance (PVR) and increasing S values in the basal (Fig. 1 left) and apical (Fig. 1 right) segments of the RV free wall, in the period after Tx. SR seemed to be less sensitive to PVR changes. The interventricular septum did not show any changes. The ratio of S/PVR did not change over time.

Conclusions: Strain imaging detects changes in RV deformation, which reflect the changes in PVR, early after Tx. This offers possibilities for the non invasive echocardiographic evaluation the RV and failure in heart transplant recipients.
1018
Is routine pulmonary artery systolic pressure calculation by Doppler a correct estimation?
M. Dominguez, M. Martinez-Sellés, M.A. García-Fernández, E. García. Hospital Gregorio Maranon, Madrid, Spain

Background: Application of the Bernoulli equation allows the determination of pulmonary artery systolic pressure (PASP) by Doppler echocardiography.

Methods: We studied all consecutive patients with one or more invasive measurement of right ventricle and pulmonary artery pressures performed at the haemodynamic laboratory of our institution from September 1996 to December 2003. Patients with congenital heart disease or previous heart transplantation were excluded from the study. From this population with 584 patients and 771 invasive measurement of PASP we selected 276 cases with a time from invasive PASP measurement to echo doppler <5 days.

Results: Mean age was 57.5±11.4 years (range: 23 to 86), 83 were women (30.1%). Doppler estimation of PASP could not be performed in 136 cases (49.3%), due to absence/minimal tricuspid regurgitation. The other 140 cases were divided in two groups according to left ventricular ejection fraction (LVEF): 38 (27.1%) had LVEF>40 (Normal LVEF) and 102 (72.9%) had depressed LVEF. Correlation of PASP measured invasively and by Doppler was acceptable in patients with normal LVEF (Pearson Coefficient 0.53), but was poor in patients with depressed LVEF (Pearson Coefficient 0.53). Doppler overestimation was frequent, particularly in patients with normal LVEF (82%), in these patients there were no cases of severe under estimation (table 1).

Conclusions: Doppler estimation of PASP is frequently unavailable due to absence/minimal tricuspid regurgitation. This measure frequently overestimates PASP, particularly in patients with normal LVEF.

Table 1

<table>
<thead>
<tr>
<th>Difference in PASP (Doppler – invasively).</th>
<th>Normal LVEF</th>
<th>Depressed LVEF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct estimation (&lt; 5 mmHg)</td>
<td>12 (32%)</td>
<td>30 (30%)</td>
</tr>
<tr>
<td>Mild underestimation (5 to -10 mmHg)</td>
<td>5 (2%)</td>
<td>11 (11%)</td>
</tr>
<tr>
<td>Severe underestimation (&lt; -10 mmHg)</td>
<td>0</td>
<td>8 (8%)</td>
</tr>
<tr>
<td>Mild overestimation (5 to 10 mmHg)</td>
<td>9 (24%)</td>
<td>15 (15%)</td>
</tr>
<tr>
<td>Severe overestimation (&gt;10 mmHg)</td>
<td>14 (38%)</td>
<td>36 (38%)</td>
</tr>
</tbody>
</table>

1019
Differential diagnosis of left bundle-branch block using tissue Doppler echocardiography: importance of both right and left ventricular systolic velocities and isovolumic relaxation times
S.K. Saha, S. Govind, M. Quintana, L.A. Brodin. Karolinska Univ Hospital, Huddinge, Stockholm, Sweden

Background: Left bundle-branch block (LBBB) has profound therapeutic and prognostic implications in patients without known heart disease (idiopathic LBBB), or with diabetes (ICM) and dilated (DCM) cardiomyopathy. We investigated the role of color tissue Doppler echocardiography (TDE) in the differentiation these conditions.

Methods: We studied 86 subjects using standard and tissue Doppler. The subjects were: 20 controls (G1), 21 with idiopathic LBBB (G2), 19 with LBBB in presence of ICM (G3), and 26 LBBB with DCM (G4). TDE profiles were obtained in 4 left ventricular (LV) basal segments (septal, lateral, inferior and anterior) in the right ventricular (RV) base by digital post-processing. 1% end systolic velocity (PSV, cm/s) and the isovolumic relaxation time (IVRT, ms) were computed. Data were mean±SD.

Results: QRS duration (ms) was 85±8, 14±9, 15±28, and 154±34 in G1 through G4 with no difference among G 2-4. LV internal diameter (mm) was significantly greater in DCM (72±28) and ICM (72±12) compared with others (43±6 in G1 and 46±6 in G2, all p<0.005). LV ejection fraction (EF%) was depressed in all forms of LBBB: 46±6 in G 2, 32±8 in G 3, 31±15 in G 4 vs. 54±4 in G 1 (p<0.005). The duration of IVRT (Fg) was universally prolonged in all groups compared with G1 (p<0.001), longest duration being observed in G4. RV PSV was similar in G1 and G2 (100±23 vs. 93±2, p=0.05) but significantly lower in both G3 and G4. LV PSV did not differ.

Conclusion: QRS duration, LV dimension, LV EF and IVRT do not not differentiate between isolated and pathologic LBBB, PSV and IVRT not only differentiate between isolated and pathologic LBBB, they also help to distinguish DCM from ICM. The findings suggest that both LV and RV studies using TDE are needed to differentiate LBBB of diverse etiology.

1020
Tissue Doppler assessment of right ventricular diastolic dysfunction in systolic and diastolic heart failure

Background: Tissue Doppler Imaging (TDI) is a promising tool for assessment of the right ventricular diastolic dysfunction (RVDD). The influence of left ventricular heart failure (HF) on RVDD has not been sufficiently assessed.

The aim of the study was to determine the RVDD in PTS with systolic and diastolic HF.

Methods: We studied 39 patients (23 males) divided in 2 groups: Group I (n=23, 17 males) with systolic HF (LVEF<45%) and Group II (n=16, 9 males) with diastolic HF (LVEF<45% and impaired mitral pattern). TDI velocities of tricuspid annulus (E’a, A’a, S’a waves) and basal lateral segment of right ventricle (RV) (E’, A’, S’ waves) were measured. Doppler tricuspid flow parameters (E, A, and E wave deceleration time [DT]) were assessed. Four chamber view RV dimensions (long axis in systole [LS] and diastole [Ld], transverse diameter in systole [Ds] and diastole [Dd], RV fractional area change [FAC] and tricuspid plane systolic excursion [TPSE] were also measured.

Results: In both groups E/A, E’a/A’a and E’/A’ ratios were lower than normal without significant differences between groups. DT, S’a, B’, FAC and TPSE were higher in group II. RV systolic dimensions were higher in group II. RV systolic velocities were higher in group II.

Conclusion: Diastolic dysfunction of right ventricle assessed by Tissue Doppler Imaging may occur in both systolic and diastolic heart failure despite of preserved right ventricular systolic function.

Table 1

<table>
<thead>
<tr>
<th>Baseline</th>
<th>Controls (G1)</th>
<th>LBBB (G2)</th>
<th>ICM (G3)</th>
<th>DCM (G4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVDT (cm)</td>
<td>18±4.2</td>
<td>20±7.8</td>
<td>20±3.5</td>
<td>17±2.8</td>
</tr>
<tr>
<td>LVDD (mm)</td>
<td>69±5.9</td>
<td>61±4.8</td>
<td>62±2.4</td>
<td>58±3.7</td>
</tr>
<tr>
<td>LVEF (%)</td>
<td>62±16</td>
<td>50±14</td>
<td>50±14</td>
<td>45±15</td>
</tr>
<tr>
<td>LVPS (cm/s)</td>
<td>1.65±0.33</td>
<td>1.61±0.4</td>
<td>1.59±0.3</td>
<td>1.60±0.3</td>
</tr>
</tbody>
</table>

Regional isovolumic relaxation times

Fig. Right and left ventricular IVRTs

Conclusion: QRS duration, LV dimension, LV EF and IVRT do not not differentiate between isolated and pathologic LBBB, PSV and IVRT not only differentiate between isolated and pathologic LBBB, they also help to distinguish DCM from ICM. The findings suggest that both LV and RV studies using TDE are needed to differentiate LBBB of diverse etiology.
1021
Right ventricular function. How to analyze it?
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The aim of study was to analyze the role of traditional Echocardiography (EchCOG) and Doppler tissue imaging (DTI) in assessment of systolic and diastolic right ventricular (RV) function in normal patients (pts).

