

POSTER SESSION 1

Thursday 8 December 2011, 08:30–12:30

Location: Poster Area

THE ECHOCARDIOGRAPHIC EXAMINATION

P254

Can application of appropriateness of use criteria reduce the workload in a tertiary echocardiographic laboratory? A single centre experience

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Background: The American Heart Association has devised 202 appropriateness of use criteria (AUC) for echocardiography. They provide guidance for clinical decision-making and a potential framework for reimbursement. The impact of applying these criteria on current practice has not been assessed outside the USA.

Setting. Tertiary regional cardiac centre serving a population of 1 million and performing 8,000 TTEs per year in South-West Wales, UK.

Methods: We selected a random sample of transthoracic echocardiograms over a period of 6 months and analysed the requests forms, the clinical notes and the transthoracic echocardiography (TTE) reports in order to determine whether the requests were appropriate. We ascertained whether the result of the TTE was documented in the clinical notes, and whether it had prompted any change in the management of the patients' condition.

Results: We selected 70 scans and excluded 2 (N=68) because we could not trace the clinical notes. There were 43 M; mean age (SD) was 66.2 (15.6) years, range 25-89 years. Forty-seven requests (69%) were appropriate, and 21 (31%) were not. By specialty there were 19/25 (76%) appropriate scans requested by tertiary cardiologists, 7/20 (35%) by cardiothoracic surgeons, 10/11 (91%) by secondary cardiologists, 9/9 (100%) by primary care physicians through the open-access service, and 1/3 (67%) by other specialties ($p < 0.0001$ for cardiac surgeons vs. other specialties). New or unexpected findings leading to a change in management were present in 12 cases (18%): 2/21 (10%) of the inappropriate requests and 10/47 (21%) of the appropriate requests ($p = \text{NS}$). The most frequent appropriate indications (numbers denote the criterion number in the AHA guidelines, and square brackets denote the level of appropriateness, with the highest level = 9) were: '70. Initial assessment of suspected heart failure' [A9] – 11 requests (16%), '1. Symptoms potentially due to cardiac aetiology' [A9] – 8 requests (12%), and the most frequent inappropriate indications were '48. Routine (<3 years after valve implantation) surveillance of prosthetic valve if no known or suspected valve dysfunction' [I 3] – 9 requests (13%) and '43. Routine (<3 years) surveillance of mild valvular regurgitation w/o change in clinical status or cardiac exam' [I2] – 5 requests (7%). Scan results were documented in the notes in 59 (87%) of cases.

Conclusions: Major potential reductions in the number of transthoracic echocardiograms could be achieved by adhering to appropriateness criteria, mainly by rejecting inappropriate requests from cardiothoracic surgeons and tertiary cardiologists.

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Are we using Dobutamine stress echo appropriately? A survey of conformity to appropriateness criteria in a tertiary centre

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Background: Avoidance of un-necessary medical investigations is an essential component of effective cost-management in a strained financial milieu. Recently, professional societies in cardiology have devised appropriateness criteria for the performance of stress echocardiography. **Setting.** Cardiac tertiary centre serving a population of 1 million and performing 500 Dobutamine stress echocardiograms (DSE) / year.

Aim: To assess whether DSEs in our centre are requested for appropriate indications.

Methods: We used the American Heart Association (AHA) appropriateness criteria for DSE, which rank the indications for DSE as highly appropriate (appropriateness score A 7-8), uncertain (A 4-6) and inappropriate (A 1-3), to categorise a random sample of referrals for DSE over a period of 6 months in 2010.

Results: We selected 45 requests and excluded 8 which did not contain enough information to calculate the appropriateness score. There were 19 males and 18 females, age range 33-85 years, mean (SD) 63.3 (11.9) years, with 33 (89%) appropriate requests (A8 – 24 requests; A7 – 9 requests). The leading appropriate request reasons were: assessment of chest pain after coronary revascularisation (11 patients, 28%), evaluation of chest pain in patients who were unable to exercise or in whom exercise ECG was equivocal (11 pts, 26%), and re-evaluation of patients treated medically (6 pts, 15%). There were 2 (5%) requests for inappropriate indications (in low-risk patients who were able to exercise) and 1 (3%) request of uncertain appropriateness (DSE for the assessment of transmitral gradient in mitral stenosis).

Conclusions: In our practice, requests for DSE are overwhelmingly made for appropriate reasons, and 'managing demand' for this service is unlikely to produce major cost savings.

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Usefulness of the color doppler handheld echocardiography in the daily clinical practice

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The aim of the study was to evaluate the sensibility and the specificity of a handheld ultrasound scanner compared to a standard machine in assessment of routine patients.

Methods: 32 consecutive patients (mean age 68 ± 12 years, 18 women) referred for routine echocardiography in a cardiology department underwent examinations with a handheld ultrasound scanner (HHUS) (2D and color doppler) and a high-end standard ultrasound scanner (SDUS). We assessed the sensibility and specificity of the handheld device for chambers size quantification, severity of regurgitations and valve abnormalities.

Results: the sensibility and specificity of HHUS used to detect wall hypertrophy was 99% and 73%. The corresponding values for chamber dilatation were 100% and 85% dilatation, with 95% CI: 0,78-1. Severe mitral regurgitation was identified with a sensibility of 100% and specificity of 84% with 95% CI: 0,74-1, respectively 92% and 78% for aortic regurgitations. Valve defects were identified by HHUS with a specificity of 87% for the aortic valve and 89% for the mitral valve while the sensibility was 62% respectively 67%.

Conclusion: HHUS is an efficient tool for the identification of chambers size abnormalities. Valve abnormalities were identified in a lesser degree and needed standard scanning for complete assessment.

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Predictors of clinical usefulness of pocket-sized ultrasound in a general medical department

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Purpose: By performing a cardiovascular and an abdominal screening by pocket-sized ultrasound lasting less than 10 minutes we changed, verified or added important diagnosis in 47 % of patients admitted to a general medical department. The aim of this study was to evaluate predictors of usefulness with respect to diagnostic adjustments.

Methods: Patients admitted to a non-university hospital in Norway in the period from March 1st 2010 to September 30th 2010 were screened with pocket-sized ultrasound with b-mode and color flow imaging (size of unit: 135x73x28 mm). After a principal diagnosis was set in the emergency room, the patients underwent cardiac and abdominal ultrasound screening performed by one of three performing physicians, all cardiologists with some experience in abdominal ultrasound. The usefulness of the screening was classified as 1) change of principal diagnosis, 2) verification of principal diagnosis, 3) additional diagnosis made and 4) no diagnostic change. All patients were categorized by the Study Committee. Diagnostic influence was classified as any of the first three.

Results: 196 patients were included (male=57%, 68.1 ± 15.0 years old). The Odds ratio (OR) for any diagnostic usefulness was 1.6, 95% CI (1.3-2.0), (p<0.001) per 10 years higher age and 2.0, 95% CI (1.7-2.3), (p 0.02) for those with known cardiovascular disease (CD). In the group of patients with either known CD or increased risk of CD (hypertension, diabetes mellitus) the OR was 2.9, 95%CI (2.6-3.2), (p<0.001). Looking only at the patients having their primary diagnosis changed the OR was 1.6, 95% CI (1.4-1.9), (p 0,003) per 10 years higher age and 1.2, 95% CI (0.8-1.6), (p 0.63) for those with known CD. In the group of patients with either known CD or increased risk the OR was 3.0, 95% CI (2.5-3.4), (p 0.02).

Conclusions: Age, known CD or increased risk of CD are predictors for clinical usefulness of a bedside screening with pocket-sized ultrasound in patients admitted to a medical department.

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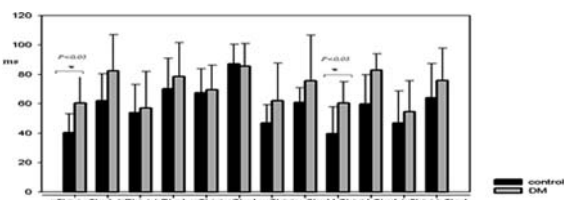
Assessment of atrial electromechanical function by tissue Doppler echocardiography and atrial fibrillation promotion in alloxan-induced diabetic rabbits: an experimental study

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Purpose: Diabetes mellitus is an independent risk factor for atrial fibrillation (AF). However, the underlying mechanisms are still not clearly elucidated. The aim of this study was to evaluate atrial electromechanical delay by tissue Doppler echocardiography (DTE), atrial electrophysiological changes and AF promotion in alloxan-induced diabetic rabbits.

Methods: In 8 alloxan-induced diabetic rabbits and 8 healthy controls, we measured atrial electromechanical coupling start intervals (PAstart) and PA peak intervals (PA peak) by TDE. Isolated Langendorff perfused rabbit hearts were used to evaluate interatrial conduction time (IACT) and vulnerability to AF which examined by burst pacing.

Results: Compared with controls, left atrial diameter (LAD), interventricular septum thickness (IVST), Atrial PAs measured at the left atrial (LA) lateral wall (latPAstart) and right atrial (RA) wall (raPAstart) were greater in diabetic rabbits (LAD 6.8 ± 0.6 vs. 8.3 ± 0.6mm, P<0.01; IVST 1.9 ± 0.2 vs. 3.0 ± 0.5mm P<0.01; latPAstart 40.5 ± 12.9 vs. 60.4 ± 20.4ms P<0.05; raPAstart 59.8 ± 20.1 vs. 83.0 ± 11.0ms P<0.05) (Figure 1). IACT in diabetic rabbits was prolonged than controls (37.6 ± 8.9 vs 27.7 ± 2.1ms P<0.01). Inducibility of AF in diabetic group was significant higher than controls (6/8 vs 1/8, P<0.05). Correlation analysis showed that inter-atrial septum (IAS) PAstart, LA post wall PAstart and LA post wall PApeak were correlated with IACT (r=0.634, 0.562, 0.629 respectively, P<0.05) Conclusion: Atrial electromechanical function is impaired in diabetic rabbits, which may relate to interatrial electrical conduction delay and development of AF.



atrial electromechanical coupling

ASSESSMENT OF DIAMETERS, VOLUMES AND MASS

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The atrial function after cardioversion for atrial fibrillation: one month of echocardiographic follow up

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Background: Atrial fibrillation is the most common arrhythmia in clinical practice. Echocardiography is important for an initial evaluation and for the management in patient presenting AF. It is also useful to assess the left atrial (LA) function recovery after cardioversion(CV) to SR.

The aim of the study was to assess the LA function recovery after CV for persistent AF to SR through a one month follow up.

Population. We enrolled 34 pts (mean age 65 ± 12,32 y.o.) who underwent successful CV from AF to SR. 17,7% had a recent onset of AF (less than 48 h), in the 41,1% AF lasts more than 7 days and less than 3 months and in the 42,4% AF lasts more than 3 months. We excluded patients with severe cardiovascular diseases (severe valvular disease, low EF) or previous transcatheter ablation.

Methods: Each patient underwent an echo study before CV. After restoration of the SR echo was repeated at day 0, after 48 hours, 1 week, 2 weeks, 3 weeks and at one month from CV. Echo parameters evaluated were: LA size (linear measurements, areas, volumes), total emptying fraction[TEF], active emptying fraction [AEF], A wave by PW, Aa by PW TDI, speckle tracking LA. Statistical analysis was performed by repeated measures analysis of variance.

Results: LA volumes were average enlarged (46.5 ± 17.8 ml/m2). We had no reductions in volume (p=0.8) and diameter (p=0.9). Statistically significant differences were recorded analyzing the TEF (p<0.0001), with a significant increase from baseline in the first week, and of the AEF(p<0.001) with significant increase from baseline in the 3rd week. We had similar results analyzing the A wave by PW (p<0.005), the Aa wave by TDI (p<0.001) and velocity of the atrial basal segments studied by speckle tracking (p=0.03). Dividing the population by the onset of arrhythmia, patients with AF lasting <7 days had a prompt recovery either of the total emptying function (p = 0.03) either of the active emptying function (stable values from the first control in SR, no significant improvement during FU). In patients with AF lasting from 7-90 days and in those with AF duration > 90 days we had a significant recovery of TEF and AEF (7-90 days: TEF p=0.01 AEF p=0,01, > 90 days TEF p=0,01 AEF p=0.002) with a significant improvement at the fourth week of FU (p=0.003).

Conclusion: Echocardiography plays a key role in the evaluation of the LA. It is important to add to the traditional measurements (LA volume, A and wave Aa), functionality parameters such as the TEF, AEF. The offline analysis by speckle tracking can also be useful. Moreover the timing of CV is critical for the recovery of the LA function.

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Left atrial shape evaluation based on endocardial surfaces obtained by 3D echocardiography

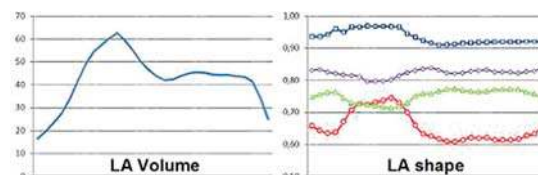
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Purpose: With the advent of 3D echocardiography, novel interest has emerged to combine functional assessment with cardiac chamber shape quantitation, particularly to evaluate cardiac remodelling following therapy or intervention. However, studies in this field are limited to the left ventricle (LV). Our aim was to extend a recently proposed technique for 3D shape indexes to the analysis of the left atrium (LA), and to describe its changes during the cardiac cycle in normal subjects.

Methods: Full-volume 3D data sets (Vivid E9, GE Healthcare, Horten, N) were acquired in 62 healthy subjects (age 18-65). LA endocardial surfaces were obtained with commercial software (4D AutoLVQ, EchoPac BT 11, GE Healthcare, Horten, N). The method was based on 3D LA shape description using 1D signal by sampling the LA endocardial surface through a helical pattern, and on its comparison with the signal obtained from a reference shape. Four dimensionless indexes (range 0-1) were defined: sphericity (S), ellipticity (E), cylindricity (CI) and conicity (Cn). LA shape values in the frames with maximal (M) and minimal (m) LA volumes were compared using Wilcoxon-signed rank test.

Results: All LA shape indexes (median, 25%-75%) showed a significant (p<0.03 for all) cyclic behaviour (Figure), but with different amplitude changes, which were maximal for S (12%) and minimal for E (3%). At M, it corresponded to max E (.94,.92-.94) and max S (.7,.67-.74), with min Cn (.73,.71-.74) and CI (.82,.78-.84), while at m lower E (.92,.9-.93) and S (.65,.6-.67) and higher Cn (.76,.75-.78) and CI (.85,.81-.88) were observed.

Conclusions: LA 3D shape analysis is feasible, showing cyclic changes in all shape indexes. This approach could be used, together with LV analysis, to assess the effects of remodelling on LA-LV functional coupling.



3D Left Atrial Volume and Shape Changes

P261**Assessment of left atrial volume in hypertension with and without left ventricle hypertrophy**

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Objectives: This study was designed to identify an association between left atrial volume index (LAVi) and hypertension (HTN) with or without left ventricle hypertrophy (LVH).

Background: Left atrial enlargement has been suggested as a robust marker of cardiovascular disease. However, the association between atrial enlargement and hypertension was not clearly defined.

Methods: A cross-sectional sample of 60 HTN patients <60 years of age underwent comprehensive Doppler echocardiography in Departement of Cardiology and Vascular Medicine, Faculty of Medicine, University. All patients with normal LV systolic function were grouped according to the presence of HTN with and without LVH. Left atrial volume was assessed with Biplane-Area length method from four-chamber and 2-chamber views, and indexed to body surface area. The measurement of diastolic function was done according to Recommendations of European A Society of Echocardiography.

Results: Of 46 patients included, 23 with LVH and 23 without LVH. There were no significant different in clinical characteristic (age, gender, body surface area (BSA), blood pressure) between the two group. Left ventricular mass index (LVMI) in HTN group with LVH was 129.80 ± 26.03 gram/m² and significantly different ($p < 0.001$) compare to HTN group without LVH (89.49 ± 16.70 gram/m²), HTN group with LVH had LAVi 33.34 ± 9.23 ml/m² while in HTN non LVH 26.05 ± 6.76 ml/m² ($p = 0.004$). LVMI grade was positively associated with LAVi ($r = 0.30$; $p = 0.04$). Proportion of diastolic dysfunction was higher in LVH group compare those non LVH (86% vs 47%; $p < 0.005$). Conclusions The larger LAVi was observed in HTN with LVH compare to those who had no LVH. It apparently due to higher proportion of diastolic dysfunction in HTN with LVH. This study suggest the importance of LAVi assessment in patients with hypertension.

P262**Three-dimensional assessment of left atrial remodelling in atrial fibrillation using 3D echocardiography and angio CT multislice 64**

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Introduction: We aimed to study the correlation between the extension of structural and mechanical remodelling of left atrium (LA) (evaluated with Computerized 3D Echocardiography -C3DE and Multislice 64 Computed Tomography -MSCT) and recurrence of atrial fibrillation (AF) after cardioversion in order to identify predictors for recurrence of AF.

Methods: Thirty-six patients with AF shorter than 6 months, in whom we performed C3DE and MSCT immediately after cardioversion. In all cases we performed a computerized analysis of LA shape, geometry and volumes, using an adapted 3D echo Qlab software. Contraction amplitude of LA myocardial fibers was determined based on the amplitude of endocardial border movement and displayed as graphical representation and bulls-eye chart. LA contraction amplitude, left ventricular ejection fraction, LA volumes and diameters were determined. LA volumes and diameters were also assessed using MSCT. Follow-up was performed at 1 month and 3 months to analyse the recurrence of AF.

Results: 21 patients converted to sinus rhythm maintained the sinus rhythm at 3 months (group 1) and 15 presented AF recurrence (group 2). Both mechanical and structural remodelling were more pronounced in patients who presented AF recurrence. C3DE parameters characterising structural remodelling at 1 month were: LA maximum volumes - 94.2 ml in gr.1 and 142.3 ml in gr.2 ($p = 0.05$), LA maximum diameters - 43 mm in gr.1 compared with 56.5 mm in gr.2 ($p = 0.03$). MSCT derived parameters characterising structural remodelling were similar: LA maximum volumes - 89.5 ml in gr.1 and 146.3 ml in gr.2 ($p = 0.002$), LA maximum diameters - 44 mm in gr.1 and 54.2 mm in gr.2 ($p = 0.03$). Analysis of mechanical remodelling parameters showed a superior contraction amplitude in the rhythm control group - 2.1 mm, compared with recurrence group - 1.62 mm ($p = 0.2$). Ventricular function was superior in the rhythm control group - LVEF 46.5%, compared with the recurrence group - LVEF 45.3% ($p = 0.02$).

Conclusions: We recorded a good correlation between data obtained with 3D echo and MSCT as regard to assessment of structural remodelling in AF. 3D analysis identified several predictors for rhythm outcome, like parameters characterising left atrial structural (increase of LA diameters and volumes) or mechanical remodelling process (LA contraction amplitude), while ventricular function was more depressed in patients with AF recurrence. However, extension of structural remodelling showed a higher correlation with AF recurrence than contractile remodelling.

P263**Cardiac structural abnormality in acute myocardial infarction patients at high risk of obstructive sleep apnea.**

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Purpose: The aim of this study was to determine cardiac structural abnormalities by echocardiography in unselected group of acute myocardial infarction (AMI) patients who are at high risk of obstructive sleep apnea (OSA).

Methods: We identified AMI patients treated with primary angioplasty who are at high risk of OSA (high risk based on Berlin questionnaire and Epworth sleepiness scale result ≥ 10). All patients underwent echocardiographic study. Studies were carried out with Philips iE 33 and 2.5-3.5 MHz transthoracic probe. Left ventricular (LV) hypertrophy was defined as LV mass index >95 g/m² in women and >115 g/m² in men.

Results: 158 consecutive patients were enrolled in the study (mean age was 57.11 ± 8.72 SD, 68% were male). 54 (34.2%) patients were at high risk of OSA. Patients at high risk of OSA had higher body mass index (32.3 ± 4.6 vs. $27. \pm 3.8$ kg/m²; $p < 0.0001$), systolic (149.91 ± 34.2 vs. 128.36 ± 23.57 mmHg; $p < 0.0001$) and diastolic (87.65 ± 17.49 vs. 76.18 ± 12.06 mmHg; $p < 0.0001$) blood pressure on admission. High-risk patients' LV diastolic diameter (52.2 ± 7.3 vs. 48.2 ± 5.1 mm; $p = 0.01$), left atrial diameter (41.3 ± 5.4 vs. 38 ± 4.6 mm; $p = 0.0001$) and interventricular septal thickness (12.6 ± 2.4 vs. 11.5 ± 1.7 mm; $p = 0.0028$) were increased compared with low-risk subjects. The LV mass (300.7 ± 105.7 vs. 237.5 ± 59.6 ; $p = 0.0002$), and LV mass index (140.3 ± 47.4 vs. 122.8 ± 28.2 g/m²; $p = 0.023$) were significantly higher in high-risk patients. There was no statistically significant difference in LV ejection fraction (49.88 ± 8.73 vs. 49.79 ± 8.75 ; $p = 0.953$), right ventricular diameter (25.66 ± 3.01 vs. 24.97 ± 3.12 ; $p = 0.199$), and aortic thickness (32.2 ± 4.7 vs. 31.1 ± 3.7 ; $p = 0.261$) between low- and high risk patients. LV hypertrophy was present in 64.8% of high risk for OSA and in 61.5% of low risk group ($p = NS$). In multiple logistic regression analysis LV diastolic diameter >49 mm [OR 3.5 (95% Confidence Interval): 1.05-11.6; $p = 0.042$], LV mass index >122.6 g/m² [OR 0.26 95% CI: 0.07-0.94; $p = 0.04$], and interventricular septal thickness >12 mm [OR 4.44 95% CI: 1.15-17.1; $p = 0.03$], history of hypertension [OR 4.42 95% CI: 0.96-20.5; $p = 0.057$], body mass index >30 kg/m² [OR 6.82 95% CI: 2.33-20; $p < 0.001$], diastolic blood pressure >90 mmHg [OR 6.4 95% CI: 1.58-25.9; $p = 0.009$] were independent risk factors for high risk of OSA.

Conclusions: High risk of OSA in AMI patients was associated with increased LV mass, and LV mass index. LV diastolic diameter, LV mass index, interventricular septal thickness, hypertension, body mass index, diastolic blood pressure are all independent risk factors for high risk of OSA.

P264**Increased right ventricle and pulmonary artery dimensions in adults with osteogenesis imperfecta**

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Purpose: The aim of our study was to examine the dimensions of the right ventricle (RV) by echocardiography in adults with osteogenesis imperfecta (OI), compare to the controls and investigate if pulmonary function might have an influence on the RV dimensions.

Methods: The present echocardiographic survey included 99 adults with OI divided in three clinical types, I, III and IV, and 52 controls. RV cavity diastolic dimensions at base (RVD1) and from base to apex (RVD3), distal RV outflow tract (RVOT) and pulmonary artery (PA) diameters were measured and indexed for body surface area (BSA). Forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and FEV1/FVC ratio were measured in 75 patients.

Results: The OI group had significantly lower BSA than the control individuals, 1.7 ± 0.3 vs. 1.9 ± 0.2 m² ($p < 0.05$). All RV dimensions were significantly larger in the OI group when compared to the controls, RVD1, $1.9 \pm .5$ vs. $1.7 \pm .3$ cm/m², ($p < 0.05$), RVD3, 4.3 ± 1.1 vs. $4.0 \pm .5$ cm/m², ($p < 0.05$) and RVOT, $1.2 \pm .3$ vs. $1.1 \pm .2$ cm/m², ($p < 0.05$). Furthermore PA, $1.2 \pm .3$ vs. $1.0 \pm .2$ cm/m², ($p < 0.05$) were also significantly larger in OI group. Besides RVD1, RVD3, RVOT and PA were significantly larger in OI type III as compared OI type I and IV, RVD1, $2.7 \pm .4$ cm/m², ($p < 0.05$), RVD3, 6.7 ± 1.4 cm/m² ($p < 0.05$), RVOT, $1.7 \pm .3$, ($p < 0.05$), and PA, $1.6 \pm .3$ cm/m², ($p < 0.05$). In the OI group, mild restrictive pulmonary pattern was recognized in 12 and mild obstructive pulmonary pattern in 5 patients. There were no differences in RV, RVOT or PA dimensions between the patients with restrictive ventilatory pattern and patients with normal ventilatory pattern.

Conclusion: Increased RV and PA dimensions were found in the OI patients in comparison with the control group. Patients with OI type III seemed to have greater RV and PA dimensions in relation to both controls and other two OI types. Ventilatory pattern did not influence RV dimensions in OI patients.

NON-INVASIVE HEMODYNAMICS DERIVED FROM ECHO-DOPPLER**P265****Assessment of pressure reflection in the pulmonary circulation using echocardiography: A possible gatekeeper for right heart catheterization?**

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Purpose: Pulmonary hypertension is a frequent finding in patients with cardiopulmonary disorders. It is important to recognize pulmonary hypertension due to increased pulmonary vascular resistance (PVR). In a recent study we describe a novel echocardiography method to identify patients with increased PVR (>3 WU) based on detection of pressure reflection (PR) in the pulmonary artery (PA). The patient population studied was biased towards high PVR and therefore, in the present study we evaluate the method in a more representative population undergoing right heart catheterization.

