**DOPPLER MYOCARDIAL IMAGING**

**646**

Interimachine and interoperator variability in measuring myocardial velocities and deformation

A. Williams 1, A. Roberts 1, M. Rohani 1, C. Raji 1, J. Edwards 1, C. Gherginecu 1, C. Palermo 2, A.G. Fraser 3, 1Wales Heart Research Institute, Department of Cardiology, Cardiff, United Kingdom; 2University of Pisa, Cardiology, Pisa, Italy; 3Wales Heart Research Institute, Senior Lecturer and Consultant Cardiologist, Cardiff, United Kingdom.

Tissue Doppler provides a powerful tool for precise quantitative diagnosis of regional myocardial function that could be used for monitoring hemodynamic status, studying the progression of disease, and estimating prognosis. For this to be clinically useful, studies should be comparable between different machines and investigators or laboratories, but this has not been established.

**Methods:** 60 subjects (37 male) aged 21-88 years, including healthy controls and patients with ischemic or dilated cardiomyopathy, underwent 4 consecutive transthoracic echocardiographic studies on the same day according to a standard protocol, using 4 high-end systems (Acuson Sequoia, Aloka SSD-5500, GE Vivid Dimension, and Toshiba Aplio); each machine was operated by the same echocardiographer throughout the project. 1-3 beat loops depending on each machine’s capacity were recorded at maximal frame rates and stored digitally; regional velocities were measured by post-processing and averaged. Data were analysed using SPSS.

**Results:** For peak systolic velocity in the basal septal segment recorded from the apex, correlations for measurements obtained using 6 pairs of machines, ranged from 0.55 (p<0.01; Pearson) to 0.72 (p<0.001); the mean difference in measurements between the 2 machines with the highest correlation was 0.49 (ns 1.56) cm/s (range -4.2 to +2.2). For comparable measurements of peak early diastolic velocity, the correlations ranged from 0.58 (p<0.01) to 0.82 (p<0.001) and the mean difference between the machines with the closest correlation was 0.78 (1.68) cm/s (range -7.0 to +6.2). For peak systolic velocity in the basal posterior segment, measured from a parasternal window, correlations ranged from 0.06 (ns) to 0.49 (p<0.001). Mean systolic strain in the basal septal segment, measured using 3 machines, was 20(10%), 23(11)% and 21(25%); correlations were 0.15 and 0.31 (both ns) and 0.44 (p<0.05).

**Conclusions:** In this study, there were considerable and potentially clinically significant variations in myocardial velocities and deformation recorded on different echocardiographic machines by different operators, in the same patients under similar physiological conditions. The causes of these differences need to be understood, and overcome perhaps by standardised acquisition, tracking, and signal averaging, if the diagnostic potential of tissue Doppler is to be optimised.

**647**

Accuracy of velocity and strain rate by two high-end ultrasound systems

J. Kjaergaard 1, J. Korinek 2, M. Belohvek 2, J.O. Oh 2, P. Sogaard 3, C. Hassager 4, 1University of Copenhagen, Dept. of Cardiology, Rigshospitalet, Copenhagen, Denmark; 2Mayo Clinic College of Medicine, Division of Cardiovascular Diseases, Rochester, United States of America; 3University Hospital of Gentofte, Dept. of Cardiology, Hørsholm, Denmark; 4University of Copenhagen, Dept. of Cardiology, Rigshospitalet, Copenhagen, Denmark.

**Purpose**

Accuracy of the measurement of velocity is essential, not only for the clinical application of Tissue Doppler Imaging (TDI), but also to allow estimation of derived parameters such as Strain Rate (SR) and strain.

We aimed at testing the accuracy of tissue velocity measurement in vitro using a tissue mimicking phantom and in vivo in a random sample of 20 healthy control subjects by two high-end ultrasound systems.

**Methods**

A 9 cm gelatin phantom was cyclically compressed by a moving piston at 8 different velocities (range 1.9 to 14.7 cm/s, SR range -0.3 to -2.1 cm/s, strain -21%). TDI scans were obtained using the GE Vivid 7/Echopac 3.1 and the Philips SONOS 7500/Qlab 2.0 systems at a depth of 6 cm and compared to the velocity of the piston.

The basal segments of the right and left ventricular (RV and LV) free wall and posterior septum in 20 healthy volunteers were examined by both systems. Results are shown as mean difference ± SD.* p<0.05 (paired t test). Results

<table>
<thead>
<tr>
<th>In vitro</th>
<th>In vivo RV</th>
<th>In vivo LV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piston vs.</td>
<td>Piston vs.</td>
<td>Piston vs.</td>
</tr>
<tr>
<td>VIVID</td>
<td>SONOS vs.</td>
<td>VIVID vs.</td>
</tr>
<tr>
<td>VIVID</td>
<td>SONOS</td>
<td>VIVID</td>
</tr>
<tr>
<td>VIVID</td>
<td>SONOS</td>
<td></td>
</tr>
<tr>
<td>Velocity (cm/s)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5±0.2</td>
<td>0.5±0.2</td>
<td>0.2±0.2</td>
</tr>
<tr>
<td>Strain rate (s⁻¹)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0±0.2</td>
<td>2.0±0.2</td>
<td>-1±0.7</td>
</tr>
<tr>
<td>Strain (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1±1</td>
<td>3±2</td>
<td>2±4</td>
</tr>
</tbody>
</table>

In vivo: Volunteers were 62±11 years of age, 50% female. The velocities were slightly smaller, whereas the strain and strain rate were larger when measured by the SONOS system compared to VIVID.

**Conclusion:** Overall only minor difference was found in vitro, none were of clinical significance. In vivo, the mean differences found were not of clinical importance, but the amount of variation found, indicates that further studies are needed before results from the two systems can be used interchangeably.

**648**

Two dimensional strain imaging. A new method for automatic quantification of myocardial deformation

C. Rest 1, S. Korber 2, G. Wasniewski 2, F.A. Flachskampf 2, W.G. Daniel 2, J-U. Voigl 1, 1Pfleiderklinik der Universität Würzburg, Würzburg, Germany; 2Universitätsklinikum Erlangen, Medizinische Klinik II, Erlangen, Germany.

**Background:** Two-dimensional strain imaging is a novel method for angle independent quantification of regional myocardial function, based on grey-scale 2D image analysis (2DA). After defining the endocardial border, the myocardium is detected automatically and quality and detection is rated by an integrated scoring algorithm (ISA). We validated ISA against conventional tissue Doppler (TD) measurements and evaluated the accuracy of ISA.

**Methods:** In 20 consecutive patients with myocardial hypertrophy, we acquired TD and 2DA data from the apical view by two independent observers (Vivid 7, GE, Norsay). The left ventricle was divided into 6 walls and 3 segments. Longitudinal systolic and diastolic velocities and systolic and maximal strain were calculated with 2DA and compared to TD. Quality of detection with 2DA was rated by ISA in each segment by a number between 1.0 and 3.0.

**Results:** Velocity data from TD and 2DA analysis showed good correlation (r=0.88, p<0.01). Correlation was lower in the apical segments than in the mid and basal segments (r=0.74 and r=0.9, both p<0.01). Correlation of strain data was low...
649 Importance of temporal reference frame for strain calculation

F. Labombarda, P. PonGabrielsen, A. Pelissier, E. Filippi, P. Scano, G. Grotli, E. Solou
CHU Caen Cote de Nacre, cardiology department, Caen, France
Background: Biventricular pacing (BVP) improves left ventricular (LV) performance. Strain peak (PS_max) is a main index to analyse myocardial deformation recently used to evaluate BVP therapy effects. Calculation is not standardized, temporal reference frame (TRF) is not clearly established. PS_max is the time integral of myocardial velocity gradient. TRF choice for PS_max calculations may have important implication.

Objective: We studied the influence of TRF on the PS_max value in BVP.

Methods: We studied 15 patients with heart failure and BVP. Tissue Doppler Imaging (TDI) was acquired during three cardiac cycles in the apical four and two-chamber view. Analysis of regional PS_max was performed in 12 LV segments (Base, Mid, Apex of: septal, lateral, anterior and posterior walls). PS_max was calculated during BVP and base-line. Calculation of PS_max was done using two different TRFs: TRF1 (onset of the ECG R wave), TRF2 (onset of isovolumic contraction). Paired Student t-test was used for TDI measurements comparisons at baseline and during BVP.

Results: According to pacing settings, significant change of PS_max occurred with TRF2 (-4.3±0.5% vs -4.1±0.4%, p<0.001) and with TRF1 (-2.5±0.7% vs -2.6±0.6%, respectively). Further, good scores were correlated with TRF1 (-4.3±0.5% vs -4.1±0.4%, p<0.001) but there was no significant influence of the scores on the amplitude of strain.

Conclusion: Accuracy of velocity and strain measurements based on 2DA depend on the TRF setting, which differs in distinct segments of the myocardium. Quality of myocardial detection can be estimated by ISA. Best scores and correlations of 2DA with TDI were assessed in the mid segments of the septum, anteroseptal and interventricular septal walls. Differences between 2DA and TDI and strain and stress data of hyperdynamic myocardium is lower than reported in healthy patients, as expected.