**Methods:** 30 pts (range 18 - 45 y.o.; mean 32.4±7.7 y.o.) were examined. EchCOG study was performed with Technos (Esato, Italy) Vivid – 7 (GE, USA). All of the systolic and diastolic RV parameters were calculated:

- systolic pulmonary artery pressure (SPAP), diastolic pulmonary artery pressure (EDPAP), mean pulmonary artery pressure (MPAP) and Doppler Index (Di) of RV were analyzed. With DTI tricuspid annular velocities, time intervals and pressure in the right atrium (RA) were calculated.

**Results:**

- RV: ejection fraction (EF) in normal pts is 66±3.7%; Di of RV –0.28±2.29 mm; E/A tricuspid annular excursion was 22.5±1.2; IVRT RV is 82.47±4.7 ms; IVCT RV is 82.3±4.0 ms; PASP is 22.8±1.25 mmHg, EDPAP is 8.3±0.75 mmHg; MPAP is 14.6±1.52 mmHg.

**Conclusion:**

The best correlation with RV EF were found in Di, tricuspid annular excursion and the peak systolic tricuspid annular velocity (Sa) in DTI (P<0.05).

1022
The potential role of ultrasonic myocardial deformation imaging in arrhythmogenic right ventricular dysplasia
J.L.B. Pena, M.G. Silva1, T.A. Grillo1. Clínica Baeta Vianna, Belo Horizonte, Brazil, 2Clínica Baeta Vianna, Belo Horizonte, Brazil

**Background:** Arrhythmogenic right ventricular dysplasia (ARVD) is a heart muscle disease involving the free walls of the right ventricle (RV), in which the myocardium is gradually replaced by fatty and fibro-fatty tissue. It is a familiar disorder, the clinical course is highly variable and is an increasingly recognized cause of sudden cardiac death in young people. The diagnosis remains a challenge, especially in early stages. The identification of abnormal deformation properties in the RV free wall, using regional strain rate and strain imaging (SR/S) could be useful.

**Methods:** We compared standard 2D and M-mode echocardiography, regional myocardial velocities by PW and Colour Doppler, SR/S of the RV free wall with an age and sex matched normal control and with an arrhythmogenic right ventricular dysplasia (ARVD) patient.

**Results:**

- We measured right ventricular outflow tract fractional shortening (RVOTfs). The aim of study was to analyze the role of traditional Echocardiography (EchCOG) and Doppler tissue imaging (DTI) in assessment of systolic and diastolic right ventricular (RV) function in normal patients (pts).

- In the group of 48 previously diagnosed ARVD patients we used two dimensional echocardiography to measure right ventricular diameters of inflow and outflow tract in standard views. Diagnostic criteria for patient inclusion were based on ISFC recommendations encompassing genetic, electrocardiographic, arrhythmic, morphofunctional and histopathological factors. In apical four-chamber view we recorded long axis systolic shortening (TAPSE) as well as in parasternal short axis at the level of aortic root we measured right ventricular outflow tract fractional shortening (RVOTfs).

- We used pulsed wave Doppler tissue imaging (sample volume size 4) to assess TAPSE and RVOTfs%. Values of all echocardiographic parameters were averaged over five cardiac cycles. RVEF was estimated objectively by RV and compared with those parameters of ECHO. Statistical analysis was Chi square test or Fisher’s exact test used to assess the level of significance between the groups. A value of p<0.05 was considered statistically significant.

**Conclusion:**

We concluded that the PW velocities obtained by tissue Doppler are not definite for the diagnosis of ARVD. Strain rate and strain can be useful as a diagnostic tool in this disease and probably can quantify it quite properly. It can also certainly be used as a screening method as we detected abnormalities in one asymptomatic first-degree relative of a patient.

**Velocity and SR/S distributions**

<table>
<thead>
<tr>
<th>Velocity</th>
<th>Strain</th>
<th>Strain</th>
<th>SR</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apex</td>
<td>apico</td>
<td>apico</td>
<td>apex</td>
<td>apex</td>
</tr>
<tr>
<td>(cmm/s)</td>
<td>(mm/s)</td>
<td>(mm/s)</td>
<td>(m/s)</td>
<td>(m/s)</td>
</tr>
<tr>
<td>5.00±1.00</td>
<td>7.33±0.58</td>
<td>6.33±0.58</td>
<td>2.90±0.36</td>
<td>5.67±0.58</td>
</tr>
<tr>
<td>4.10±3.37</td>
<td>4.13±0.37</td>
<td>3.66±0.37</td>
<td>2.40±0.37</td>
<td>1.15±0.37</td>
</tr>
</tbody>
</table>

**1023**

Tissue Doppler contraction patterns of the right ventricle free wall in arrhythmogenic right ventricle dysfunction
L. Vidal Bonet, J. Nunez Morcillo, G. Pons Llado1, C. Caldes Lulli, C. Fernandez Palomque. Hospital San Juan de Dios, Hospital Son Dureta, IUNICS, Palma de Mallorca, Spain; 2Hospital Santa Creu i Sant Pau, Barcelona, Spain

**Echocardiographic diagnosis of Arrhythmogenic Right Ventricular Dysplasia (ARVD) has a low sensitivity.**

**Purpose:** To assess by Tissue Doppler Imaging (TDI) the right ventricular (RV) contraction pattern in ARVD.

**Material and methods:** 16 ARVD patients and 31 healthy people (control) were studied. A conventional echocardiogram was performed and TDI registers were obtained from an apical view, including the RV lateral wall. Strain curves were analysed at the basal and medial segment of the RV free wall. 4 different contraction patterns were defined depending on strain (S) magnitude during ejection and the relationship between the curves of each segment: Type I: Parallel curves with a magnitude greater than 30%. Type II: Parallel curves with a magnitude less than 30%. Type III: Parallel curves with a magnitude less than 15%. Type IV: Divergent curves.

Studies limited by echocardiographic window problems were not excluded. Statistical comparison was made by Chi-square test. See table.

**Conclusions:**

- Contractions in ARVD determined by TDI - strain considered as normal (parallel curves with a magnitude greater than 15%) are frequent in ARVD. In this case this finding enhances echocardiographic sensitivity in the diagnosis of this illness.

- Comparison between Control and ARVD groups concerns contraction patterns of the right free wall.

<table>
<thead>
<tr>
<th>ARVD</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>p=0.033</td>
<td>Type I</td>
</tr>
<tr>
<td>ARVD</td>
<td>2 (12.5%)</td>
</tr>
<tr>
<td>Control</td>
<td>17 (54.8%)</td>
</tr>
</tbody>
</table>

**Results:**

The group comprised of 25 female (52.08%) and 23 male (47.92%) patients, age between 21 and 69. All of them were classified in one of the following groups: A clinically silent form, B moderately severe and C severe form of the disease. Classification into three groups was made according to the severity of signs and symptoms at their first visit. In all ARVD patients TAPSE and RVOTfs% correlated well with RV EF as compared to RVIT in a table below.

**Conclusion:**

Development of heart failure among ARVD was found to critically depend on CS function as expressed by RVOTfs% and TAPSE. In addition to this, those are shown to be good clinical parameters in monitoring the progression of the disease.

**Crista supraventricularis in ARVD**

<table>
<thead>
<tr>
<th>ARVD pts.</th>
<th>RVIT</th>
<th>RVOTfs%</th>
<th>TAPSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>34.63±4.81</td>
<td>21.06±1.67</td>
<td>14.25±1.58</td>
</tr>
<tr>
<td>B</td>
<td>33.73±4.95</td>
<td>30.20±1.80</td>
<td>13.20±1.86</td>
</tr>
<tr>
<td>C</td>
<td>38.86±5.55*</td>
<td>16.86±0.82</td>
<td>11.43±1.81*</td>
</tr>
</tbody>
</table>

* p<0.05.
1025

Right ventricular dysplasia/cardiomyopathy. Echocardiographic signs of progressive disease with frequent biventricular involvement

L. Vitalli Serdoz, B. Pinamonti, C. Mazzone, A. Di Lenarda, G. Sinagra.
Azienda Ospedaliera di Trieste, Trieste, Italy

Background: Right ventricular dysplasia/cardiomyopathy (RVD/C) is a heart muscle disease of unknown cause that mainly affects the right ventricle (RV) with muscle atrophy and fibro-fatty substitution; it is clinically characterized by ventricular arrhythmias and risk of sudden death (SD) in the young. Few data are available about long-term evolution of the disease and of left ventricular (LV) involvement.