Methods: Echocardiography and catheterization were performed within one week in 108 patients. Three PR variables were selected: the interval from valve opening to peak velocity in the PA (Act, ms), the interval between PA peak velocity and peak tricuspid velocity (tPV-PP, ms), and the right ventricular pressure increase after peak velocity in the PA (augmented pressure, AP, mm Hg). Cut-of values indicating increased PVR for Act, tPV-PP, AP were <103 ms, > 89 ms, > 8 mmHg.

Results: The mean \pm SD age was 52 ± 14 years, 44% were female. Forty-six percent had left heart disease, 21% were heart transplant patients and 18% had pulmonary arterial hypertension. The proportions with increased PAMP (>25 mmHg) increased pulmonary capillary wedge pressure (PCWP >12 mmHg), increased PVR (>3 WU) or both increased PVR and PCWP were 54%, 40%, 36% and 15%. There was no significant linear relation (correlation coefficient, R) between PCWP and Act (R=0.18), tPV-PP (R=0.11) and AP (R=0.10). The positive predictive value was 94% with equal to or > 2 PR variables and the negative predictive value was 92% with no PR variables present (Table).

Conclusions: Assessment of PR in the pulmonary circulation identifies patients with normal as well as increased PVR and the finding suggest that echocardiography can be used as a gatekeeper for right heart catheterization.

Diagnostic performance

Variables	Sensitivity (95% CI)	Specificity (95% CI)	NPV	PPV
≥ 2 variables indicating PR	74 (58–85)	97 (90–99)	87	93
≥ 1 variable indicating PR	89 (77–96)	64 (52–74)	92	58

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Noninvasive estimation of pulmonary vascular resistance during transthoracic echocardiography and dobutamine stress echocardiography in patients before orthotopic liver transplantation

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Aim: The aim of this study is to investigate pulmonary vascular resistance response to dobutamine stress testing in patients with end-stage liver disease.

Methods: We followed 54 patients (34 men and 20 women, aged 19 to 63 years, mean 51,9) undergoing evaluation for orthotopic liver transplantation. In all patients was diagnosed liver cirrhosis. Four of them were evaluated for re-transplantation. Transthoracic echocardiography and dobutamine stress echocardiography was performed in all patients. Estimation of pulmonary vascular resistance was performed in all patients at rest and at peak dose of dobutamine. We have used an equation for noninvasive calculation of PVR : $PVR (WU) = 10 \times TRV / TVI RVOT$.

Results: An average peak dose of 39 (SD 6,9) micrograms/kg/min dobutamine was given. 49 (90,7%) patients reached 85% maximum heart rate. An average tricuspid regurgitant velocity (TRV) at rest was 2,5 m/s (SD 0,3) and at peak dose of dobutamine was 2,7 m/s (SD 0,4) and an average right ventricular tract time velocity integral (TVI RVOT) was 19,6 cm (SD 3,3) and 24,6 cm (SD 4,9) respectively. The average pulmonary vascular resistance (PVR) measured at rest was 1,3 Woods units (SD 0,3) and at peak dose of dobutamine was 1,1 Woods units (SD 0,3). PVR estimated by echocardiography decreased significantly ($p < 0,001$).

Conclusions: Dobutamine infusion leads to peripheral vasodilatation and an increase in cardiac output. Our data indicated that pulmonary vascular resistance decreased during dobutamine infusion in patients with end-stage liver disease.

P267

New portable device and coefficient for ultrasound diagnosis of cerebrovascular reactivity.

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Objectives: The aim of this study was evaluate state cerebrovascular reactivity in condition of hypercapnia- hiperoxia induced cerebrovascular reserve in hypertensive patients.

Methods: We used ultrasonography of transcranial Doppler's method in the study of middle cerebral arteries (MCA) from temporal window. We studied the changes of flow velocity (FV) and diameter (D) starting, at the time of hypercapnia (inhalation 2min 4% mixture of carbonic gas (MCG) with air) and hyperoxia (inhalation 2min 100% oxygen), FV in period of recovery (rec) (air-inhalation min) of 77 patients (1group) with essential hypertension of grade II-III and 52 healthy volunteers (2group) without cerebral stroke during of the life history (age $40 \pm 12,5$ years) with a new portable device. At the time of vascular evaluation, none of the patients had a history or clinical evidence of peripheral vascular disease, coagulopathy, or

any disease predisposing them to vasculitis. All participants of research have given the informed agreement. We used index of flow velocity $IFV = (V_0 - V_2) / V_0 * 100$, coefficient modification of flow velocity $CFV = V_2 / V_0$ and new coefficient - normalized to BP auto regulation answer $NBPA = (V_2 - V_0) / (V_0 * (BP_2 - BP_0))$ and index of recovery $IR = V_0 / V_{rec}$. V_0 and BP_0 are starting parameters, V_2 and BP_2 are during inhalation and V_{rec} - after inhalation parameters. Statistical analysis: descriptive, M-U-test, correlation matrix, multiple regression independent by groups.

Results: Patients and healthy volunteers had no distinctions of anthropometrical parameters. Significant difference was found between 1 and 2 groups: $IFVCO_2 = 64.5 \pm 40.5\%$ and $22.9 \pm 24.0\%$ $p = 0.00$; $CFVCO_2 = 258.5$ and 119.5 $U = 28.5$, $Z = 3.03$ $p = 0.00$; $NBPACO_2 = 241$ and 137 $U = 46$, $Z = 2.18$ $p = 0.03$; $IFVO_2 = 33.7 \pm 2.8\%$ and $15.5 \pm 2.5\%$ $p = 0.02$; $CFVO_2 = 1.34 \pm 0.28$ and $1.15 \pm 0.25\%$ $p = 0.03$; $NBPAO_2 = 4.9 \pm 2.7$ and 10.2 ± 3.8 $p = 0.00$ respectively.

Conclusion: Ultrasonography transcranial Doppler's method in the MCA with help new portable device and new coefficient NBPA does possible the quantitative and qualitative description of functional changes of the cerebrovascular reserve. Patients with a hypertension and without cerebral stroke during of the life history have inhibited cerebrovascular reactivity and decrease in adequacy of the answer of arterial blood circulation of a brain in condition of hypercapnia and hiperoxia.

ASSESSMENT OF SYSTOLIC FUNCTION

P268

Best determinants of left atrial function are left ventricular longitudinal systolic function and arterial stiffness

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Interaction between ventricular and arterial function, "ventriculo-arterial coupling", was studied extensively. However, left atrial (LA) function, part of this continuum, was ignored, mainly because is difficult to assess it.

Methods: We studied 80 subjects (44 ± 18 years, 43 men) from a large clinical spectrum: 20 athletes, 20 normals, 20 patients with risk factors, and 20 with dilated cardiomyopathy, with an ejection fraction (EF) from 12 to 76%. LA reservoir function was assessed from total LA strain (TLAS), while LA conduit function from passive atrial EF (PAEF); LV global systolic function from EF; longitudinal systolic function from global longitudinal strain (GLS), mean 6 basal segments systolic velocity (S'), mean systolic mitral annular velocity (Sa), and mean MAPSE; LV diastolic function from E/Vp, mean 6 basal segments diastolic velocity (E'), and mean mitral annular diastolic velocity (Ea). Arterial function from intima-media thickness (IMT) and stiffness parameters (Ep and local wave speed - LWS); endothelial function from flow mediated dilation (FMD).

Results: LA reservoir function (TLAS) correlated positively with LV longitudinal, both systolic and diastolic functions (table). Meanwhile, TLAS correlated inversely with arterial stiffness and positively with endothelial function. PAEF correlated with LV relaxation, arterial stiffness, and endothelial function. By stepwise multiple regression analysis, best determinants of LA reservoir function were LV longitudinal (GLS) and arterial functions (LWS): $r = -0.78$, $r^2 = 0.53$; and of LA conduit function were Ea and E/Vp: $r = 0.78$, $r^2 = 0.61$ (all $p = 0.001$). Conclusion. LA function is mainly determined by LV longitudinal function and arterial stiffness. This should be taken into account when targeting atrial-ventriculo-arterial coupling by medication.

Correlations

	age	BMI	EF	GLS	S'	Sa	MAPSE
TLAS	$r = -0.62^*$	$r = -0.37^*$	$r = 0.61^*$	$r = 0.75^*$	$r = 0.78^*$	$r = 0.69^*$	$r = 0.67^*$
E/Vp	E'	Ea	IMT	Ep	LWS	FMD	
	$r = -0.66^*$	$r = 0.75^*$	$r = 0.68^*$	$r = -0.59^*$	$r = -0.45^*$	$r = -0.61^*$	$r = 0.57^*$
	E'	Ea	E/Vp	IMT	Ep	FMD	
PAEF	$r = 0.68^*$	$r = 0.76^*$	$r = 0.66^*$	$r = -0.42^*$	$r = -0.48^*$	$r = 0.56^*$	

* $p < 0.001$.

P269

Novel strategies for echocardiographic evaluation of left ventricular function in a mouse model of myocardial infarction

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Purpose: Optimize the acquisition and analysis of echocardiographic images of the left ventricle (LV) to characterize cardiac dysfunction and adverse remodeling in a murine model of myocardial infarction (MI).

Methods: 13 female DBA/2J mice underwent permanent occlusion of the left anterior descending coronary artery (LAD) leading to MI. Animals were echocardiographed with a Vevo 770 at 110-120 fps before infarction (0d) and 7,14,30, 60 and 90 days after LAD ligation. LV systolic function was evaluated using the fractional area change (FAC%) computed in four high-temporal resolution EKVB-mode parasternal

short axis images taken at different ventricular levels, and in one EKVB-mode parasternal long axis. Pulsed wave and tissue Doppler modes were used to evaluate the diastolic function and Index Tei for global cardiac function. Infarct size was histologically quantified by measuring collagen deposition labeled by Sirius red and measured as the mean percentage of infarcted area vs. total LV area. All data was analyzed using Shapiro-Wilk and Student's t-tests. Pearson's correlation coefficient was used to estimate the strength of the relationship between the infarcted size and FAC%.

Results: LV dilation extends progressively from the infarcted areas to the healthy myocardial tissue resulting in adverse LV remodeling (internal apical diameter, $0d=2.81 \pm 0.25$, $7d=3.49 \pm 0.41$, $30d=3.60 \pm 0.41$, $90d=3.81 \pm 0.45$; $p < 0.001$). The end-diastolic area changed significantly as well ($0d=18.98 \pm 1.88$, $7d=22.03 \pm 2.11$, $30d=22.83 \pm 2.37$, $90d=24.08 \pm 2.44$; $p < 0.001$). The LV FAC% decreased significantly between the basal and final time points being more visible in the parasternal long-axis view ($0d=63.76 \pm 3.87$, $7d=37.33 \pm 9.30$, $30d=35.41 \pm 7.69$, $90d=35.63 \pm 8.12$; $p < 0.001$). The diastolic dysfunction displayed a significant increase of the ratio E/A 7 days post infarction ($0d=1.57 \pm 0.23$, $7d=1.96 \pm 0.47$; $p < 0.05$) in contrast to the IVRT that increases steadily ($0d=13.75 \pm 1.50$, $7d=17.50 \pm 1.36$, $30d=18.75 \pm 2.60$, $90d=17.72 \pm 2.29$; $p < 0.001$). The Tei Index increased significantly until the final point ($0d=0.46 \pm 0.07$, $7d=0.55 \pm 0.08$, $30d=0.54 \pm 0.06$, $90d=0.57 \pm 0.08$; $p < 0.01$). Linear regression analyses showed significant correlation between infarct size and FAC% ($r=-0.946$; $R^2=0.90$; $p < 0.05$).

Conclusion: The use of the long axis to measure %FAC since it provides better visualization of the LV infarction and higher correlation with cardiac systolic dysfunction than the short axis view. Isolated analysis of systolic/diastolic mechanisms may not be reflective of overall cardiac dysfunction. The combined myocardial performance index (Tei) properly characterizes global cardiac dysfunction in murine MI models.

P270

Does the simplified approach on left ventricular (LV) elastance measurements provide reliable results of LV contractility?

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Background: Much echocardiographic research into left ventricular (LV) function relies heavily on the assumption: that LV systolic function can be described by the contractility index end-systolic elastance (Ees). It has been suggested that Ees can be simply calculated as the ratio between LV end-systolic pressure (ESP) to end-systolic volume (ESV). As based on pressure-volume loop analysis, this method relies on the fundamental assumption that the slope of the LV end-systolic pressure-volume relations intersects the volume axis at a negligible value and therefore can be approximated as zero, which however is controversial. We wished to critically test this assumption.

Methods and Results: Pressure and volume data were obtained at baseline and after a load intervention with iv. nitroglycerin (NTG) in n=65 patients (age=67±9) undergoing coronary angiography and simultaneous echocardiography (LVEF=55±8%). The simplified Ees (EesSimp=baseline ESP/baseline ESV) was compared to the Gold Standard (GS) ratio obtained using delta pressure and volume values from baseline to post-NTG (EesGS=dESP/dESV). It was found that EesSimp correlated relatively poorly to EesGS ($r=0.34$; $p=0.04$) and that the two methods provided values of volume axis intercept that substantially differed from the assumed zero value (EesSimp V0 : mean -7.0mL vs EesGS V0 : -62.2mL).

Conclusion: The very popular systolic index ESP/ESV agrees relatively poorly with Gold Standard LV contractility as the volume axis intercept is non-negligible.

P271

The diagnostic value of layer-specific quantification of myocardial deformation in the assessment of patients with coronary artery disease

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Purpose: The left ventricular (LV) wall of the heart comprises three myocardial layers. The subendocardial layer is most susceptible to ischemic injury. We hypothesized that patients with coronary artery disease (CAD) and significant coronary artery stenosis have reduced subendocardial function assessed by strain compared to patients without stenoses.

Methods: Fifty-one patients with suspected non-ST elevation myocardial infarction (NSTEMI) and unstable angina pectoris (UAP) were included. Thirty of these patients had significant stenosis in one or more coronary arteries while 21 patients did not have significant stenosis and served as controls. Peak systolic longitudinal subendocardial, subepicardial and transmural (including all cardinal layers) strain were assessed by 2D speckle tracking echocardiography in a 16 LV segments model and averaged to global longitudinal strain subendocardially, subepicardially and transmurally.

Results: Patients with significant coronary artery stenosis had worse overall myocardial function compared to patients without significant stenosis (Table). Subendocardial strain ($-17.6 \pm 2.6\%$) was significantly greater than subepicardial strain ($-13.3 \pm 1.9\%$, $p < 0.001$) in the whole study population. The absolute difference between subendocardial and subepicardial strain was lower in patients ($\Delta 3.8\%$) than in controls ($\Delta 4.9\%$, $p=0.02$). This reflects more pronounced ischemic injury in the subendocardial layer in patients with significant stenoses. In a ROC analysis, subendocardial strain had the best AUC 0.83 (95% CI 0.71-0.95) to identify significant coronary stenosis, while

transmural strain showed 0.82 (95% CI 0.70-0.94) and subepicardial strain 0.74 (95% CI 0.71-0.95).

Conclusions: Subendocardial function was more affected in NSTEMI and UAP patients with significant coronary artery stenosis compared to subepicardial function. Assessment of layer-specific strain echocardiography might identify NSTEMI and UAP patients with significant coronary artery stenosis.

Layer-specific left ventricular function

	Controls (n=21)	NSTEMI/UAP (n=30)	p-value
Subendocardial LV GLS (%)	-19.2 ± 2.3	-16.4 ± 2.1	<0.001
Subepicardial LV GLS (%)	-14.3 ± 2.0	-12.6 ± 1.6	0.002
Transmural LV GLS (%)	-15.8 ± 1.5	-13.5 ± 2.2	<0.001

NSTEMI = non-ST elevation myocardial infarction; UAP = unstable angina pectoris; LV = left ventricular; GLS = global longitudinal strain.

P272

3D-4D quantification of left ventricular volumes and ejection fraction on the basis of feature strain echocardiography

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Purpose: The aim of this study was to evaluate the accuracy of a 3D-4D quantification of left ventricular (LV) volumes and ejection fraction (EF) using a feature tracking echocardiographic software and related post-processing tools.

Methods: 20 subjects were enrolled in this study; of these 10 healthy subjects (5 male, 32 ± 4 years), and 10 patients (4 male, 66 ± 17 years) with heart diseases (2 with dilated cardiomyopathy, 3 previous myocardial infarction, and 5 patients with hypertrophic cardiomyopathy), underwent to 2D conventional echocardiography (Simpson method), XStrain 4D (XS4D) analysis and to cardiac magnetic resonance (MRI), in the same day and in random order to quantify end diastolic volume (EDV, ml), end systolic volume (ESV, ml) and EF (%). The Simpson method was determined from four- and two-chamber (Ch) views. XS4D is a software solution merging Esaote's XStrain 2D tracking technologies with Tomtec's 3D/4D rendering. Starting from standard apical 4Ch, apical 2Ch and apical long axis heart's views elaborated with 2D Strain, XS4D provides temporal compensation of the heart rate variation, spatial alignment of the 3 views in 3D space and adaptation of a dynamic LV surface. Using well proven numerical methods XS4D provides various derives dynamic measurements among which global and regional volumes curves (including EDV,ESV and EF). The MRI quantification of LV volumes and EF included 9-13 short axis views (thickness 8 mm, gap interslice 0 mm). MRI was used as the gold standard method.

Results: LV volumes obtained by XS4D (EDV:92 ± 43 ml, ESV: 49 ± 31 ml) and Simpson method (EDV: 82 ± 39 ml, ESV: 35 ± 29 ml) were significant underestimated ($P < 0.001$) in comparison with MRI (EDV:159 ± 54ml, ESV: 76 ± 45 ml). No significant difference regarding EF was found among XS4D ($54 \pm 12\%$), Simpson method ($61 \pm 13\%$) and MRI ($56 \pm 11\%$). Bland-Altman analysis between XS4D and cardiac MRI showed a low level of agreement for EDV (mean difference=66.6; SD=32) and for ESV (mean difference= 31.6; SD=23); similarly Simpson method and MRI showed a low level of agreement for EDV (mean difference= 76.5; SD=30) and for ESV (mean difference= 31.6; SD=23); On the contrary, a very low bias (mean difference = 2.2; SD=9.7) was found between XS4D and cardiac MRI for the quantification of EF, and between Simpson method and MRI (mean difference -4.6; SD=7.4).

Conclusion. Quantification of LV volumes using XS4D allows an accurate, and reliable assessment of LV EF and a rough estimation of LV volumes compared with cardiac MRI. XS4D provides volumetric data that are similar to those computed using Simpson Biplane.

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New application of 2-dimensional midwall ejection fraction by speckle tracking echocardiography.

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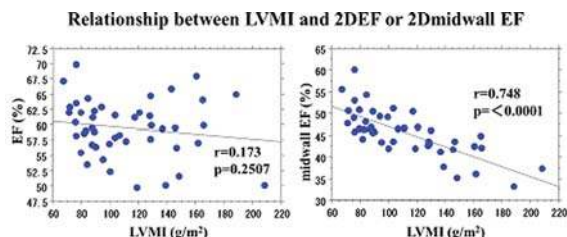
Purpose: Left ventricular midwall fractional shortening (FS) has been used as a more physiologically appropriate measurement of left ventricular systolic performance in patients with left ventricular hypertrophy than conventional FS. On the other hand, 2-dimensional echocardiography is more accurate for evaluating left ventricular volume and ejection fraction (EF) compared with M-mode echocardiography. The purpose of this study was to assess the usefulness of midwall EF using 2-dimensional speckle tracking echocardiography.

Method: Forty six patients with or without left ventricular hypertrophy were enrolled in this study. Left ventricular systolic function was assessed by EF, midwall FS and midwall EF. Relationship between these parameters and left ventricular mass index (LVMI) were investigated in this study. We also investigated the correlation between midwall EF and conventional tissue Doppler index.

Results: The EF did not correlate with LVMI ($r=0.173$, $p=NS$). There was significant correlation between midwall EF and LVMI ($r=0.748$, $p < 0.0001$). There was also significant correlation between midwall FS and LVMI ($r=0.692$, $p < 0.0001$). The early systolic

mitral annular velocity and the early diastolic mitral annular velocity correlated with LVMI ($r=0.446$, $p=0.0019$, $r=0.418$, $p=0.0038$, respectively). Midwall EF correlated with the early systolic mitral annular velocity and the early diastolic mitral annular velocity ($r=0.418$, $p=0.0039$, $r=0.430$, $p=0.0028$, respectively).

Conclusion: Midwall EF correlates with the degree of left ventricular hypertrophy. Midwall EF can detect the left ventricular systolic dysfunction which cannot detect by conventional EF. Assessment of midwall EF may apply to assessment of left ventricular systolic performance in patients with various left ventricular geometry.



P274

Echocardiographic risk stratification in pulmonary arterial hypertensive patients

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Purpose: The aim of this study was to create an echocardiographic algorithm for risk stratification following a retrospective analysis of echocardiographic data in pre-capillary pulmonary hypertensive (PH) patients.

Methods: All patients referred to the National Pulmonary Hypertension Service of Hammersmith Hospital from 2002 until 2008 were included in the study. The patient cohort was solely focused in all pre-capillary PH patients and consisted of 762 patients. The data was analysed using a time-dependent Cox model. The survival outcome was determined by death. Of 762 patients, 226 (30%) died. Indices that determined survival were inserted into a receiver – operating curve (ROC) analysis in order to identify the optimal cut-off value for predicting mortality at 12 months.

Results: When specific cut-off points were determined for each echo parameter, moderate TR (AUC: 0.875) had the greatest sensitivity and specificity to predict 12-month survival, followed by a fractional area contraction (FAC) < 30% (AUC: 0.725). An eccentricity index in end-systole (EIs) > 1.98 (AUC: 0.664), an MPI > 0.84 (AUC: 0.654), presence of PerEf (AUC: 0.623), acceleration time (AT) ≤ 62 msec (AUC: 0.583), right atrial volume (RAvol) > 158 mls (AUC: 0.546), and finally a tricuspid annular plane systolic excursion (TAPSE) ≤ 14 mm (AUC: 0.544) were high risk echocardiographic markers for low survival within 12 months of follow up.

Conclusions: In a homogenous group of pre-capillary PH patients, echocardiographic predictors of overall survival were severity of tricuspid regurgitation, MPI, PerEf followed by AT, RAvol and TAPSE. These may risk stratify prospective pulmonary hypertensive patients.

P275

Regional wall motion variations in right ventricular systolic impairment in patients with pulmonary hypertension as assessed by three dimensional speckle tracking

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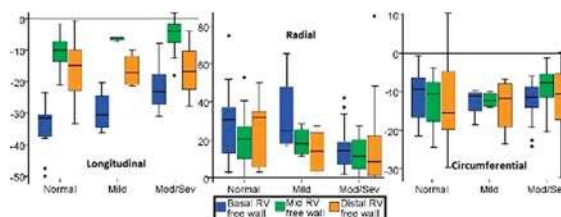
Purpose: Two-dimensional speckle tracking (2DST) imaging of the right ventricle (RV) has been used to demonstrate reduced longitudinal strain (LS) in the basal, mid and distal segments in patients with pulmonary hypertension (PHT) when compared to healthy controls. Thus far only LS has been measured in these populations with the transverse directions almost entirely ignored, and only in 2D. The advent of three-dimensional speckle tracking (3DST) allows for the analysis of longitudinal, radial (RS) and circumferential (CS) strain from the same 3D full volume capture, and eliminates the effect of out-of-plane data loss.

Methods: N=28 patients with PHT (59.5 ± 15.9y, RVSP 89.9 ± 26.5mmHg) with satisfactory imaging for 3DST and N=10 healthy volunteers (38.0 ± 16.8y, RVSP 27.8 ± 4.7mmHg) were included in the study. In addition to standard 2D and Doppler studies, a 3D full volume capture of the RV was acquired. The RV free wall was divided equally into basal, mid and distal segments and analysed by 3DST for RS, LS and CS.

Results: LS was reduced in the basal (-35.9 ± 7.4 vs. -23.3 ± 7.2, $p<0.001$) and mid (-10.3 ± 6.0 vs. -5.5 ± 4.3, $p=0.009$) segments but not the distal segment, and only the mid-level demonstrated a statistically significant difference between groups for RS (22.9 ± 15.7 vs. 12.5 ± 8.9, $p=0.027$). There were no significant differences in regional CS between groups. When divided into groups according to the subjective assessment of RV systolic function, there were significant differences between

groups for basal and mid LS, and basal RS (see picture). When comparing between regions, basal LS was significantly greater than mid and distal LS ($p<0.001$, both).

Conclusions: 3DST is able to demonstrate differences in regional wall motion for the RV in normal subjects and patients with PHT.