650 Is 2D strain by speckle tracking and tissue Doppler Imaging comparable at high heart rate?

K. Dale, A. Stoylen, T. Trondheims University Hospital, Department Of Cardiology, Trondheim, Norway; NTNU, Dept. of Circulation & Medical Imaging, Trondheim, Norway
Background: Strain (E), Strain Rate (SR) and tissue velocity (V) calculated from Tissue Doppler Imaging (TDI) has a high temporal resolution, but also a high variability. 2D strain (STE) is a new application based on speckle tracking in B-mode images, giving better spatial-, but poorer temporal resolution, possibly resulting in undersampling and underestimated peak values, particularly at higher heart rates (HR).

Objective: To compare peak systolic E, SR, and V, assessed by the two methods at normal and high heart rate, and to quantify the differences.

Methods: In 10 patients who underwent dobutamine stress echo, TDI (160 fps) and separate B-mode images (55 fps) were obtained at baseline and peak and HR from three standard apical planes. In both applications peak systolic E and -SR were analysed in all segments (total 166). Peak systolic velocity was measured in A-plane at 6 points (total 60). 5 patients had ischemia at peak stress.

Results: The results are summarised in table 1, as mean values. There was significantly lower measurements with TDI, both at baseline (5.2±3.1 and 1.6 ms⁻¹) and at peak (7.1±0.9 and 4.7 ms⁻¹). The difference increased with high HR (Table 1). This increase in difference between TDI- and STE measurements with higher HR was significant for all three measurements (E, p<0.05, SR and V, p<0.005) and TDI vs STE (p<0.001).

Conclusion: 2DST measures significant lower values for both E, SR and V compared to TDI. In addition to the noise in TDI, and the increased smoothing in 2DST, this difference may be due to undersampling, as the difference increases with heart rate.

651 Analysis of mitral annulus motion measurements derived from M-mode, anatomical M-mode, tissue Doppler displacement and speckle tracking


Left ventricular (LV) longitudinal shortening plays an important role in cardiac contractility and can be evaluated by the mitral annulus motion (MAM) towards the cardiac apex. Objective: The aim of the study was to evaluate four different methods: conventional M-mode (MM), anatomical M-mode (AMM), tissue Doppler displacement (TDD) and speckle tracking (ST). Methods: MAM was evaluated in 25 patients, with cardiac disease using MM, AMM, TDD and ST. Apical four chamber view was analyzed. Results: MAM using angle correction up to 20 degrees did not differ significantly from MM (mean differences between, septum 2.3±1.5 and lateral 4.1±1.4, p<0.05). ST measurements were not significantly different from MM and AMM. TDD measurements were significantly lower compared with MM, AMM and ST in septum (2.9±3.3 vs 11.0±2.4 mm, p=0.011), and the lateral wall (2.5±3.3 vs 11.9±2.3 mm, p=0.001). The limits of agreement between MAM and TDD in septal and lateral walls were: -2.3 to 2.9 and -2.5 to 9.2 mm, between MM and ST were: -5.2 to 7.5 and -5.8 to 8.7, between AMM and TDD was -2.5 to 5.5 and -2.3 to 7.9, between AMM and ST was -8.7 to 7.5 and -9.8 to 9.6 and between TDI and ST was -5.5 to 8.5.

Conclusions: MM, AMM and TDD are angle-dependent and can therefore underestimate MAM. ST, lacking angle-dependence, seems to be a new promising way to evaluate MAM. In summary, the methods are non-interchangeable.

652 Speckle tracking echocardiography: angle-independent strain measurements with better repeatability than strain from tissue Doppler Imaging

B.H. Amundsen, S. Malm, L.A. Rustad, J. Crosby, A. Stoylen, H. Torp, S.A. Stordahl, NTNU, Dept. of Circulation and Medical Imaging, Trondheim, Norway; St Olav Hospital, Dep of cardiology, Trondheim, Norway; NTNU, Dept. Circulation and Medical Imaging, Trondheim, Norway

Purpose: Myocardial strain measurements in the left ventricle derived from tissue Doppler imaging (S-TDI) are limited by angle dependency and noise. We have implemented a method using speckle tracking echocardiography (STE) to measure strain in B-mode images. Strain is measured over the entire segments, by tracking of seven selected regions of interest (Figures). The aim of the present study was to compare this application to S-TDI.

Methods: In 15 patients with STEMI and five healthy persons we acquired both B-Mode (75-96 frames/s) and TDI (100-124 frames/s) images in the three standard apical views. Peak systolic strain was analysed in 6 segments in each view and averaged over three cycles. Segments were excluded from S-TDI analysis if angle deviation >30°. The coefficient of repeatability (COR) was calculated from strain in the first and third heart cycle in each recording.

Results: Strain could be measured in 77 and 76% of the segments with STE and S-TDI, respectively. 95% limits of agreement between the methods was (12.5 to 103%); and the correlation was r=0.71 (p<0.001). Absolute strain values were lower for STE than for S-TDI (12.8±6.5 vs 14.1±8.1%, p<0.01). The correlation was better for midventricular segments (r=0.84) than for basal (r=0.43) and apical (0.79) segments (p<0.001). COR was lower for STE than for S-TDI (6.4 vs 7.7%, p<0.01).

Conclusion: STE agrees moderately with S-TDI. Poorer correlations in the apical and basal segments were probably due to angle deviation >30°, near field reverberations and poorer lateral resolution with increasing image depth. Improved repeatability should be a good reason for considering the method for clinical use.
Table 1. Estimated peak rotation and time to peak rotation with 3 regions of interest (2 x 4 mm, strain length 2 mm) for peak systolic strain in J. Crosby 1, T. Helle-Valle 2, B.H. Amundsen 3, H. Torp 3, echocardiography (STE) software (EchoPAC 2D Strain, GE) on six healthy humans.

<table>
<thead>
<tr>
<th>Region</th>
<th>Peak rotation [deg]</th>
<th>Time to peak [s]</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRA</td>
<td>2.97±0.72</td>
<td>2.94±0.64</td>
</tr>
<tr>
<td>TDI</td>
<td>0.39±0.015</td>
<td>0.39±0.011</td>
</tr>
<tr>
<td>PLA</td>
<td>-1.63±0.35</td>
<td>-1.67±0.321</td>
</tr>
<tr>
<td>TDI STE</td>
<td>0.280±0.112</td>
<td>0.290±0.101</td>
</tr>
<tr>
<td>PLA STE</td>
<td>-0.79±0.368</td>
<td>0.362±0.087</td>
</tr>
<tr>
<td>TDI STE</td>
<td>0.309±0.088</td>
<td>0.309±0.088</td>
</tr>
</tbody>
</table>

0.84 and 0.96, respectively. The method may also be used to assess circumferential strain, but this has not yet been tested.

Conclusion: Assessment of regional LV rotation from the TDI velocity field was shown to be feasible.

Does speckle tracking analysis of both radial and longitudinal myocardial motion add to the diagnostic power of tissue Doppler analysis during dobutamine stress echocardiography?

P Jacobsen 1, Y. Mobjassen 2, S. Roumiantz 3, P. Winter 1, L.-A. Brodin 3, 1Karolinska University Hospital, Department of Clinical Physiology, Stockholm, Sweden; 2Karolinska University Hospital, Dept of Clinical Physiology, Stockholm, Sweden; 3Karolinska University Hospital, Department of Physiology, Stockholm, Sweden

Background: Tissue Doppler imaging (TDI) is an established tool for quantification of myocardial function, and has been validated for dobutamine stress echocardiography. However, TDI has one major limitation in measuring only longitudinal velocities. The novel 2D strain modality, using speckle tracking analysis, has allowed for detection of myocardial movement and deformation in both longitudinal and transversal direction during 2D echocardiography, thus allowing for measurement of both radial and longitudinal myocardial velocities. A ratio between longitudinal and radial myocardial movement might be sensitive to subclinical myocardial disease.

Aim: The aim of this study was to determine the incremental value in measuring both longitudinal and radial motion.

Methods: From the stress echo archive, 200 clinical stress echo studies were screened for digitally stored recordings with both TDI and speckle tracking modalities. The patient files were also investigated. Hologic Image Analysis (HIA) was performed for each patient. The results were compared to the TDI and speckle tracking readings with an unpaired t-test.

Results: TVI velocities measured in the basal left ventricular segments showed the strongest correlation to basal myocardial ischemia. Using unpaired t-test there was a highly significant difference in the peak to basal ratio velocity for tissue Doppler velocities. The difference was the greatest (1.38) and highly significant comparing longitudinal velocities in the basal segments (p < 0.0001). There were no statistically significant differences in peak to basal ratio Radial velocities, displacement or the ratio of longitudinal/radial velocities at segmental level showed any incremental in this study.

Conclusions: Measurement of radial myocardial velocity and displacement using the novel speckle tracking modality does not appear to add to the diagnostic power of TDI analyses during DASE.

