551 Physiological range of left ventricular asynchrony: an ultrasonic velocity and strain rate imaging study.  
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Background: Left ventricular (LV) asynchrony occurring in patients with heart failure can be successfully restored by cardiac resynchronisation therapy (CRT). However, there is still lack of consensus regarding the choice of the most suitable parameter to quantify asynchrony and to guide CRT. Aim of the study was to assess the physiological ranges of systolic and diastolic mechanical asynchrony in normal hearts.  
Methods: Study-one subjects aged 40-84 years with normal coronary angiograms and 12-lead ECG recordings, without LV hypertrophy or wall motion abnormalities underwent tissue Doppler and strain rate imaging. Long-axis function was determined at rest in 4 basal and 4 middle-wall LV segments. Maximal differences between the time-to-peak tissue displacement (async_D), respectively time-to-peak systolic (async_S) and time-to-peak systolic (async_Vs) and early diastolic (async_Ve) velocities were measured and expressed as values corrected for heart rate (after dividing by the square root of the cardiac cycle duration).  
Results: The highest values were found for async_S (168 ± 141 ms), followed by async_D (80 ± 92 ms), async_Vs (66 ± 43 ms) and async_Ve (48 ± 24 ms). Async_S and async_Vs correlated linearly with the age of the patients (r = 0.63, p < 0.001 for async_S and r = 0.52, p = 0.004 for async_Vs), while async_D and async_Ve were not age-dependent. All parameters reached their maximal values within the basal segments.  
Conclusions: (1) Peak systolic strain showed the highest degree of asynchrony under physiologic conditions. (2) A certain delay between LV walls in peak long-axis displacement (~150 ms) can be accepted as a normal finding. (3) Systolic asynchrony implying either motion and especially deformation increases proportionally with the age, reflecting the degree of cardiac heterogeneity. (4) In normal hearts peak relaxation is less affected by intraventricular mechanical asynchrony compared to the myocardial contraction.

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552 Left ventricle dysfunction in adolescents and adults with patent ductus arteriosus 15-20 years after surgery.  
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Background: The majority of the patients after ligation of patent ductus arteriosus (PDA) in infancy and early childhood do not have clinical symptoms. However, some patients may present left ventricle (LV) dysfunction.  
Methods: The aims of this study were Doppler echocardiographic (ECHO) quantify the age, reflecting the degree of cardiac heterogeneity. (4) In normal hearts peak relaxation is less affected by intraventricular mechanical asynchrony compared to the myocardial contraction.

CONGENITAL HEART DISEASE

553 Echocardiographic follow-up of patients after surgical correction of atrioventricular septal defect.  
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Introduction: Patients who are operated for atrioventricular septal defect (AVSD) can develop left-sided atrioventricular valve regurgitation (LAVVR) during follow-up. This LAVVR is the main indication for reoperation in these patients. Until now, the ideal time for reoperation is difficult to assess. We sought to determine the outcome of severe LAVVR, both medically treated or reoperated.  
Methods: Retrospective review of echocardiographic, clinical and operative data of all patients, who had performed preoperatively and postoperatively at regular intervals, using a Sonos 5500 (Philips Medical Systems, Andover, Massachusetts). The degree of LAVVR was measured by color Doppler echocardiography. It was graded as none or mild (a thin jet extending to the wall of the atrium), moderate (a broad jet extending to the wall of the atrium) or severe (a broad jet occupying more than half of the left atrium). All studies that gave unequivocal results were reviewed by two of the investigators. From 1990 until 2001 164 patients died in the immediate postoperative period, and 2 patients were lost to follow-up. Ninety-four patients (60%) had Down syndrome. Results: During follow-up (9 months to 12 years; median 6 years), 30 patients (19%) developed severe LAVVR. Sixteen of these patients had severe LAVVR in the immediate postoperative period. Of these 16 patients 4 patients showed spontaneous regression to near-normal valve function during follow-up. The other 14 patients developed severe LAVVR during further follow-up. Sixteen out of 30 patients with severe LAVVR were reoperated. Of these 16 patients 11 underwent valvuloplasty- 