Regional strain (%) vs systolic function

P276

Right ventricular outflow tract systolic excursion. A novel echocardiographic parameter of right ventricular function associated with poor survival

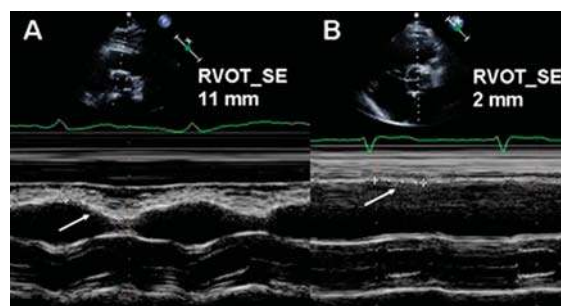
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Background: Right ventricular (RV) function has important prognostic and therapeutic implications. Assessment of RV function using echocardiography is challenging. The aim of this study was to evaluate a new parameter of RV function, right ventricular outflow tract systolic excursion (RVOT_SE).

Methods: RVOT_SE was measured using the parasternal short axis view at the level of the aortic valve and M-Mode echocardiography (Figure). We measured the systolic excursion of the RVOT anterior wall. RVOT_SE was measured in 45 patients (age 63 ± 19y, 26 males) with normal RV function (RV fractional area change (RVFAC) > 32% and tricuspid annular plane systolic excursion (TAPSE) > 1.5 cm) and 27 patients (age 68 ± 14y, 23 males) with reduced RV function (RVFAC < 32% and TAPSE < 1.5 cm).

Results: RVFAC was 46 ± 6% in the normal RV group and 22 ± 5% in the reduced RV group ($p<0.0001$). TAPSE was 2.2 ± 0.4 cm in the normal RV group and 1.0 ± 0.2 cm in the Reduced RV group ($p<0.0001$). RVOT_SE was 9.5 ± 1.4 mm in the normal RV group and 1.6 ± 1.1 mm in the reduced RV group ($p<0.0001$). An RVOT_SE < 6 mm identified patients with reduced RV function with a 100% sensitivity and 100% specificity. Survival at one year was 60% in patients with RVOT_SE < 6 mm and 86% in patients with RVOT_SE > 6 mm, $p<0.002$. The figure below shows RVOT_SE measurements (arrows) in a patient with normal (A) and reduced (B) RV function.

Conclusions: RVOT_SE is a novel, simple, and promising parameter for assessing RV function, and it is associated with poor survival. Further study is needed to determine the usefulness of RVOT_SE for echocardiographic assessment of RV function.



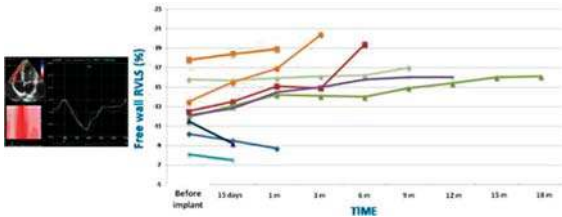
P277

Right ventricular function assessment by speckle tracking echocardiography in patients undergoing left ventricular assist device

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Background: Right ventricular (RV) systolic function has a critical role in determining the clinical outcome and the success of using left ventricular assist devices (LVADs), in patients with refractory heart failure. RV deformation analysis by speckle tracking echocardiography (STE) has recently allowed a deeper analysis of RV longitudinal function. The aim of the study was to evaluate right ventricular function by speckle tracking echocardiography (STE) in patient with advanced heart failure before and after LVAD implant.

Methods: Transthoracic echo-Doppler was performed in 9 patients referred for LVAD implant at baseline and with serial echocardiograms after LVAD implant (Jarvik 2000). In a subgroup of patients an additional intermediate echo evaluation, after intra-aortic balloon pump (IABP) implant, was performed. All echocardiographic images were analyzed off-line to calculate the free wall RV longitudinal strain (RVLS). **Results:** All patients, except two, which presented the lowest RVLS values at baseline, showed a progressive increase of RVLS after LVAD implant. Analyzing five patients undergone to IABP as an intermediate step, it was clear that only patients that presented an increase of RVLS after IABP implant, showed progressive increase of RVLS levels after LVAD implant. Three patients, that did not experienced an increase of RVLS after IABP implant, presented a RV failure after LVAD implant. **Conclusions:** This new parameter of RV myocardial deformation, RVLS, may have interesting clinical implications for LVAD patients; it can be applied for evaluation of RV function before LVAD implant, to potentially help in decision-making about the management of this kind of patients, and after LVAD implant, for the follow-up of patients.



RV strain before and after LVAD implant

ASSESSMENT OF DIASTOLIC FUNCTION

P278

Atrial septal defect in adults: reasons for closure

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Doppler techniques are widely used for assessment of ventricular diastolic function. **Purpose:** The aim of the study was to evaluate the influence of atrial septal defect (ASD) closure in adults on left ventricular (LV) diastolic function assessed by conventional and tissue Doppler imaging.

Methods: Thirty consecutive patients with a history of ASD (77% type secundum, 10% type primum, 13% type sinus venosus) and 30 healthy controls matched by sex and age were involved in our research (43.3% M; mean age 36.2 ± 12.5 years). 23.3% pts had transcatheter ASD closure. All patients were observed before, a month and a year after closure. Conventional Doppler (pulsed and continual) and pulsed tissue Doppler imaging examination were performed in all patients before and after closure and in all control subjects. The parameters for LV diastolic function assessed by conventional Doppler examination were mitral diastolic flow peak velocity ratio (E/A) and mitral flow deceleration time (MF DT). The basal free LV wall was sampled. The parameters for LV diastolic function assessed by tissue Doppler examination were early and late myocardial peak diastolic velocity ratio (Em/Am ratio) and isovolumic relaxation time (IVRt). The ratio of early mitral diastolic flow peak velocity and early myocardial peak diastolic velocity (E/Em) was calculated as an index of LV filling pressure.

Results: In our study there was no significant difference between parameters obtained in patients before closure and control subjects (E/A, MF DT, Em/Am, IVRt, E/Em). We also didn't observe significant difference between these parameters obtained one month and one year after closure compared with controls and baseline (Table 1).

Conclusions: The presence of ASD in adults doesn't have influence on left ventricular diastolic function and filling pressure assessed by Doppler techniques. Closure preserves this function, immediately and one year after it.

Parameter	Control group	ASD Baseline	ASD 1 month after closure	ASD 1 year after closure	p
E/A	1.2 ± 0.5	1.3 ± 0.4	1.3 ± 0.5	1.2 ± 0.6	> .05
MF DT, ms	176 ± 44	167 ± 38	172 ± 41	171 ± 47	> .05
Em/Am	1.4 ± 0.4	1.5 ± 0.4	1.5 ± 0.3	1.4 ± 0.5	> .05
IVRt, ms	57 ± 22	64 ± 28	59 ± 25	58 ± 23	> .05
E/Em	5.1 ± 1.2	5.2 ± 1.4	5.2 ± 1.3	5.4 ± 1.2	> .05

P279

Impaired LV diastolic function in long term type 1 diabetes is associated with advanced glycation endproducts

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Purpose: The LV function in long term (40 years duration) type 1 diabetes without symptoms is not well known. Therefore we assessed LV systolic and diastolic function

in such a cohort, and studied if advanced glycation endproducts (AGE) were associated with these parameters. AGEs contribute in the development of diabetic vascular complications and have also been suggested as a mechanism for a specific diabetic cardiomyopathy.

Methods: 27 (54 ± 7 years) patients with type 1 diabetes of 40 ± 3 years duration from the cohort "Oslo study" underwent clinical examination, standard echocardiography and tissue velocity imaging (TVI), and were compared with 26 age and sex matched healthy controls (55 ± 6 years). LV ejection fraction (EF) were measured by two-dimensional (2D) echo and tricuspid annular systolic excursion (TAPSE) by M-mode as a measure for right heart systolic function. LV diastolic function was assessed by peak early (E) and atrial (A) diastolic transmitral velocities by pulsed Doppler, and TVI E' as an average of early diastolic septal and lateral TVI velocities. E/E' and E/A ratio were then calculated. Systolic S by TVI was measured at septum and lateral LV wall from four chamber view and averaged. All echocardiographic recordings were analyzed by the same investigator, who was blinded to the clinical status of the participants. The AGE modification methylglyoxal derived hydroimidazolone was analyzed in serum by immunoassay.

Results: There were no significant difference in age, body mass index, EF, TAPSE or systolic blood pressure between the diabetics and the controls, and the ECGs were normal in both groups. The diabetic patients had lower diastolic blood pressure and increased heart rate, 65 ± 8 vs 73 ± 9 mmHg (p < 0.01) and 76 ± 10 vs 67 ± 10 beats/min (p < 0.01), respectively. Systolic S was significantly lower in the diabetics compared to the controls, 6.9 ± 1.6 cm/s vs 7.9 ± 1.5 cm/s (p < 0.05), and transmitral E and E/E' were significant higher in the diabetics, 0.8 ± 0.1 m/s vs 0.7 ± 0.2 m/s (p < 0.01) and 7.2 ± 2 vs 6.0 ± 1.5 (p < 0.05), respectively. Hydroimidazolone (AGE) correlated significantly with E/E', R=0.45 (p < 0.05), but not with S.

Conclusion: The present study has demonstrated a reduced LV systolic function by TVI and increased E/E', which reflects increased LV filling pressures and thus LV diastolic dysfunction in this cohort of diabetics type I of 40 years duration compared to controls. The association between E/E' and methylglyoxal derived hydroimidazolone may suggest AGEs as a mechanism for the enhanced LV filling pressure in these patients-perhaps by inducing stiffening of LV connective tissue.

ISCHEMIC HEART DISEASE

P280

Transthoracic echocardiography for detection of coronary artery stenoses by use of coronary poststenotic diastolic to systolic velocity ratio in the left anterior descending and circumflex arteries

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Purpose: Recent reports have indicated that use of the diastolic to systolic flow velocity ratio (DSVR) measured by transthoracic Doppler echocardiography (TTE) in the distal left anterior descending coronary artery (LAD) is a simple noninvasive method for detecting coronary stenoses located more proximally in the LAD, with significant reduction of the diastolic relative to the systolic flow component when measured post-stenotically. However, various cut-off values for significant stenosis have been proposed, with peak DSVR (pDSVR) < 1.6 – 1.8 representing significant stenosis in different studies. To the best of our knowledge, there are no data on TTE DSVR measurements of the circumflex coronary artery (Cx). The purpose of this study was to evaluate by TTE the potential of DSVR measured in distal-to-mid LAD (dmLAD) and marginal branches of Cx (CxMb) for detecting coronary stenoses in the left main (LM), LAD and Cx arteries, compared with quantitative coronary angiography (QCA).

Methods: A total of 108 patients scheduled for coronary angiography because of chest pain or acute coronary syndrome were studied. When the relevant coronary segment was identified with antegrade flow, the pDSVR was measured in dmLAD and CxMb. Peak DSVR results were compared with results from QCA, with stenosis severity in the LM/LAD and LM/Cx divided into 2 groups: (1) diameter stenosis 0-49%; (2) diameter stenosis 50-100%. Each main coronary artery could have more than one stenosis, with the most tight stenosis defining the degree of stenosis.

Results: Peak DSVR was successfully measured in dmLAD and CxMb in 83% and 31% of patients, respectively. Among coronary arteries with DSVR measurements, QCA identified 34 group 2 stenoses in LAD and 5 group 2 stenoses in Cx. Peak DSVR was significantly different between the groups, with pDSVR 1.90 ± 0.31 in group 1 and 1.50 ± 0.16 in group 2 (p < 0.001). ROC analysis showed that a pDSVR cut-off value of 1.68 had specificity of 90 % and sensitivity of 84 % for detection of group 2 stenoses. Excluding the Cx, the same pDSVR cut-off value had specificity of 91 % and sensitivity of 86 % for detection of group 2 stenoses in LAD.

Conclusions: DSVR measurements in dmLAD were feasible in the majority of patients and in CxMb in 1/3 of patients. The ROC analysis showed that a pDSVR cut-off value of 1.68 had high precision for identifying significant stenoses in LAD and Cx, defined as diameter stenosis 50-100%. (ClinicalTrials.gov number NTC00281346.)

P281

Lipoprotein-phospholipase A2 is associated with abnormal digital reactive hyperemia and impaired coronary flow reserve in patients with stable CAD

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Lipoprotein phospholipase A2 (Lp-PLA2) is an emerging inflammatory marker with prognostic value. Reactive hyperemia peripheral arterial tonometry (RH-PAT) is a method to assess peripheral microvascular endothelial function and is linked to coronary microvascular endothelial dysfunction. We investigated the association of Lp-PLA2 with RH-PAT, coronary flow reserve (CFR), and carotid intima media thickness in CAD patients

Methods: Using RH-PAT, digital pulse volume changes during reactive hyperemia were assessed in 43 patients with angiographically documented CAD. RH-PAT index, a measure of reactive hyperemia, was calculated as the ratio of the digital pulse volume during reactive hyperemia divided by that at baseline using the Endo-PAT apparatus. Coronary flow reserve (CFR) of the LAD after adenosine infusion was assessed using Doppler echocardiography. The mean intima-media thickness (IMT) in common carotids and carotid bulbs using ultrasound imaging was also measured. According to the values of the 25th percentile of CFR, RH-PAT and IMT, patients were categorised in to those with CFR <2.1, RH-PAT index <1.4, or IMT >0.9 mm

Results: Increasing levels of Lp-PLA2 were related with smoking, decreasing CFR, decreasing RH-PAT index and increasing IMT values ($r=0.41$, $r=-0.39$, $r=-0.45$ and $r=0.38$ respectively, $p<0.05$). Lp-PLA2 was higher in patients with CFR <2.1 than in those with CFR >2.1 (169 ± 48 vs. 117 ± 24 ng/ml, $p=0.003$), in patients with RH-PAT index <1.4 than in those with RH-PAT >1.4 (144 ± 40 vs. 115 ± 29 ng/ml, $p=0.02$) and in patients with IMT >0.9mm than in those with IMT <0.9mm (138 ± 36 vs. 97 ± 40 ng/ml, $p=0.015$)

Conclusions: Increasing levels of Lp-PLA2 are related to endothelial dysfunction, impaired CFR and evidence of carotid atherosclerosis suggesting a potential role for Lp-PLA2 to identify stable CAD patients with adverse prognosis.

P282

Duration of myocardial systolic lengthening at rest predicts the presence of significant coronary artery disease

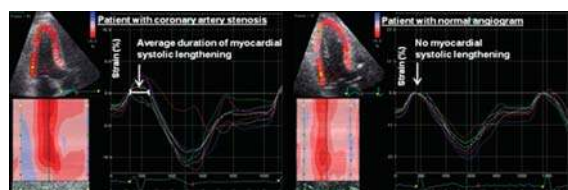
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Purpose: Ischemic myocardium with reduced active force will lengthen when left ventricular (LV) pressure is rising during early systole before onset of systolic shortening. The object of this study was to investigate whether the duration of LV systolic lengthening measured by two dimensional speckle tracking echocardiography (2D-STE) at rest could accurately identify patients with significant coronary artery disease (CAD).

Methods: We included 65 patients with suspected CAD referred to an elective diagnostic coronary angiography. None of these patients had a previous history of overt myocardial infarction. 2D-STE was performed before angiography. Global longitudinal strain and duration of LV systolic lengthening were recorded in 3 apical long-axis recordings and averaged from 16 LV segments (Figure).

Results: Of the 65 patients, there were 26 with significant CAD defined as $\geq 50\%$ diameter stenosis in any coronary artery. The duration of systolic lengthening was significantly prolonged in patients with CAD as compared with patients without significant coronary artery stenoses (84 ± 41 ms vs. 38 ± 24 ms, $P<0.001$). Correspondingly, global systolic longitudinal strain was significantly lower in patients with CAD ($-17.7 \pm 3.2\%$ vs. $-19.6 \pm 2.6\%$, $P=0.01$).

Conclusions: Duration of myocardial systolic lengthening was prolonged in patients with significant coronary artery stenoses and might be a useful tool to identify these patients. Our results indicate that patients with significant CAD have myocardial segments with reduced active force also at rest.



P283

Global 3D circumferential strain is related to infarct size and transmural extent of myocardial necrosis in patients with successfully reperfused STEMI

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Infarct size represents a powerful predictor of mortality and adverse events. The ability of 3D speckle-tracking to estimate infarct size in STEMI was not explored.

Methods: 49 pts (age 60 ± 15) with a first recent STEMI (8 ± 3 days) successfully reperfused by primary PCI were studied. Peak global 2D longitudinal strain (LS) from 3 apical views (68 ± 9 fps) and 3D LS, circumferential (CS), radial (RS) and area strain (AS) from 4-beat LV data sets (30 ± 3 vps) were measured. Infarct size was estimated by peak cTnI levels in all pts. In 27 pts, delayed-enhancement MRI (DE-MRI) was performed within 24h from echo study. Transmural extent of necrosis (% DE) was

measured and infarct size index (ISI, %) was calculated as the sum of %DE for all LV segments divided by 17.

Results: Peak cTnI (mean $162 \mu\text{g/L}$, range 2.0-916) was correlated with 2D LS and all 3D strains, as well as with 3D LV volumes and ejection fraction (Table). At multivariable analysis, only CS emerged as significant independent predictor of infarct size (β 0.584, $p<0.001$). In MRI pts, CS showed the closest correlation with ISI among all strains ($r=0.716$, $p<0.001$) and the best discriminative power to predict the extent of necrosis transmurally at DE-MRI (F ANOVA 82.1, $p<0.0001$). In 20 pts, intraclass correlation coefficient for 3D CS was 0.98 for intra- and 0.95 for interobserver reproducibility.

Conclusion: In STEMI pts, 3D CS showed good reproducibility and accuracy for infarct size estimation in comparison with DE-MRI and cTnI, being superior than 2D and 3D LS. This is the first study demonstrating that 3D CS may be used as an objective marker of infarct size and necrosis transmurally at bedside.

Correlates of peak cTnI level.

Parameter	Bivariate analysis	
	r (Pearson)	p
3D global LS (%)	0.35	0.014
3D global CS (%)	0.48	<0.001
3D global RS (%)	-0.45	0.001
3D global AS (%)	0.48	0.001
3D EDV (mL ²)	0.33	0.019
3D ESV (mL/m ²)	0.45	0.001
3D EF (%)	-0.43	0.002
2D global LS (%)	0.50	<0.001

P284

Coronary flow analysis after acute myocardial infarction: are there differences in conventional echocardiographic parameters in patients with microvascular dysfunction?

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Background: Assessment of distal left anterior descending coronary artery (LAD) flow after reperfused acute myocardial infarction (AMI) may provide important insights in myocardial reperfusion assessment and microcirculatory dysfunction. However, its relation to other echocardiographic parameters describing left ventricular (LV) function after AMI is not well established.

Aim: To evaluate LAD flow pattern after reperfused AMI and to analyze its relation with other echocardiographic parameters.

Methods: 53 patients (pts) without known coronary artery disease (CAD), 42 men, $m=58.5 \pm 13.1$ y, with ST-elevation AMI submitted to primary percutaneous coronary intervention (PCI) 9.8 ± 14.3 hours after the beginning of symptoms. Fibrinolytic therapy was administered in 4pts before PCI and percutaneous thrombus aspiration was achieved in 18pts. A complete transthoracic echocardiogram with LAD flow evaluation was performed between the second and fifth day ($m=3.6 \pm 1.9$ days) after the PCI. We evaluated demographic, clinical, angio and echocardiographic parameters [right and left ventricular (LV) function, LV deformation and volumes, filling patterns] between two groups: LAD deceleration time below and above 600ms (A and B respectively), the accepted cut-off value defining microvascular obstruction after recanalization. Therapeutic strategies were compared. We also assessed cardiovascular outcomes between both groups at 18.1 ± 11.2 months of follow-up after the event.

Results: 37pts (69.8%) had LAD criteria for microvascular dysfunction after PCI (mean deceleration time= $266.6 \pm$ ms, peak flow velocity 42.1 ± 22.9 m/s and coronary flow systolic inversion in 4pts). In this group of pts, LV ejection fraction was significantly depressed as compared to group B (85.7% with LV ejection fraction <50% vs. none; $p=0.001$). We also found significant differences in the wall motion score index (1.77 ± 0.23 vs. 1.55 ± 0.33 ; $p=0.008$), global longitudinal strain ($-10.41 \pm 2.41\%$ vs. $-12.62 \pm 3.23\%$; $p=0.032$) and E wave deceleration time (166.6 ± 44.2 vs. 206.9 ± 56.2 ; $p=0.018$). Neither fibrinolytic therapy nor thrombectomy and time to PCI were different among the groups. Cardiovascular outcome was also not different among.

Conclusion: In these patients with AMI, microvascular dysfunction as assessed by non-invasive coronary flow pattern was associated with several criteria of worse LV performance.

P285

Left atrial strain may predict LV remodeling in patients after acute myocardial infarction

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Background: Recently echocardiographic strain imaging has been proposed as a novel approach for the assessment of cardiac function after acute myocardial infarction (AMI).

Purpose: The aim of our study was to evaluate contraction of the left atrium (LA) using speckle tracking echocardiography (STE) technique in patients with AMI and to define the feasibility of this method in AMI patients with LV remodeling.

Methods: A total of 136 patients (mean age 57.2 ± 9.8) with a first AMI and 36 controls (mean age 60.8 ± 10.2) were enrolled into the study. All of them underwent an echocardiographic investigation with STE for evaluation of LA strain. AMI patients were examined within 24-72 hours of the onset of AMI symptoms and in 4 months after AMI. 46 (33.8%) patients with LV remodeling were identified where LV remodeling was defined as a 15% increase from the baseline in LV end diastolic volume.

Results: Conventional atrial measurements such as LA diameter, LA volume and LA volume index did not differ between the AMI patients and controls. LA peak systolic strain was markedly impaired in AMI patients (27.5 ± 9.1% vs. 36.7 ± 6.5%, p < 0.001). LA peak systolic strain was evaluated in AMI patients with LV remodeling and without LV remodeling. Both groups had comparable baseline clinical and echocardiographic characteristics, except for predominating anterior wall MI (p < 0.01), higher leukocyte count value at admission (p < 0.01), lower ejection fraction (p < 0.05) and increased end systolic volume (p < 0.05). LA peak systolic strain was lower in patients with LV remodeling if compare to non-LV remodeling patients (21.8 ± 7.4% vs. 29.5 ± 8.8, p < 0.05) while LA diameter and LA volume did not have significant differences between the two groups at the baseline. Logistic regression analysis showed that LV ejection fraction (O.R. 0.9; 95% CI 0.84-0.99, p < 0.05) and atrial peak systolic strain (O.R. 0.8; 95% CI 0.83-0.97, p < 0.01) were independent determinants of LV remodeling after AMI.

Conclusions: Our study demonstrates that STE is a promising non-invasive technique to assess LA atrial function in patients with AMI and may have an impact on LV remodeling prediction.

P286

Ischemic right ventricular dysfunction predicts lower exercise capacity in patients after myocardial infarction.

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Background: Right ventricular (RV) systolic myocardial velocity (SmRV) was shown to be an indicator of RV systolic function. RV dysfunction causes worsening of exercise capacity (EC) in patients with chronic heart failure but data on impact of RV function on EC in patients after inferior myocardial infarction (MI) with preserved left ventricle (LV) EF are scarce.

Aim: To assess EC in patients with RV dysfunction complicating inferior MI in comparison to patients without RV dysfunction.

Methods: We evaluated prospectively patients with first inferior MI with ST segment elevation treated by primary percutaneous coronary intervention (pPCI) and preserved or mildly impaired LV systolic function (EF LV ≥ 45%). ECHO was performed post pPCI within 48 hours from the onset of symptoms. RV systolic dysfunction was defined as SmRV < 11.5 cm/s at the basal segment of RV free wall in pulse wave Tissue Doppler Echocardiography (TDE). Cardiopulmonary exercise test (CPET) was done on day 14 ± 10. Oxygen uptake at peak exercise (VO2peak) and at anaerobic threshold (VO2-AT) and percent of predicted values (%) were assessed as EC parameters.

Results: Patients (n=90, 75.5% males, mean age 60.5 ± 10 years) were divided into two groups: the group with RV systolic dysfunction (n=49, 77% males, mean age 60.4 ± 9.1 years) and the group without RV dysfunction (n=41, 80% males, mean age 60 ± 9 years). The group with RV dysfunction has a significant lower EC measured as percent of predicted values of VO2max (Table). LV systolic parameters and maximal troponin level have no impact on EC.

Conclusion: RV systolic dysfunction assessed with TDE in patients after acute inferior MI, correlates well with other RV systolic parameters and has a significant impact on exercise capacity estimated with cardiopulmonary stress test.

Exercise capacity	The group with RV dysfunction N=49	The group without RV dysfunction N=41	P=
VO2peak/VO2maxpred. L/min[%]	71.2 ± 11.9	82.9 ± 16	0,0001
VO2-AT/VO2maxpred. L/min[%]	60,6 ± 10,9	68,7 ± 16,9	0,0073
VO2peak/VO2maxpred. ml/kg/min[%]	62,4 ± 14,3	74,3 ± 21,5	0,0023
VO2-AT/VO2maxpred. ml/kg/min[%]	53 ± 12	61,4 ± 19	0,0125

P287

Early prediction of infarct size after primary PCI by left ventricular rotation and longitudinal mechanics - which parameter is the best?