The non-invasive ultrasonic assessment of radial, longitudinal and circumferential cardiac strain in normal and chronic ischemic pigs

S. Langeland, S. Cronen, M. Wu, F.E. Rademakers, J. D'hooge, Catholic University Leuven, Department of Cardiology, Leuven, Belgium

Ultrasonic strain (S) imaging has been used to study cardiac (pathophysiology) in the porcine model. However, due to the angle dependency of the current S methodology and the limited amount of acoustic windows, all these studies have been investigating radial (SR) S only. Nevertheless, a significant amount of information might be available from the longitudinal (SL) and circumferential (SC) S. In our laboratory, a new ultrasound methodology has previously been developed allowing the measurement of all-in-plane S components. The aim of this study was to apply this to a closed-chest porcine model.

Methods: 13 closed-chest pigs were imaged using a Toshiba Apio in LAX and SAX views at baseline (BL) and after 3 weeks (3W) of chronic ischemia in the infarcted wall (ILW). The SR, SL and SC of the anteroseptal wall (ASW) and ISW were extracted using this new method and custom made software (SPECULE-2D).

Figure 1. Mean curves with standard error

Picture

Eur J Echocardiography Abstracts Supplement, December 2005
Transmural cardiac strain gradients in the antero-septal wall of the ovine left ventricle: a myocardial velocit imaging study

J. D'hooge, E. Eroglu, S. Langeland, W. Anna, I. Lenaerts, R. Willems, H. Heidbuchel, F. Rademakers. University Hospital Gasthuisberg, Department of Cardiology, Leuven, Belgium

Background: Despite its clinical relevance, defining the transmural deformation characteristics within the myocardial wall in a non-invasive manner remains a technical challenge. The value of myocardial velocity imaging (MVI) has been firmly established in the quantification of regional deformation. Combining MVI with high-frequency epicardial imaging might thus allow the assessment of transmural differences in myocardial radial deformation. The aims of this study were: 1) to test the feasibility of MVI using an epicardial transducer and 2) to describe and quantify the regional deformation characteristics within the myocardial wall.

Methods: 6 anesthetised, open-chest sheep were scanned using a 13 MHz epicardial transducer (13L, GE Vingmed). Colour Doppler myocardial velocity data were acquired from the antero-septal wall, with the probe positioned parallel to the left anterior descending coronary artery. All datasets were transferred to a personal computer for offline analysis using dedicated software (SIFQUEL). Strain rate (S) was extracted in the sub-endocardial (ENDO), midwall (MID) and subepicardial (EPI) regions using an estimation length of 1.5mm.

Results: All the datasets acquired were suitable for analysis. The mean strain profile (indicated with standard errors) extracted from the ENDO, MID and EPI were shown in figure 1. Sub-endocardial strain was not found to be higher than the mid-myocardial one. Mean ± SD end-systolic S values were as follows: ENDO: 40±1.9%, MID: 70±23% and EPI: 20±32%.

Conclusions: MVI using an epicardial transducer was shown to be feasible for the assessment of transmural myocardial strain gradients. Our results suggest that a transmural radial strain gradient might not be a fundamental requirement for normal systolic wall thickening.

658

Automatic timing of aortic valve closure using tissue Doppler imaging

S. Asa1, A. Stoylen1, C.B. Inge1, S. Frigstad2, H. Torp1. 1NTNU, Dept. Circulation and Medical Imaging, Trondheim, Norway; 2GE Vingmed Ultrasound, Trondheim, Norway

Purpose: Aortic Valve Closure (AVC) is important for timing post-ejection events. Due to heart rate variability, AVC timing in the heart cycle used for analysis is problematic. AVC can be detected in tissue Doppler imaging (TDI) data from the base of the left ventricle (LV). We have developed a new automatic algorithm for detecting the timing of AVC using TDI. The aim of this study was to evaluate this method.

Methods: The automatic algorithm for detecting AVC was implemented in a customized ultrasound analysis toolbox (GoMat, GE Vingmed Ultrasound). The algorithm consisted of detection of the two points where the atrioventricular (AV) plane was connected to LV walls, extracting TDI velocities originating from those points and finally automatic curve analysis. E wave and systolic velocities were detected using a temporal search interval for AVC. AVC was then automatically detected with a certain confidence score. The confidence score of AVC is calculated as a function of the maximum acceleration value within the search interval (see picture).

Results: The automatic algorithm signalled failure to detect AVC in 2 cases (4%). For the remaining 46 cases (96%), the mean difference ± standard deviation of difference between calibrated phonocardiography (RPA) and automatic AVC was 2.8±9.1 ms.

Conclusions: Automatic detection of AVC using TDI with apical insonation on normal resting subjects is feasible and reliable.

659

The detection of abnormal segmental strain and strain rate characteristics using a statistical model of normal deformation


Background: Strain (S) and strain rate (SR) imaging have been introduced for the assessment of regional myocardial function. To date, the normality has been defined based on systolic S/R values. However, as S/R is measured over the whole cardiac cycle, this approach might ignore a significant amount of information. The aim of this study was to set out a methodology, which compares S/R over the whole cardiac cycle to a statistical model of normal S/R profiles using principal component analysis (PCA).

Methods: S/R imaging data were acquired (GE Vivid7) in 90 normals (N) and 10 patients (PTS) with coronary artery disease (CAD). Data were recorded in apical 2-, 3- and 4-chamber views and processed using custom software (SIFQUEL) in order to extract S/R traces in a 18-segment left ventricle model. S/R curvses from 80 randomly selected N were used to construct a statistical model for principal modes of variations (PMV). The 10 remaining N and 10 PTS were used for validation of the model. S/R curves extracted from each segment were given a likelihood of being normal based on the model. This likelihood was presented in a color-coded bull's-eye representation for visual interpretation by a blinded reader. Based on these readings, sensitivity (Sens) and specificity (Spec) were calculated.

Results: Sens and spec of the method were 80% and 100%, respectively. The mean distance from normality was 0.25±0.04 vs 0.45±0.05 for N and PTS, respectively. The first two PMV (amplitude, PMV 1 and timing, PMV 2) for normal S/R profile with a pathologic example are shown in Fig. 1.

Conclusions: Our study showed that PCA of S/R is reliable in detecting CAD. It might offer a new approach towards the automated detection of abnormal myocardial deformation patterns.

660

Correlation between equilibrium radionuclide ejection fraction and systolic tissue Doppler velocity

E. Lindf Ringsell1, M. Quintana1, M. Edwall2, R. Muller-Suhr3, M.J. Eriksson4, 1Karolinska University Hospital, Dept. Of Physiology, Stockholm, Sweden; 2Danderyd Hospital, Department of Medicine, Stockholm, Sweden; 3Danderyd Hospital, Department of Clinical Physiology, Stockholm, Sweden; 4Karolinska University Hospital, Department of Clinical Physiology, Stockholm, Sweden

Purpose: Left ventricular (LV) ejection fraction (EF) is a widely used index in patients with congestive heart failure (CHF). EF measured by means of equilibrium radionuclide angiography (ERNA) is an accurate and highly reproducible index of a global systolic LV function, and is considered to be the golden standard. The aim of this study was to examine the relationship between EF measured by ERNA and newer indexes of LV function such as: systolic Tissue Velocity (TV) measured by means of TV Imaging and Atrio-Ventricular Plane Displacement (AVPD) measured by 2-D guided M-mode.

Eur J Echocardiography Abstracts Supplement, December 2005
Methods: Twenty five (23 men) consecutive CHF patients (mean age 68 ± 13 years) with NYHA Class II symptoms at admission, were investigated with TVI, AVPD and ERNA. Echocardiography and ERNA were performed on the same day within four hours. EF measured by ERNA was correlated to 1), peak systolic tissue velocity in basal septum, 2), peak systolic TV in the basal septum, 3), peak systolic TV in 4-site average, and 4) Mean AVPD 4-site average. Correlation coefficients (Pearson's) were computed for comparison of the various estimates of systolic LV function.

Results: Echocardiographic dimensions were: LV end-diastolic diameter 63±17 mm, LV end-systolic diameter 63±10 mm, left atrial diameter 46±8 mm, inter-ventricular septum 12±2 mm, posterior wall 11±2 mm. EF according to ERNA was 33±16%, mean AVPD 16±2 mm, mean TVI 3.21±1.6 mm, mean TVI-4 site 3.2±1.6 mm, mean AVPD 10.6±2 mm. Correlations between EF by ERNA and other systolic indexes are shown in the Table.

Correlations between EF by ERNA and TVI

<table>
<thead>
<tr>
<th>EF ERNA vs.</th>
<th>Systolic TV sept</th>
<th>Systolic TV 5</th>
<th>Systolic TV-4</th>
<th>AVPD-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>r = 0.81</td>
<td>r = 0.65</td>
<td>r = 0.56</td>
<td>r = 0.46</td>
<td>p = 0.001</td>
</tr>
<tr>
<td>r = 0.06</td>
<td>r = 0.03</td>
<td>r = 0.01</td>
<td>r = 0.003</td>
<td>p = 0.003</td>
</tr>
</tbody>
</table>

Conclusions: We found significant correlations between EF by ERNA and all newer indexes of LV systolic function based on TVI and AVPD. However, the measurement of peak systolic TV in the basal septum correlated best with EF by ERNA, and may be a useful simple tool in the evaluation of CHF patients.