554 Impact of pulmonary regurgitation and age at surgical repair on textural myocardial properties in patients operated on takedown of Fallot.  
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Study aim was to identify non-invasively the potential impact of pulmonary regurgitation and age at surgical repair on the right ventricular (RV) textural and functional myocardial properties in pts operated on takedown of Fallot (TOF).  
Methods: We assessed the averaged intensity (Int.IB) and the cyclic variation (CVIB) of the echo backscatter curve in 30 pts (mean age 16.2±8.3 yrs), who had undergone corrective surgery for TOF (mean age at repair 3.2±2.6 yrs, range 0.2-11 yrs). They were divided into three age- and BSA-matched subgroups according to the results of the surgical repair: 12 pts had no significant postoperative sequelae (Group I), 12 pts had isolated moderate-severe pulmonary regurgitation (Group II) and 6 pts had pulmonary regurgitation associated with significant (>30 mmHg) RV outflow tract obstruction (Group III). In addition, 30 age-, sex- and BSA-matched normal subjects were identified as the controls.  
Results: CVIB was decreased (7.8±6.2 vs 10.6±1.4 dB; p<0.001) and Int.IB was increased (-18.6±4.1 vs -21±2.8 dB;p=0.01) compared to controls. Comparison between controls and each subgroup of TOF pts showed: a) comparable values of CVIB and Int.IB in Group I; b) Int.IB significantly differed only in Group III (p<0.0001) c) CVIB differed either in Group II and Group III (p<0.001). Group III pts, which had the highest significant RV dilatation, compared to Group II (p=0.038) and Group I (p=0.001), showed the lowest values of CVIB (5.6±1.8 dB) and the highest values of Int.IB (-13.3±4.6 dB). Finally, in our study population, both the degree of RV dilatation, the age at surgery and exsanguination repair significantly correlated with Int.IB (>0.55 ± 0.41; r=0.05 and 0.03 respectively) and inversely correlate with CVIB (r=-0.55 and -0.53; p=0.002 and 0.003 respectively).  
Conclusions: In pts on operated on TOF a) Int.IB analysis is able to identify pts with significant RV myocardial abnormalities related to postoperative sequelae: b) residual PR, particularly if associated to pulmonary stenosis, strongly affects RV myocardial properties; c) an earlier repair of TOF may result in better preservation of myocardial characteristics.

Eur J Echocardiography Abstracts Supplement, December 2003
556 Successful device closure of atrial septal defect after the fifth decade of life: effect on symptoms and ventricular function.

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Background: Device closure of secundum atrial septal defect (ASD) is now well established as a therapeutic option. However its beneficial effect in older patients remains disputable. Aim: To assess beneficial effect of ASD device closure on symptoms and ventricular function in patients >50 years of age. Methods: We studied right and left heart size and function in 18 patients, age 64±8 years, 12 female who underwent successful ASD device closure procedure. Patients were clinically as well as echocardiographically assessed before and 2-18 months after procedure. Results: 16 patient reported significant symptomatic improvement following the procedure, in whom the right atrial size (transverse diameter) fell from 6.0±1.2 to 4.9±1.1 cm, p<0.01 as did the right ventricle (inlet diameter) from 5.2±0.9 to 4.1±0.9 cm, p<0.001. Peak pulmonary flow velocity also dropped from 110±30 to 90±20 cm/s, p<0.05, while aortic velocity increased from 105±25 to 115±25 cm/s after procedure. The left ventricular size modestly increased (end-diastolic dimension) from 4.2±0.9 to 4.7±0.7 cm, p<0.002. The remaining 2 patients who had additional coronary artery disease, reported no change in symptoms despite successful device implantation. In them, the left ventricle was at the upper limit of normal before procedure and dilated afterwards while the left atrium was already dilated before procedure (~5 cm) and increased further in diameter during follow-up. Left ventricular filling demonstrated signs of raised left atrial pressure before procedure (short isovolumic relaxation time and dominant E wave with short deceleration time ~120 ms) and became more restrictive afterwards. Conclusion: The symptomatic improvement with ASD device closure in the elderly is associated with right ventricular remodelling and increased left ventricular size and stroke distance. However, careful patient selection should be considered, particularly in those with coronary artery disease and left ventricular dysfunction that could be masked by the ASD.