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Background: Assessment of myocardial deformation after reperfusion in acute myocardial infarction was shown to predict LV remodeling, functional recovery of myocardium within infarct zone and is closely related to the transmural extent of the infarction. Nevertheless, power of early strain, strain rate and especially LV rotation to predict final infarct size is still challenging.

Aim: examine whether longitudinal global and segmental myocardial deformation and LV rotation assessed 48h after primary PCI can predict final infarct size estimated by SPECT one month later.

Methods: 29 patients with first anterior myocardial infarction successfully treated with primary PCI were examined 48h after primary PCI. Transthoracic echocardiography was done using Syngo US workplace. Systolic and peak strain, systolic and diastolic strain rates (SR S; SR E and SR A) were measured as indices of longitudinal LV function in apical 4-, 2- and 3 chamber views. Global and territorial (for LAD territory) strain and strain rates were calculated. Rotations of LV base and apex were measured (rotation angle and rotation velocities), LV twist and LV torsion were calculated. SPECT imaging with 99mTc-MIBI was done a month after index event and defect in myocardial perfusion measured as percent of the total myocardial surface.

Results: both global and territorial peak strains were closely related to SPET perfusion defect (r = - 0.68, p=0.001 and r=- 0.76, p=0.004). Global and territorial systolic SR correlated well with SPET perfusion defect (r=-0.59, p=0.007 and r=-0.68, p=0.022), whereas global SR-E showed less strong correlation (r= 0.42, p=0.05). The strongest correlation SPET perfusion defect had with apical rotation angle (r= -0.80, p<0.001), LV twist (r=- 0.77, p<0.001) and LV torsion (r=- 0.74, p<0.001). In multivariate logistic regression analysis that includes global peak longitudinal strain, global SR S, LV EF 48h after the primary PCI, peak CK-Mb mass and LV apical rotation angle, LV apical rotation angle (beta=-0.615, p=0.012) and peak CK-Mb mass (beta=0.365, p=0.013) were independent predictors of infarct size.

Conclusion: LV apical rotation, as well as territorial and global longitudinal strain and strain rates 48h after reperfusion therapy in patients with first anterior myocardial infarction well correlate with size of infarction as determined by SPECT a month later. The best correlation had LV apical rotation. These parameters could be of clinical value for risk stratification early after myocardial infarction.

P288

Assessment of the influence of hibernated myocardium on left ventricular function and clinical improvement in patients with ischemic heart failure and coronary artery bypass revascularization

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Aims: The aim of the study was assessment of the influence of viable myocardium on left ventricular function and clinical improvement in patients (pts) with severe ischemic heart failure referred for coronary artery bypass surgery (CABG).

Materials and methods: We have evaluated 85 pts, age 66+/-5, with ischemic heart failure (LV ejection fraction <35%) referred for myocardial viability assessment before CABG. Evaluation of left ventricular function was performed with echocardiography and rest/nitrate myocardial perfusion imaging (MPI) with Tc-99m sestamibi Gated SPECT before and 10+/-3 months after CABG. Control MPI and echocardiography study were used for assessment of LVEF, LV regional and global function, SPECT myocardial perfusion and MPI wall motion index. MPI images were read using 17-segment analysis, with Bull's eye quantitative analysis. Postoperative improvement in LVEF >5% was considered significant.

Results: Patients with viable myocardium in >4 segments of LV assessed by MPI (n= 46) had improvement in regional and global function and also in LV geometry (shape and size) on both MPI and echocardiography, which was incremental to the improvement in LV function. They demonstrated improvement of LVEF at 12 months after CABG (from 32 ± 5 to 43 ± 7%, P<0.001), with reverse remodelling (LV ESV decreased from 145+/-32 to 89+/-21ml, P<0.001; LV EDV decreased from 254 ± 23 to 188 ± 17 ml, P<0.001), and improved in NYHA class with average one grade. Complete revascularization of viable segments improve regional perfusion and function (WMI index decreased from 3.4+/-0.6 to 2.3+/-0.3, P<0.001), that had contributed for global LV function improvement. Conversely, patients with <4 jeopardized segments on MPI (n=39) failed to improve in LVEF (32 ± 4 vs. 30 ± 5%, NS), and exhibited ongoing remodelling (LV ESV increased from 122+/-21 to 153 ± 19 ml P<0.001; LV EDV increased from 277 ± 21 to 318 ± 25 ml, P<0.001), without improvement in NYHA class in 9 pts (23%). Ongoing remodeling and failed improvement in LVEF after CABG was also find in patients with large non viable areas (>20% of myocardium). Pts with improved LVEF after CABG also had improved quality of life.

Conclusion: Revascularization of viable myocardium in ischemic heart failure can improve regional and global LV function, and LV geometry. Improvement in LV geometry contributes to better LV systolic function, which is predictor of clinical improvement after revascularization. Non-invasive assessment with echocardiography and MPI before revascularization can predict postoperative improvement of LV function in high risk patients with severe ischemic heart failure.

HEART VALVES

P289

Feasibility and accuracy of 3DTEE vs computed tomography in evaluation of aortic valve annulus to left main ostium in patients candidates to percutaneous aortic valve implantation.

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Purpose: Percutaneous aortic valve implantation (AVI) has become a valid alternative to conventional surgery in selected high-risk patients (pts), however some major complications have been reported including coronary ostia impairment due to the presence of low coronary ostia and the occluding effect of aortic leaflets displacement by prosthetic implantation. Moreover a reduction of the distance between aortic valve annulus and left main coronary artery ostium (AN-LM) has been demonstrated due to remodeling of the aortic root in calcific aortic stenosis. Therefore a careful preoperative evaluation of AN-LM is necessary and it is usually obtained by computed tomography (CT), the gold standard in this context, but cannot be accurately performed in arrhythmic pts. In the AVI pts management, 3DTEE is known to be very useful. Aim of our study was to analyze the feasibility of AN-LM 3DTEE evaluation and its accuracy compared with CT values.

Methods: In 103 pts with aortic valve stenosis candidate to AVI, 3DTEE and CT AN-LM measurements were obtained and compared. Inter and intra-observer variability were calculated. Max (D1) and min (D2) AN diameters were also evaluated. AN-LM 3DTEE measurements were calculated by 3D analysis software (Figure).

Results: In all pts, 3DTEE was obtained and left main ostium visualized. 3DTEE (13.6 ± 2.2 mm) and CT (13.9 ± 2 mm) AN-LM strictly correlated ($r=0.82$, $p<0.001$, bias -0.3 , LOA 2.7). No significant differences were observed between 3DTEE and CT D2 (21.4 ± 2.0 vs 21.2 ± 2.3 mm) and D1 (24.5 ± 2.3 vs 25.4 ± 2.7 mm). Inter and intra-observer variability in AN-LM 3DTEE measurements (30pts) were respectively 2.6% and 1.9%.

Conclusions: evaluation of AN-LM by 3DTEE was feasible and accurate and may be a valid alternative to CT in cases with inability or contraindication to obtain CT data.

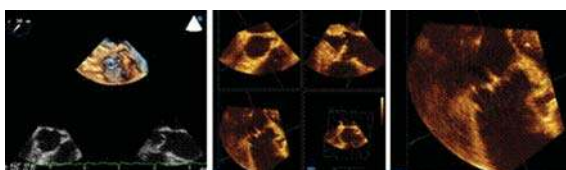


Figure 1

P290

Prognostic significance of valvulo-arterial impedance and left ventricular longitudinal function in asymptomatic severe aortic stenosis

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Purpose: To evaluate the role of left ventricular (LV) global afterload and various echocardiographic parameters of systolic function in a prospective cohort of 52 asymptomatic patients (pts) with severe aortic stenosis (indexed aortic valve area: 0.4 ± 0.1 cm²/m²) and normal LV ejection fraction (EF= $61 \pm 5\%$).

Methods: By 2D Speckle Tracking Echocardiography, myocardial strain, rotations and twist were evaluated. The valvulo-arterial impedance (Zva) was calculated, as a measure of LV global afterload. Predefined end-points were the occurrence of symptoms (dyspnea, angina, syncope), aortic valve replacement or death.

Results: At study entry, all pts had decreased longitudinal strain (LS= $-15 \pm 4\%$) and increased circumferential strain (CS= $-22 \pm 5\%$), twist ($24 \pm 7^\circ$) and Zva (5.8 ± 2 mmHg/ml/m²). Increased Zva was closely associated with CS increase ($r=0.59$, $p=0.02$) and LS decrease ($r=-0.56$, $p=0.016$). Whereas no relationship was found between myocardial function and trans-aortic gradients. During follow-up (11 ± 7.5 months, range 1- 23 months), in univariable Cox regression analysis, predictors of events were: LVEF ($p=0.02$), mass index ($p=0.01$), LS ($p<0.0001$), radial strain (0.04) and Zva ($p=0.0002$). In multivariable Cox regression analysis, only global LS (HR 95% CI 1.41 (1.01 to 1.95, $p=0.03$) and Zva (HR 95% CI 2.78 (1.09 to 7.08, $p=0.03$) were independently associated with the combined end-point. Using receiver-operator characteristic curve analysis, a LS $\leq -18\%$ (sensitivity=96%, specificity=73%) and a Zva ≥ 4.7 mmHg/ml/m² (sensitivity=100%, specificity=91%) were identified as the best cut-off values to be associated with events.

Conclusions: Prognosis of pts with aortic stenosis may depend not only on valvular load but also on arterial load imposed on the ventricle and its consequences on longitudinal function.

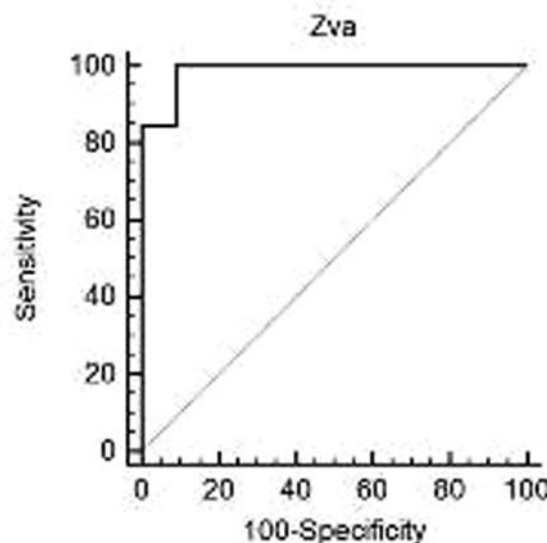


Figure 1

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3D imaging reveals an oval LVOT, leading to underestimation of LVOT and aortic valve area by 15% on average, when using 2D echocardiography

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Background: Measurement of left ventricular outflow tract area (LVOTa) for estimation of aortic valve area (AVA) and for transcatheter aortic valve implantation (TAVI) using transthoracic 2D echocardiography (2DE) and the continuity equation assumes a round shape for the LVOT. The aim of this study was to determine the effect of direct measurement of LVOTa using cardiac computed tomography angiography (CCTA) and 3D echocardiography (3DE) on LVOTa and AVA estimation.

Methods: We prospectively studied 50 patients (age 68 ± 12 y, 24 males, 25 with aortic stenosis (AS) and 25 without AS). LVOTa and AVA were estimated using 2DE and the continuity equation ($\text{Pai} \times \text{sqr}(\text{LVOTd}^2/2)$ assuming a circular LVOT). LVOTa and diameters (D1 & D2) were measured using retrospective gated 128 slice CCTA and 3DE. AVA was also planimetered using CCTA in mid systole. LVOTa and AVA estimated by 2DE were correlated with 3DE and CCTA measurements.

Results: LVOT was usually oval and not circular, with an eccentricity index (D2/D1) of 1.24 ± 0.10 for CCTA and 1.18 ± 0.1 for 3DE. There was good correlation between 2DE and CCTA for LVOTa ($r=0.84$) but 2DE systematically underestimated LVOTa (and therefore AVA) by $15 \pm 16\%$ (AS vs. no AS $p=0.8$). The correlation between CCTA and 3DE for LVOTa was only moderate ($r=0.72$), due to inadequate 3DE image quality. AVA was 0.92 ± 0.44 cm² by 2DE and 1.15 ± 0.72 cm² by CCTA ($p=0.003$). There was good correlation between 2DE and CCTA for AVA ($r=0.94$), but 2DE underestimated AVA by $13 \pm 19\%$ compared to CCTA. After correcting 2DE determined AVA by a factor of 1.15 (accounting for the elliptical LVOTa), the difference was only $-0.3 \pm 22\%$.

Conclusions: 3D imaging revealed an oval LVOT in most patients, resulting in underestimation of LVOTa and AVA by 15% using 2DE. This accounted for the difference in AVA between 2DE and CCTA. Current 3D TTE image quality is inadequate to accurately determine LVOTa. These findings carry important implications for selecting AS patients for surgery or TAVI.

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Transcatheter aortic valve implantation : our experience at three years of follow-up.

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Purpose: Transcatheter aortic valve implantation (TAVI) is an emerging technique in the treatment of symptomatic patients with severe aortic stenosis and contraindications to surgery. Transthoracic echocardiography plays an essential role for the proper selection of candidates for TAVI. Echocardiographic follow-up is also essential for determining performance of the prosthesis and hemodynamic changes over time. We report our echocardiographic experience of the early 30 patients who underwent successful transcatheter aortic valve implantation at three years of follow-up.

Methods: From July 2007 to March 2011, 184 patients (76 male, mean age 81 ± 5 years) with contraindications to surgery (mean logistic Euro-score 22 ± 14) who underwent TAVI, were evaluated by clinical and echocardiography follow-up at 24 hours, 1 month, six months, one, two and three years after the procedure. Left

ventricular function, transaortic pressure gradient, aortic valve area and aortic regurgitation were assessed.

Results: Median echocardiographic follow-up was 32 ± 3 months. Procedural success was of 95.7%. We reported one intra-procedural death (0.7%). Pre-procedural aortic valve area was 0.59 ± 0.2 cm², transaortic peak pressure gradient and mean pressure gradient averaged 89 ± 26 mmHg and 56 ± 26 mmHg respectively. Ejection fraction was $52\% \pm 10\%$. At 3 years of follow-up survival was 71%. After the procedure, 91% of patients had an improvement in NYHA functional class, aortic valve area significantly increased and both peak and mean transaortic pressure gradients decreased ($P < .0001$ and $P < .0001$, respectively). Improvement was stable at follow-up. At 1- and 3- years follow-ups, patients showed no severe degree of aortic regurgitation. Paraprothetic leaks were detected in 98% of cases, but only two of these resulted in significant paravalvular AR. Post-procedural paraprothetic regurgitation was trivial or mild in severity in 68%, moderate in 30% and severe in 2% of cases. No residual regurgitation worsened during 3-years follow-up, in contrast AR reduced of one degree in 9.7% of cases at the follow-up. This reduction occurred mainly after six months-1 year from TAVI.

Conclusions: Transcatheter aortic valve implantation shows good long term durability. Echocardiography at three years demonstrates correct prosthesis positioning and function after percutaneous aortic implantation. The procedure can offer an adequate solution in selected patients with aortic stenosis.

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2D strain analysis under dobutamine provocation in patients with moderate and severe aortic stenosis and nonobstructive coronary arteries

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Purpose: When in patients with aortic stenosis (AS) left ventricle (LV) systolic dysfunction does occur, it may be reversible after valve replacement. Thus early detection of LV systolic dysfunction could be clue for surgery treatment. Therefore, we evaluated LV peak global longitudinal strain using speckle tracking imaging (ST) at rest and during low-dose dobutamine provocation in asymptomatic patients with moderate and severe AS and preserved LV ejection fraction (EF).

Method: Peak global longitudinal 2D strain was measured from acquired apical 4ch and 2ch cine loops using EchoPac PC-workstation at rest and during 5, 10, and 20 μ g/kg/min dobutamine provocation, respectively. The global strain was the average of the segment strains from the apical views. For each measurement, at least two cardiac cycles were averaged.

The image acquisition frame rate was 60-90Hz, mean value 75Hz.

Results: A total of 62 patients with moderate and severe AS (average aortic valve area (AVA) $<= 1.5$ cm²), mean age 66.12 ± 9.91 ; (57.14% males), were enrolled in this prospective study. All patients underwent coronary angiography and had no obstructive coronary disease (defined as having no stenosis greater than 50% in diameter). At rest, average AVA was 0.83 ± 0.23 cm², mean gradient (Pmean) was 43.57 ± 0.29 mmHg and mean EF was $72.24 \pm 0.45\%$. Peak global strain 4ch at rest was -10.4% with increase during maximal DS of 20 μ g/kg/min to -11.5% and in 2ch view from -8.9% to -9.8%, $p=ns$. Heart rate was increasing in correlation with increasing dobutamine doses from 70 ± 5.03 at rest to 84 ± 13.2 at peak dobutamine, $p=ns$. In patients with severe AS (Pmean >40 mmHg) global strain increased from $-9.2 \pm 4.4\%$ to $-12 \pm 4.5\%$ ($p<0.05$), while in patients with moderate AS global strain increased from $-10.3 \pm 7.0\%$ to $-11.7 \pm 4.3\%$, $p=ns$.

Conclusion: 2D strain speckle tracking analysis of myocardial deformation with measurement of peak systolic strain during dobutamine provocation is feasible and accurate method to determine myocardial systolic function and contractile reserve and may contribute to clinical decision making in management of patient with significant AS. However, decrease of LV systolic function in AS cannot be simply related to the severity of valve obstruction and needs to be evaluated in comparison with healthy control groups.

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Blood pressure impact on aortic stenosis severity evaluation in everyday clinical practice

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Purpose: Aortic stenosis (AS) is frequently associated with hypertension but its real impact on AS severity evaluation is not clear. However guidelines recommends reporting blood pressure to allow comparison between serial echocardiographic studies. The aim of this study was to assess the impact of blood pressure on parameters of AS severity during a single echocardiography.

Methods: Brachial blood pressure was measured at the beginning and at the end of a transthoracic echocardiography for 30 consecutive patients referred for aortic stenosis evaluation. Aortic continuous-wave and pulsed-wave Doppler were acquired at both time in order to measure off-line maximum velocity, mean gradient and valve area.

Results: Systolic blood pressure significantly decreased between the beginning and the end of the examination ($p<0.001$). Mean transvalvular gradient, maximum velocity and stroke work loss increased ($p<0.01$). On the contrary, effective orifice area decreased ($p<0.001$). Cardiac output did not change. Systolic blood pressure was

correlated with effective orifice area ($r=0.51$, $p<0.01$) and was inversely correlated with maximum velocity ($r=-0.47$, $p<0.05$). Seven patients crossed a threshold value which made AS change of classification : 3 patients turned from sclerosis to mild AS, 1 from mild to moderate AS and 3 from moderate to severe AS. No patient crossed a threshold value making AS appearing less severe.

Conclusion: Blood pressure variation during echocardiographic examination has an impact on AS severity, which appears to be more severe at the end of the examination. One should take care to have optimal blood pressure conditions when acquiring doppler measurements for evaluation of AS severity, thus allowing a more reliable assessment.

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Surprising secular increasing mortality of asymptomatic aortic stenosis

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Introduction: The guidelines that asymptomatic severe Aortic Stenosis (AS) has low mortality and therefore should be managed conservatively have recently been challenged. We assessed whether mortality has changed over the decades.

Method: We analysed all published data on the follow up of patients with asymptomatic aortic stenosis from 1960 to 2010. We calculated five-year mortality figures for each study from the Kaplan-Meier curves and produced weighted averages for each decade using the mid-recruitment point from each study for time-stratification.

Results: 7 studies incorporating 1359 patients were identified. 5 year mortality was significantly correlated with decade ($r^2=0.91$, $p<0.01$). Mid-recruitment point was not correlated with mean age ($r^2=0.417$, $p=0.12$), average length of follow up ($r^2=0.06$, $p=0.15$) or, if given, the presence of coronary disease ($r^2=0.04$, $p=0.67$), LVH ($r^2=0.36$, $p=0.15$) or ejection fraction ($r^2=0.04$, $p=0.67$).

Conclusion: The published mortality of patients with severe asymptomatic aortic stenosis managed conservatively has increased over the decades from the 1970's to the 2000's. This increase is not adequately explained by ageing of the population and is in contrast to decreases in other cardiovascular diseases.

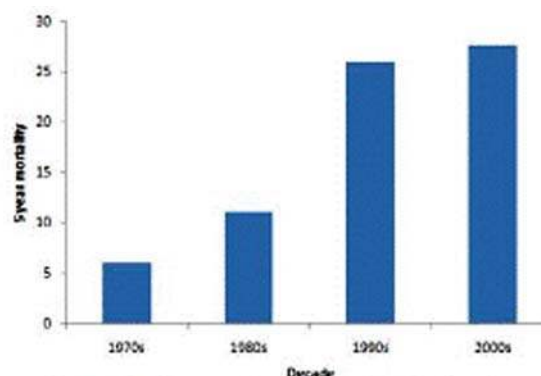


Fig1. Mortality of asymptomatic aortic stenosis weighted by patient numbers for each decade stratified by mid-point of recruitment

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Arterial stiffness relates to heart failure symptoms in patients with severe aortic stenosis and preserved ejection fraction

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Background: In patients with severe aortic stenosis (AS) the development of symptoms plays an important role in clinical decision making. The occurrence of heart failure (HF) symptoms could be unpredictable, even in patients with normal left ventricular (LV) ejection fraction, and regardless of AS severity. The double load (valvular and vascular) imposed on the LV in AS leads to progressive LV remodeling and dysfunction and could be related to HF symptoms development.

Purpose: to assess the relation between arterial mechanical properties and the presence of HF symptoms in patients with severe AS and preserved LV ejection fraction.

Methods: A comprehensive echocardiogram was performed in 36 consecutive patients (73 ± 11 years, 20 men) with severe AS (aortic valve area, AVA = 0.47 ± 0.13 cm²) and preserved LV ejection fraction ($66 \pm 10\%$). Carotid stiffness index (beta) was measured by a real time echo-tracking system. Aortic beta index was calculated based on systolic and diastolic ascending aorta diameters and systolic and diastolic arterial blood pressure. Systemic arterial compliance (SAC) and

valvulo-arterial impedance (Zva) were also determined. Global longitudinal strain (GLS) was assessed from the apical views using a commercially available 2D Strain software. Patients were divided into two groups according to the presence (18 patients) or absence (18 patients) of HF symptoms.

Results: Carotid beta index (11.9 ± 4.4) was significantly correlated with aortic beta index (13.5 ± 6.3) ($r=0.78$, $p<0.001$) and SAC ($r=-0.37$, $p=0.03$) but not with Zva or AS severity indices ($p>0.05$ for all). Symptomatic patients were older (79 ± 8 years vs 67 ± 11 years, $p=0.001$), had higher values for carotid beta index ($p=0.004$), aortic beta index ($p=0.01$), LV mass index ($p=0.003$), E/E' ($p=0.003$) and logBNP ($p=0.01$) and lower values for GLS ($p=0.001$) than asymptomatic patients. There were no significant differences between groups with respect to AS severity indices, Zva or SAC. Receiver operating characteristic curve analysis confirmed that carotid beta index, E/E', GLS and logBNP, all provide incremental information (area under the curve = 0.75, 0.81, 0.78, 0.76, $p<0.05$ for all) in distinguishing patients with HF symptoms.

Conclusion: In patients with severe AS and preserved LV ejection fraction, increased arterial stiffness correlates with HF symptoms. The automatic measurement of carotid beta index, using an echo-tracking system, could be an useful additional tool for identification and follow-up of patients at risk for HF symptoms development.

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Mitral valve remodelling caused by increased diastolic shear-stress mediated forces: observations in patients with a bicuspid aortic valve

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Background: Recent studies have shown that mitral valve leaflets enlarge as a response to increased systolic stress produced by subvalvular tenting. This adaptative mechanism is mediated by systolic leaflet stress and reduces the degree of functional mitral regurgitation. However, flow-mediated shear-stress is the most important hemodynamic force responsible for physiological development of most vascular structures. Eccentric aortic regurgitation in pts. with a bicuspid aortic valve BAV rises diastolic shear-stress on the anterior mitral leaflet during diastole and could be responsible for triggering leaflet remodeling.

Objective: We aimed to characterize mitral valve geometry in patients with (BAV) and without aortic regurgitation (AR).

Methods: 50 patients (43 ± 14 years old, 82% male) with BAV were studied. Mitral valve annular diameter (MAD), leaflet length and thickness, leaflet coaptation pattern (% of anterior leaflet projection onto the MAD), tenting area (area between leaflet and mitral annulus) and LV volumes were measured using 2D echocardiography. AR was graded as absent or nonsignificant (Group I), or moderate or severe (Group II), based on American Society Echocardiography guidelines.

Results: 19 patients had significant AR; these GII patients showed significantly higher values of anterior leaflet length compared with GI (4.6 ± 0.3 vs. 3.5 ± 0.5 cm $p<0.001$). This caused posterior displacement of the coaptation point (72 ± 6 vs. $59 \pm 12\%$, $p<0.001$). Valve thickness was not different between both groups. Despite larger LV volumes in GII (143 ± 60 vs 105 ± 35 ml, $p=0.01$), tethering forces were not higher (tenting area GI: 1.9 ± 0.2 vs GII: 1.01 ± 0.2 cm², $p=0.5$). In a multivariate linear regression analysis we observed an independent association between the grade of AR and the length of the anterior leaflet and not to the LV diastolic volumes.