661 Impact of aging of left ventricular longitudinal function in a healthy reference population: a pulsed tissue Doppler study

P. Inzitari,1 M. Galetsi,2 M. Fossa,2 M. Di Marco,1 M. Papi1, M. Pardo,1 G. de Simone1, D. Giovannini1,1 Federico University, Clinical and Experimental Medicine, Naples, Italy; 2Naples, Italy

Purpose: Although pulsed Tissue Doppler (TD) of LV left ventricular (LV) mitral annulus can be used to quantify global LV longitudinal function and provides information on both systolic and diastolic function, it is known about normal values and determinants of mitral annular TD. In this study we assessed demographic and echocardiographic correlates of TD-derived longitudinal myocardial function in a healthy reference population.

Methods: Standard echocardiographic examination and pulsed TD of the left ventricle were performed in 131 healthy, normo-weight, normotensive subjects (M/F=87/44) by TD, recorded by placing the sample volume at the level of LV lateral mitral annulus. Myocardial systolic and diastolic velocities (Em, Am, Em/Am ratio) and myocardial time intervals (relaxation time (RTm), pre-contraction and contraction time) were measured. The ratio between transmural Doppler E peak velocity and TD-derived Em (E/Em ratio) was calculated as an index of LV filling pressure. Blood pressure (BP), heart rate and anthropometric measurements were also taken, and body mass index computed.

Results: The age of the study population was 33±14 years (range = 71-71 years), body mass index was 23.1±4 kg/m2, blood pressure was 117±127/80±2 mmHg, heart rate = 72±11 bpm. LV ejection fraction was 62±9%, mean TD-derived Em (Em) was 11.5±3.7 cm/s and mean TD-derived Em/Am ratio was 0.56±0.16. No sex-specific significant difference of TD measurements was found. By dividing the population according to age, subjects <50 years had a lower Em and Em/Am ratio and younger RTm than those >50 years (p <0.05). The Pearson correlation coefficient between the area fraction and RTm was 0.70 and -0.58, respectively, p =0.001. In the overall population ejection fraction was related positively with Em (r = 0.19, p =0.01) and negatively with RTm (r = -0.18) (both p<0.05). Significant relations of age were observed with Em (r = -0.64, p<0.0001), Em/Am ratio (r = -0.64, p<0.0001), RTm (r = -0.17, p=0.05) and Em (r = -0.31, p=0.001). Aging was also associated to a higher E/Em ratio (r = 0.40, p=0.0001). All these associations remained significant even after adjusting for heart rate and body mass index.

Conclusions: In a healthy reference population, TD-derived LV longitudinal function does not show sex-specific differences and is marginally associated to changes in ejection fraction but strongly influenced by age. Em/Am ratio exhibits an increment with advancing age, independent on heart rate and body size changes. Aging has to be taken into account when assessing LV myocardial longitudinal function and LV filling pressure.

662 Global systolic strain rates measured by 2D strain tissue tracking method match diastolic function analysis by transmural flow Doppler better than tissue Doppler of mitral annular motion

J. Korinek, P.P. Bang Gupta, S. Yoshifuku, A. Romero-Corral, E. McMahon, M. Sekhlalsingh. Mayo Clinic College of Medicine, Division of Cardiovascular Diseases, Rochester, United States of America

Background: Pattern of transmural flow into the left ventricle (LV) measured by pulse wave Doppler (PW) is generally used to evaluate LV global diastolic function. We hypothesized that changes measured by PW will be reflected in global myocardial strain rate (gSR), particularly if regional impairment of myocardial relaxation is present.

Methods: We performed echocardiographic scans in open-chest pigs in long-axis, 2-, and 4-chamber views and in short-axis apical, mid, and basal portion of LV at baseline (8 animals) and following 60 minutes of distal left anterior descending coronary artery occlusion (6 animals). To assess diastolic function, PW of mitral regurgitation jet was used (ratio of early E and atrial contraction A); E/A was measured between 2.0 and 4.0, and may be a useful simple tool in the evaluation of CHF patients.

Results: E/Em ratio was correlated to 1), peak systolic TV in the basal septum, 2), peak systolic TV in the basal septum, 3), peak systolic TV in 4-site average, and 4) Mean AVPD 4-site average. Correlation coefficients (Pearson's) were computed for comparison of the various estimates of systolic LV function.

Results: Echocardiographic dimensions were: LV end-diastolic diameter 63±17 mm, LV end-systolic diameter 63±10 mm, left atrial diameter 46±8 mm, inter-ventricular septum 12±2 mm, posterior wall 11±2 mm. EF according to ERNA was 33±16%, mean AVPD 16±2 mm, mean TVI 3.21±1.6 mm, mean TVI-4 site 3.2±1.6 mm, mean AVPD 10.6±2 mm. Correlations between EF by ERNA and other systolic indexes are shown in the Table.

Conclusions: We found significant correlations between EF by ERNA and all newer indexes of LV systolic function based on TVI and AVPD. However, the measurement of peak systolic TV in the basal septum correlated best with EF by ERNA, and may be a useful simple tool in the evaluation of CHF patients.

663 Fractional myocardial infarct area size estimated by reconstructed 3-dimensional parametric strain rate imaging

S. Mair1, A. Stoylen2, H. Torp3, E. Sagenberg4, B.H. Amundsen4, T. Skjærpe1

1University Hospital of Tromso, Cardiology Dept., Tromsoy, Norway; 2Norwegian Univ. of science and technol., Dep. of circulation and medical imaging, Tromsoy, Norway

Objective: To evaluate the feasibility of a reconstructed 3D left ventricular(LV) surface model based on strain rate (SR) data, displaying area of myocardial dysfunction in acute myocardial infarction (MI), and to compare the fractional myocardial LV area to wall motion score index (WMSI) and ejection fraction (EF).

Methods: Tissue Doppler data in standard apical views were acquired using Vivid 7 in 48 consecutive patients(paired 58.1±14) within 24h after first time acute STEMI, regardless of aspirin window. The cinealogs were post-processed by custom-made software (ClimatGE, Vingmed) to a LV 3D surface model, that could be scrolled in time and rotated in space, showing colour-coded SR data. Arealous were identified from 3D wall motion and Sulls eye view, and excluded by manual editing. Setting a cut-off of SR = -0.25 e−1 in mid-systole, the area fraction of severely dysynergic LV surface was automatically measured and displayed (Fig. 1). WMSI was assessed according to standard criteria, and EF calculated by biplane Simpson's method.

Results: EF was 48±8% and WMSI 1.36±0.99. Reconstruction of the LV surface model was feasible in all patients, but areas of typical reperfusion noise were removed in 89%. The Pearson correlation coefficient between the area fraction and WMSI and between the area fraction and EF were 0.70 and -0.58, respectively, p < 0.01 for both.

Conclusion: Semi-automatic display and measurement of severely dysynergic area in acute STEMI, with a SR-based colour-coded surface model of the LV is feasible. Manual editing is necessary and requires some experience. The fractional myocardial area correlated well with both WMSI and EF, indicating that this could be a potential tool in assessment of MI size and prognosis.

664 2-Dimensional strain echocardiographic assessment of myocardial function in patients with myocardial bridge

K.I. Cho, J.H. Park, T.I. Kim: Maryknoll Hospital, Cardiology Dept., Busan, Korea, Republic of

Background: Myocardial bridging occurs when a branch of cardiac muscle overlies an intramural segment of a coronary artery. Phasic systolic vessel compression...
with persistent mid-to-late diastolic diameter reduction and increased intracor-
tary pressures. These variables are responsible for the coronary flow reserve in the
distal vessel and for clinical signs and symptoms of myocardial ischemia. We
sought to approach for quantitative echocardiographic assessment of myocardial
function in patients with myocardial bridge by 2-dimensional strain, novel software.
Methods: Novel computer software for tissue tracking echocardiography for ad-
vanced wall-motion analysis were performed in 18 symptomatic patients (mean age
57±17.9 years, 10 females) with myocardial bridge of left anterior descending
artery and no angiographic signs of coronary artery disease. Regional strain and diam-
eter reductions were evaluated by quantitative coronary angiography, and there were
no anagogic signs of coronary artery disease. 2-dimensional strain is on the
basis of the estimation that a discrete set of tissue velocities are present per
each of small elements on the ultrasound image.

Results: The maximal angiographic systolic lumen diameter reduction within the
myocardial bridges was 85.2±6% at rest, with persistent diameter reduction of
41±11%. Conventional wall-motion scoring was normal in all patients, and they were
adequately studied by the software. Regional strain and displacement of anterior seg-
ments were significantly reduced than posterior segments at the papillary muscle
level (30±2;13±2% vs. 51±2±17±3% and 48±20±7.5±1, respectively, all P<0.05), and showed plateau (30% and 30%) or biphasic (50% and 50%) pat-
terns. Peak rotation angle was significantly reduced or positive direction in anterior
segments at the systolic phase than posterior segments at papillary muscle level
(2.4±0.20 vs. 3.7±0.40, respectively, all P<0.05). Time from R wave on electrocar-
diography to transition from regional systole to early diastolic longening (T) were
significantly delayed in patients with myocardial bridge than controls (497±20.4 ms
vs. 348±12.5 ms, P<0.05).