Aims of study: to assess spectrum of clinical presentations, frequency and characteristics of LV involvement and of clinical and structural progression of the disease.

Methods and results: 86 consecutive patients affected by RVD/C (international diagnostic criteria) were evaluated at diagnosis and during follow-up clinically and by echocardiographic studies. 58 were males (67%), mean age 33 ± 14 years, mean NYHA class 1.1 ± 0.4 (1-3); clinical presentation was characterized by ventricular arrhythmias in 65%, supraventricular arrhythmias in 8%, heart failure (HF) in 4%; 15% was asymptomatic. Familial history was present in 31%. RV abnormalities were demonstrated by echocardiography: aneurysms in 79%, and global systolic dysfunction in 79%. LV abnormalities were present in 48%, with global systolic dysfunction in 30%, and aneurysms in 3%. During follow-up (mean 103 ± 76 months) 12 pts died (7 SD, 5 HF) and 6 were transplanted. Clinical progression with appearance or worsening on HF was observed in 27% of cases; worsening of RV abnormalities was 50%, whereas new LV involvement in 10% and worsening in 19%.

Conclusions: RVD/C is characterized by a spectrum of clinical and echocardiographic presentations. LV involvement is common in up to half of the patients. At follow-up the progression of disease is frequent with appearance or worsening of HF and of RV and LV dysfunction. Prognostic significance and possible genetic correlation are presently unknown.

1026

Right ventricular function during thromboendarterectomy for chronic thromboembolic pulmonary hypertension


Objective: To evaluate the impact of pulmonary thromboendarterectomy (PTE) for chronic pulmonary embolism on the right ventricular performance.

Method: In the period 2002 to 2004, 36 patients underwent PTE. Their mean age was 49 years. Preoperatively, all of the patients were in functional New York Heart Association (NYHA) class II or III. In the last 12 patients a complete echocardiographic evaluation was performed preoperatively and during long-term follow-up. We compared preoperative with postoperative and values postoperative and at 3 months. T-test was used to determine the statistical differences between preoperative and postoperative values and the values postoperative and at 3 months.

Results: The in-hospital mortality was 3/36 (8%) due to persisting pulmonary hypertension and right heart failure. At a mean follow up of 13 months all surviving patients had a satisfactory remodelling of the apical right ventricle, other parameters showed a temporary decrease of systolic function but was characterized by ventricular arrhythmias in 50%, whereas new LV involvement in 10% and worsening in 19%.

Conclusions: RVDC is characterized by a spectrum of clinical and echocardiographic presentations. LV involvement is common in up to half of the patients. At follow-up the progression of disease is frequent with appearance or worsening of HF and of RV and LV dysfunction. Prognostic significance and possible genetic correlation are presently unknown.

1027

Right ventricular function in patients with chronic pulmonary hypertension evaluated by tissue Doppler derived isovolumic acceleration

V. Dambrauskaite, P. Claus, J. D’hooge, B. Bijnen, G. Sutherland, M. Dekroix, Santariskiu Klinikos, Vilnius, Lithuania, 1 University Hospital Gasthuisberg, Leuven, Belgium, 2 University Hospital Gasthuisberg, Leuven, Belgium

Tissue Doppler derived isovolumic acceleration (IVA) recently has been proposed as a non-invasive parameter to measure right ventricular (RV) contractility. In animal studies IVA was shown to be unaffected by acute preload and afterload changes. How IVA is affected by a chronic increase in RV afterload remains unknown.

Aim of study: To evaluate tissue Doppler derived IVA in patients with pulmonary hypertension (PH).

Methods: Right heart catheterisation for pressure and cardiac output measurements was performed in 18 patients (age 57 ± 17 years) with PH using a flow directed Swan-Ganz Catheter. These patients and 18, age, and gender matched, healthy subjects underwent an echocardiographic 2 dimensional tissue Doppler examination. The RV free wall was imaged in a 4-chamber apical view, and a cineloop of 4 consecutive heartbeats was stored digitally for off-line analysis. Echopac software (GE Vingmed) was used to analyse the stored data. The sample volume was placed in the middle of the myocardial wall and IVA was measured on regional velocity curves as the difference between the zero-crossing line and the peak myocardial velocity during isovolumic contraction (IVC) divided by their time interval. IVC was defined as time interval from the Q wave systolic deflection to the onset of the IVC according to AHA guidelines.

Results: Patients with PH (13 with pulmonary arterial hypertension and 5 with chronic thromboembolic PH) had a mean pulmonary arterial pressure of 48.1 ± 15 mmHg (range 27 - 68 mmHg) and a pulmonary vascular resistance of 789 ± 394 dyne.s.cm -5. The cardiac index was 2.6 ± 0.9 l.min -1.m-2. The velocity pattern during IVC in patients with PH was in most cases different from normals, but IVA values could be obtained following the proposed methodology. In PH patients IVA (1.3 ± 0.6 m/s 2, range 0.3 - 2.4) was significantly lower (p = 0.0006) compared to healthy subjects (2.3 ± 0.6 m/s 2, range 1.0 - 3.4 m/s 2). IVA showed no correlations with hemodynamic variables, diastolic function (E/A < 1), right ventricular systolic function (RVEF > 50%)

Conclusions: Tissue Doppler echocardiography derived RV IVA is decreased in patients with PH. This finding could not be related to contractility or to geometric changes of RV alone. Most likely it reflects a combination of these factors.

1028

The complex evaluation of right ventricular dysfunction with pulsed wave Doppler tissue imaging in patients with chronic obstructive pulmonary disease

V. Pyanov, Kirov, Russian Federation

The development of right ventricular (RV) dysfunction associated with pulmonary artery hypertension in patients with chronic obstructive pulmonary disease (COPD) has important prognostic implications. The noninvasive evaluation of the RV dysfunction in patients with COPD still represents a problem. The purpose of this study was to evaluate RV dysfunction in patients with COPD using pulsed wave Doppler tissue imaging (DTI).

Material and methods: 23 patients (males, mean age 57 ± 8 years, range 43-75) with severe COPD, who were clinically stable, and had FEV1 value less than 50% (mean FEV1 30 ± 8%, range 17-48%) were included in the study. All patients underwent clinical and laboratory examination. RV wall thickness, RV end-diastolic diameter, RV systolic and diastolic functions were evaluated with transthoracic echocardiography. The tricuspid inflow profile (E, A, E/A, DTI) and hepatic vein flow velocity (S, D, A) were measured by pulsed Doppler at the basil segment of the free wall and IVA were derived from pulsed DTI.

Results: RV systolic dysfunction was detected in 13% of cases. RV diastolic dysfunction was detected in 100% of cases. Impaired relaxation pattern of tricuspid inflow was detected in 69.6%, pseudonormal pattern - in 17.4%, restrictive pattern - in 13%. There were significant correlations between tricuspid annular motion (Ea/Aa) and tricuspid inflow profile (E/A = 0.56; p = 0.019), RV wall thickness (r = 0.72; p = 0.001), RV end-diastolic diameter (r = 0.70; p = 0.001) and RV ejection fraction (r = 0.70; p = 0.001) between systolic pulmonary artery pressure and hepatic vein flow velocity (retrograde A velocity) (r = 0.60; p = 0.007).

Conclusions: We conclude that the complex echocardiography evaluation with DTI provides a simple, rapid and noninvasive tool for diagnostic of RV dysfunction in patients with severe COPD.
**Abstracts**

**1029** Right ventricular myocardial acceleration during isovolumic contraction: comparison to hemodynamic data in patients with primary pulmonary hypertension


**Purpose:** Myocardial acceleration during isovolumic contraction (IMA) has been experimentally validated as an index of contractile function unaffected by shape or loading conditions but has never been compared to hemodynamic data in clinical practice. The aim of our study was to assess the clinical value of IMA as compared to hemodynamic data in patients with primary pulmonary hypertension (PPH).