Conclusion: Diastolic shear-stress on the mitral valve is associated with remodeling changes in mitral valve geometry. Diastolic jet impact seems responsible of anterior mitral length enlargement and posterior displacement of coaptation point. These changes in mitral valve geometry are independent of tethering forces. This hemodynamic mechanism and not intrinsic congenital abnormalities are most probably responsible for abnormal mitral structural findings frequently observed in patients with BAV.

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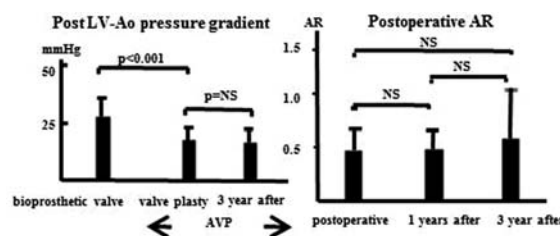
Mid-term outcome of aortic valve plasty utilizing an autologous pericardial patch in patients with severe aortic regurgitation

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Background: We previously reported our experience with an aortic valve plasty (AVP) technique for repairing a stenotic aortic valve. We investigated the feasibility of AVP in patients with aortic regurgitation (AR). Method: Ninety patients underwent aortic valve plasty using a pericardial patch. Patients characteristics of the patients were as follows: mean age; 68 ± 12 years; the left ventricular ejection fraction, $56 \pm 12\%$; and the left ventricular end-diastolic dimension, 58.1 ± 5.8 mm. Transesophageal and transthoracic echocardiography were performed up to three year after the operation.

Results: There was no postoperative AR in 81 patients and trivial postoperative AR in 9 patients. The peak systolic pressure gradient across the aortic valve was 14.5 ± 5.6 mm Hg after valve plasty. No patient underwent reoperation for any reason. Peak systolic gradient was significantly lower in aortic valve plasty group compared with aortic valve replacement group using bioprosthetic valve with or without stent (14.5 ± 5.6 vs 28.6 ± 10.2 , respectively, $p<0.001$). The peak systolic gradient was 13.0 ± 7.1 mm Hg after two year. Up to three years later, there was no significant increase in the peak

systolic gradient or significant worsening in AR (Figure). Conclusion: Aortic valve plasty using an autologous pericardial patch to treat aortic regurgitation is safe and feasible.



Aortic valve plasty follow up

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Patient-specific mitral valve model from 3D echocardiographic imaging: towards the virtual heart for surgery planning

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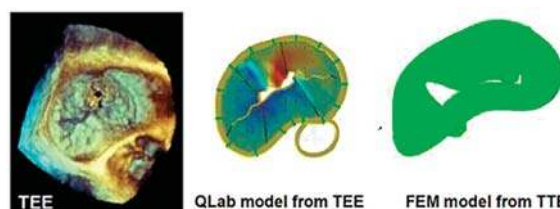
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Purpose: Finite element models (FEMs) represent an innovative approach for biomechanical analysis of cardiac structures. Our aim were to: 1) obtain a realistic FEM of the mitral valve (MV) by using mitral annulus (MA) and papillary muscles (PMs) patient-specific information from transthoracic (TTE) real-time 3D echocardiography (RT3DE), applying this strategy to 3 normals (NL) and 3 patients with organic MV prolapse (MVP); 2) test for differences in FEM quantitative parameters; 3) validate FEM morphology in MVP by comparison with transesophageal (TEE) RT3DE.

Methods: RT3DE (Philips) was performed via TTE in all subjects, and also by intraoperative TEE in MVP patients. The MA position was obtained frame-by-frame from TTE data, by custom 3D tracking, and integrated into patient-specific FEM, where time-dependent pressure up to 120 mmHg was applied on the leaflets to simulate closure. TEE data were separately analyzed (QLab, Philips) to obtain 3D MV reconstructions.

Results: Compared to NL, in MVP leaflets maximum principal stresses showed asymmetric distribution at systolic peak, larger in anterior MA and decreasing towards the free margin, with the most stress focused in fibrous trigones. Both PMs tension and MA reaction forces at trigones increased by 50% in MVP, consistent with abnormal anchorage associated to MV insufficiency. FEM morphology captured with good approximation the position and extent of regurgitant areas, compared to TEE data (Figure).

Conclusions: The adopted FEM strategy seemed flexible enough to reproduce different pathological scenarios and inter-subject variability, providing quantitative biomechanical parameters useful to interpret the effects of organic MV insufficiency. This approach represents the basis for the development of a patient-specific surgical planning tool.



Comparison of obtained model with TEE

P300

Ischemic mitral regurgitation in response to the increase of closing force in anterior and inferior myocardial infarction

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Purpose: This study was conducted to explore the role of closing force in the mechanism of ischemic mitral regurgitation (IMR) in anterior (ant) and inferior (inf) myocardial infarction (MI) through the low dose dobutamine echocardiography (LDSE).

Methods: Forty two patients (ant-MI: inf-MI=20:22, age=62 ± 14yrs) with significant (> grade1) IMR were enrolled and underwent LDSE (peak dose: 10µg/kg/min). Left ventricle end diastolic volume (LVEDV), end systolic volume (LVESV) and LV ejection fraction (LVEF) were calculated by the modified Simpson's method. The MR severity was defined by effective regurgitation orifice area (EROA) using conventional PISA method. Peak systolic trans-mitral valvular pressure gradient (trans-MV PG), reflecting

closing force of the mitral valve, was estimated by measuring peak velocity of MR jet. Mitral valve tenting area (MVTa) and tenting height (MVTh) were also measured. All variables were acquired before and after stress.

Results: In the baseline data, there were significant differences between ant and inf-MI in LVEDV (127 ± 42 vs. 85 ± 25ml, p=0.02), LVESV (79 ± 26 vs. 45 ± 15ml, p=0.03), LVEF (36 ± 5 vs. 45 ± 3%, p=0.01) MVTa (2.0 ± 0.5 vs. 1.2 ± 0.4 cm2, p=0.03), and MVTh (1.1 ± 0.26 vs. 0.72 ± 0.25cm, p=0.02). However, there was no significant difference in EROA (17 ± 3.6 vs. 19 ± 4.5mm2, p=0.54) between two groups. In ant-MI, all patients showed central MR jet on the apical 3 chamber view. Whereas in inf-MI, only 5 patients showed central MR jet, rest of patients (n=17) revealed posterior directed MR jet.

During stress, LVESV (79 ± 26 vs. 67 ± 14ml, p=0.03), (45 ± 15 vs. 40 ± 11ml, p=0.035), MVTa (2.0 ± 0.5 vs. 1.7 ± 0.12cm, p=0.03), (1.2 ± 0.4 vs. 1.02 ± 0.15cm2, p=0.02) and MVTh (1.1 ± 0.26 vs. 0.9 ± 0.08cm, p=0.03), (0.72 ± 0.25 vs. 0.67 ± 0.05cm, p=0.04) significantly decreased in both ant and inf-MI. LVEF (36 ± 5 vs. 43 ± 5%, p=0.01), (45 ± 3 vs. 52 ± 7%, p=0.02) and trans-MV PG (110 ± 44 vs. 145 ± 35mmHg, p<0.001), (116 ± 32 vs. 148 ± 27mmHg, p=0.001) showed significant increase during stress in both ant and inf-MI, reflecting the increase of closing force. EROA significantly decreased in ant-MI (17 ± 3.6 vs. 9 ± 2.5mm2, p=0.01) during stress while it significantly increased in inf-MI (19 ± 4.5 vs. 21 ± 3.2mm2, p=0.025), particularly in patients showing posterior directed MR jet.

Conclusion: This study suggests that the closing force plays a different role in the mechanism of IMR between ant and inf-MI. The higher closing force gets, the less IMR develops in ant-MI. On the contrary, the higher closing force gets, the more IMR develops in inf-MI.

P301

Dynamic mitral valve behavior in ischemic mitral regurgitation

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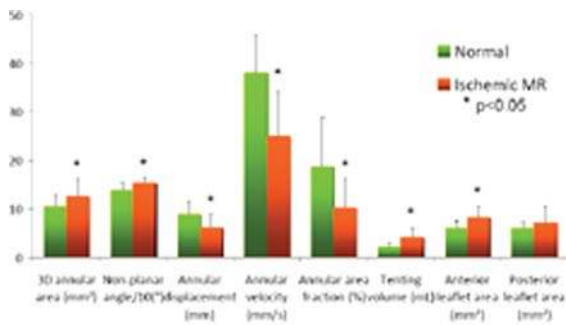
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Background: Current surgical strategies for ischemic mitral regurgitation (IMR) include implantation of an undersized mitral annuloplasty ring with or without chordal cutting regardless of the underlying anatomy. We used three-dimensional echocardiography (3DE) to quantify the dynamic behavior of the mitral annulus and leaflets in patients with IMR compared to normal subjects.

Methods: Full-volume 3D transesophageal images (Philips iE33, X7-2t probe) were obtained in 44 patients, including 27 patients with moderate to severe iMR (age 62 ± 10 yrs) and 17 normal controls (NL; age 62 ± 16 yrs). Prototype software (4D MVA, TomTec) was used to analyze mitral annular and leaflet dynamics throughout systole. The following mitral annular parameters were measured: non-planar angle, displacement, velocity, 3D area and area fraction. The following mitral leaflet parameters were measured: tenting volume, anterior leaflet area and posterior leaflet area.

Results: Compared to normal patients, iMR patients had larger mitral annular areas with a flatter annulus (Figure). The annulus also had reduced displacement, velocity and area fraction. Mitral leaflet tenting volume and height were larger with iMR due to an increase in anterior leaflet area. Measured parameters correlated moderately with left ventricular ejection fraction (Table). In the iMR group, there was wider variability in measurements compared to normal controls.

Conclusions: The great variability in mitral annular and leaflet parameters in iMR patients suggests that the standardized surgical approach may not be suitable for iMR treatment in all patients.



	Correl. w/EF	Variability (SD in % mean)	
		NL	Ischemic MR
3D annular area (mm ²)	-45%	23%	31%
Tenting volume (ml)	-70%	40%	51%
Annular displacement (mm)	56%	31%	47%
Annular velocity (mm/s)	68%	20%	34%
Annular area fraction (%)	55%	56%	71%

P302

Right ventricular dilation and pulmonary arterial systolic pressure are both independently associated with the degree of tricuspid regurgitation in patients with pulmonary arterial hypertension.

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Purpose: Elevated pulmonary arterial systolic pressure (PASP) is known to cause functional tricuspid regurgitation (TR). In pulmonary arterial hypertension (PH), a significant degree of TR is related with worse outcome. However the differential contribution of pressure load and right ventricular dilation has not been established yet. We aimed at evaluating both variables related with TR.

Methods: We conducted in a larger database project a cross-sectional study of consecutive transthoracic echocardiographic studies of patients followed at our institution with PH. Of these patients demographic data (age, gender) as well as echocardiographic 2D and Doppler right ventricular parameters were collected from November 1st 2010 until January 6th 2011. TR was graded in a semi-quantitative manner from 0 to a maximum of 4 out of 4. Right ventricular dilation was defined as no, mild, moderate and severe. Pearson's correlation coefficients between the different obtained parameters and TR were calculated. To assess independence between parameters, multivariate linear regression analysis of the significantly correlated parameters was done.

Results: Eighty-two patients (32.9% male; mean age of 61 ± 15) years with PH (46.3% Group 1; 0% Group 2; 45.1% Group 4; 2.4% Group 5 according to the 2009 DANA POINT classification of PH) were evaluated. Significant correlations were found between TR and PASP (0.547; p<0.001), Pulmonary Acceleration Time (PAT) (-0.367; p=0.001), right ventricular dilation (0.643; p<0.001), and Vena Cava Inferior diameter measured at inspiration (0.435; p<0.001). In the multivariate analysis, only right ventricular dilation (p=0.002) and PASP (p=0.009) were independently correlated with the degree of TR.

Conclusion: These echocardiographic findings suggest that not only PASP but also right ventricular dilation itself are independently related to increasing severity of TR. Therefore it is plausible that, when focussing on the severity of TR to improve prognosis in patients with PH, the PASP as well as the right ventricular dimensions should be targeted.

P303

Infective endocarditis in a Tunisian high-volume tertiary care center: Demographic, laboratory and echocardiographic results and prognosis

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Background : Infective Endocarditis(IE) remains a serious disease affecting the population in the Developing Countries.

objectives: The aim of the study was to describe the epidemiological, laboratory, and echocardiographic aspects of IE in a Tunisian cardiology department and to identify the predictors of in hospital mortality.

Materials and methods: Our study is retrospective enrolling 297 patients, hospitalized in our institution between January 2001 and January 2010 for infective endocarditis, according to the modified DUKE criteria. Demographic, clinical, laboratory, and echocardiographic characteristics were examined.

Results: The Mean age was 41.45±18.17 years. The mean diagnosis delay was 9.34 days. Rheumatic heart disease (RHD) was the predominant (40.5%) underlying heart condition. Diagnosis was definite in 48.5% of cases. Left-sided native valve IE, left-sided prosthetic valve IE, right-sided IE were noted respectively in 53.6% cases, in 31% cases, in 10.4% cases. Device-related IE is noted in 5% cases. Echocardiographic findings showed that vegetations were detected in more than 53.7% of cases. Vegetation size>15 mm was found in 17.1%. Abscess was noted in 5.4% of cases. Dehiscence of a prosthetic valve was revealed in 4.4% of patients. Fistula and perforation were respectively detected in 2.3% and 7% of cases.

In 155 cases (52%), blood cultures remained negative. Serology was positive in 12 cases. Causative microorganisms were mainly Streptococci (n = 48) and Staphylococci (n = 32). Surgery was indicated in 49% cases. Overall mortality was 16.1%. On multivariate analysis: RHD (P=0.001), prosthetic valve IE (P=0.032) and congestive heart failure (p = 0.0001) were predictive of in-hospital mortality.

Conclusion: Rheumatic heart disease remains the most common underlying heart disease for infective Endocarditis in Tunisia. Despite progress in therapeutic modalities, IE remains very serious condition carrying high mortality rates.

CARDIOMYOPATHIES

P304

Left ventricle synchrony and contractile function in heart failure patients with systolic dysfunction

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Objective: Evaluate in heart failure patients due to left ventricle (LV) systolic dysfunction the relationship between LV longitudinal dyssynchrony and LV global function.

Methods: 100 pts (60% M), age 72.5 ± 10 years old regularly followed in a heart failure clinic, ejection fraction (EF) of the left ventricle (LV) $30.78 \pm 9.5\%$, cardiac output 4.25 ± 1.59 , Nt-ProBNP median 1337.0 pg/ml, LV end diastolic diameter 6.82 ± 0.97 cm.). LV Dyssynchrony: SD of longitudinal time-peak systolic in 12 LV segments (LV-SD12). LV longitudinal global strain (GS) and strain rate (GSR), mitral (septal) TDI S, E and A waves, LVEF and left atrium EF (LAEF) evaluated. Relationship between parameters evaluated with Pearson correlation coefficient and linear regression model (backward method). Dyssynchrony grouped accordingly to the quartiles (55.3, 79.4, 126.7).

Results: LV dyssynchrony correlated with: (1) LV systolic function- LVEF ($r = -0.30 = 0.004$), LV end diastolic dimension ($r = 0.337 p = 0.001$), TDI Mt-S ($r = -0.27 = 0.014$), LV-GS ($r = 0.494 p < 0.001$), LS-GSRs ($R = 0.504 p < 0.001$). (2) Diastolic function: TDI Mt-A ($r = -0.246 p = 0.05$), TDI Mt-E ($r = -0.264 p = 0.010$), GSRs ($r = -0.425 p < 0.001$) and GSRa ($r = -0.263 p < 0.001$). (3) By multiregression dyssynchrony was independently associated with GSRs ($p = 0.011$) and GSRa ($p = 0.076$).

Conclusion: LV Dyssynchrony in HF patients is associated with longitudinal contractile function impairment, which reinforces the need for cardiac resynchronization therapy.

	Dyssynchrony Quartiles (ms)				P value
	<55.3	55.3 – 79.4	79.4-126.7	>126	
LV Ejection F	34.1 ± 11.1	30.4 ± 7.4	32.6 ± 8.1	25.6 ± 10.0	0.018
LV end-Diast	63.9 ± 8.2	69.8 ± 9.2	66.7 ± 9.7	73.5 ± 9.6	0.004
Nt-ProBNP	1555.0 ± 1993	1577.0 ± 1863	4398.3 ± 5840	6206.0 ± 6236	0.002
LV-GS	-9.9 ± 2.8	-8.4 ± 1.6	-8.0 ± 2.2	-6.1 ± 1.4	<0.001
LV-GSRs	-0.54 ± 0.12	-0.46 ± 0.09	-0.48 ± 0.11	-0.33 ± 0.08	<0.001
LV-GSRa	0.71 ± 0.18	0.52 ± 0.21	0.56 ± 0.17	0.34 ± 0.12	<0.001

Dyssynchrony quartiles by LV global function.

P305

The role of RT3DE to improve response to cardiac resynchronization therapy after optimal positioning of the resynchronization lead: a prospective study

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Aims: A non-optimal resynchronization lead (RL) position is a possible cause of poor CRT response. The study aims to test the value of RT3DE for individual assessment of LV dyssynchrony and prospective evaluation of CRT response after RL implantation at the pre-determined segment of maximal delay (SMMD) whatever the method of CRT used.

Patients and Methods: Seventeen HF patients were prospectively included in the study. RT3DE data were obtained before and after 1, 3, 6 months of CRT. Time/volume curves and parametric imaging were applied for pre-implant identification of SMMD and for individual assessment of CRT response. Delta-time delay (delta-t) and selective parameters between tmsv of the latest and earliest activated segments were calculated. All patients received CRT according to accessibility of the SMMD. We used bifocal right ventricular pacing (BFRVP) in 5 patients with septal SMMD; biventricular pacing (BVP) in 12 patients with LV SMMD.

Results: The RL was successfully implanted at the SMMD or nearest segment in 14 (82.4%) initial responders (5 BFRVP, 9 BVP). Twelve of them were still responders after 6 months. CRT response was comparable in BFRVP and BVP. A moderate correlation was found between % change of EF and that of SDI ($r = -.406$), delta-t ($-.497$). Baseline delta-t showed a stronger correlation with % change of EF ($r = -.718^{**}$, $P = 0.009$) than that of SDI ($r = -.509$, $P = 0.091$). Conclusion: The use of RT3DE for individual assessment of LV mechanical dyssynchrony and for optimal RL positioning at the pre-identified SMMD can provide more optimum CRT regardless the method of CRT.

Dyssynchrony indices and % change of EF%

Baseline indices	% change of EF%	% change of indices	% change of EF%
SDI r	-.509	SDI r	-.406
P value	.091	P value	0.191
Delta-t r	-.718**	Delta-t r	-.497
P value	.009	P value	0.101
Sel. SD r	-.322	Sel. SD r	-.650*
P value	0.308	P value	.022
Sel. SD% r	-.462	Sel. SD% r	-.538
P value	.131	P value	0.071
Sel. dif. r	-.455	Sel. dif. r	-.559
P value	.138	P value	.059
Sel. Dif.% r	-.007	Sel. Dif.% r	-.503
P value	.983	P value	.095

Delta-t=delta time delay, sel SD= selective tmsv SD, sel dif= selective tmsv difference, sel SD % = the % of Tmsv sel SD, Sel. Dif%= the % of Tmsv sel, * = $p < 0.05$, ** = $P < 0.01$.

P306

Impact of left ventricular hypertrophy and diastolic dysfunction on left atrial volume in patients with hypertrophic cardiomyopathy

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Background: Patients with hypertrophic cardiomyopathy (HCM) and left atrial (LA) enlargement have increased mortality and morbidity, including a high risk of atrial fibrillation (AF). Although LA size may reflect chronic changes due to diastolic dysfunction (DD) the relationship between LA size and left ventricular filling pressures is modest in HCM patients.

Purpose: To identify the independent correlates of LA volume and the relationship between LA dilation and new onset atrial fibrillation in patients with HCM.

Methods: We prospectively enrolled 37 consecutive patients with HCM (51 ± 16 years, 18 men) and sinus rhythm. Indexed LA volume (LAVi) was determined using the area length method. Left ventricular (LV) filling pressures were assessed using average E/ ratio. DD has been graded according to the ASE/EAE recommendations. Global longitudinal LV strain (GLS) was assessed from the apical views using a commercially available 2D Strain software. Basal and apical LV rotation and backrotation rate, peak systolic LV torsion and peak untwisting rate have been also measured. Time intervals from peak R wave (ECG) to each of them were measured and normalized to the RR interval. Mitral regurgitation (MR) severity was graded as mild, moderate or severe. A subgroup of 20 patients has been followed up for 1 year for the occurrence of paroxysmal/persistent AF.

Results: All patients had preserved LV ejection fraction ($65 \pm 7\%$), LV hypertrophy (187 ± 64 g/m²) and enlarged LA (67 ± 34 ml/m²). LV outflow tract obstruction was present in 20 patients. LAVi correlated significantly with LVmass ($r = 0.64$, $p < 0.001$), GLS ($r = 0.54$, $p = 0.02$) and time to LV peak untwisting velocity ($r = 0.35$, $p = 0.04$). In patients with moderate to severe MR ($n = 24$), LAVi was significantly higher than in patients with mild MR (75 ± 38 vs 50 ± 13 ml/m², $p = 0.03$). LAVi was not significantly related to E/E', DD degree or dynamic LV outflow tract gradient ($p > 0.2$ for all). In multivariate regression analysis LVmass ($\beta = 0.71$, $p < 0.001$) and time to LV peak untwisting velocity ($\beta = 0.32$, $p = 0.01$) have been independently correlated with LAVi ($r^2 = 0.65$, $p < 0.01$). Moreover, LAVi emerged as the only parameter that was significantly different between patients with ($n = 8$) and without AF during follow up (86 ± 31 vs 61 ± 20 ml/m², $p = 0.04$).

Conclusions: In patients with HCM, increased LV mass and delayed LV untwisting are independently related to LA enlargement. The degree of LA dilation is related to the occurrence of paroxysmal/persistent AF.

P307

Coronary flow reserve of left anterior descending coronary artery in hypertrophic cardiomyopathy: relation with pathophysiological characteristics

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Background: Microvascular dysfunction reflected by the decreased coronary flow reserve (CFR) in response to adenosine infusion is a common finding in hypertrophic cardiomyopathy (HCM). Decreased CFR is recognized as a major mechanism for ischemia which is related with unfavorable long term outcome. Its pathophysiology is multifunctional, including reduced arteriolar density, fibrosis, myocyte disarray, elevated left ventricular end-diastolic pressure and structural abnormalities of small coronary vessels. Plasma levels of NT-pro-BNP in HCM correlates positively with cardiac filling pressures and is excellent marker for the abnormal LV wall stress and disease progression.

Aims: 1. To examine relations between CFR, assessed in left anterior descending coronary artery (LAD) in HCM patients using transthoracic echocardiographic (TTE) techniques and morphological characteristics, LV mass and LVOT pressure gradient. 2. To explore relation between plasma levels of NT-pro-BNP and microvascular function.

Methods: In 63 pts (mean age 48.6 ± 16.4 yrs; 27male) with asymmetric HCM, 21 pts with LVOT obstruction and 42 pts without LVOT obstruction, transthoracic echocardiographic examination with measurement of CFR in LAD was done. CFR was defined as the ratio between maximal velocity of diastolic coronary blood flow during maximal hyperemia and in rest, induced by i.v. infusion of adenosine (140mcg/kg/min).

Results: When HCM pts with LVOT obstruction were compared to HCM pts without LVOT obstruction, first group had strong trend for lower value of CFR-LAD (1.93 ± 0.42 vs. 2.20 ± 0.56 , $p = 0.06$). In the whole study group CFR-LAD was significantly inversely correlated with LVOT PG ($r = -.392$, $p = 0.024$). CFR-LAD was also inversely correlated with LVmass (CFR-LAD: $r = -.320$, $p = 0.01$) and with septal thickness ($r = -.511$, $p < 0.001$). Levels of NT-pro-BNP were significantly inversely correlated with LAD-CFR in the whole study group ($r = -.545$, $p < 0.001$).

Conclusion: In patients with asymmetric HCM, coronary microvascular function determined as CFR is significantly inversely related to LV mass as well as to septal thickness. Coronary microvascular function is inversely correlated to gradient of LVOT obstruction showing that LVOT obstruction additionally aggravates microvascular dysfunction in LAD territory. In the whole study group, even in non-obstructive form of HCM coronary microvascular function is significantly related to left ventricular wall stress.

P308
Magnetic resonance imaging of myocardial fibrosis in hypertrophic cardiomyopathy

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Introduction: hypertrophic cardiomyopathy (HCM) is the most common genetic cardiovascular disorder and increasingly diagnosed using cardiovascular magnetic resonance (CMR), which is requested for confirmation of a suspected diagnosis by echocardiography. CMR accurately measures left ventricular (LV) thickness, is highly sensitive in detecting myocardial scar and hypertrophy and is considered to be a gold standard for scar quantification and LV dimension measurement.