Conclusion: Delayed systolic contraction and diastolic relaxation is an import-
ant mechanism contributing to ischemia in patients with myocardial bridge. 2-
dimensional strain can accomplish real time wall-motion analysis, and has the po-
tential to improve identification and functional quantitation of myocardial bridge.

665
Two-dimensional strain imaging predicts left ventricular remodeling in
patients with first myocardial infarction
B. Kaya1, N. Ozar1, E. Atalay1, S. Alakoglu2, K. Ozcak1, F. Ozmen2, N. Naci3, A. S. Kese1, Hacettepe University, Medical School, Cardiology Dept., Ankara, Turkey; Ankara, Turkey

Background: Left ventricular remodeling is a complex pathological process of pro-
gressive dilation, leading to systolic dysfunction and heart failure in patients with ac-
tue myocardial infarction. We aimed to determine and evaluate myocardial strain
echocardiographic parameters, predicting cardiac remodeling process in patients
with the first myocardial infarction.

Methods: For the consecutive male, mean age: 58±2;11±89) with a first ST
segment elevated acute myocardial infarction were included in the study. Con-
ventional echocardiography with tissue Doppler, mitral color M-mode imaging and
strain imaging were performed during initial hospital admission and after 6 month.
Peak systolic myocardial velocities (S'm) were recorded from 4 different sites on
the mitral annulus corresponding to the septum, lateral, inferior and anterior sites
of the left ventricle by pulsed wave Doppler tissue interrogation. A mean mitral annular
systolic motion (MVA) value was calculated from these sites. E'peak and E' values,
which were derived from transmural flow velocities, tissue Doppler and mitral color
M-mode flow propagation velocities were calculated. Left ventricular myocardial
systolic strain (MSS) were measured from 12 segments (apical 2 and 4 chamber loops),
and a mean value was calculated from these measurements.

The remodeling group was composed of 19 patients, and defined as an
increase in left ventricular (LV) end-diastolic volume index more than 5 ml/m2 from
baseline by using modified Simpson method. We compared basal clinical features,
tenants and BNP levels (R=0.46, p=0.012) and E/E' (R=0.393, p=0.05)
following discharge.

Results: There was no difference in the baseline characteristics or LV ejection
fraction (56±2;7.90 vs. 56±2;8.51) between groups. The E/A'peak, E' and MSS
value were similar in both groups. MVA values were lower in the remodeling group
(-9.51±2.08% vs. -12.01±9.61%). A cut off value of MVA < -12.12% had a sensi-
tivity of 100%, specificity of 51.7% in predicting left ventricular remodeling.

Conclusions: These findings indicate that in patients with acute myocardial infarc-
tion, two-dimensional strain imaging has an accurate noninvasive and quantitative tool
for prediction of post-infarct remodeling.

666
Comparative usefulness of myocardial velocity gradient and tissue
Doppler imaging in detecting ischemic myocardium by dobutamine challenge
in patients with single vessel coronary artery disease
K. El Monoawya, G. El-Shahid, M. Mahdi, M. Fahmi, N. El Mahallawi. Ain Shams University. Cardiology Department, Cairo, Egypt

Background: Tissue Doppler imaging is a new quantitative technique for identi-
fication of CAD; it improves the results of DSE in less export responders. However, in-
creased translational motion during a dobutamine challenge may affect the results
of the endocardial velocities. Myocardial velocity gradient (MVG) is an indicator of regional myocardial contractile independent systolic motion.

Objective: We sought to assess the clinical significance of MVG in detection of
ischemic myocardium in patients with single vessel disease.

Methods: We studied thirty patients with confirmed single vessel coronary artery
disease. An ischemic protocol was established by dobutamine induced endocar-
dial velocities at rest and at high dose dobutamine. We measured the MVG at rest, low dose (10µg/kg/min) and at high dose (30µg/kg/min) dobutamine.

Results: While pulsed wave TDI could detect statistically significant difference in
the systolic velocities in the ischemic basal & mid territories at rest, it failed to detect
statistically significant difference between the ischemic & non ischemic territories in
the systolic velocities at peak stress. There was no statistically significant differ-
ence in diastolic velocities in the ischemic and non ischemic territories at peak stress except in the inferior and posterior walls that showed sig-
nificant decrease in the ischemic territories velocity. So PW-TDI could differentiate between the ischemic and non ischemic territories at rest. But at high dose dobutamine the MVG in the ischemic mid anteroseptal segments was (1.7±2.7±0.7±1) for the corresponding non-ischemic mid anteroseptal segments, (P<0.05).

Conclusion: The mean MVG in the ischemic mid posterior segments at low dose was (2±0.5
1±3) vs (3±4;0;7±1) in the non ischemic mid posterior segments, (P<0.05). So, MVG could differentiate the ischemic and non ischemic segments at low dose dobutamine stress. Mean while, the response of MVG to dobu-
tamine could differentiate the ischemic mid non ischemic territories. In this study we
could create a potential cutoff value of mean MVG for differentiating the ischemic
segments in the mid anteroseptal territories equals 1.7 and in the mid posterior
teritories equals 1.9.5.

Conclusion: Detecting the mean MVG with sub-maximal dobutamine protocol would be a very safe and sensitive method of detecting ischemic myocardium in patients with single vessel disease.

667
Assessment of regional left ventricular diastolic function in patients with
preserved systolic function before and after angioplasty-TDE study
A. Kliewerz, P. Michalew, A. Witkowsi, P. Holman. Warsaw, Poland

Objective: Distortion of left ventricular diastolic function is an early sign of ischemia. Tissue Doppler Echocardiography (TDE) allows regional assessment of diastolic function. To assess the influence of coronary angioplasty (CA) on regional diastolic function, we compared changes of several diastolic parameters in patients before and after angioplasty by means of TDE.

Methods: Studied group comprised 31 males and 9 females (age: 49±8;18±6 yrs), who were preservd systolic function were qualified for CA. Patients were divided into two groups: group I – artery stenosis < 70%, group II – artery stenosis > 70%. Regional wall diastolic function was assessed by TDE one day before (examin 1), 2 days after (examin 2) and after successful CA (examin 3). We measured the diastolic velocities (En and Am wave, En/Am ratio) and time intervals (isovolumic relaxation time - IRT, atrial filling time - AFT) were measured in the long axis.

Eur J Echocardiography Abstracts Supplement, December 2005
adventitia and 3) <50% stenosis and/or diffuse irregularities with significant lumen narrowing. Differentiation between these groups was assessed using a one-way ANOVA with a Tukey-Kramer post-hoc test when appropriate.

Results: See Table 1

Methods: Although myocardial velocities were not different between the three groups, deformation indices showed a reduced LV systolic function in both severe and mild TX-CAD. These results show that longitudinal systolic myocardial function in Tx patients is already decreased before the angiographic severity of CAD reaches a clinical significance.

671

The influence of autologous mononuclear bone marrow cells on myocardial function assessed by Doppler tissue imaging

J. Maksim 1, L. Groch 1, I. Hornacek 1, S. Janousek 2, J. Mayer 2, Z. Korak 2, M. Kravkev 1, R. Piatekow 2,3 1. 2. Anna University Hospital, 1st. Department of Internal Medicine, Brno, Czech Republic; 3. Brno University Hospital, Dept. of Internal Medicine-Cardiology, Brno, Czech Republic; 4. Olomouc University Hospital, Dept. of Nuclear Medicine, Olomouc, Czech Republic

The purpose of this study was to determine the influence of the number of transplanted mononuclear bone marrow cells (MBMC) on myocardial function in patients after acute myocardial infarction (MI).

Methods: The study comprised patients with the first acute MI treated with coronary angioplasty and stent implantation (resultant TIMI III flow). Only patients with the evidence of irreversible damage of infarcted myocardium proved by dobutamine echocardiography and Tx-CAD were enrolled. Single photon emission computed tomography (SPECT) (18F) was performed. The study included 2 groups: Group A patients (n = 16) were transplanted with a higher number of MBMC (100 000 000 cells), Group B patients (n = 15) received a lower number of MBMC (10 000 000 cells). Twelve patients who were not treated with cell transplantation served as controls (Group C). Cell transplantation was performed by intracoronary catheter cell implantation; 5-9 days after the onset of MI. Longitudinal myocardial function of individual left ventricular (LV) walls was determined by Doppler tissue imaging 1-4 days before the cell transplantation and 3 months later.

Results: The peak systolic velocity of the longitudinal contraction of infarcted wall (SVA) increased from 4.8 cm/s to 5.06 cm/s in group A (p < 0.01), but did not change significantly in groups B (from 4.53 cm/s to 4.8 cm/s, p = NS) and C (from 4.9 cm/s to 4.7 cm/s, p = NS). The differences in pre- and post-transplant values of SAa differed significantly between groups A and B (p < 0.05) and A versus C (p = 0.01). The peak early diastolic velocity of the longitudinal contraction of infarcted wall (EAa) increased in groups A (from 4.98 cm/s to 5.62 cm/s, p = 0.05) and B (from 4.55 cm/s to 5.54 cm/s, p < 0.05). The differences in post-transplant changes in SAa did not differ among the groups (all p = NS).