**Methods:** We studied 25 pts with PPH at various stages of evolution (12 M/13 F, 56±13 years). They all underwent complete echocardiography and right heart catheterisation with measurement of right ventricular ejection fraction (RVEF) by thermodilution technique in a delay no longer than 48 hours. From apical 4C view, we recorded long-axis myocardial motion within the RV lateral (Lat) and septal (Sep) walls, 1 to 2 cm away from the level of valvular annulus. We then measured IMA and maximal (Smax) velocities and time-velocity integrals (SVI) of systolic myocardial motion waves.

**Results:** Main results of KT were the followings: mean PAP: 47±22, cardiac output: 4.3±1.3 l/min, PVR: 857±645 dynes.s.cm-5, RVEF: 26±14%, Lat (245±39 cm/s) and Sep (160±29 cm/s) IMA both correlated weakly with pulmonary out (respectively r=0.416, p=0.04 and r=0.427, p=0.04). Lat IMA also correlated with mean PAP (r=0.556, p=0.005) and PVR (r=-0.527, p=0.01). However, both Sep and Lat IMA failed to correlate with RVEF, which showed a strong and significant correlation with both Lat and Sep S max (respectively r=0.552, p=0.005 and r=0.632, p=0.001) and Lat and Sep TVI (respectively p=0.688, p=0.000 and r=0.795, p=0.000).

**Conclusion:** IMA measured in the RV free wall showed quite weak correlations with cardiac output, PAP and RVP among patients with PPH. However, no correlation was found between this parameter and RVEF. Our study furthermore confirmed the interest of RV systolic longitudinal motion waves in the assessment of RV systolic function.

**1030** Right ventricular dysfunction and pulmonary hypertension prevalence in systemic sclerosis with normal left ventricular ejection fraction


**Introduction:** Heart may be involved in systemic sclerosis (SS) through pulmonary hypertension (PH) and myocardial left ventricular (LV) dysfunction. However, right ventricular (RV) function has not been fully evaluated in such patients. We undertook a case control study to evaluate RV filling pressures and pulmonary pressures (PAP) in patients (Pts) with proven SS and controls.

**Methods:** A comprehensive Doppler echocardiographic examination was undertaken in 69 SS Pts and 31 matched healthy subjects. The follow- ing pulsed Doppler parameters were averaged on 3 consecutive beats: peak velocity during early (Ei), atrial RV filling (Ati) and ratio (Ei/At). Tricuspid annular velocities were obtained using Doppler myocardial tissue imaging, at its lateral site in systole (Sti), early (Eti), late diastole (Ati) and ratio (Eti/Ati). RV hemodynamics was assessed using tricuspid regurgitation for PAP determination and RV filling pressure using pulmonary regurgitation. Pulmonary hypertension (PH) was diagnosed when tricuspid maximal regurgitation (TMR) velocity was >2.5 m/s.

**Results:** The 2 groups did not statistically differ with regard to right atrial size and RV inflow or Eti/At parameters. Sti was significantly lower in SS patients. Mean tricuspid regurgitation velocity was significantly higher in SS patients. Ph was observed in 18 patients (26%) and no controls (p<0.01). Increased RV filling pressure was observed in respectively 13 of 66 patients and only 1 of 31 healthy subject (p=0.0002).

**Conclusion:** SS Pts exhibit a significant trend toward asymptomatic RV dysfunction and increased prevalence of PH. Further studies are needed to evaluate the prognostic implications of such findings.

**1031** Right ventricular volumes and function assessed by Live-3D echocardiography

S. Mott-Liink, W. Hosch1, S. Witte2, I. Wolf2, M. Hastedleuf3, H.P. Meineker1, S. Hagi2, R. De Simone5 on behalf of SFB 414 (Collaborative Research Centre); Project H1 (Novel 3D tools). University of Heidelberg, Heidelberg, Germany, 1University Heidelberg, Heidelberg, Germany, 2University Heidelberg, Heidelberg, Germany, 3Deutsches Krebsforschungszentrum, Heidelberg, Germany, 4University Heidelberg, Heidelberg, Germany.

**Purpose:** The complex morphology and geometry of the right ventricle cannot adequately be visualized by 2-dimensional echocardiography. Aim of the present study was to evaluate the accuracy of Live-3D echocardiography for determination of right ventricular volumes and function.

**Methods:** Magnetic resonance imaging and transthoracic, apical Live-3D echocardiography was performed in 30 patients. There was no patients’ selection based on image quality. For echocardiographic determination of right ventricular volumes (RVESV and RVEDV) and ejection fraction (RVEF) the software CardioView (Tomtec) was used. The system offered the opportunity for panning (skipping, shifting and rotating) within live-3D data sets and allowed consecutive interaction in four different vertical planes, but not in horizontal planes.

**Results:** RVEF by Live-3D echocardiography showed significant correlation and agreement (r=0.93, p<0.0001, SEE=3.6%, SD of differences=-5.4%) with MRI. However, volumes were highly underestimated (Mean/SD diff RVESV: -78.3±60.5 ml; RVEDV: -42.2±44.6 ml) by Live-3D. Between the interactive planes the endocardial borders calculated by CardioView were not able to match the half-moon shaped endocardial contours in horizontal planes. However, panning within Live-3D data sets enabled right ventricular analysis in 96.7% (n=29) of all patients.

**Conclusions:** Live-3D echocardiography has an enormous potential for the assessment of right ventricular function because of spatial continuity of data. However, software tools originally designed for left ventricular analysis are not suitable for accurate visualization of the complex right ventricular geometry yet.

**1032** Assessment of complex right ventricular geometry by semi-automated segmentation

S. Mott-Link, I. Wolf1, W. Hosch2, S. Witte3, M. Hastenteufel1, H.P. Meineker2, S. Hagi3, R. De Simone5 on behalf of SFB 414 (Collaborative Research Centre); Project H1 (Novel 3D tools). University of Heidelberg, Heidelberg, Germany, 1University Heidelberg, Heidelberg, Germany, 2University Heidelberg, Heidelberg, Germany, 3University Heidelberg, Heidelberg, Germany.

**Purpose:** Commercially available semi-automated segmentation developed for echocardiographic analysis of left ventricular function is not suitable for the right ventricle. The purpose of this study was to develop software for 3D-echocardiography allowing accurate 3D-reconstruction of the complex right ventricular geometry.

**Methods:** Three-dimensional transesophageal echocardiography (3D-TEE) and magnetic resonance imaging (MRI) was performed in 28 patients. The software (EchoAnalyzer) was developed at our institution allowing the determination of endocardial border in all three dimensions. Right ventricular end systolic (RESV) and end diastolic (REDV) volumes as well as ejection fraction (RVEF) obtained by 3D-echocardiography were compared with MRI.

**Results:** Three-dimensional-reconstruction was able to represent the complex geometry of the right ventricular chamber. The indentation of the tricuspid valve, the convex and concave sides as well as the right ventricular outflow tract could be detected. Right ventricular end systolic (RESV: r=0.95; p<0.001; SEE=14.7 ml) and end diastolic (REDV: r=-0.82; p=0.001; SEE=16.7ml) volumes as well as ejection fraction (RVEF) determined after 3D-echocardiography showed significant correlations to MRI.

**Conclusions:** The presented method was able to assess right ventricular volumes and function accurately. Furthermore, the complex geometry of the right ventricular chamber could adequately be reproduced by 3D-echo-cardiography.
Predictors of right ventricular dysfunction in patients with significantly impaired left ventricular ejection fraction: an ADEPT trial ancillary study

J.A. Sallach, R.W. Troughton, A. Fogarty, M. Martin, A.L. Klein on behalf of The ADEPT Investigators. Cleveland Clinic Foundation, Cleveland, United States of America, 1University of Christchurch, Christchurch, New Zealand

Background: Although right ventricular (RV) dysfunction is of significant prognostic utility in congestive heart failure, clinical and transthoracic echocardiographic (TEE) variables associated with RV dysfunction are not well defined in patients with depressed left ventricular (LV) function. The purpose of this study was to determine if clinical and TTE variables can predict which patients with severe LV dysfunction will have impaired RV systolic function.