Purpose: We studied the incidence and pattern of fibrosis in HCM using late enhancement cardiovascular magnetic resonance (CMR).

Methods: 23 consecutive patients (pts), (14 males; mean age 52 ± 16 years, range 17-77 years), with HCM, were included. Diagnosis was made on clinical and echocardiography evaluation and established by CMR using accepted criteria. All pts underwent complete CMR examination on 1.5 T scanner (Intera, Philips). LV was evaluated using a 17-segments model: a) SSFP short-axis LV volumes and ejection fraction; b) SSFP 2, 3, 4-chambers for thickness measurement; c) LV segmental LGE (segmented inversion-recovery fast gradient-echo sequence, 10-15 min after 0.2 mmol/kg of Gd-DTP); the presence, the location and amount of LGE was assessed.

Results: Septal hypertrophy (maximal thickness > 12 mm) was present in all pts (mean septal thickness was 17,65 ± 4 mm). LV end-diastolic volume was 101 ± 33 ml, LV end-systolic volume 28 ± 18 ml, LV mass 170 ± 46 g and ejection fraction 73 % ± 9. LGE was detected in 12 pts (52%) and median LGE mass was 14,5 g (interquartile range from 10 to 18.9).

Conclusion: CMR LGE was a frequent finding in HCM. CMR should be considered in HCM pts for precise calculation of ventricular thickness and accurate scar quantification.

P309
Prognostic role of transmitral Doppler/Tdi in hypertrophic cardiomyopathy

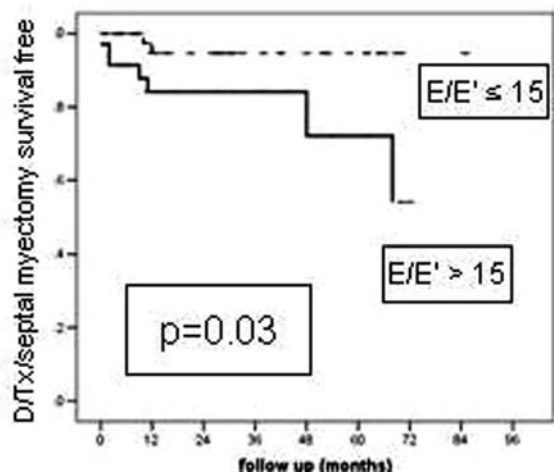
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Background: clinical usefulness of echo-Doppler parameters of left ventricular (LV) diastolic dysfunction in hypertrophic cardiomyopathy (HCM) is presently debated.

AIM: to assess the value of TDI imaging, and in particular of E/E' ratio, in predicting the clinical course of patients with HCM.

Methods and results: Eighty HCM patients consecutively observed in our Department from 2000 to 2010 (60% males, mean age 43 ± 19 years) and studied by echo-Doppler and TDI were prospectively included in the study and followed-up for a combined clinical end-point (cardiovascular death, heart transplantation or septal myectomy). E/E' ratio was evaluated by ratio of peak E wave velocity at pulsed Doppler transmitral curve and of E' wave at basal septal TDI. The patients were divided into 2 groups: - group 1: E/E' > 15 (35 patients/44%); - group 2: E/E' ≤ 15 (45 patients/66%). In comparison with group 2, patients of group 1 were significantly older (51 ± 18 vs 37 ± 19, 0.001), showed more frequently atrial fibrillation (18% vs 2%, p=0.014), a more severe LV hypertrophy (interventricular septum 22 ± 7 mm vs 18 ± 5 mm, p=0.003; posterior wall 14 ± 4 mm vs 12 ± 3 mm), a larger left atrium area (29 ± 9 cm² vs 22 ± 8 cm²) and a more frequent systolic anterior motion (43% vs 20%, p=0.03). During a mean follow-up of 46 ± 95 months, 9 patients (11%) reached the combined clinical end-point; event-free survival rates were 80% vs 96% in group 1 vs group 2, respectively (p=0.03).

Conclusions: Evaluation of E/E' ratio at diagnosis is an important tool in identifying patients with a particularly poor prognosis. Elevated values of E/E' (> 15) are probably related to a more advanced stage of the disease.



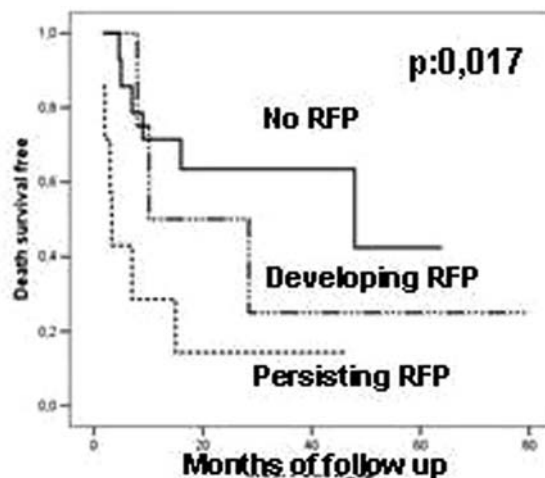
P310
Prognostic role of echocardiography during follow-up in cardiac amyloidosis

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Aim: to assess the prognostic impact of follow-up echo-Doppler assessment in cardiac amyloidosis.

Methods and Results: we retrospectively evaluated a series of 25 patients (69% males, mean age 63 ± 12 years) with a bioptic diagnosis of systemic amyloidosis and cardiac involvement (documented at echocardiography). All patients were studied by echo-Doppler both at diagnosis and after a mean follow-up of 17.4 ± 19.8 months. At diagnosis, the mean IV septum thickness was 16 ± 4 mm, and 31% presented a restrictive filling pattern (RFP) at Doppler evaluation. Two follow-up echo-Doppler variables were selected as prognostically useful: 1) concentric reverse remodelling (CRR) defined as a decrease of interventricular septal thickness ≥ 2 mm. 2) persistence or development of RFP. At follow-up echocardiogram 6 patients (24%) showed CRR, 4 patients (16%) developed a RFP and 7 patients (28%) maintained a RFP. During a mean follow-up of 24 ± 22 months 16 patients (64%) died; survival rates were 83% vs 29% in patients with CRR with respect to remaining patients (p=0.019). In addition, survival rates were significantly lower in patients in whom RFP persisted or developed, with respect to those without RFP during follow-up (14% vs 25% vs 57%, respectively; p=0.017).

Conclusions: The prognosis of cardiac amyloidosis is confirmed as severe in the short time. The absence of CRR and persistence or development of RFP during follow-up emerged as markers of worse prognosis in the mid-term. In cardiac amyloidosis echocardiography has not only a diagnostic role at initial evaluation, but also an important prognostic role during follow-up.



P311
New findings about ventricular and atrial function assessed by Speckle Tracking and 3D echocardiography in arrhythmogenic right ventricular cardiomyopathy (ARVC)

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Purpose: The evolution of ARVC is more diffuse right ventricle (RV) involvement and, sometimes, left ventricular(LV) abnormalities, that may result in heart failure. We evaluated the potential utility of two-dimensional (2D) Strain-Strain rate (S-SR) and 3D echocardiography to quantitatively assess RV, LV and atrial function in ARVC patients (pts), with apparently normal LV.

Methods: we studied 70 subjects: 35 pts with ARVC and 35 healthy controls. By E9GE we measured LV ejection fraction (EF%), LV diameters and volumes, RV dimension (apex, outflow tract and infero-basal segment, near tricuspidal valve), fractional area change (FAC%), RVOT fractional shortening (RVOTfs%), RA volume. By DTI we measured velocity of early (E') and late (A') diastolic and systolic wave (S) at level of tricuspidal annulus. We measured 2D longitudinal systolic ventricular and atrial S-SR in apical 4 and 2-chambers views, at level of LV segments (4 basal,4 mid,4 apical), RV segments (1 basal,1 mid,1apical) and atrial walls and circumferential and radial peak systolic LV 2D S-SR in short axis views. By 3D echocardiography with volumetric probe we measured RA, RV volumes and RV EF.

Results: RV dimension, 3D RV end-diastolic (52,8 ± 9vs33 ± 11ml/mq) and end-systolic volume (27 ± 6,8vs16 ± 6ml/mq) were higher in all pts than controls; FAC (27,8 ± 12,1%), RVOTfs (27,2 ± 16%) and 3D RVEF (49 ± 7,4vs67 ± 8%) were lower. While 2D RA volume were higher in pts (52,8 ± 20vs37 ± 7,5ml;index:25,6 ± 10,4 vs18,7 ± 6ml/mq), no significant differences were found for 3D RA volume (56,4 ±

13vs ± 51 ± 13ml; index 27.9 ± 5vs 28 ± 10ml/mq). At TVI of tricuspid valve ratio E/A' was = 0.73 in pts vs 1.2 in controls. RV systolic 2D SR-S were significantly lower in pts compared with controls (SR = -1.37 ± 0.37 vs -2.37 ± 0.51 S-1, p < 0.001; S = -12.45 ± 4.4% vs -26.6 ± 8.1%, p < 0.001). Also LV 2D SR (longitudinal: -1.01 ± 0.21 vs -1.53 ± 0.49 S-1; circumferential: -1.18 ± 0.33 vs -1.62 ± 0.4 S-1; radial: 1.19 ± 0.26 vs 1.58 ± 0.3 S-1, p < 0.003), and LV 2D S (longitudinal: -15.2 ± 4.3% vs -20.59 ± 4.47%, circumferential: -15.12 ± 3.9 vs -21 ± 5.1%; radial: 16.25 ± 8.9 vs 46.3 ± 9.2%, p < 0.003) were significantly lower in pts, even if LV diameters, LVEF and 3D LV volumes and 3D EF were normal. RV systolic 2D S (-18.5 ± 4.8%, p < 0.002) and SR (-1.54 ± 0.4, p < 0.002) and RA systolic 2D S-SR were significantly lower in ARVC pts than in controls.

Conclusions: RV 2D S-SR and 3D RVEF were significantly lower in ARVC pts compared with controls. 2D S-SR enables to show early LV dysfunction in these pts, when standard echocardiography doesn't show any impairment.

P312

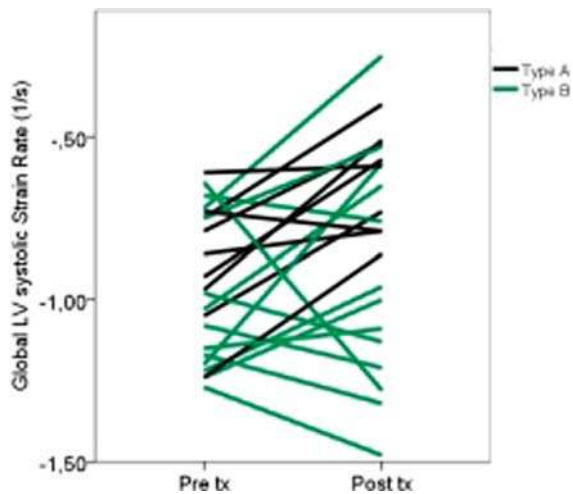
Amyloid fibril composition predicts the development of cardiac dysfunction after liver transplantation for hereditary transthyretin amyloidosis

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Background: Liver transplantation (LTx) is today the only available treatment for inhibiting the amyloid deposition in transthyretin amyloidosis (TTA). However, we have recently demonstrated continuing amyloid deposition in fat tissues after LTx, along with faster turn over in patients with truncated and full length TTR (type A) compared to those with only full length TTR (type B). We therefore hypothesize that the fibril composition predicts the cardiac function after LTx.

Methods: 24 patients with hereditary TTA who had undergone liver transplantation were examined by echocardiography including tissue Doppler (TDE) and speckle tracking echocardiography (STE) before and at least one year after LTx were included in the study. They were divided into two groups according to fibril composition, 10 patients (64 ± 7 years, 7 males) with type A fibrils who had LTx 4.3 ± 4.0 years after onset of disease and 14 patients (56 ± 14 years, 11 males) with type B fibrils who had LTx 3.0 ± 1.0 years after onset of disease. There was no difference in the time to the follow up echocardiography between the two groups.

Results: After LTx only type A patients developed increased left atrial volume, left ventricular (LV) wall thickness, early to late diastolic ratio (E/A), reduced myocardial systolic velocity (s') and significantly reduced LVEF as well as regional and global longitudinal function (p < 0.05). No changes in LV function after LTx were detected in type B patients.



P313

Echocardiographic findings in cardiac sodium channel alpha-subunit gene mutation carriers.

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Background and aims: Mutations in the human cardiac sodium channel alpha-subunit gene (SCN5A) are involved in the pathophysiology of cardiac arrhythmias (Brugada syndrome (BS), Long QT syndrome (LQTS), cardiac conduction defects and idiopathic ventricular fibrillation), cardiomyopathies (dilated cardiomyopathy (DCM) and left ventricular non-compaction (LVNC) and other cardiac structural abnormalities. We aim to evaluate echocardiographic findings in carriers of SCN5A variants.

Methods: Sequencing of SCN5A gene was performed in 103 patients diagnosed with BS (93.89%), LQTS (8.8%) and cardiac arrest or ventricular arrhythmias in (3.3%). SCN5A mutations/variants (3 families G1743R and 1 family each R27H, S524Y, R620H, V728I, E901K, E1032K, E1151stop and N1443S) were identified in 11 unrelated probands after excluding known polymorphisms. Echocardiographic findings from both probands and relatives from these 11 families were analysed. Echocardiograms from carriers (34.65%) and non-carriers (18.35%) were compared.

Results: 52 individuals (ind.) from 11 different families (mean 4.7 ind. per family) comprised the study population. Reason for SCN5A study was BS in 9 families (39 ind.), cardiac arrest in 1 (5 ind.) and ventricular arrhythmias in 1 (8 ind.). 12 (23%) ind. had echocardiographic abnormalities. 3 ind. had DCM (all from the same family, all carriers), 3 had left ventricular hypertrophy (from 3 different families, all carriers of SCN5A mutations, 2 with G1743R, 1 with E901K), 2 had left ventricular hypertrabeculation (both from same family and carriers of the same mutation S524Y), 1 had right ventricular dilatation (carrier of G1743R), 4 had significant valvular disease (3 aortic regurgitation and 1 tricuspid regurgitation, 3 of them carriers). 2 out of the 3 patients with aortic regurgitation had significant aortic and left ventricular dilatation (both carriers of R620H). 1 non-carrier had subaortic membrane and another non-carrier had anterior scar from an old myocardial infarction. 10 (26%) of carriers had echocardiographic abnormalities versus 2 (11%) non-carriers (p=0.1).

Conclusions: Echocardiographic abnormalities seems to be particularly frequent in SCN5A carriers. Chamber dilatation, left ventricular hypertrophy, left ventricular non-compaction and valvular disease have been demonstrated in our series. Larger and multicentre registries are needed to appropriately address this observation.

P314

Acute depression of left ventricular function after single alcohol consumption.

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Background: Little is known on the acute impact of single alcohol consumption on myocardial function.

Methods: We studied 19 party guests by high-end ultrasound-scanners before and 16-18 hours after alcohol consumption. 5 individuals served as controls. Population and echocardiographic parameters were analysed blindly.

Results: Baseline data of controls and alcohol-consumers were comparable. Body-weight and vital signs remained unchanged at the second visit. In the alcohol consumption group, peak-blood alcohol-concentration was 1.4 ± 0.4 g/kg without gender differences (p=0.6). Diastolic function was impaired (E/A-ratio: 1.7 ± 0.4 vs. 1.6 ± 0.4, p=0.02). Systolic LV-function was reduced (EF 58 ± 8 vs. 52 ± 6, p < 0.001 and GS -22.9 ± 2.9 vs. -19.2 ± 3.2%, p < 0.001). GS-reduction correlated with peak alcohol concentration (r = -0.7, p = 0.002).

Conclusion: By means of echocardiography we observed for the first time a dose-dependent depression of left ventricular function after single acute alcohol consumption. Further studies are warranted to elucidate the clinical relevance of this effect in patients with impaired left ventricular function.

P315

Early Trastuzumab-induced cardiotoxicity in breast cancer patients.

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Background: Trastuzumab (TZB) is a recombinant humanized monoclonal antibody used for the treatment of HER2-positive breast cancer. In spite of its recognized cardiotoxicity, pathophysiological mechanisms explaining side effects remain poorly understood and the methods for its early sub-clinical detection are not well defined.

Aim: To evaluate TZB-induced cardiotoxicity in patients (pts) with breast cancer followed for a 3-month period of treatment.

Methods: Prospective study (evaluation of cardiotoxicity induced by chemotherapy - ACT-QT study) of consecutively pts, enrolled between May and September 2010, treated with TZB for advanced HER2-positive breast cancer. A comparison of clinical, laboratory and echocardiographic data, prior and at the 3rd month after starting TZB was performed. Left ventricular systolic function deterioration (LVSF), defined according to the criteria established by the CREC - Cardiac Review and Evaluation Committee, and diastolic function, under the classification proposed by ASE - American Society of Echocardiography, were studied. Hospitalization and mortality were also analyzed.

Results: Data were available for 51 women, mean age = 55.4 ± 14.0y. At 3 months, no pts had symptomatic heart failure. LVSF by Simpson biplane formula calculation did not differ at 3-months (69.3 ± 7.4 vs 67.1 ± 6.5%, p > 0.05), decreasing in 57.9% pts (only one to left ventricular ejection fraction < 55%); 19.4% pts developed impaired ventricular relaxation, with a significant increase in E/e' ratio (3.9 ± 0.8 vs 8.0 ± 1.9, p < 0.001). Pericardial effusion was present in five pts at the 3rd month (>1mm). Both left atrial and left ventricle volumes remained unchanged after TZB treatment. N-terminal pro-B type natriuretic peptide values did not increase. During the follow up two pts died and two were admitted to the hospital, both for non-cardiovascular causes.

Conclusion: During the first 3 months of TZB treatment none of the pts presented overt heart failure or significant LVSF deterioration although almost one-fifth of them

developed impaired ventricular relaxation, eventually as an early sign of TZB-induced cardiotoxicity.

P316
Cardioprotective role of lisinopril and rosuvastatin in the prevention of anthracycline induced cardiotoxicity

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Purpose: In the present study we aimed to evaluate by echo-Doppler echocardiography the cardioprotective effect of an angiotensin-converting enzyme inhibitor and a statin added to the standard chemotherapy regimen in the prevention of anthracycline induced cardiotoxicity.

Methods: In this prospective study we evaluated by Doppler echocardiography 26 patients with various malignant tumors treated with epirubicin in doses up to 500 mg/m², who were receiving a cardioprotective treatment with Lisinopril 10 mg and Rosuvastatin 10 mg (study group- SG) and a gender and age matched group of 31 oncologic patients who were not receiving the cardioprotective treatment (control group-CG). None of the patients had any history of cardiovascular disease. The left ventricular (LV) systolic function was assessed by measuring the LV ejection fraction (LVEF) by Simpson method and the LV diastolic function was assessed by measuring transmitral flow: the maximal velocity of the E wave (rapid filling) and A wave (atrial filling), the ratio of E max/ Amax, the pressure half time (PHT) of the E wave, the E wave deceleration time (EDT) and the isovolumic relaxation time (IVRT). The echo-Doppler study was performed at the beginning and at the end of chemotherapy.

Results: We documented a further deterioration of LV diastolic function in patients without cardioprotection with Lisinopril 10 mg and Rosuvastatin 10 mg compared with those in the SG by finding a significant decrease of Emax, an increased Amax and subunitary E/A ratio (p<0.02), the prolongation of IVRT (p<0.2), of PHT (p<0.02) and of the EDT (p<0.01) in the CG. LV systolic function was less influenced by this treatment (p < 0.21).

Conclusions: In our echo-Doppler study we have documented the cardioprotective role of Lisinopril and Rosuvastatin in the prevention of cardiac dysfunction. The patients who were not receiving the above mentioned cardioprotective treatment had a much rapid deterioration of the LV diastolic function. It appears that the LV systolic function was less influenced by this cardioprotective treatment.

P317
Prognostic role of myocardial performance index after heart transplantation: a prospective study

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Background: Myocardial performance index (MPI) is a Doppler-derived index of combined systolic and diastolic function. Abnormal MPI is a reliable marker of early graft dysfunction because of chronic rejection. We evaluated the prognostic role of MPI in a prospective cohort of long term (> 1 year) heart transplanted (HT) patients (pts).

Methods: In this prospective study 152 long term (time from transplant: 5.2 ± 3.6 years) HT pts (54.6 ± 12.2 years) were enrolled. Protocol includes echocardiographic (887 exams) and clinical annual follow up. Prespecified cut-off values of increased risk of events were: FE ≤ 50% and MPI ≥ 0.45. The primary end point was a composite of death from cardiovascular causes, hospitalization for cardiac disease and heart failure; secondary end point was cardiac death.

Results: During follow-up (69 ± 22 months) 68 patients (44.7%) had any event (1.6 ± 0.9 event/patient). Overall cardiac mortality rate was 13.16%. Among all the prespecified clinical (recipient age, time from transplantation, diabetes mellitus, number and degree of rejection during the first year, immunosuppressive and heart failure treatment) variables, use of tacrolimus and mycophenolate significantly correlated with a reduced risk of events (respectively: odds ratio 0.35; 95% CI: 0.12-0.92; p 0.03; odds ratio 0.42; 95% CI: 0.19-0.85; p 0.02) whereas diabetes was a risk factor for events (OR: 2.26; 95% CI: 1.03-5.1; p: 0.04). Patients who had events during follow-up showed at echo-Doppler examination lower EF (56.2 ± 10.6 vs. 62.9 ± 6.7 p < 0.001) and higher MPI (0.42 ± 0.18 vs. 0.36 ± 0.13; p 0.017). EF and MPI were not correlated (r2 0.2). Both parameters showed a good diagnostic power for events (EF: ROC area 77%, with sensitivity 54% and specificity 91% for cut-off value of 50%; MPI: ROC area 79%, with sensitivity 79% and specificity 81% for cut-off value of 0.45). At Kaplan Meier analysis, EF ≤ 50% and MPI ≥ 0.45 were associated with decreased freedom from first cardiac event (10 years: 24% vs. 73%, p < 0.0001; 41% vs. 75%, p < 0.00001; respectively). MPI and EF significantly predicted cardiac events (MPI ≥ 0.45: OR 16.08, 95% CI 9.746-27.37; EF ≤ 50%: OR 13.64, 95% CI 8.55-21.92) and death (MPI ≥ 0.45: OR 27.7, 95% CI 7.35-178, p < 0.001; EF ≤ 50% : OR 8.6, 95% CI 3.45-22.11, p < 0.001). Only 2% of patients with EF > 50% and MPI < 0.45 had events during follow-up.

Conclusions: MPI is a new prognostic index for long-term event free survival after HT. Combining MPI with EF can enhance the prognostic power of the echocardiographic examination.

SYSTEMIC AND PULMONARY HYPERTENSIVE HEART DISEASE

P318
Additive effect of noninsulin dependent diabetes mellitus on left ventricular mass in systemic hypertension. Assessment with cardiac magnetic resonance

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Non-insulin-dependent diabetes mellitus (NIDDM) may increase left ventricular mass (LVM). NIDDM is a frequent finding in patients with systemic hypertension (HT). Our objective was to quantify with cardiac magnetic resonance (CMR) the additional effect of NIDDM on LVM in hypertensive patients.

Methods: All hypertensive patients aged 30-80 yrs referred for a stress myocardial perfusion CMR between January 2008 and December 2010 were studied. Cardiovascular risk factors were recorded. The CMR protocol included TrueFISP cine sequences in the usual views, myocardial perfusion sequences after administration of iv dipyrindamole (0.4mg/kg) and late gadolinium enhancement sequences. Patients with signs of necrosis on CMR or with features suggestive of other type of cardiomyopathy or secondary hypertension were excluded. Hypertensive patients were divided according to the presence (HD) or absence (H) of NIDDM.

Results: 875 hypertensive patients were included, 585 H (51% males, 65 ± 11 yrs) and 290 HD (45% males, 67 ± 10 yrs). Two-way ANOVA (factors: group H/HD, gender; covariables: age, body mass index, duration of HT) was done. Group HD showed increased septum and posterior wall diastolic thickness (SD, PWD, mm), LVM (g), indexed LVM (LVMI, g/m²) and relative wall mass (RWM, g/mL). Chi-square analysis showed that group HD had a higher risk of developing a concentric remodelling pattern (CR, OR= 1.69) and concentric left ventricular hypertrophy (cLVH, OR= 1.71), while group H had a higher risk of developing eccentric hypertrophy (eLVH, OR= 1.78). Lineal regression analysis showed that, in hypertensive patients, concomitant NIDDM induced a mean further increase of 6gr in LVM.

Conclusions: In hypertensive patients, concomitant NIDDM causes a significant further increase in LVM, as well as a more severe pattern of LV remodelling and of LV hypertrophy. These findings may contribute to explain the worse prognosis of hypertensive patients with concomitant NIDDM.