Conclusion: Intracoronary implantation of MBMC improves regional myocardial systolic function of the acutely infarcted myocardium in a dose-dependent manner.

672

Speckle tracking, a powerful tool for the detection of myocardial ischemia: a pilot study in the catheterization laboratory during PCI

R. Winter, L. A. Brodin, 1. Karolinska University Hospital, Department of Clinical Physiology, Stockholm, Sweden

Background: The novel 2D strain modality, using speckle tracking analysis, has allowed for detection of myocardial movement and deformation in both longitudinal and transversal direction during 2D echocardiography, thus allowing for measurement of both radial and circumferential myocardial velocities. Animal studies and case reports have indicated that circumferential strain and strain rate analyses in short axis view might be a sensitive marker of myocardial ischemia. In order to study the ischemic response in radial compared to circumferential myocardial direction we performed a study during ten balloon inflations in the catheterization laboratory during invasive PCI procedures.

Methods: Recordings using speckle-tracking software (2D strain) were collected during balloon inflation in parasternal short axis view at the papillary muscle level. Post processing of one heart cycle from the recording was made at two different time points, the first at the start of balloon inflation, and the second heart cycle immediately before deflation. The echocardiographic equipment used for the study was GE Vivid 7. Speckle tracking analyses were made using the GE Echocap workstation. Calculations of maximum percentage decrease in circumferential and radial strain, displacement and rotation were made in the ischemic area, as well as measurement of maximum time delay of peak motion in respective area, compared to before the balloon was inflated.

Results: All parameters showed statistically significant changes during ischemia. Both circumferential and radial strain, displacement and rotation decreased significantly during ischemia, 36%±23%, 27%±23%, 42%±27%, and 49±27%, respectively. Peak values of radial and circumferential strain, as well as radial displacement and the time of maximal rotation were significantly delayed during ischemia, at mean from 70-92 ms to 206±101 ms. The most consistent changes in this study were increase of peak rotation and peak rotation diameter during ischemia.

Conclusion: Decrease in regional circumferential strain and rotation as well as time delay in maximal regional strain and delayed maximal rotation seem to be more sensitive parameters for detecting ischemia compared to radial displacement, strain and delay in maximal radial strain.

Eur J Echocardiography Abstracts Supplement, December 2005
Dobutamine induced changes of strain rate by either 2D or Doppler tissue imaging in LAD territory: relationship with respective flow reserve

Background: Regional strain rate (SR) may be estimated using either Doppler tissue imaging (TDI) or 2D-SR in left anterior descending artery (LAD) territories and we correlated changes in the myocardial response to HD-dependent preload changes in human subjects with ESRD having different background diseases. Moreover, in presence of DM myocardial functions continue to remain diminished irrespective of concomitant CAD. TVE lherelore unmasks the differences in the myocardial response to a single session of haemodialysis in patients with ESRD having different background diseases in this setting is also not known. We propose that tissue velocity echocardiography (TVE) offers a rapid, bedside choice to follow changes in global myocardial functions in patients with ESRD with or without Type 2 diabetes (DM) and coronary artery disease (CAD).

Methods: 46 subjects (50±13 yrs) with ESRD (17 without DM & CAD, 15 with DM, and 14 with CAD+DM) undergoing periodic HD were investigated prior to and immediately after one randomly chosen HD session using both standard Doppler & TVE. A GE VIVID V apparatus equipped with Echopac software was used. Standard 2-D and Doppler measurements were followed by colour TVE estimations of average longitudinal left ventricular (LV) regional myocardial systolic and diastolic (‘End A’) velocities, strain rate (SR) and displacements. Radial TVE data were obtained from parasural short axis projection. Pre and post HD data, expressed as mean±SD, were considered to be significant if p<0.05 was considered significant.

Results: Average loss of body weight post-HD was 4.8±0.7 kg. Average LV ejection fraction was 56±8%. LV internal dimensions (mm) were significantly lower post HD (51±6 vs 48±2; p<0.01). Average (mean of 4 LV bases) peak systolic velocities (cm/s) at pre- and post HD respectively were 0.3±1.6 vs. 0.2±1.2 in ESRD (p<0.001); 4.7±1.2 vs. 4.9±1.2 in ESRD+DM (p=ns), and 4.3±0.9 vs 4.2±1.1 in ESRD+DM+CAD (p=ns). The corresponding 2D velocities (cm/s) were 0.2±0.5 vs 0.1±0.2 (p=ns); 2.9±0.5 vs 3.5±1.7 (p=ns); and 2.5±1.3 vs 1.1±1.8 (p<0.01). Similar response was seen in DM with or without CAD (p=ns).

SR, displacement, & radial parameters followed the same pattern.Conclusion: A single HD session improves LV functions in ESRD only in absence of co-morbidities. Moreover, in presence of DM myocardial functions continue to remain diminished irrespective of concomitant CAD TVE therefore unmasks the differences in the myocardial response to HD-dependent preload changes in human subjects with ESRD having different background diseases.

Early detection of ventricular dysfunction in sickle cell disease demonstrated by strain rate and strain imaging

A.M.G. Almada1, C. Rokicki2, C.N. David3, M.M. Pedro2, F. Rego2, J.C. Cunha2, J. Ducla-Soares2, Lisbon, Portugal; 2Hospital Santa Maria, Medicina 1, Lisbon, Portugal; 3Hospital Santa Maria, Cardiology Lisbon, Portugal.

Sickle cell disease is a hereditary disorder with mendelian transmission, characterized by the production of haemoglobin S and severe haemolytic anaemia in homozygous patients (pts). Heart failure prevalence in these pts is high and one possible mechanism in the development of micro-infarctions due to microvascular occlusions by sickle cells, is the explanation of partial or complete new LV abnormalities of left ventricular (LV) function due to micro-infarctions in adults with drepanocytosis could be detected by tissue Doppler evaluation of strain (SR) and strain rate (SR') earlier than by use of conventional indexes of left ventricular function.

Methods: 23 consecutive pts were included (Group A), all homozygous, 25±6 years-old, 14 women and 21% black. All were in NYHA class I, sinus rhythm. Inclusion criteria: good echocardiographic window, normal LV function by conventional echocardiography. Exclusion criteria: more than mild valvular disease. A second group (Group B) of 20 normal individuals (12 women, aged 24±13 years-old), were also studied. Hemoglobin and ferritin were assessed. All were submitted to: a) conventional echo: LV end-diastolic dimension, fractional shortening (FS), ejection fraction (EF), b) Tissue Doppler obtained in the three spacial axis: systolic wave velocity (Sm) in basal and mid segment of all six LV walls, ASE model; Sr and SR of all six LV walls. Analysis of SI and SR was performed off-line, using a dedicated software.

Results: Pts in Group A had been submitted to 2±3±0.6 blood transfusions and had lower levels of hemoglobin (10.1±4±12.2±6.6; p<0.001) in comparison to Group A. There was no significant difference between levels of ferritin of both groups. Group A and Group B pts showed normal values for LV end-diastolic dimension (as indexed to body surface area), FS and EF and there was no difference between the two groups. There was no difference, also, between Sm of each segment, with the exception of lateral segment of basal wall which was higher in Group A (3.8±1.1 vs 4.7±1.7cm/s; p<0.004). We found a significant difference between SI of all six LV walls of the two groups, which was lower in Group A (p<0.01 to p<0.05). There was also significant difference of SI of all six LV walls, between Group A and Group B (p=0.01 to p=0.05).

Conclusion: In pts with homozygous sickle cell disease and normal LV function assessed by conventional echocardiography, strain and strain rate assessment demonstrated early abnormalities of LV function, which may be due to microvascular abnormalities, related to sickle cell crises.

Tissue Doppler imaging in localization of the site of accessory pathways in Wolff-Parkinson-White syndrome

K. El-Menyawi, M. El-Asmy. An Shane University. Cardiology Department, Cairo, Egypt

Background: Non-invasive evaluation of the site of accessory pathways in Wolff-Parkinson-White (WPW) syndrome can be done using 12 lead ECG and echocardiography which allows detection of the abnormal ventricular wall motion. In this study, we tried to assess the role of tissue Doppler imaging (TDI) in the localization of the site of accessory pathways in WPW syndrome and study the effect of radiofrequency (RF) ablation on the TDI imaging.

Methods: Eighty patients with accessory pathways were studied by using 12-lead ECG, echocardiography and TDI before and after EPs and trials for ablation. Mapping during Eps revealed 48 left side accessory pathways, 12 septal accessory pathways and 20 right accessory pathways. Ablation was successful in 65% of cases (50 patients). Twelve lead ECG could accurately localize the site of the accessory pathways in all cases but misclassified it in one patient as left lateral instead of left posterior (overall sensitivity was 96%). Tissue Doppler imaging could accurately localize the site of the accessory pathways in left side and septum with 100% sensitivity but sensitivity was only 20% in right side accessory pathways. Early contraction sites by TDI disappeared in all patients who had successful ablation. Patients with failed ablation had deeper and larger areas of early contraction sites.