557 Echocardiographic exam accuracy in evaluation of cardiac findings spectrum in Marfan syndrome.


The diagnosis criteria in Marfan Syndrome (MS) include phenotypic expression at bone skeletal structure, eyes, cardiovascular system, lungs and central nervous system. Aim: The study of echocardiographic (ECHO) findings spectrum in MS; the appreciation of ECHO contribution in evaluation of patients (pts) with MS. Methods: We evaluated 16 pts with MS by means of 3-D echo. Results: There were 15 males) admitted in a ten years period 1992-2003. All pts had clinical and paraclinical (ECG, x-ray, ECHO) evaluate; to 18 pts we made cardiac catheterisation and aortography; 15 pts had a CT exam; 11 pts had 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 (diam), progression rate, Ao distensibility (syst.Ao area-diat.Ao area)/(diat. Ao area puls pressure) and Ao rigidity index (syst.pressure/diat. pressure multiplied by diat. Ao area puls pressure)/(syst. Ao area-diast. Ao area). We also studied their first-degree relatives. Results: The spectrum of ECHO findings of the 41 pts with MS included modification of Ao root- 37 patients (90%); mitral valve (MV)- 13 pts (32%); pulmonary artery (PA) dilatation- 5 pts (12%); tricuspid valve prolaps (TPV)- 4 pts (8%); interatrial septum aneurysm (IASA)-3 pts. Also the most affected structure in MS is the MV, in our cases it was the aortic valve. There was no correlation between the Ao dilatation and Ao regurgitation. The dissection risk risen with Ao diam (correlation coefficient r=0.95). The Ao dilatation progression rate was 1.7mm/year. The ECHO study in families with MS has allowed an early noninvasive diagnosis for cardiac lesions, an early initiation of treatment (beta-blockers) and comparison with data from pts without family history (Ao diam 47±9mm vs. 40 ±7mm, P >0.001. The surgical proper moment was established on ECHO data, for asymptomatic pts (Ao diam >55 mm), ECHO examination was also used for the postoperative follow-up: 1 aneurysm at the anasthomosis level, 1 prosthesis dysfunction and 2 distal dissections). Prior to intervention, 54 pts were symptomatic. Of these, 44 pts were older than 40 years. Limited exercise capacity and shortness of breath (NYHA class 2-3 or 20 pts) were the most frequently reported symptoms. At follow-up, all pts improved but two. These patients remained in NYHA class 3 but had persistent marked pulmonary hypertension. All other patients were asymptomatic or had only mild exertional shortness of breath. All of the 26 pts who were 65 yrs or older and who were treated because of significant symptoms markedly improved. Conclusion: Transcatheter atrial septal defect closure can be feasible and safely fully performed in adults. Regression of RV size and pulmonary artery pressure as well as symptomatic improvement can generally be expected even in patients of advanced age.

558 Do adult patients, particularly those of advanced age, benefit from transcatheter atrial septal defect closure? A single center experience.

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Background: Transcatheter atrial septal defect closure has been shown to be feasible and safe in children as well as adults. However, little is known about the clinical benefit of this procedure in adult pts, particularly those of advanced age. Methods: We performed transcatheter ASD closure with the Amplatzer Septal Occlude in 105 adults (mean age 51 ± 17 years, 73 female) of whom 76 were older than 40 years (up to 82 yrs). Patients were followed for up to 4 years. Results: In all pts ASD was successfully closed (occluser size 24 ± 5 mm, range 10 -34mm). No major complications occurred. Minor complications were atrial fibration (2), transient AV-block (1) and transient ST-elevation (2). At follow-up, a mild residual left-to-right shunt was found in 3 pts. Right ventricular diameter (4-Ch view) decreased from 43 ± 6 mm to 35 ± 6mm at 3 months with the most decrease occurring already on the first day post intervention (p <0.0001). Pulmonary artery pressure decreased from 39 ± 16 mmHg to 30 ± 12 mmHg at 3 months (p<0.0001). Prior to intervention, 54 pts were symptomatic. Of these, 44 pts were older than 40 years. Limited exercise capacity and shortness of breath (NYHA class 2-3 or in 20 pts) were the most frequently reported symptoms. At follow-up, all pts improved but two. These patients remained in NYHA class 3 but had persistent marked pulmonary hypertension. All other patients were asymptomatic or had only mild exertional shortness of breath. All of the 26 pts who were 65 yrs or older and who were treated because of significant symptoms markedly improved. Conclusion: Transcatheter atrial septal defect closure can be feasible and safely fully performed in adults. Regression of RV size and pulmonary artery pressure as well as symptomatic improvement can generally be expected even in patients of advanced age.