Methods: The Assessment of Doppler Echocardiography for Prognosis and Therapy (ADEPT) Trial enrolled 223 consecutive patients with LV ejection fraction (LVEF) <35%. Patients were categorized as normal or abnormal RV function based on visual estimation, baseline demographics, cardiovascular risk factors and TTE variables were compared between these two groups to determine variables associated with RV dysfunction.

Results: RV systolic function was classified as normal in 34% (76) and abnormal in 66% (147) of patients. Patients with abnormal RV function were classified as mild hypokinesia (HK) (24%), moderate HK (18%), moderate/severe HK (15%) and severe HK (9%). Baseline clinical and TTE variables in these 2 groups are displayed in Table 1. Patients with abnormal RV function had lower LVEF, more advanced LV systolic dysfunction and greater mitral regurgitation (MR). In multivariate analysis, stage of LV diastolic dysfunction was the strongest predictor of RV systolic dysfunction (p<0.001).

Conclusions: In patients with impaired LV function, lower LVEF, more severe MR and advanced LV diastolic dysfunction were independent predictors of abnormal RV systolic function. This finding should alert clinicians to the potential for RV dysfunction and subsequent increased risk of adverse clinical outcomes.

Table 1

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Normal RV (n=76)</th>
<th>Abnormal RV (n=147)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>58±12</td>
<td>57±14</td>
<td>0.825</td>
</tr>
<tr>
<td>LVEF (%)</td>
<td>27±6</td>
<td>24±6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LV Diastolic Dysfunction</td>
<td>76%/20%/4%</td>
<td>24%/25%/57%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>MR (&gt;2+)</td>
<td>17%</td>
<td>38%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mitral Inflow E/A</td>
<td>0.8±0.6</td>
<td>2.1±1.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pulmonary Vein S/D</td>
<td>1.4±0.5</td>
<td>0.8±0.5</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

1034 Correlations of normal right ventricular diastolic function by Doppler tissue imaging

M. Lengyel, M. Dénes, A. Zorándi. Gottsegen G. Hung.Inst.of Cardiology, Budapest, Hungary

Left ventricular (LV) diastolic function has been extensively studied by Doppler tissue imaging (DTI) while few data are known of normal right ventricular (RV) diastolic function. The purpose of this study was to establish normal values and age-related changes in RV diastolic function and the relationship of RV and LV DF in a normal population. Valve disease, valve calcification and LV hypertrophy were excluded. 42 consecutive patients were included into the study, 13 males and 22 females, aged 17-90, mean 51.5 years. By transthoracic echocardiographic mean LV ejection fraction was 63.8±6.2%. E/A ratio 1.1±0.4 and deceleration time 176.3±40.9 sec. DTI was performed at the lateral mitral anulus of the LV and of the RV. Mean LV Ea was 16.15±4.2, LV Aa 18.4±4.4 cm/s, LV Ea/Aa 0.96±0.38, E/Ea 4.8±1.5. Mean RV Ea was 16.1±2.6, RV Aa 20.4±4.8 cm/s, RV Ea/Aa 0.8±0.3. Thus there was no difference in Ea between RV and LV, but RV Aa was significantly higher (p<0.001) than LV Aa while LV Es/Aa was significantly higher than RV Es/Aa (p<0.001). Correlations between LV and RV diastolic function were significant for Ea (r=0.55, p<0.001), and for Es/Aa (r=0.69, p<0.001). Significant age dependency was found in LV E/A (r=0.8, p<0.001), in LV Ea (r=0.72, p<0.001), and in RV Ea (r=0.67, p<0.001), and in RV Es/Aa (r=0.65, p<0.001). There was no correlation of any variable with heart rate.

In conclusion: There was a positive correlation between diastolic function of LV and RV, although normal values of Aa were significantly higher in the RV than in the LV and there were similar age correlations of diastolic function in both ventricles, without any heart rate correlation.
1037 Strain and strain rate imaging in the diagnosis of arrhythmogenic right ventricular dysplasia
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Objective: Arrhythmogenic right ventricular dysplasia (ARVD) is a heart muscle disease which is characterized pathologically by fibrofatty replacement of the right ventricular myocardium. Clinical manifestations include structural and functional abnormalities of the right ventricle, and presentation with ventricular tachycardias with left bundle branch pattern. We sought to characterize regional myocardial movement by strain rate and strain imaging in patients with ARVD.

Methods: Philips Sonos 5500 with S4 probe and QLAB software, and GE Vivid 7 with M3S probe and Q-analysis software were used to quantitatively assess tissue velocity (V), strain rate (SR) and strain (e) of right ventricular wall motion. We studied 5 patients with ARVD confirmed by magnetic resonance imaging.

Results: Wall thinning and aneurysms with abnormal movement (AN) were found in right apices in 3 patients and in ventricular outflow tracts in 2 patients. The systolic peak V, e and SR were significantly lower in AN than those of adjacent normal segments (3.85 cm/s vs 4.77 cm/s, -5.9% vs -19.17%, -0.52 1/s vs -1.67 1/s). The decrease of e and SR in AN was significantly prominent than that of V (13.2%, 1.21/s vs 0.91 cm/s). In one patient, e and SR found paradoxical movement in AN, but tissue velocity could not.

Conclusions: The strain and strain rate imaging allows sensitive distinguishing between abnormal and normal segments of right ventricle, and offers specific advantage for the diagnosis of ARVD.

1038 The usefulness of tissue Doppler imaging for the evaluation of right ventricular function

Purpose: In recent years consensus has grown on the role of right ventricular (RV) performance in the clinical outcome of patients with advanced congestive heart failure (CHF). The objective evaluation of RV contractility is a quite difficult task. In the clinical practice, it is grossly estimated by the systolic excursion of the tricuspid annulus. The purpose of this study is the evaluation of the global RV contractility by the use of a novel method (the systolic wave of Tissue Doppler Imaging of tricuspid annulus).

Methods: We studied 55 patients (pts) [23 pts (14 male, 9 female, 49±18 years old) with normal RV contractility and 32 pts (16 male, 16 female) with symptoms and signs of CHF. The evaluation of RV function was made by estimating 1) the tricuspid annulus plane systolic excursion (TAPSE, cm) from the M-mode echocardiographic examination after alignment of the M-mode line with the tricuspid annulus and 2) the measurement of the systolic wave of tricuspid annulus movement by TDI (sTDI, cm/sec). It was considered that the RV function is preserved when the values of sTDI and TAPSE were above 11 cm/s and 1.4 cm respectively. The student's t-test method was used for the statistical analysis.

Results: It was revealed that both the sTDI and the TAPSE were significantly different between pts with normal vs impaired RV function (TAPSE: 2.1±0.3 cm vs 1.1±0.1 cm, p<0.001, sTDI: 16.93±2.24 vs 9.42±1.78 cm/sec, p<0.001 respectively). The sTDI was more sensitive (9/32, 28%) than TAPSE (3/32, 9.3%, p=0.05) to evaluate a preserved global RV function in patients with CHF.

Conclusions: It seems that Tissue Doppler Imaging may be a useful means for the evaluation of the RV performance. Moreover, it helps to discriminate the patients with CHF and preserved RV function which may be quite important in their management and follow-up.
**Sequence of progression of subclinical cardiovascular risk factors and cardiac dysfunction in type 1 diabetes mellitus**

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**Purpose:** We examined the sequence of progression of subclinical cardiovascular disease in type 1 DM.

**Methods:** We included 100 patients (51 females, age 22-63 years) with a disease duration between 2 to 36 years, without any cardiovascular complaints, and 75 controls (41 females, age 20-60 years). Standard 2D and Doppler echocardiography, and pulsed wave tissue Doppler (TD) mapping of systolic (Sm) and diastolic (Em, Am) velocities (16 LV segments and right heart) was done. An Em/Am ratio of <1 was considered abnormal segmental diastolic function (ADF). The flow mediated dilatation (FMD, marker of endothelial function) was expressed as a percentage increase in brachial artery diameter, 4.5 minutes post occlusion. Carotid intima media thickness (IMT) measurement and extensive laboratory analysis was done.