	SD	PWD	LVM	LVMI	RWM	%CR	%eLVH	%cLVH
H	9.1 ± 0.1	8.6 ± 0.1	139 ± 1	73 ± 1	1.2 ± 0.01	32	8	10
HD	9.5 ± 0.1	9.0 ± 0.1	145 ± 1	77 ± 1	1.3 ± 0.01	40	5	17
p	0.019	0.006		0.008	0.000	0.017	0.046	0.007

P319
Right ventricular impact in patients with arterial hypertension and sigmoid interventricular septum

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Aim: An increased incidence of sigmoid interventricular septum (SIS) is noted in patients (pts) with arterial hypertension (HTN). This morphological aspect can represent an important tool to evaluate the heart in hypertensive pts. The impact of HTN in the right ventricle (RV) is still underdefined. We evaluated the repercussion of arterial hypertension in the RV (global and regionally) in patients with SIS.

Methods: Retrospective study of 44 pts with essential HTN, all in sinus rhythm, 38,6% female, 60,5 ± 9,3 years old, body mass index 27,9 ± 4,22 Kg/m². Complete echocardiographic study including tissue Doppler imaging of the RV and myocardial deformation imaging through speckle tracking. Longitudinal strain(S) and strain rate (SR) of the RV were analysed by post processing. Pts were divided in 2 groups: pts with sigmoid interventricular septum (SS) — 19 pts and without sigmoid septum (NSS) — 25 pts.

Results: No differences were noted between both groups regarding age, gender, anti-hypertensive medication, number of pts with controlled arterial hypertension and number of pts with structural changes of the left ventricle (remodelling/hypertrophy). Global RV function — by tissue Doppler (RV s', RVe' and RV a'), Tei index, TAPSE, global S and SR no differences were noted between both groups. Regional RV function — the following differences were noted — table.

Conclusion: A compensatory increase of the RV free wall myocardial deformation is noted in pts with SIS and HTN, counteracting a decreased myocardial deformation of the interventricular septum. Speckle tracking is a sensitive method to detect this changes, and can become an early marker of right and left ventricle longitudinal changes.

		SS	NSS	P
Basal Interventricular septum	Peak S longitudinal SR (1/sec)	9,8+/-2,3	22,1+/-4,4	<0,001
	Peak E longitudinal SR (1/sec)	17,9+/-4,1	18,6+/-3,7	<0,001
Median Interventricular septum	Peak S longitudinal SR (1/sec)	8,6+/-1,9	10,7+/-2,1	0,001
	Peak E longitudinal SR (1/sec)	15,9+/-3,6	11,3+/-2,2	0,006
Basal lateral wall	Peak S longitudinal SR (1/sec)	31,1+/-7,3	25,7+/-5,2	0,029
	Peak E longitudinal SR (1/sec)	39,6+/-9,3	26,6+/-5,4	0,03
Median lateral wall	Peak S SR longitudinal (1/sec)	30,4+/-7,1	20,6+/-4,2	0,034
	Peak E longitudinal SR (1/sec)	34,4+/-8,1	24,4+/-4,5	0,045

P320**Role of post-systolic shortening of left ventricle for heart failure with preserved ejection fraction in untreated hypertension**W-C. Tsai¹; Y-W. Liu¹; J-Y. Shih²; Y-Y. Huang¹; J-Y. Chen¹; L-M. Tsai¹; J-H. Chen¹¹National Cheng Kung University Hospital, Tainan, Taiwan; ²Tainan Hospital Sin-Hua Branch, Tainan, Taiwan

Background: Decreased global longitudinal strain (GLS) of left ventricle (LV) was noted in heart failure with preserved ejection fraction (HFpEF). This study investigated the contribution of both GLS and post-systolic shortening of LV to HFpEF in untreated hypertension.

Methods: This study recruited 63 patients (mean age 57 ± 12 years, 34 men) with untreated hypertension with normal LV ejection fraction. All patients did not have overt vascular diseases, valvular heart diseases, renal diseases, and other coronary risk factors. HFpEF was diagnosed based on typical symptoms of heart failure without other known causes. Two-dimensional speckle tracking echocardiography with automated function imaging was used for measurement of GLS and post-systolic strain index (PSI). PSI was calculated as [(post-systolic peak longitudinal strain – end-systolic strain)/end-systolic strain] $\times 100\%$. Mitral early filling velocity to average mitral annulus early velocity ratio (E/e') was used as an index for LV filling pressure.

Results: HFpEF was diagnosed in 17 patients (27%). Patients with HFpEF had lower early mitral velocity, lower mitral early to atrial velocity ratio, and longer isovolumic relaxation time. There were no differences in biplane LV ejection fraction, blood pressure, heart rate and body weight. GLS was significantly lower (-16.1 ± 3.1 vs. $-19.1 \pm 3.1\%$, $p = 0.001$), and PSI (303 ± 249 vs. $84 \pm 51\%$, $p < 0.001$), left ventricular mass index (110 ± 38 vs. 87 ± 22 gm/m², $p = 0.006$), E/e' (12.2 ± 3.5 vs. 8.5 ± 1.8 , $p < 0.001$) were significantly higher in patients with HFpEF. Multivariable analysis showed GLS (OR 1.695, 95%CI 1.055-2.723, $p = 0.029$), PSI (every 10% increment OR 1.159, 95%CI 1.029-1.304, $p = 0.015$), and E/e' (OR 1.798, 95% CI 1.053-3.071, $p = 0.032$) were independent factors for HFpEF. Area under receiver-operating characteristics curve for diagnosis of HFpEF was 0.888 for PSI, 0.814 for E/e', and 0.757 for GLS.

Conclusions: Both systolic strain and post-systolic shortening were contributed to HFpEF. PSI had significant effect on HFpEF in untreated hypertension.

P321**Nt-ProBNP and ventricular global function in pulmonary hypertension. 2D-Strain study.**L. Sargento; M. Satendra; S. Longo; N. Lousada; R. Palma Reis
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Introduction: Nt-ProBNP is an important prognostic marker in heart failure patients

Objective: Assess Nt-ProBNP relationship with right (RV) and left (LV) ventricles global function evaluated by TDI and 2D-strain parameters.

Methods: 20 patients, age 65.4 ± 13.5 , with PAH on specific therapy, median Nt-ProBNP 730, TAPSE 21.0 ± 5.7 , RV ejection fraction $36.7 \pm 18.4\%$, pulmonary artery pressure (PAP) 85.9 ± 15 mmHg. RV and LV longitudinal global strain (GS), tricuspid annulus TDI S wave, Mitral S and A wave and TAPSE evaluated. Relationship between parameters evaluated with Spearman correlation coefficient and linear regression model (backward method). Nt-ProBNP was grouped accordingly to the tertiles (730.0 and 1029.0pg/ml).

Results: (1) Nt-ProBNP correlated with: (i) RV function: TAPSE ($r = -0.583$ $p = 0.007$), TrS ($r = -0.539$ $p = 0.017$), RV-GS ($r = 0.563$ $p = 0.010$), RV-GSRs ($r = 0.485$ $p = 0.03$) and RV-GSRa ($r = -0.654$ $p = 0.006$). (ii) LV function: Mt-A ($r = -0.599$ $p = 0.031$), LS-GS ($r = 0.585$ $p = 0.008$) and LV-GSRa ($r = 0.565$ $p = 0.022$). By multiregression the independent predictors of Nt-ProBNP were TAPSE ($p = 0.08$), TrS ($p = 0.017$), RV-GSRa ($p = 0.019$) and LV-GSRa ($p = 0.027$). (2) Greater Nt-ProBNP tertiles (see table) greater the LV and RV dysfunction.

Conclusion: In pulmonary hypertension Nt-ProBNP is associated with systolic and diastolic parameters; however it's mainly dependent on RV and LV longitudinal strain markers of diastolic dysfunction.

Parameters by Nt-ProBNP tertiles

	Nt-ProBNP Tertiles			P value
	<287	287-1029.0	>1029.9	
TAPSE	23.6 ± 3.9	22.2 ± 7.3	16.9 ± 3.2	0.032
Tr-S vti	23.8 ± 4.2	20.5 ± 6.6	12.9 ± 6.1	0.021
Mt-A	10.7 ± 1.1	10.1 ± 1.2	5.1 ± 1.7	0.036
RV-GS	-18.9 ± 3.3	-10.8 ± 2.4	-13.9 ± 4.9	0.006
RV-GSRs	-1.12 ± 0.26	-0.65 ± 0.15	-0.75 ± 0.12	0.005
RV-GSRa	1.28 ± 0.30	0.70 ± 0.41	0.37 ± 0.38	0.012
LV-GS	-18.7 ± 2.8	-15.3 ± 3.3	-13.5 ± 5.9	0.061
LV-GSRa	1.33 ± 0.33	1.10 ± 0.24	0.78 ± 0.24	0.041

P322**Systemic lupus erythematosus: impact of myocardial strain evaluated by speckle tracking**

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Systemic lupus erythematosus (SLE) may be associated with pulmonary hypertension and left ventricular dysfunction, which have clinical impact.

The purpose of this study was to evaluate myocardial deformation using speckle tracking echocardiogram in patients with SLE and normal left ventricle ejection fraction (LV EF), for the detection of earlier ventricular function disturbances when LV EF is still normal.

Methods: 55 (consecutive) patients with SLE (39 ± 4 years; 50 female) were studied. Patients with LV EF $< 55\%$, hypertension, ischemic or valvular heart disease were excluded. A control group was composed by 17 healthy subjects (37 ± 4 years; 13 females). The parameters analyzed in both groups were: global systolic strain and strain rate (two-chamber, four-chamber and short-axis), left atrium volumes and ejection fraction, E/E' mitral and Tei index.

Results: The quality of image was adequate to the study by speckle-tracking in most studies, rejecting readings in $< 1\%$ of the segments. Compared with the control group, volumes and LV EF of patients with SLE did not differed significantly, as well as left atrium volumes and ejection fraction and global systolic strain. Patients with SLE showed significantly lower global strain rate than the control group (-0.97 ± 0.20 vs -1.14 ± 0.17 , $p = 0.01$), and also significantly increased Tei index ($00:40 \pm 0:11$ vs $0:31 \pm 0.03$, $p = 0.01$).

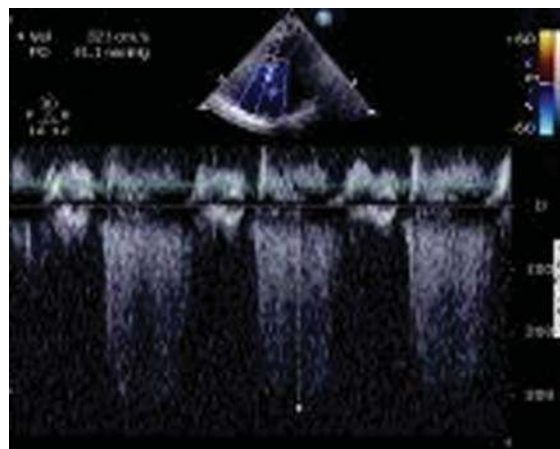
Conclusion: Myocardial deformation assessed by speckle tracking and Tei index may detect early cardiac involvement in patients with SLE and normal LV EF. Clinical and prognostic impact of these findings should be examined in future studies

P323**Sildenafil inhibits altitude-induced pulmonary hypertension on One Day Ascent to Mount Fuji**M. Iwase¹; Y. Itou¹; S. Yasukochi²; K. Shiino¹; H. Inuzuka¹; K. Sugimoto¹; Y. Ozaki¹
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Exposure to high altitude especially with rapid ascent would induce pulmonary hypertension that may lead to life-threatening conditions. The oral sildenafil was effective for pulmonary hypertension and this study was intended to examine its effectiveness on one day rapid ascent to Mt. Fuji (3775m) in normal subjects.

Twelve subjects were exposed to 3,775 m at top of mount Fuji from sealevel to 2400m with automobile and then to ascent with their own foot.

Systolic TR pressure gradient (echocardiography) increased from 15.6 mm Hg (CI, 9.0 to 21.0 mmHg) at sealevel to 23.1 mmHg (CI, 8.0 to 41.0 mmHg) at 3775m. Two subjects showed TR PG > 30 mmHg (32 & 41 mmHg) and they took oral sildenafil of 50mg and TR PG decreased from 37 to 28mmHg after 30minutes with headache. In conclusion, a rapid one day ascent to Mt. Fuji might induce pulmonary hypertension and the oral sildenafil could relieve pulmonary hypertension with minimum side effect.

**P324****Systemic endothelial function and risk for pulmonary hypertension in connective tissue diseases.**K. Gieszczyk-Strozik¹; A. Sikora-Puz¹; M. Mizia¹; B. Lasota¹; A. Chmiel¹; A. Lis-Swiety²; J. Michna¹; L. Brzezinska-Wcislo²; K. Mizia-Stec¹; Z. Gasior¹¹2nd Department of Cardiology, Medical University of Silesia, Katowice, Poland; ²Department of Dermatology, Medical University of Silesia, Katowice, Poland

Background: Pulmonary artery hypertension (PAH, Pulmonary Artery Hypertension) is the most serious cardiopulmonary findings in patients with connective tissue diseases (CTDs, Connective Tissue Diseases) and its early identification is of critical value for proper diagnosis, treatment and final prognosis. PAH is characterized by pulmonary endothelial dysfunction and intense smooth muscle cell proliferation. There are limited data regarding to potent relationship between pulmonary pressure and systemic endothelial function.

Aim: was to assess relationship between systemic arteries' vasodilatation and risk for PAH established by standard transthoracic echocardiography (TTE, Transthoracic Echocardiography) in patients with CTDs.

Material and methods: 32 patients (K/M: 27/5, age: 55.8 ± 3.1 years) with CTDs (30 - systemic scleroderma, 2 - systemic lupus erythematosus) were enrolled into the study. Pulmonary fibrosis and extrasystemic causes of pulmonary hypertension were excluded in all patients. Clinical data, TTE parameters, baseline brachial artery diameter (BAD, Brachial Artery diameter), flow-mediated dilatation (FMD, Flow-Mediated Dilatation) and nitroglycerin-mediated dilatation (NMD, Nitroglycerin -Mediated Dilatation) were assessed in all subjects. According to the values of tricuspid regurgitation velocity (TRV, Tricuspid Regurgitation Velocity) and right ventricular systolic pressure (RVSP, Right Ventricular Systolic Pressure) all patients were divided into the three groups: the PH unlikely - group I (n=21), the PH possible - group II (n=7) and the PH likely - group III (n=4).

Results: Mean FMD values were comparable between the groups I, II and III (12.6 ± 8.2 vs 11.5 ± 8.6 vs $14.8 \pm 6.6\%$, respectively; $p=0.84$). The group III showed increased NMD values compared to the group I and II (group I, II, III, respectively : 21.6 ± 8.6 vs 15.0 ± 6.5 vs $41.3 \pm 13.9\%$, $p=0.01$). Mean values of baseline BAD were as follows: 3.37 ± 0.8 vs 3.11 ± 0.3 vs 2.76 ± 0.8 mm in the groups I, II and III. The BAD values correlated to FMD ($r = -0.68$, $p=0.03$) and NMD ($r = -0.71$, $p=0.02$) in the entire examined groups.

Conclusions: Systemic endothelial function defined as brachial artery vasodilatation does not correlated to the risk for PAH in patients with CTDs.

BASICS IN CONGENITAL HEART DISEASE IN THE ADULT

P325

Mitral valve pathology in aortic coarctation

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Purpose: Aortic coarctation (CoA) is a typical left-sided obstructive lesion. Mitral valve pathology has only been described in the context of Shone's complex, a severe type of congenital left-sided obstructive lesion of multiple cardiovascular levels, including CoA. However, the prevalence of mitral valve pathology in adults after coarctation repair has never been evaluated. The aim of this study was to describe the mitral valve apparatus in consecutive CoA patients after repair.

Methods: Echocardiograms of 58 consecutive adults after coarctation repair were retrospectively analyzed. The presence of mitral valve stenosis (MS) (gradient > 5 mmHg) and or mitral valve insufficiency (MI) was determined. The mitral valve annulus was evaluated in end diastole and end systole, in the parasternal long axis-, short axis-, and apical four- and two-chamber views. Mitral valve parameters were compared with normal values as described in the literature. Additionally the aortic valve morphology was determined.

Results: Fifty-eight adult patients (mean age 35.7 years, range 18-82 years; male 61%) were included. Thirty-six patients (62%) had BAV. Mitral valve prolaps was found in 2 patients, double orifice mitral valve in 2 patients. MS was found in 3 patients (all BAV patients). Moderate to severe MI was found in 29 (50%) patients. An increased pressure half time was found in 8 (14%) patients (7 BAV patients). Patients with an increased PHT demonstrated a significantly shorter end systolic annulus length in the 4 chamber view. Of all patients without MI and MS, 6 (10%) patients (5 BAV patients) demonstrated a peak E wave > 105 mm/s and 3 patients a peak A wave > 82 mm/s. Patients with an increased peak E wave had a significantly shorter end systolic-, and end diastolic mitral valve annulus length in the parasternal long axis view as compared to patients with a normal peak E wave. ($P=0.008$ vs $P=0.03$). Of the patients without MI and MS, 13 patients (45%) showed a shorter end- systolic and end-diastolic mitral valve annulus length as compared to literature reference values.

Conclusion: These findings provide new insights into the mitral valve apparatus in adults after CoA repair, and demonstrate that mitral valve abnormalities are present even in CoA patients without MI or a significant gradient. These findings might suggest that mitral valve abnormalities have a developmental origin in these patients.

P326

Correct identification of mitral valve anomalies of insertion changes the therapeutic approach to the patients affected by misdiagnosed severe left ventricular hypertrophy.

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Purpose: Mitral valve anomalies of insertion are not so rare but often misdiagnosed and confused with other pathologies (HCM, subaortic stenosis, storage diseases). Hypertrophic cardiomyopathy in particular is associated in 5-8% of the cases to mitral valve anomalies: in these patients differential diagnosis is mandatory. Five different types of mitral valve anomalies of insertion have been identified. The most frequent type is associated to left ventricular outflow gradient, significant mitral regurgitation and left ventricular hypertrophy. Medical therapy is not so beneficial and surgical therapy is decisive, hence recognition of such anomalies has a strict relation to prognosis for the patients affected. Our aim was to evaluate the importance of correctly identifying mitral

valve anomalies of insertion as a possible cause of left ventricular hypertrophy, in order to decide the appropriate therapeutic approach for these patients.

Methods: From 1990 to 2011 we have found 18 cases of patients with mitral valve anomalies of insertion during the daily routine activity in our Echocardiography Laboratory. These patients were previously diagnosed as affected by congenital hypertrophic cardiomyopathy or severe left ventricular hypertrophy without a clear etiology. All the patients had a significant left ventricular outflow gradient and different degrees of mitral regurgitation.

Results: The specific anomalies in the 18 patients were: anomalous insertion of the mitral valve tissue on the ventricular wall in 13 patients and accessory valvular tissue in 5 patients. There were no other cardiac abnormalities associated. The identification of the specific cause avoided inappropriate therapies such as defibrillator implantation. Three patients underwent surgical repair: the simple disinsertion of the anomalous tissue allowed complete disappearance of the outflow gradient, complete or significant reduction of the mitral regurgitation and progressive reverse remodeling of the left ventricle with regression of the left ventricular hypertrophy, as shown in the post-operative echocardiograms.

Conclusions: Correct identification of mitral valve anomalies as a possible etiology of ventricular hypertrophy is fundamental to address such patients to the correct therapeutic pathway, including surgical repair as a choice for a definitive solution. Most importantly, the diagnosis of these specific mitral valve abnormalities has a great prognostic relevance towards more severe diseases such as Hypertrophic cardiomyopathy, the latter having a totally different prognostic and therapeutic impact.

MASSES, TUMORS AND SOURCES OF EMBOLISM

P327

Thrombi on the Amplatzer Cardiac Plug after LAA occlusion: evaluation of potential echocardiographic risk factors

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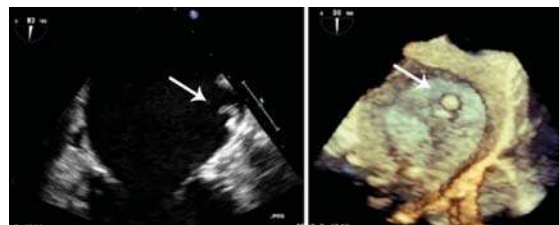
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Background: Percutaneous left atrial appendage (LAA) occlusion is a novel approach for stroke prophylaxis in patients with atrial fibrillation and contraindications for oral anticoagulation. The Amplatzer Cardiac Plug (ACP) consists of a lobe anchored in the LAA with a connected disk shielding the LAA ostium. We observed 6 cases with thrombus formation on the device. We analyzed pre interventional echocardiographic parameters to identify potential risk factors.

Methods: LAA occlusion was performed in 34 patients (CHADS2 score ≥ 2) with the ACP under conscious sedation. Post interventional dual antiplatelet therapy was initiated according to manufacturer's instructions of use. Transthoracic (TTE) and transesophageal echo (TEE) were performed pre interventionally as well as pre discharge, 3 and 6 months TEE follow ups. Pre procedural ejection fraction (EF), left atrial volume index (LAVi), LAA velocity, spontaneous echo contrast (SEC, scored 0 to 4) and transmitral gradient (TMG) were analyzed.

Results: In 36 procedures 34 ACP were implanted successfully. 2 ACP could not be placed due to an inappropriate anatomy. Mean occluder size was 24.1 ± 3.1 mm. In 3 patients thrombus was detected in the pre discharge TEE, in 3 further patients after 3 months. Mean EF was $50.6 \pm 11.4\%$ in the non-thrombus vs. $39.7 \pm 10.6\%$ in the thrombus group ($p = 0.039$, significant). LAVi was 46.9 ± 20.8 vs. 56.6 ± 14.2 ml/m² ($p = 0.285$), LAA velocity was 51.3 ± 25.1 vs. 36.8 ± 17.7 cm/s ($p = 0.194$), SEC was 1.3 ± 0.9 vs. 1.5 ± 0.5 ($p = 0.632$) and TMG was 1.9 ± 2.0 vs. 1.4 ± 0.5 mmHg ($p = 0.568$).

Conclusions: Thrombus formation on the ACP device is a serious complication. The EF was significantly lower in the thrombus group and could be therefore identified as a potential risk factor under the current antiplatelet regime.



2D & 3D TEE with thrombus on ACP

P328

Carotid Intima-Media Thickness not carotid plaque is an independent predictor of recurrence in the patients with ischemic stroke

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Background: Common carotid artery intima-media thickness (IMT) and carotid plaque are established vascular risk factors and are considered to be an early marker of carotid atherosclerosis. In this study, we explore the potential value of carotid IMT

P332**Stress echocardiography in older patients with suspected coronary ischaemia. Survival analysis study**

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Background and purpose: Prevalence rates of Coronary Heart Disease (CHD) increase with age, with around one in four men and one in five women aged 70 years and above living with CHD. Stress Echocardiography has high sensitivity and specificity for coronary ischaemia. In this study we assess the diagnostic impact of stress echocardiography including Dobutamine and treadmill stress tests in older patients in relation to their event free survival.

Methods: A cohort of patients above the age of 70 years who had stress echocardiography was studied retrospectively. A combined end point was defined as cardiac death, non fatal myocardial infarction and hospital admission with acute coronary syndrome. Stress echocardiography results were coded as normal, one vessel, two vessel or three vessel disease based on the wall motion score index (WMSI). Survival curves were calculated by the Kaplan-Meier method. The log-rank test was carried out to determine significance of differences in survival times and to compare events occurring at all time points on the survival curves.

Results: 509 cases were studied, 299 (59%) males and 210 (41%) females with mean age 77 years (70-93) and a median follow up period of 42 months. 406 (80%) patients had Dobutamine Stress Echocardiography and 101 (20%) patients had Treadmill Stress Echocardiography. There was no evidence of inducible coronary ischaemia in 278 (54.7%) patients with median survival of 74 months. 169 (33.2%) patients had one vessel ischaemia with median survival of 71 months, 47 (9.2%) patients had two vessel ischaemia with median survival of 57 months and 15 (2.9%) patients had three vessel ischaemia with median survival of 44 months. Log Rank test showed the difference in survival times between the different outcome groups to be very significant.

Conclusions: Stress echocardiography findings in older patients correlate well with the Event Free Survival Time. Findings suggestive of multiple vessel coronary ischaemia have worse survival time. This has great implications on risk stratification of older patients with suspected coronary ischaemia with more targeted use of coronary intervention.

P333**Limited exercise capacity after valve replacement for aortic stenosis: the impact of reduced right ventricular systolic function**Y. Zhao¹; P. Lindqvist¹; A. Holmgren²; S. Morner¹; M. Henein¹*¹Heart Centre & Department of Public Health & Clinical Medicine, Umea University, Umea, Sweden; ²Department of Surgery and Perioperative Sciences, Umeå University, Umea, Sweden*

Background: Surgical aortic valve replacement (AVR) for aortic stenosis (AS) results in depressed right ventricular (RV) systolic function but the relationship between such disturbances and exercise capacity remains unknown.

Material and Methods: Exercise capacity and RV systolic function were assessed in 21 AVR patients (age 61 ± 12 years, 14 male) using conventional semi-supine bicycle exercise together with fully equipped Doppler echocardiographic set-up. Peak oxygen consumption (pVO₂) as well as conventional and systolic myocardial velocity (Sm) from RV free wall was measured at rest, suboptimal, peak exercise and 4 min after exercise. The data were compared with 21 age and gender matched controls.