Conclusion: We conclude that TDI is feasible and accurate in localizing left sided accessory pathways in WPW syndrome and can predict the success rate of RF ablation and we recommend it before EPs study and trial for RF ablation.

Tissue Doppler imaging contributes to the early detection of systolic cardiac dysfunction in hypertensive individuals

E.N. Tapalis, D.N. Chrisso1, A.A. Katsaras, E. Chatzimastou, A.T. Akavas, N.C. Korvez, C.P. Tzotis, E. Kalliaziou. Hippokration Hospital, Department of Cardiology, Athens, Greece

Introduction: According to large clinical trials, chronic arterial hypertension increases by 2- to 5-fold the risk for heart failure, the incidence of which is reduced >50% after effective antihypertensive therapy. The purpose of this study is to determine the role of tissue Doppler imaging (TDI) on the evaluation of systolic function (SF) of left and right ventricle (LV and RV respectively) in hypertensive individuals (HI).

Eur J Echocardiography Abstracts Supplement, December 2005
678 Longitudinal myocardial functions are affected by chronic smoking in young healthy people: a study of color tissue Doppler imaging

O. Gulsel, K. Soyul, M. Yazici, S. Demircan, K. Darma, M. Sahin. 1 Mayo University, 2Cardiology, Samsun, Turkey

Many cardiac and hemodynamic alterations occur after acute consumption of cigarettes.

Aim: To evaluate the effect of chronic smoking on longitudinal myocardial functions of left ventricle in young, healthy people by using color 2-dimensional tissue Doppler imaging modalities.

Methods: Ninety-nine healthy participants were studied. There were 65 smokers and 34 non-smokers. All subjects were between 20 and 35 years old. For color 2-dimensional tissue Doppler imaging, apical views were acquired. Sample volumes were placed on the mid left ventricular surface in the inner half of the myocardium at the septum, lateral, inferior, and anterior walls. The peak systolic strain (S-S), peak systolic strain rate (S-SR), peak early diastolic strain (E-TV) and peak late diastolic strain (A-W) values were measured. Three consecutive beats were measured and averaged for each measurement. To simplify the analysis, the values at each wall were combined and averaged to obtain mean values.

Results: For the systolic parameters S-S, S-SR and S-TV values were not different between the groups. For the diastolic parameters smokers had lower E-SR and E-TVs than non-smokers (p = 0.038 and p = 0.037, respectively). Although there was a trend towards higher A-SR and A-TVs in the smokers, they were not reaching the statistical significance (Table 1).

Table 1

<table>
<thead>
<tr>
<th>Measure</th>
<th>Smokers (n=65)</th>
<th>Non-smokers (n=34)</th>
<th>p values</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-S (%)</td>
<td>15.6±4.4</td>
<td>14.6±3.9</td>
<td>0.302</td>
</tr>
<tr>
<td>S-SR (1/sec)</td>
<td>1.48±0.35</td>
<td>1.51±0.39</td>
<td>0.091</td>
</tr>
<tr>
<td>E-SR (1/sec)</td>
<td>2.14±0.33</td>
<td>2.39±0.63</td>
<td>0.031</td>
</tr>
<tr>
<td>A-SR (1/sec)</td>
<td>1.12±0.36</td>
<td>1.16±0.32</td>
<td>0.044</td>
</tr>
<tr>
<td>S-Tv (cm/sec)</td>
<td>4.78±1.24</td>
<td>5.01±1.60</td>
<td>0.470</td>
</tr>
<tr>
<td>E-Tv (cm/sec)</td>
<td>9.06±1.43</td>
<td>9.72±2.27</td>
<td>0.033</td>
</tr>
<tr>
<td>A-Tv (cm/sec)</td>
<td>3.73±1.98</td>
<td>3.56±1.26</td>
<td>0.588</td>
</tr>
</tbody>
</table>

Conclusion: Chronic smoking in young, healthy people causes significant alterations in some of the longitudinal myocardial function parameters as assayed by color 2-dimensional tissue Doppler imaging.

679 Left ventricular longitudinal myocardial function in overt hypothyroidism: a tissue Doppler echocardiographic study

S.K. Tiryakoglu1, H. Ozkam, M.C. Basak3, 4, S. Akdemir1, 2, O. Tiryakoglu2, 4, T. Bozat1 1. Bursa Yuksek Ihtisas Hospital, Cardiovascular Department, Bursa, Turkey; 2Bursa Yuksek Ihtisas Hospital, Cardiovascular Department, Bursa, Turkey

Aim: The aim of this study was to assess left ventricular myocardial regional function in overt hypothyroidism by using tissue Doppler imaging in relation to the hormonal profile and standard Doppler echocardiographic examination.

Methods: We studied 50 patients in this study and divided them into two groups. Group 1 consisted of 25 patients (23 women, 2 men) with newly diagnosed, untreated overt hypothyroidism and compared with Group 2 which consists 25 (21 women, 4 men) healthy individuals. Baseline demographic characteristics were homogenous.

Levels were significantly higher and IT3 and IT4 levels were lower in Group 1. All patients underwent to echocardiographic examination. Pulsed TDI tissue velocity imaging, strain and strain rate imaging measurements at the basal, mid and apical segments were performed from apical 2 and 4 views.

Conclusion: In standard echocardiographic examination, left ventricular inter-dia-

680 Myocardial Doppler parameters add incremental benefit over clinical and standard echo parameters in predicting outcome in chronic kidney disease

D. Rahimi1, M.N. Isbel2, T.H. Mannick3, 4, C. Sarnak5, 6, 3University of Queensland, Department of Medicine, Brisbane, Australia; 4PA Hospital Renal Unit, Brisbane, Australia; 5University of Queensland, Brisbane, Australia

Background: Myocardial injury in pts with chronic kidney disease (CKD) is multifactorial, involving hypertrophy and coronary heart disease and metabolic disturbances including calcium homeostasis. We hypothesized that myocardial tissue velocities could add incremental benefit to existing clinical and echo predictors of mortality.

Methods: Clinical data, resting 2D echocardiograms and dobutamine echocardiograms (DSE) were obtained in 155 pts with CKD (mean age 59±9 years, 87 male, and 48% of pts were hypertension-dependent). LA volume was calculated from the mitral jet using the parasternal long axis, and minor and major axes in the 4 chamber view. LV mass was calculated using ASE guidelines and indexed for height2.7. Mitral inflow velocities, E/A ratio and deceleration time (DT) were recorded. Colour tissue Doppler images (TDI) were used to measure myocardial velocity during systole (Sm), early diastolic filling (Em) and late diastolic filling (Am). Ischemia was defined as a new or worsening echo measurements.

Results: There were 24 deaths over 1.7 yrs. Clinical predictors of events were: phosphate (1.84±0.5 mmol/l; HR 6.1, p = 0.001) and albumin (38.0±4.5 g/l; HR 0.9, p = 0.05). Echo predictors were septal thickness (1.4±0.9 cm, HR 4.7, p = 0.003) and ischemia by ETE (16%, HR 4.3, p = 0.05) but not LA volume, E/A ratio or LV mass index. Average Sm (5.6±1.9 cm/s; HR 0.6, p = 0.002) and Em (5.4±2.3 cm/s; HR 0.7, p = 0.003) were also predictive of outcome. In sequential Cox regression models (Table), addition of both smoking status and TDI parameters added incremental value to clinical predictors of outcome.

Conclusion: Myocardial characteristics can predict mortality in pts with CKD. Tissue velocities provide incremental value above both clinical data and standard echo measurements.

801 Results: Tissue characterization in chronic kidney disease is not influenced by aggressive risk factor modification

D. Rahimi1, R. Lean2, M.N. Isbel3, T.H. Mannick3, 4 1University of Queensland, Department of Medicine, Brisbane, Australia; 2University of Queensland, Brisbane, Australia; 3University of Queensland, Brisbane, Australia; 4PA Hospital Renal Unit, Brisbane, Australia

Background: Myocardial changes from hypertension and fibrosis are common in chronic kidney disease (CKD). We sought whether markers of subclinical sys-

Conclusion: Myocardial characteristics can predict mortality in pts with CKD. Tissue velocities provide incremental value above both clinical data and standard echo measurements.

801 Results: Tissue characterization in chronic kidney disease is not influenced by aggressive risk factor modification

D. Rahimi1, R. Lean2, M.N. Isbel3, T.H. Mannick3, 4 1University of Queensland, Department of Medicine, Brisbane, Australia; 2University of Queensland, Brisbane, Australia; 3University of Queensland, Brisbane, Australia; 4PA Hospital Renal Unit, Brisbane, Australia

Background: Myocardial changes from hypertension and fibrosis are common in chronic kidney disease (CKD). We sought whether markers of subclinical sys-

Conclusion: Myocardial characteristics can predict mortality in pts with CKD. Tissue velocities provide incremental value above both clinical data and standard echo measurements.
Serum cardiac troponin I (cTnl) and T (cTnT) concentrations have been used for diagnosis of a cardiac origin of chest pain or acute coronary syndrome. In CKD patients, the clinical use of these biomarkers is hindered by the fact that they are increased by renal failure and other cardiovascular risk factors. The present study was undertaken to assess the role of cTnl and cTnT concentrations in patients with chronic kidney disease (CKD).