559 Right ventricular function evaluation by means of 3D echocardiography in postoperative hypoplastic left heart syndrome (HLHS) patients.

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Background: Three-D echocardiography has been validated as a reliable tool to evaluate RV volumes and function in pediatric pts. Long term fate of pts with HLHS lies on the durability of the RV as the solo pumping chamber of the heart. Methods: We evaluated 16 pts with HLHS by means of 3-D echo. Prior to II stage, 11 after Fontan completion Mean age was 5 yrs (range 2-9yrs) and the mean follow-up after the II stage (unloading procedure) was 4.6 yrs (range 0.7-8.5 yrs). HP Sonos 5500 echocardiographer was employed in all, with a standard transthoracic 4 MHz rotating probe; the images were 3-D reconstructed by means of the summation disks method. No sedation was necessary in all. Results: At least 1 acquisition eligible for the 3-D reconstruction was obtained in 15/16 pts, the time of mean acquisition was 6 min (3-9) and the mean time of offline 3-D reconstruction was 45 min (30-60min). The mean RVEDV was 65.49 ml/m2 (range 35.5-99.73), the mean RVESV was 38.8 ml/m2 (range21.4-59.36) and the mean EF was 41.3% (range 35.5-99). Comparison between the measured RVED, ES volumes and the EF and the normal values of the literature for the same parameters showed that pts with HLHS have larger volumes and reduced EF than normal. Biovariate regression analysis, considering the time interval between the echo examination and the date of birth, II stage and Fontan operation, showed that the RVED volume tends to decrease significantly during time, after the II stage. The same trend was shown by the RVEV volume, while the ejection fraction was lower than normal but did not change in time. Conclusion: 3-D echo is a reliable tool for evaluating RV volumes and function in pediatric age. Pts with HLHS have larger ED and ES RV volumes and reduced EF in comparison to normal population, but volumes tend to decrease after the II stage and the EF does not tend to reduce with time.

Eur J Echocardiography Abstracts Supplement, December 2003
560 Characterization of left ventricular function in patients with hypertrophic cardiomyopathy: an ultrasound based regional strain and strain rate imaging study.

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Background: The echocardiographic evaluation of myocardial systolic function in pts with hypertrophic cardiomyopathy (HCM) is still insufficient. This disease may be shown to exhibit LV relaxation and filling abnormalities despite normal LV ejection fraction (EF). However, EF only detects radial motion and the normal value of systolic function described in HCM pts may be due to a relative insensitiveness of the used technique. Strain (S) and Strain Rate (SR) imaging is a new technique able to quantify both radial and longitudinal regional myocardial deformations and potentially is more sensitive compared to 2D grey scale imaging.

Methods: We studied 25 HCM pts (aged 16-53 yrs) using standard grey scale echo-cardiography and S/SR imaging. Regional peak systolic longitudinal function was assessed from the apical views while regional peak systolic radial function was evaluated from the parasternal views. We studied also the time to peak systolic deformation (from the onset of ECG Q wave to the peak systolic S) for both radial and longitudinal function, in the mid segment of posterior wall from the apical 3 chamber view and the parasternal view, respectively. Data were compared with that of 33 age comparable healthy subjects.

Results: All pts showed a normal LVEF. Radial peak systolic S and SR in HCM pts were comparable to healthy subjects. Conversely, regional longitudinal function was significantly reduced when compared to healthy subjects (S [%], HCM=10,6± vs healthy subjects =25,5±, p<0.01; SR(1/s), HCM = 1,2±0,6 vs healthy subjects = 1,8±0,3, p<0.01). This reduction was also found in apparently non-hypertrophied segments. In HCM pts the time to both radial and longitudinal systolic peaks were significantly prolonged when compared to healthy subjects. Moreover, while in healthy subjects the time to longitudinal systolic peak (290±37ms) was shorter than the time to radial systolic peak (310±37 ms), in HCM pts the time to longitudinal systolic peak (366±56 ms) was longer than the radial one (344±28 ms).

Conclusions: Despite a normal LVEF, systolic longitudinal deformation is significantly reduced in HCM pts and this reduction is present also in the apparently normal segments. S/SR imaging demonstrated in HCM that longitudinal function not only is reduced but is also delayed in this disease.

561 Exercise-induced regional diastolic dysfunction identifies persistent coronary stenosis in asymptomatic children with history of Kawasaki disease.