**Results:** The global and regional myocardial contractility was normal in all. The FMD was reduced, and IMT increased in patients. Endothelial dysfunction was seen early, followed by regional diastolic dysfunction, which preceded the increased IMT, and regional systolic dysfunction (lower Sm values) and increased prothrombotic state. Significant correlations were found between FMD and the number of LV segments with dysfunction, the duration of DM, and fibrinogen (p<0.0001 for all). Stepwise regression analysis showed that FMD, triglyceride level, fibrinogen and age were predictive of abnormal tD derived function (p<0.0001). K-means cluster analysis defined 3 clusters of patients, representing patients in early, mid- and later phase of the disease (Table 1, data given are mean±SD, *p<0.05 vs cluster 1).

**Conclusion:** This study shows for the first time the sequence of progression of subclinical cardiovascular disease in type I DM, and suggests assessment of subclinical risk factors with earlier therapeutic interventions.

**Table 1**

<table>
<thead>
<tr>
<th>Duration of DM</th>
<th>cluster 1</th>
<th>cluster 2</th>
<th>cluster 3</th>
<th>controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>segments with abnormal Sm</td>
<td>7.5±4.3</td>
<td>15.6±7.6</td>
<td>24.2±8.8</td>
<td>none</td>
</tr>
<tr>
<td>Segments with ADF</td>
<td>none</td>
<td>1±1</td>
<td>5.4±2.6</td>
<td>none</td>
</tr>
<tr>
<td>FMD%</td>
<td>0.4±1.1</td>
<td>3.5±5*</td>
<td>10±1.6*</td>
<td>none</td>
</tr>
<tr>
<td>IMT (micrometer)</td>
<td>10.8±1.3</td>
<td>7.5±1.3*</td>
<td>4.6±1.7*</td>
<td>10.1±2.1</td>
</tr>
<tr>
<td>Fibrinogen (mg/dL)</td>
<td>517±75</td>
<td>609±98</td>
<td>708±123</td>
<td>509±57</td>
</tr>
</tbody>
</table>

**Cardiac, vascular and metabolic abnormalities in diabetes**

4 December 2004, 8:30 to 10:00

Location: Room 2

**LV systolic function by tissue velocity imaging in type 1 diabetes mellitus is related to atherosclerosis**

K. Steine, J.R. Larsen, T. Julsrud Berg, K. Dahl-Jørgensen, M. Slugaard, Aker University Hospital, Oslo, Norway, Ullevaal University Hospital, Oslo, Norway

**Objectives:** Diabetes mellitus type I (DM) is associated with atherosclerosis and ischemic heart failure. Recent reports, however, have suggested advanced glycation endproducts (AGEs) as contributing to development of a separate diabetic cardiomyopathy. In order to explore this issue we applied novel modalities of tissue velocity imaging (TVI) to assess LV function in patients with long term DM.

**Methods:** Twenty-seven patients with DM for 32±5 years and 45±6 years of age were included and compared to a control group of 16 healthy sex and age-matched individuals. HbA1c was repeatedly measured during 18 years and an average value for each patient was calculated. Tissue plasminogen activator antigen (tPAag), as an indicator of atherosclerosis, and serum levels of AGEs were determined. Intravascular ultrasound was performed and coronary atherosclerotic burden was determined according to the American Heart Association grading criteria. Finally, conventional echocardiography was applied and recordings of TVI were sampled in basal and middle segments of LV septum and lateral wall from apical 4 chamber view. A new global index of systolic function based on displacement of basal segments as percentage of total length from base to apex was calculated (SYS). The echocardiographic images were blinded prior to measurements.

**Results:** Mean HbA1c during 18 years was 9.2 (6.6-11.3) mmol. Diastolic E/A ratio was significantly lower in DM (1.5±0.3 vs. 1.7±0.6, p=0.04) than controls. All other echocardiographic parameters were similar in DM and controls. Mean TVI velocity from the four segments tended to be lower in DM (n.s.) and showed significant correlations to atherosclerotic burden (r=-0.54, p=0.005), tPAag (r=-0.43, p=0.03) and to mean HbA1c (r=-0.44, p=0.03), but not to AGEs. In addition, SYS was slightly lower in DM (n.s.), and correlated significantly to tPAag (r=-0.44, p=0.02), but not to AGEs. Finally, ratio of E to velocities at the mitral annulus, as an index of LV filling pressure, showed correlations to HbA1c (r=0.47, p=0.02) and tPAag (r=-0.42, p=0.03), but not to AGEs.

**Conclusions:** TVI is a feasible method to assess LV systolic function in DM. Our data indicate that both segmental and global LV systolic function in DM are related to atherosclerosis but not to any AGE-dependent diabetic cardiomyopathy. Metabolic control in the long term might prevent deterioration of LV function.
Advanced congestive heart failure in the diabetic patient: echocardiographic characteristics and prognosis

R. Couto, M. Trabulo, C. Aguiar, J. Ferreira, M.J. Andrade, A. Ferreira, R. Gouveia, R. Seabra-Gomes, Hospital de Santa Cruz, Oeiras, Portugal, Hospital de Santa Cruz, Carnaxide, Portugal

Background: Type 2 diabetes mellitus is known to be associated with an unfavorable prognosis in ischemic heart disease, but the overall impact of diabetes on advanced congestive heart failure (CHF) in the current era of medical therapy has yet to be established.

Objectives: The aim of this study was to compare patients with and without diabetes admitted to a Cardiac Intensive Care Unit (CICU) due to uncompensated advanced HF, with respect to echocardiographic, demographic, labora-
torial features and prognosis.

Methods: We studied a group of 61 consecutive patients (Pt) admitted to our CICU with HF in New York Heart Association (NYHA) class III (21 Pt) or IV (40 Pt), mean age 66 ± 12 years, 14 female. Diabetes was present in 25 Pt (41%) according to the American Diabetes Association criteria. Pt with and without diabetes were compared with respect to demographics, echocardiographic (left ventricular volumes, ejection fraction, pulmonary artery systolic pressure, Doppler transmural inflow pattern), laboratorial and clinical features. An E/A ratio >2 or E/A >1 with an E-deceleration time >150 ms were defined as restrictive filling pattern (RF). The study endpoint was the combined incidence of death or heart transplantation during a mean follow-up of 297 ± 199 days.

Results: The presence of a RF pattern in Doppler transmural flow was more frequent in diabetics (72%) than in non-diabetics (27%; p = 0.03). Ejection fraction (28 ± 6 versus 26 ± 9), left ventricular volumes and pulmonary artery systolic pressure did not differ significantly between the 2 groups. Sex distribution, mean age, atrial fibrillation and medicating with beta-blockers and con-
verting enzyme inhibitors were similar in both groups. N-terminal-pro-BNP was similar in both groups. N-terminal-pro-BNP levels were higher in diabetics (1047% ±/− 7026 pg/mL versus 4736% ±/− 3147 pg/mL; p = 0.0001). Iaesoclomic asthemia was more frequent in diabetics (89%) then in non diabetic (50%); p = 0.03. During follow up, the incidence of death or heart transplantation was higher among the diabetic patients (13 died or were transplanted vs 8 in the non-diabetic group, log-rank p = 0.024).

Conclusions: Diabetic patients admitted to the Intensive Cardiac Care Unit due to advanced CHF had higher incidence of ischaemic asthemia, more severe echocardiographic and laboratorial parameters and a poorer progno-
sis. These results emphasize the importance of this metabolic disease in the setting of congestive heart failure.

Left ventricular diastolic function in patients with impaired glucose tolerance and heart failure

E. Straburszynska-Mijag, A. Szyszka, R. Ochotny, Poznan, Poland

Background and aim: It is known that diabetes impairs myocardial func-
tion and may cause some cardiac diabiotic cardiomyopathy. In patients with heart failure (HF) and decreased left ventricular ejection fraction (LVEF) it may further impair myocardial function. Our aim was to asses relation of glucose metabolism disturbances – impaired glucose tolerance - to diastolic function in pts with heart failure.