Methods: A cohort of 80 CKD patients (age 62+19 years, 57 men and 23 women) and 30 control participants (age 61+16 years, 18 men and 12 women) were included in this study. Semiquantitative levels of cTnl and cTnT were determined by enzyme-linked immunosorbent assay (ELISA) and lateral flow immunoassay (LFA) in sera from all participants both before and after hemodialysis. The median follow-up was 15 months (range: 1-30).

Results: No significant difference was found in cTnl concentrations before dialysis between CKD patients and controls (P=0.18). After dialysis, significant decreases were found in both groups (CKD patients: 35% decrease, p<0.001; controls: 24% decrease, p=0.04). No significant difference was found in cTnT concentrations in both groups before dialysis (P=0.38). After dialysis, significant decreases were found in both groups (CKD patients: 35% decrease, p=0.01; controls: 24% decrease, p=0.04).

Conclusion: In patients with CKD, serum cTnl and cTnT concentrations were decreased by hemodialysis. The results of this study suggest that cTnl and cTnT may be useful markers for the detection of acute coronary syndrome in CKD patients.
39%).

Volumetric relaxation time (IVRT), isovolumetric contraction time (IVCT), and Ea were abbreviated to achieve >90% ventricular pacing at an optimal AV interval for short term cardiac pacing on right ventricular (RV) functions.

Results: The conventional and tissue Doppler measurements at baseline and after pacing were similar except A wave. Immediately after pacing, IVCT (82±9.4 cm/s vs. 82±9.4 cm/s, p = 0.63) and Ea (74.3±9.3 cm/s vs. 74.9±9.2 cm/s, p = 0.62 and S velocity duration 224±8.2 ms vs. 223±7.3 ms, p = 0.03, and IVCT 65±8.1 cm/s vs. 67±8.2 cm/s, p = 0.72). The diastolic parameters of RV were impaired slightly after pacing.

Conclusion: Short-time pacing seems to have no effects on RV systolic function parameters, but have a minimal adverse effect on RV diastolic functions.

686 Contribution of new echocardiographic regional right ventricular function assessment in chronic heart failure. Relevance of the strain analysis

E. Donal,1 M. Poulouss,2 P. Raulz-Reynier3, C. De Bischoff,2 P. Derumeade, A. Denjean1, 1Cardiology, Rennes, France; 2Laboratory of Human Performance EA3913, Poitiers, France; 3CHU La Militerie, Cardiology, Poitiers, France; 4University Hospital, INSERM 2226, Lyon, France

Objective: We sought to evaluate the additive value of right ventricular (RV) function assessed by longitudinal systolic strain (%, ROI 12 mm) in the comparison with exercise stress test with metabolic gas exchange (ESM) and Brain Natriuretic Peptide (BNP).

Method: 19 heart failure (NYHA III-IV) patients (56±8 years) underwent a standard and tissue Doppler echocardiography (Vivid 7, GE), an ESM and BNP dosage on the same day. RV free wall function was assessed by systolic strain (S, %, ROI: 11 mm) in the mid-segment. Follow-up was obtained at 6-month.

Results: S (19±8±8%) was significantly correlated with BNP (R=0.52, p=0.02), VE/VCO2 (R=0.86, p=0.003), peak VO2 (R=0.46, p=0.04) and the maximal strength developed during the ESM (R=0.50, p=0.02). During the follow-up, 6 major cardiovascular events; one death and 5 rehospitalizations (1 heart transplantation, 4 worsening heart failure). Patients with cardiac events were significantly different from those without cardiac events regarding: BNP level (852.8ng/mL vs. 1114.3 vs. 610±49±2 mmHg, p=0.08) and S (-13±9±4% vs. 22±5±8%, p=0.001).

Conclusion: Heart failure patients, RV function assessed by systolic strain is relevant, easy to measure and appears strongly linked to the CHF prognosis.

687 Assessing right ventricular flow velocities before and after short term pacing by tissue Doppler echocardiography

G. Quilme,1 A. Eker,2 E. Cado, A. Alar, C. Tsimouk, A. Vlaskas, M. Sideris, G. Orm, Baskent University, Department of Cardiology, Ankara, Turkey

Aim: Tissue Doppler echocardiography (TDE) provides a quantitative analysis of myocardial function. The aim of the present study was to investigate the effects of short term cardiac pacing on right ventricular (RV) functions.

Method: Eighty patients with normal chamber pacing or with bundle branch or left anterior fascicles were evaluated. Twenty-five patients (mean age 64±11 years, 9 female) with > 20% pacing within previous 6 months (16% of V0D mode, 84% of DDR mode) were included in the study. TDE Doppler echocardiography, TDE were performed at baseline. After, intraventricular AV delay (AV) were abbreviated to achieve >90% ventricular pacing at optimal AV interval for 4 hours. After 4 hours long AV delay that achieved > 90% sensing was chosen and an echocardiography repeated. Pulmonary maximal velocity (P), pulmonary ejection time (P et) were measured from the parasternal short axis view. Tissue Doppler velocities (S, E, wave velocity (A), tricuspid annulus (TR), and Doppler velocities systole (S), early (Ea), and atrial (Aa), S velocity duration, iso-volumetric relaxation time (IVRT), isovolumetric contraction time (IVCT), and Ea

688 Doppler Tei index for the diagnosis of subclinical right ventricular dysfunction associated with acute inferior wall myocardial interaction

G.R. Hong1, J.H. Lee2, H.J. Kim2, J.S. Park2, D.G. Shin3, J.Y. Kim2, B.S. Shim1,1 Yeungnam University, Cardiology Dept., Daegu, Korea, Republic of; 2Yeungnam Unl. Hospital, Cardiovascular, Daegu, Korea, Republic of

Background: Recognition of ischemic right ventricular (RV) dysfunction in the presence of LV dysfunction is important for clinical practice, because it is associated with a higher hospital morbidity and mortality.

Methods: The Doppler Tei index is useful for estimating global cardiac function. However, the clinical usefulness of RV Tei index to diagnose subclinical RV dysfunction has not been investigated. The purpose of this study was to assess the clinical value of RV Tei index for the diagnosis of subclinical RV dysfunction associated with acute inferior wall myocardial infarction who did not have definite ECG changes at right precordial leads suggesting RV infarction.

Methods: The study population consisted of 32 consecutive patients with acute inferior myocardial infarction who did not have specific ST segment changes at right precordial leads. RV Tei index = measured by two dimensional echocardiography and RV ejection fraction (EF) was measured by multigated blood pool (MUGA) scan. Defined RV dysfunction as estimated RA pressure was <10mmHg (group 1) by right heart catheterization.

Results: Two-dimensional echocardiography showed no significant evidence of RV regional wall motion abnormalities in all patients: In patients with RV dysfunction, RV Tei index was significantly increased compared with those without RV dysfunction (0.51±0.22 vs 0.35±0.18, P = 0.05). RV/EF by MUGA blood pool SPECT was significantly decreased in patients with RV dysfunction (35±11% vs 47±12, p = 0.05).

Conclusion: RV Tei index is a simple and useful non-invasive method for diagnosis of subclinical RV dysfunction associated with acute inferior wall myocardial infarction in which typical ECG changes at right precordial leads are not present.

688 Abnormal left ventricular longitudinal contractile reserve in the presence of normal ejection fraction at rest in patients with apical hypertrophic cardiomyopathy

J.-W. Ha1, J.M. Kim1, J.A. Ahn2, E.Y. Choi3, S.M. Kang2, J. Rim3, N. Chung1,1 Yonsei Cardiovascular, Cardiology, Cardiology, Seoul, Korea, Republic of; 2Yonsei Cardiovascular Center, Cardiology Division, Seoul, Korea, Republic of

Background: Apical hypertrophic cardiomyopathy (APCHCM) is a unique form of hypertrophic cardiomyopathy, in which the hypertrophy of myocardium predominately involves the apex of the left ventricle (LV). In patients with APCHCM, global LV systolic function appears normal when assessed with conventional radial contrast parameters, such as fractional shortening or ejection fraction (EF), LV longitudinal contraction results in apical displacement of the mitral annulus and it can be quantified using pulsed wave tissue Doppler imaging. We hypothesized that mitral annular systolic velocity during exercise would be abnormal in patients with APCHCM.

Methods and Results: Septal mitral annular systolic velocity (S) was measured at rest and during graded supine bicycle exercise (25W, 3 minutes increments) in 53 patients (57 male, mean age 38 years) with APCHCM and 52 patients (19 male, mean age 56 years) with control. LVEF was calculated from the echocardiographic m-mode from short axis image. LVEF and S' at rest were not significantly different between the groups (EF, 70.6±9±6±6%, p=0.09; S', 6±1.3±1 vs

Eur J Echocardiography Abstracts Supplement, December 2005