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Background: Kawasaki disease is an acute systemic vasculitis in children, which causes aneurysm formation in 10-15% of patients during its acute stage, as well as residual aneurysms and persistent stenosis in some cases at long-term follow-up. The aim of the study was to assess regional myocardial function in children with documented aortitis and history of Kawasaki disease.

Methods: Eighty asymptomatic children aged 3 ± 4 years (range 6-19 years) with history of coronary vasculitis in whom coronary angiograms during acute stage and follow-up were available were included in the study. Twenty age- and gender-matched healthy subjects served as a control group. All children underwent echocardiography with tissue Doppler and strain imaging, with and without contrast, and with different imaging modalities. The relation between the midwall rate-corrected velocity of circumferential fiber shortening (mVCFc) and meridional end-systolic stress (ses) was defined. LV diastolic function was evaluated by the peak E, peak A, E/A ratio, DT and IVRT. By IBS analysis, the magnitude of cyclic variation (CV) and the averaged myocardial wall thickness (RWT) were defined to assess LV geometry, as normal (N), concentric remodeling (CR), or eccentric remodeling (ECR).

Results: Long-axis measurements were available at rest and during exercise in 245 of 456 LV segments. There were no differences evaluated between normal and formerly affected coronary arteries concerning visible wall motion abnormalities, systolic velocities, strain or strain rate both at rest and during submaximal exercise. However, VmaE during exercise decreased significantly in LV segments which were supplied by arteries with actually relevant stenosis (Table 1).

Conclusions: A possible use of regional diastolic dysfunction revealed by tissue Doppler imaging seems to identify persistent coronary segments at long-term follow-up in asymptomatic children with history of Kawasaki disease.

562 Prognostic value of strain and strain rate imaging in patients with isolated congenital aortic regurgitation.

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Background: The definition of the exact timing for cardiac surgery in asymptomatic patients with isolated congenital aortic regurgitation (ICAR) represents still a challenge. No clear criteria have emerged. Until patients with isolated aortic regurgitation develop heart failure, prevention of aortic dilatation is a very high risk of irreversible left ventricular (LV) dysfunction. The conventional echocardiographic assessment of LV function, a non-quantitative, subjective and experience dependent evaluation, showed a very low predictive value in defining the time to surgery in ICAR patients. A more sensitive, non-invasive, quantitative approach could be crucial in the management of those patients. Strain (S) and Strain Rate (SR) imaging as well as Integrated Backscatter (IBS), are new echocardiographic techniques which allow to assess regional deformation properties and textural properties, respectively.

Aims: 1 - To define the ability of these non-invasive techniques to unmask subtle functional abnormalities in asymptomatic patients with ICAR. 2 - to evaluate the prognostic value of these functional abnormalities.

Methods: We studied 15 patients (age 18±6 yrs) with moderate to severe ICAR by standard grey-scale echocardiographic indices, IBS and S/SR imaging, comparing data to those of age and BSA matched healthy subjects. We prospectively followed ICAR patients for 6 months period to evaluate the onset of symptoms and the need for surgery.

Conclusions: Standard grey scale echocardiographic indices showed that compared to normals ICAR patients presented increased LV end diastolic diameter (5.6±0.5 vs 4.2±0.6 cm, p<0.01) and a comparable shortening fraction (36±5 vs 37±5%, p=NS). Aortic regurgitation at IBS analysis was observed in both septal (9±1.7 vs 10±1.6, p<0.05) and posterior wall (7.6±1.4 vs 10.6±1.3, p<0.0001). Peak systolic S/SR were reduced for both longitudinal (S: -1.5±0.7 vs 71±9.0; S: -21±6 vs -25±5, p<0.05) and radial (SR: 3±1.1 vs 3.7±0.9, p<0.05; SR: 42±14 vs 71±14, p<0.001) deformation properties. Radial S was siginificantly correlated with LV/LDVOT (p=0.04; R=0.77), while longitudinal SR was significantly correlated with age (p=0.0031; R=0.77). In the 6 months follow-up period, 2/15 ICAR patients became symptomatic and thus the pre-symptomatic phase period. Of these, 1 ICAR patients presented the lowest value of peak systolic SR.

Conclusions: In asymptomatic ICAR patients, IBS and S/SR imaging are able to early detect functional abnormalities. IBS indices, related to both duration and degree of aortic regurgitation, seems to have prognostic value in ICAR patients.