Methods: We examined 61 patients with HF and LVEF ≤ 45%. Based on oral tolerance test impaired glucose tolerance (IGT) was diagnosed in 25 pts and normal glucose tolerance (NGT) in 36 pts. In all pts echocardiogra-
phy with Doppler measurement of diastolic function parameters was per-
formed.

Results: There weren’t any significant differences in LV EDD, LVESD and LVEF between groups. The restrictive filling pattern (E/A >1) and DT of E wave had not significant correlation. Differences between groups (p = 0.03). Ejection fraction (28 ± 6 versus 26 ± 9), left ventricular volumes and pulmonary artery systolic pressure did not differ significantly between the 2 groups. Sex distribution, mean age, atrial fibrillation and medicating with beta-blockers and con-
verting enzyme inhibitors were similar in both groups. N-terminal-pro-BNP levels were higher in diabetics (1047% ±/− 7026 pg/mL versus 4736% ±/− 3147 pg/mL; p = 0.0001). Iaesoclomic asthemia was more frequent in diabetics (89%) then in non diabetic (50%); p = 0.03. During follow up, the incidence of death or heart transplantation was higher among the diabetic patients (13 died or were transplanted vs 8 in the non-diabetic group, log-rank p = 0.024).

Conclusions: Diabetic patients admitted to the Intensive Cardiac Care Unit due to advanced CHF had higher incidence of ischaemic asthemia, more severe echocardiographic and laboratorial parameters and a poorer progno-
sis. These results emphasize the importance of this metabolic disease in the setting of congestive heart failure.
The left atrium revisited

4 December 2004, 11:00 to 12:30

Location: Room 2

1052
Effects of aging on left atrial function: a strain (rate) imaging study
C. Sirbu, L. Herbots, V. Dambrauskaite, J. Dhooge, P. Claus, B. Bijnens, F.E. Rademakers, G.R. Sutherland, C. Sirbu, L. Herbots, V. Dambrauskaite, J. Dhooge, P. Claus,
University Hospital Gasthuisberg, Leuven, Belgium

Background: The investigation of atrial function in the normal and diseased heart has been limited by the lack of effective non-invasive measurement techniques. One way to characterize myocardial function is by assessing the regional deformation of the segment under investigation. Myocardial Velocity Imaging (MVI) can be used for the quantification of regional ventricular myocardial deformation by post-processing MVI data to extract regional strain rate (SR) and strain (e).

Aims: To assess the feasibility of measuring regional atrial e/ESR profiles and to evaluate the effects of aging on atrial deformation in a healthy patient population.

Methods: MVI data were acquired in 25 healthy subjects using a GE Vivid7. Group A consisted of 15 subjects with an age ranging from 25 to 38 years while the age in group B (10 subjects) ranged from 41 to 75. Longitudinal SR and e were measured for the mid portion of the lateral atrial wall (from the apical four chamber view) using dedicated software (SPEQLE). For the 3 periods of the atrial cycle (contractile, reservoir, conduit phase) we evaluated the peak values for SR/e and the value of e at the end of each phase.

Results: Consistent patterns of wall deformation for the LA were obtained in all 25 subjects. The results are presented in Table 1. The parameters for LA contractile function are higher and the ones for LA conduit function were lower in group all 25 subjects.

Table 1

<table>
<thead>
<tr>
<th>Atrial timing</th>
<th>Indexes</th>
<th>Group A (25-38 years)</th>
<th>Group B (41-75 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contractile</td>
<td>peak SR (1/s)</td>
<td>-4.5±1.08</td>
<td>-5.55±1.80*</td>
</tr>
<tr>
<td></td>
<td>peak strain (%)</td>
<td>-22.95±9.46</td>
<td>-28.51±9.3*</td>
</tr>
<tr>
<td></td>
<td>end strain (%)</td>
<td>-20.24±7.06</td>
<td>-27.34±8.99*</td>
</tr>
<tr>
<td>Reservoir</td>
<td>peak SR (1/s)</td>
<td>4.36±1.40</td>
<td>4.26±1.36</td>
</tr>
<tr>
<td></td>
<td>peak strain (%)</td>
<td>59.47±21.63</td>
<td>59.87±17.17</td>
</tr>
<tr>
<td></td>
<td>end strain (%)</td>
<td>54.57±22.59</td>
<td>53.82±16.04</td>
</tr>
<tr>
<td>Conduit</td>
<td>peak SR (1/s)</td>
<td>-7.31±3.22</td>
<td>-5.14±2.69*</td>
</tr>
<tr>
<td></td>
<td>peak strain (%)</td>
<td>-38.26±16.20</td>
<td>-33.36±16.38*</td>
</tr>
<tr>
<td></td>
<td>end strain (%)</td>
<td>-36.39±16.60</td>
<td>-30.58±12.82*</td>
</tr>
</tbody>
</table>

*p<0.05.

1053
Non-invasive determination of the atrial fibrillation cycle length using pulsed wave tissue Doppler imaging of the right atrium
A. Heyse, M. Duytschaever, R. Tavernier, R. Tielemansen, R. Colpaert, T. Gillebert, J. De Sutter, University Ghent, Gent, Belgium, 1University Maastricht, Maastricht, Netherlands

Purpose: Measurement of atrial fibrillation cycle length (AFCL) requires invasive procedures. We studied the feasibility of echocardiographic determination of the AFCL by pulsed wave tissue Doppler imaging (PW-TDI) of the right atrium.

Methods: During an electrophysiological study 15 patients with AF (7 chronic/8 acute) were investigated. Transthoracic echocardiography (GE, VIVID 7) was performed to record PW-TDI-signals at the right atrial free wall (apical 4 chamber view). Simultaneously a bipolar atrial electrogram (EGM) was recorded from a 6F quadripolar catheter at the right atrial free wall.

Results: Measurements were obtained during AF with a mean RR-interval of 1200±328 ms. Both during acute and chronic AF, typical TDI curves revealed biphasic atrial velocity patterns which can be visualized in mid to late diastole. The mean peak velocity of the negative deflection was 5±2 cm/s. The time of onset of the negative deflection on TDI correlated best with the time of depolarization on the atrial EGM (time difference 16±15 ms). AFCL was defined as the time interval between 2 consecutive atrial events on the EGM (AFCL-EGM) and on the TDI curve (AFCL-TDI). For all patients, AFCL-TDI was 171±22 ms and AFCL-EGM 170±23 ms. AFCL-TDI correlated significantly with AFCL-EGM (R² 0.84, p<0.05).

Conclusions: Pulsed wave tissue Doppler imaging of the right atrium in patients with ongoing AF can be used to determine AF cycle length non-invasively with an excellent correlation with AF cycle length determined during electrophysiological study.
1054 Post-cardioversion left atrial appendage stunning: feasibility and accuracy of atrial contractility and flow velocity measurements
M. De Luca, P. Colonna, V. Oustni, M. Sorini, P. Bovezni, B. Del Salvatore, I. De Luca. Azienda Policlinico, Bari, Italy

Transesophageal echocardiography (TEE) is the gold standard for the study of left atrial appendage (LAA) stunning. However, the feasibility and accuracy of LAA assessment with transesophageal echocardiography (TEE) seems to be still suboptimal. Aim of this study was to evaluate the feasibility of TEE direct study of parameters of LAA function after cardioversion (C) for atrial fibrillation and to compare them with TEE measurements.

Methods: We studied 20 patients (pts) undergoing TEE after C for atrial fibrillation (7.2±2.9 days). All pts underwent a TEE with 2nd harmonic, immediately prior to a C performed by a different cardiologist; using echocardiographic views modified in order to have, both in TEE and TEE, the M-mode cursor perpendicular to medial and lateral LAA walls, approximately 1 cm far away from the junction of the LAA with the left atrium; where we detected LAA emptying Doppler velocities as well. Therefore, with both TEE and TEE we measured the LAA emptying velocity (LAA eV), considered the gold standard for LAA function, and the following monodimensional parameters, expression of LAA contractility: 1) the M-mode LAA fractional shortening (LAA FS) measuring LAA diameters during filling and emptying phases, and 2) the thickness change of medical LAA wall (LAA Delta) related to the same LAA phases.

Results: The velocity and contractility parameters were obtainable at TEE in 20/20 (100%); for LAA eV, in 16/20 (80%) for LAA FS (because in four patients it was not possible to align the M-mode beam) and in 18/20 (90%) for LAA Delta. Conversely, the measurements at TEE were feasible in 15/20 (75%) for LAA eV, 10/20 (50%) for LAA FS and in 10/20 (50%) for LAA Delta. For all the TEE parameters showed a good correlation (r) with the TEE parameters: LAA eV r = 0.93, LAA FS r = 0.89 and LAA Delta r = 0.92. In the 5 patients with post-C LAA stunning, the LAA eV: 0.25 cm/s, the LAA dystunction was easily detected at TEE for the reduction of LAA Delta (< 0.10 cm), while the other TEE parameters (LAA eV and LAA FS) were not measurable in 2 cases.

Conclusions: Transesophageal echocardiographic evaluation of LAA post-C is often feasible also with TEE. Among the TEE parameters, the LAA Delta showed the highest feasibility. If this accuracy and reproducibility will be confirmed in a larger series, this novel M-mode measurement, simple safe and fast at bedside, could be highly useful to select patients with LAA stunning after cardioversion for atrial fibrillation and to guide anticoagulation therapy.

1055 Study of both atrium mechanical stunning with tissue doppler imaging after chemical and electrical cardioversion of atrial fibrillation
M. Foukarakis, G. Papailiakis, P. Stasinos. General Hospital of Ierapetra, Ierapetra-Crete, Greece

Cardioversion of atrial fibrillation (AF) is associated with atrial mechanical stunning (AMS). We tried to study AMS of both atrium with tissue Doppler imaging (TDI) after chemical and electrical cardioversion of AF. Methods: Patients (pts) >80 years old, pts with severe valvular disease, pts with ejection fraction <40%, pts with recent coronary event were excluded. Finally 34 pts (15 men and 19 women, mean age 62.64±12 years) had been cardioverted with standard protocols of amiodarone or propafenone (group A-B). Protocols were randomized. TEE studies were performed at 1st, 7th day and 1st month after restoration of sinus rhythm. In five pts the study of month was not performed because of recurrence of AF. Left atrial appendage (LAA) diameters (in mm), LAA volumes (LAV) were evaluated with M-MODE and Two-D. Transmitial (Emax, Amax, E/A, VTIE, VTIA, VTIA/VTIE = VI index and transcistuspid (Emax, Amax, E/A, VTIE, VTIA, VTIA/VTIE = VI index), VTIA/VTIE) indexes, as well as velocities of pulmonic veins (S, D, a) were evaluated with standard pulse doppler. Moreover we evaluate with TDI peak velocities (systolic-st, early diastolic-diastole a, late diastolic) of both atrium annulus and delta LAA. The curvilinearity of the atrial pressure-volume relationship was calculated as the systolic pulmonary venin flow integral divided by pressure.

Results: Among the three groups examined (no SEC, mild SEC and severe SEC/sludge/THR) (Table 1). However, only apical peak E wave was found to be significant in differentiating the group of patients with severe SEC, sludge or THR from the other two groups. On ROC analysis, a TTDI apical E wave velocity < 9 cm/sec best identified the group of patients with severe SEC, sludge or THR.

Conclusions: TTDI of the LAA is a new echocardiographic modality useful in determining the severity of LAA SEC and the detection of sludge or THR. The results of the CLOTS multicenter trial suggest an expanding role of TTE in the evaluation of the LAA.

1056 Transthoracic tissue Doppler imaging of the left atrial appendage predicts thrombus and severity of spontaneous echo contrast on transesophageal echocardiography: the CLOTS multicenter trial
J.A. Sallach, J.K. Drinke, C.R. Asher, W.A. Jaber, M.F. Stoddard, W.A. Zoghbi, N.J. Weissmann, S.L. Mulvagh, S.E. Jasper, A.L. Klein on behalf of The CLOTS Investigators. Cleveland Clinic Foundation, Cleveland, United States of America, 2Cleveland Clinic Foundation, Cleveland, United States of America, 3Cleveland Clinic Florida, Weston, United States of America, 4University of Louisville, Louisville, United States of America, 5Baylor College of Medicine, Houston, United States of America, 6Washington Hospital Center, Washington, United States of America, 7Mayo Clinic, Rochester, United States of America

Background: In atrial fibrillation (AF), the left atrial appendage (LAA) has historically been evaluated with transesophageal echocardiography (TEE). Transesophageal echocardiographic tissue Doppler imaging (TEE-TDI) of the LAA walls has never been reported in AF. We sought to determine the role of this new modality in identifying LAA spontaneous echo contrast (SEC), sludge or thrombus (THR).

Methods: The Comprehensive Left Atrial Appendage Optimization of Thrombus (CLOTS) multicenter trial enrolled 115 patients (84 male, mean age 66±12 years) with permanent or paroxysmal AF of ≥2 days duration undergoing clinically indicated TEE, from 5 centers. On TEE, the LAA was evaluated for mild SEC, severe SEC, sludge or THR. TTE-TDI peak S and E wave velocities of the LAA walls (anterior, posterior and apical) were acquired and examined to determine their ability to identify LAA SEC, sludge or THR.

Results: TEE identified 6 (5%) patients with LAA sludge and 2 (2%) patients with LAA THR. Both LAA THR were identified on TTE. Anterior, posterior and apical wall LAA TTE-TDI velocities varied significantly between the three groups examined (no SEC, mild SEC and severe SEC/sludge/THR) (Table 1). However, only apical peak E wave was found to be significant in differentiating the group of patients with severe SEC, sludge or THR from the other two groups. On ROC analysis, a TTDI apical E wave velocity < 9 cm/sec best identified the group of patients with severe SEC, sludge or THR.

Conclusions: TTDI of the LAA is a new echocardiographic modality useful in determining the severity of LAA SEC and the detection of sludge or THR. The results of the CLOTS multicenter trial suggest an expanding role of TTE in the evaluation of the LAA.

Table 1.

LAA TTE-TDI

No SEC (n=25) Mild SEC (n=47) Severe SEC/THR (n=43)

Anterior Peak S wave (cm/sec) 7.1±1.6 6.5±3.8 5.7±1.4 0.01

Anterior Peak E wave (cm/sec) 10.6±3.1 8.9±4.7 7.7±2.5 0.05

Posterior Peak S wave (cm/sec) 7.0±1.7 6.2±3.2 5.3±1.6 <0.001

Posterior Peak E wave (cm/sec) 10.4±3.9 8.6±3.8 7.5±2.9 0.02

Apical Peak S wave (cm/sec) 8.3±1.4 6.7±3.0 5.9±1.7 <0.001

Apical Peak E wave (cm/sec) 12.5±3.9 10.2±4.3 8.7±2.8 <0.001

LAA = left atrial appendage, TDI = tissue Doppler imaging, SEC = spontaneous echo contrast, THR = thrombus.

1057 Deceleration time of systolic pulmonary venous flow - A new clinical measure of left atrial pressure
J.O. Hunderi, C.R. Thompson, O.A. Smiseth. Oslo, Norway

Background and aim: The curvilinearity of the atrial pressure-volume curve implies that atrial compliance decreases progressively with increasing left atrial pressure (LAP). We predict that reduced atrial compliance leads to more rapid deceleration of systolic pulmonary venous flow. With this rationale we investigate if the deceleration time (tdc) of pulmonary venous flow reflects mean LAP.

Methods: In 8 patients during coronary surgery, before extracorporeal circulation, pulmonary venous flow (P PVF) by ultrasonic transit time, and invasive LAP were recorded during stepwise volume loading. The tdc was calculated as indicated on the Figure. Left atrial compliance was calculated as the systolic pulmonary venin flow integral divided by pressure.

Results: Volume loading increased mean LAP from 11±3 to 20.5±5 mmHg (p<0.001), reduced left atrial compliance from 1.25±0.57 to 0.64±0.37 m/mnmg (p<0.001), and reduced tdc from 390±80 to 230±50 ms (p<0.002). Mean LAP correlated well with tdc (Figure).

Conclusion: Elevated LAP caused a decrease in atrial compliance and thus more rapid deceleration of systolic pulmonary venous flow. The tdc has potential to become a clinical, semiquantitative measure of LAP.

LAP-PVF

Abstracts