Results: At rest, patients had normal left ventricular ejection fraction (LVEF). pVO₂ at peak exercise was lower in patients than controls (18.5 ± 4.5 vs. 22.1 ± 4.3 l/min/kg, p=0.02). RV Sm was depressed at rest in patients (8.4 ± 1.4 vs. 11.4 ± 2.0 cm/s, p<0.001). During exercise, RV Sm failed to increase as controls (suboptimal exercise: 10.7 ± 2.6 vs. 15.1 ± 2.3; peak exercise: 11.3 ± 2.6 vs. 17.4 ± 2.5 cm/s; 4 minutes after exercise: 9.3 ± 1.9 vs. 13.5 ± 2.8 cm/s, p<0.001 for all).

In patients and controls as a whole, pVO₂ correlated with RV Sm at rest (r=0.52, p=0.01) and peak exercise (r=0.47, p=0.002).

Conclusion: Exercise capacity is subnormal after AVR for AS, irrespective of normal LVEF and lack of symptoms. RV systolic function is reduced after AVR and failed to increase normally during exercise. Finally, it remains an important correlate with the patients' exercise capacity.

P334**Imaging of expiratory gas exchange in detection of diastolic dysfunction in patients with hypertension : Combined stress echocardiography cardiopulmonary exercise testing**I. Nedeljkovic¹; M. Ostojic¹; V. Giga¹; J. Stepanovic¹; A. Djordjevic-Dikic¹; B. Beleslin¹; M. Nedeljkovic¹; M. Banovic¹; S. Mazic²; V. Stojanov¹*¹Belgrade Medical School, Division of Cardiology, CCS, Belgrade, Serbia; ²University of Belgrade, School of Medicine, Institute of Physiology, Belgrade, Serbia*

Background: Exertional dyspnea and exercise intolerance are a common symptoms in patients with hypertension due to development of hypertensive heart disease and diastolic dysfunction even in patients with preserved LV systolic function. Transmittal flow and tissue Doppler improved the diagnosis and stratification of diastolic impairment significantly. However, simple diagnosis and stratification of patients according to severity of diastolic dysfunction at rest is not accurate without estimation of functional significance of such impairment during cardiopulmonary exercise testing (CPET).

However, relationship between diastolic function and CPET during combine stress echo CPET is still unknown.

Objective: To determine the usefulness of combined Stress echo CPET in evaluation of patients with hypertension, exertional dyspnea and normal baseline systolic and diastolic function.

Methods: We studied 47 pts (28 male, mean age 51 ± 14 years), with the history of essential hypertension, exertional dyspnea and normal baseline echo characteristics (including normal baseline systolic and diastolic function). They all underwent CPET with supine ergometer with incremental ramp protocol, with breath by breath gas analysis, in combination with simultaneous 2D echocardiographic monitoring during exercise. Diastolic function was assessed by analyzing transmitral flow pattern using pulse Doppler and tissue Doppler (TDI) of mitral annulus. Mitral E wave / E wave of mitral annulus ≥ 8 was cut off for diastolic function.

Results: Worsening of diastolic function was found in 13 (38%) pts during combined CPET stress echo test. Patients with diastolic dysfunction were older (p=0.001), and had lower peak VO₂ (p=0.0001), shorter time to VAT (p=0.028) and shorter total exercise time (p=0.017), and higher VE/VCO₂ slope (p=0.0001). However multivariate analysis showed that only VE/VCO₂ was independent predictor of diastolic dysfunction during CPET (p=0.001; RR 1.68; 95%CI : 1.24 -2.24). We also found the strong correlation between VE/VCO₂ slope and E/Em (r=0.70; p=0.0001) which can be also used for stratification of pts with diastolic dysfunction.

Conclusion: Combined CPET stress echocardiography as a new test improves clinical assessment of diastolic function in patients with exertional dyspnea and normal baseline LV function. It adds more information to echocardiography and to CPET as a single tests. The best predictor of development of diastolic dysfunction during CPET was VE/VCO₂ slope, showing the strong relationship with E/Em as a measure of diastolic function.

P335**Utility of stress echocardiography in selecting the optimal mitral valve procedure in patients with moderate ischemic mitral regurgitation undergoing coronary artery bypass grafting**

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Optimal surgical management of moderate chronic ischemic mitral regurgitation (IMR) in patients (pts) qualified for coronary artery bypass grafting (CABG) is still controversial. This study aimed to prospectively assess the proposed diagnostic algorithm based on stress echo (ExE and dobutamine stress echo-DSE) for the appropriate surgical procedure: CABG alone or CABG+mitral annuloplasty (CABG+P) in pts with moderate IMR.

Methods: A total of 100 pts aged 18-75, with a history of myocardial infarction and moderate IMR, eligible for CABG were included in a prospective study. Patients were referred for CABG (gr.1; n=74) or CABG+P (gr.2; n=26) based on clinical assessment, 2D echo at rest and exercise as well as myocardial viability analysis (low dose DSE). Effective regurgitation orifice area (EROA) was used for quantitative IMR assessment (moderate: EROA ≥10 and < 20 mm²). Prior to surgery tenting area (TA) and coaptation height (CH) were assessed. One year after the surgery each pts underwent the evaluation of cardiovascular events.

Results: In both groups (CABG vs CABG+P) no significant differences were observed in: 30-day (1% vs 8%; p=0.103) and 12-month mortality (3% vs 12%; p=0.075), hospitalizations due to the heart failure (HF) exacerbation (5% vs 15%; p=0.107), and incidence of stroke (1% vs 8%; p=0.103). Receiver-operating characteristics (ROC) curves demonstrated that in both groups preoperative TA was strong independent predictor of adverse outcomes (NYHA III/IV symptoms and HF hospitalizations) in 12 months follow-up. The best cut-off value for TA was 2 cm² (sensitivity 83%, specificity 68%; AUC 0.72) in CABG group and 2.6 cm² (sensitivity 100%, specificity 63%; AUC 0.776) in CABG+P group. The analysis of the complex end-point (deaths/CV hosp/stroke) revealed a statistically significant difference between CABG and CABG+P groups (9% vs 35%pts; p=0.003). The most important predicting factors for the complex endpoint were: presence of atrial fibrillation (AF) before surgery (p=0.035) and the size of tenting area (TA) of the mitral valve (p=0.005).

Conclusions:

1. The strategy of the preoperative pts qualification (ExE, DSE), allows obtaining similar results with reference to 30-day and 12-month survival rates, incidence of HF hospitalizations and strokes, regardless of the surgical procedure performed.
2. AF before the surgery and TA were strong predictors of cardiovascular events in 12-month follow-up.
3. The application of proposed diagnostic algorithm may improve qualification of patients with moderate FIMR for a suitable type of surgical procedure.

TRANSESOPHAGEAL ECHOCARDIOGRAPHY**P336****Transesophageal echocardiography in the diagnosis of lost silicone tubes after transvenous lead extraction.**

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Purpose: Lead breakage is known but serious complication of transvenous lead extraction (TLE). This study stress the role of transesophageal echocardiography (TEE) in detection and management of this rare complication of TLE.

Methods: TLE procedures were performed in 758 patients, aged 5-91y. (av. $64.7 \pm 16.9y$). The TLE interventions were accomplished with the use of mechanical system of telescopic polypropylene Cook's and Byrd dilators. The TEE was done routinely before and after TLE.

Results: The analysis included 758 TLE procedures with 1113 lead extraction. In this group we found 37 lead breakage in 35 patients. In 32 patients the following TLE intervention managed to remove the broken leads with use of basket or lasso catheters. Only 3 patients were scheduled for planned cardiac surgery. During broken lead extraction the external lead silicone tube was lost in 7 patients. The broken internal metal conductor was removed transvenously but the silicone tube remained in the heart cavities. The lack of silicone tube was discovered intraoperatively ($n=4$) and confirmed by TEE. In 3 patients it was diagnosed by TEE only. In TEE silicone tube has lead appearance but different movement (elastic and gentle in the contrary to the rigid lead). Despite impossibility of X-ray visualization silicone tubes were removed transvenously in all 7 patients via jugular or femoral approach.

Conclusions:

1. TEE is the excellent method in the diagnosis and management of lost silicone tubes after TLE.
2. Lead breakage appears in 4.6% among TLE procedures and in 3.3% among extracted leads. The remnants may be usually removed transvenously.
3. Broken lead fragment extraction can be complicated by lead silicone tube loss. It may be suspected intraoperatively and confirmed by TEE. It occurs in 0.5% TLE procedures but in 20% of lead fragment extraction interventions.

P337

Relationship between circumflex artery and mitral annulus using Real Time 3 D transesophageal echocardiography in patients undergoing surgical mitral valve repair

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Purpose: During surgical mitral valve repair distortion or damage of the circumflex coronary artery (CX) is a rare but well known complication. One of the possible risk factors is the proximity of the CX to the mitral annulus which varies from patient to patient. Aim of this study was to investigate the feasibility to define the anatomical relationship between the CX and the mitral annulus with the help of Real Time (RT) 3D TOE.

Methods: After induction of anaesthesia a 3D TOE probe (iE 33, Philips Amsterdam, The Netherlands) was introduced and additionally to a comprehensive perioperative 2D TOE a RT 3D FV dataset and 3D zoom loop were recorded in midesophageal four chamber view and long axis view. The distance between CX and the mitral annulus, the diameter of the CX and the height of the CX in relation to mitral annulus were measured offline by two independent examiners using Qlab software® (Philips, Netherlands). All patients included in this study underwent preoperative angiographic evaluation of their coronary anatomy. Values are expressed as means with minimal and maximal values.

Results: After approval of the local ethic committee and written informed consent 30 patients with a mean age of 66 ± 12 years undergoing elective minimally invasive mitral valve repair were included in this study. Measurements of the CX were possible in all patients. The distance between the CX and the mitral annulus was 0,80mm ranging from 0,36 to 1,16. The diameter of the CX was 0,32 ranging from 0,13 to 0,54mm. Interobserver variability was 0,01mm for both measurements. Mean height of the CX in relation to the mitral annulus was 0,16 ranging from -0,4 to 0,54 with an interobserver variability of 0,1mm.

Conclusions: This study shows that it is feasible to measure the relationship between CX and the mitral annulus with the help of RT 3D TOE.

CONTRAST ECHOCARDIOGRAPHY AND TISSUE HARMONIC IMAGING

P338

Does contrast echocardiography still have a role for diagnosing left ventricular thrombus in patients following ST elevation myocardial infarction?

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Background: Left ventricular (LV) thrombus is reported in 4-17% of patient following acute myocardial infarction in the era of reperfusion therapy. This diagnosis has significant implications for patients in terms of risk of embolic complications and anticoagulation requirements.

Aim: We hypothesized that recent improvements in Echo equipment technology may reduce the need for contrast agents for the diagnosis of LV thrombus in this setting.

Methods: We reviewed the records of consecutive patients presenting to our institution with ST elevation MI (STEMI) and recorded the results of echocardiography using latest generation equipment, use of contrast and diagnosis of LV thrombus.

Results: 489 patients presented with STEMI between 01 Jan 2009 and 31 May 2010. 468 of these underwent at least one transthoracic echocardiogram. Median time to first echocardiogram was 1 day. It was possible to rule out thrombus in 407 (87%) patients. However, it was only possible to confidently diagnose LV thrombus in 6 patients (12

studies). In 57 studies (48% of studies with suspicion of thrombus) the diagnosis or exclusion of LV thrombus could not be made, despite the use of contemporary, high end scanners. Contrast was subsequently utilised in 40 of these studies and this confirmed the presence of thrombus in 13 studies and excluded it in the remainder.

Conclusion: LV thrombus is not an uncommon diagnosis following STEMI and has significant implications for patient care. Despite significant improvements in the resolution and image quality of contemporary ultrasound systems, contrast is still required in a substantial proportion of studies to rule in or out the presence of LV thrombus.

P339

Incremental value of contrast enhanced ultrasound (CEUS) for detection of carotid atherosclerosis.

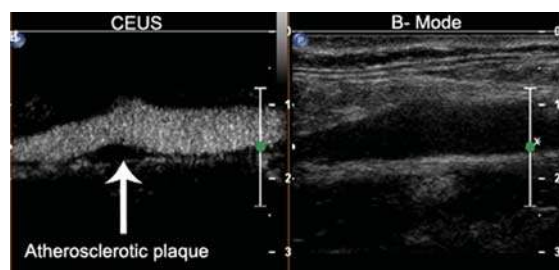
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Purpose: Atherosclerotic plaques on carotid ultrasound are associated with cardiovascular events and may be considered for cardiovascular risk prediction. The sensitivity of carotid ultrasound for detection of atherosclerosis is suboptimal. Contrast enhanced ultrasound (CEUS) provides an accurate delineation of the carotid lumen and may improve detection of atherosclerotic plaques.

Methods: Fifty patients from the outpatient clinic, with ≥ 1 risk factor were included. Bilateral carotid B-Mode ultrasound and CEUS were performed using a Philips iU22 ultrasound system (Bothell, USA), with a L9-3 probe. CEUS was performed by intravenous administration of Sonovue (Bracco, Milan, Italy). The ultrasound clips were digitally stored and reviewed by 2 independent observers. Atherosclerotic plaque was defined as a structure with a thickness >1.5 mm, encroaching the lumen for >0.5 mm or encroaching the lumen for $>50\%$ of the intima-media thickness. McNemar testing was used for comparison between groups.

Results: Using B-Mode ultrasound the observers detected plaques in 65 (65%) and 69 (69%) carotid arteries respectively. Combining B-Mode ultrasound with CEUS both observers detected plaques in 83 (83%) carotid arteries. Using B-Mode ultrasound observer 1 detected carotid atherosclerosis in 38 patients and with CEUS in 9 (18%) additional patients ($p < 0.01$). Observer 2 detected carotid atherosclerosis in 39 patients using B-Mode ultrasound and in 7 (14%) additional patients with CEUS ($p < 0.05$). The figure shows an atherosclerotic plaque visualized with CEUS (left panel) and was not detected on B-mode ultrasound (right panel).

Conclusion: CEUS has a significant incremental value for detection of carotid atherosclerosis, and can be easily incorporated into a standard carotid ultrasound examination.



P340

The usefulness of ROI, an innovative tool to measure the density in contrast-enhanced ultrasound imaging of atherosclerotic carotid plaque neovascularization.

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Background: The presence of adventitial vasa vasorum and the occurrence of plaque vascularization have been considered as predictors of unstable lesions in cerebrovascular and cardiovascular patients. Contrast-enhanced ultrasound imaging of the carotid arteries (CECU) permits direct, real-time visualization of neovascularization of the presence of atherosclerotic plaques as well as associated adventitial vasa vasorum. The aim of the study was the assessment of a new, automatically measured index of density ROI in quantitative estimation of the contrast flow through the carotid plaque (till now assessed only visually).

Materials and methods: we studied 34 patients (mean age 70.4 ± 11.4) with ultrasound diagnosed significant stenosis of internal carotid artery (ICA), after cerebrovascular or cardiovascular events, qualified for carotid artery stenting (CAS). The carotid ultrasound examinations were performed using Philips iE33 ultrasound system with QLAB software to measure ROI. The ultrasound contrast agent Sonovue was used.

Results: Visually in 16 patients (47.1%) contrast flow through the atherosclerotic plaque was found. In 17 patients (50%) massive, calcified atherosclerotic plaques were present. Patients with preserved contrast flow through the plaque more frequently

had a history of cerebral stroke ($p=0.04$). There was no relation between the history of ischemic heart disease, previous myocardial infarction, the presence and the progression of atherosclerotic changes in coronary angiography and the degree of calcification of atherosclerotic plaques. Massive calcifications of atherosclerotic plaques correlated with a previous MI ($p=0.03$), but not with a previous cerebral stroke. Contrast flow through the atherosclerotic plaque significantly positively correlated with ROI values, as an index of density ($p<0.00001$, $r=0.69$). In patients with preserved contrast flow the mean value of ROI was 22.24 ± 3.55 dB as compared with 12.37 ± 7.67 dB a value present in patients without preserved contrast flow. No significant relation was found for the degree of calcifications and the value of ROI index.

Conclusions: The assessment of ROI index is a simple and automatic method to estimate the degree of contrast flow through the carotid plaque. The values of ROI correlate with the contrast flow through the atherosclerotic plaque, but not with its calcification.

REAL-TIME THREE-DIMENSIONAL ECHOCARDIOGRAPHY

P342

Assessment of left ventricular mass in hypertrophic cardiomyopathy patients by real-time 3D echocardiography in single-beat capture image; validation with cardiac MRI

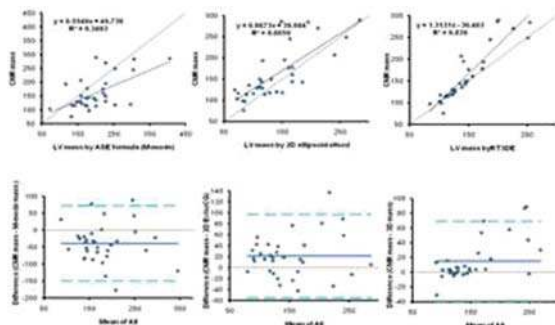
S-A. Chang; S-C. Lee; E-Y. Kim; S-H. Hahm; G-T. Ahn; M-K. Sohn; S-J. Park; J-O. Choi; S-W. Park; J-K. Oh

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Background: Left ventricular (LV) mass is an important prognostic factor in hypertrophic cardiomyopathy (HCM). LV mass can be easily accessed by M-mode or 2D echocardiography; however it includes assumption and might be incorrect in LV with asymmetry. Real time three dimensional echocardiography (RT3DE) has been introduced as an accurate method to assess the LV mass and recently, RT3DE by single beat capture with online analysis program has been introduced. We validated LV mass using new RT3DE technique compared to cardiac magnetic resonance (CMR). Method: Thirty six HCM patients was consecutively enrolled and 3 patients was excluded due to poor RT3DE image. All the patients underwent CMR and RT3DE in a day. LV mass was derived from following method; LV mass calculated from ASE formula (M-mode mass), LV mass from truncated ellipsoid method by 2D echocardiography (2D mass), and LV mass from RT3DE (RT3DE mass). RT3DE image was acquired using SC2000 System. LV mass by CMR was also calculated.

Results: Mean frame rate of RT3DE was 13.1 ± 2.3 frame/second. Pearson's interclass coefficient (ICC) showed close correlation of RT3DE mass and CMR mass ($r=0.92$ and $p<0.0001$). However, M-mode mass and 2D mass had smaller ICC when compared with CMR ($r=0.50$, $p=0.01$ and $r=0.78$, $p<0.001$) Bland-Altman analysis showed reasonable limits of agreement with small positive bias (15.1). Bias was greater in M-mode LV mass and 2D LV mass (-39.1 and 21.2)

Conclusion: LV mass measured by single-beat captured RT3DE is feasible and correct method in HCM patients. Because LV shape is asymmetrical in HCM, LV mass derived from 2D or M-mode is much more incorrect than symmetrical LV. Correct assessment of LV mass using single-beat captured RT3DE will be useful in HCM patients in real clinical practice.



P343

Utility of three-dimensional echocardiography for assessment of mitral paravalvular regurgitation: Comparison to surgical findings

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Purpose: Paravalvular leaks (PVLs) are potential complications of mitral valve replacement. Although most PVLs are asymptomatic and benign, some may cause severe regurgitation leading to reoperation. Evaluation of PVLs by two-dimensional echocardiography is limited. We performed real-time three-dimensional echocardiography

(RT-3D TEE) to observe the en face view of mitral PVLs to localize the defect, and we compared the results to surgical findings.

Methods: The study comprised of 137 patients with paravalvular regurgitation. RT-3D TEE was performed using 3D matrix-array TEE transducer immediately after detection of PVL on 2D TEE examination. The RT 3D TEE showed the the valvular anatomic appearance as seen from the atrial (surgeon's view) and we used the clock-wise format. Clinically ill patients with moderate to severe mitral paravalvular regurgitation underwent reoperation.

Results: Mitral and aortic prosthesis included 107 and 30 patients, respectively. Mitral paravalvular leak was mild, moderate and severe in 18, 32, 57 patients, respectively. Twelve patients (11%) with moderate to severe mitral PVLs underwent reoperation. In preoperative evaluation with RT-3D TEE, 3 patients had PVLs localized anteriorly (11-01), 3 patients laterally (08-10), 3 patients posteriorly (05-07), and one patient medially (02-04). In 2 patients, 2 sites of PVLs (totally, 12 patients with 14 PVLs) were noted. The site of PVLs were all (100%) confirmed at the time of surgery in each patient; 8 of them underwent surgical repair whereas the remaining 4 underwent replacement surgery with successful outcomes.

Conclusion: RT-3D TEE has emerged recently as an essential guide for surgeons, especially in delineating localization and correcting paravalvular leaks.

P344

Comprehensive assessment of left ventricular geometry and function in healthy subjects using three-dimensional echocardiography

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Recent research has identified significant inconsistency for 2D and 3D strain measurements among vendors, reflecting differences in myocardial tracking, strain computation and display. This study is the first to report reference values for 3D LV parameters, including strain, using a recently developed commercially available platform for 3D LV quantitation.

Methods: Eighty healthy volunteers (i.e. no cardiovascular risk factors, symptoms, signs or medication), aged 37 ± 11 (range 18-65 years) with good acoustic window were prospectively enrolled. 3 subjects were excluded due to previously unknown echo abnormalities or unfeasible global strain analysis. 4-beat LV full-volume data sets (31 ± 2 vps) were acquired with Vivid E9 scanner equipped with 4V probe and analyzed offline with EchoPac BT 11 software (GE Healthcare, N). Peak global LV strain components (longitudinal-LS, circumferential-CS, radial-RS, and area strain-AS), as well as LV volumes, ejection fraction, mass and sphericity were obtained from a single 3D LV full-volume acquisition. Reproducibility of LV parameters was assessed on 20 subjects.

Results: A 3D LV data set required <1 min for acquisition and <4 min for analysis. The values of LV parameters obtained from 77 healthy subjects and their reproducibility are listed in Table.

Conclusion. 3D STE is a time-saving and highly reproducible tool for LV quantitation in clinical settings. This study provides the normal ranges and variability of LV parameters pertaining to the specific 3D speckle-tracking platform used in our population.

P345

Assessment of right ventricular volumes three-dimensional echocardiography in patients with acute heart failure: a comparison of 4D RV-function by using volume 4-D RV Tom Tec and 4-D LV Echo PAC Imagi

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Objectives: This study was designed to compare two analytical methods for quantifying right ventricular (RV) size; function and geometry from real-time three-dimensional echocardiographic (4D) data in patients with acute decompensate heart failure (ADHF).

Background: Fast and accurate quantification of RV size and function is critical to managing patients in a variety of clinical settings. RV quantification remains difficult even using 4DE data due to the complex geometry of the ventricle.

Methods: 53 patients (age/sex/EF%) admitted to a heart failure intensive care unit with ADHF and suitable baseline echocardiograms were included to the study. 4DE RV volume data sets were obtained in the apical 4-chamber and subcostal views (Vingmed, System 7, General Electric Healthcare, USA). These were analyzed using 1) software designed specifically for the RV (4-D RV Tom Tec, Germany) and 2) more generic software usually used for LV quantitation (4-D LV Echo PAC, GE Healthcare). RV end-diastolic and end-systolic volumes (EDV and ESV), stroke volumes (SV), and ejection fractions (EF) were determined by both methods and compared with each other for all 53 patients. Linear regression and analysis of agreement were performed for RV EDV, ESV, SV, and EF.

Results: RV EDV and SV were slightly lower on RT 4-D LV Echo PAC imaging when compared to 4-D RV Tom Tec (186.79 ± 53.86 ml vs. 195.86 ± 53.07 ml, $p < 0.005$; 62.35 ± 21.42 ml vs. 68.07 ± 26.46 ml, $p < 0.001$), while there was no significant difference observed for ESV and EF (124.43 ± 41.01 ml vs. 127.79 ± 37.26 ml, $p = 0.16$; $33.8 \pm 8.14\%$ vs. $34.66 \pm 8.52\%$, $p = 0.17$). RV analysis by RT 4D software did not significantly depend on the shape of RV or the overall quality of the images.

Linear regression and Bland-Altman analysis comparing Tom-Tec 4D RV and Echo-PAC 4D LV showed close correlation and agreement between all RV volumes and EF (EDV: $r = 0.82$, mean difference (TomTec minus EchoPAC) = 9.1 ± 22.9 , 95% confidence interval [CI], - 36.6 to 54.9 mL; ESV: $r = 0.82$, mean difference = 3.5 ± 17.3 , 95%

Abstract 50510 Table

3D LV parameters	Mean \pm SD (95%CI)	Intra-observer reproducibility ICC (95%CI)	Inter-observer reproducibility ICC (95%CI)
End-diastolic volume (mL/m ²)	56 \pm 8 (54–58)	0.99 (0.98–1.00)	0.95 (0.88–0.98)
End-systolic volume (mL/m ²)	22 \pm 4 (21–23)	0.99 (0.98–1.00)	0.97 (0.93–0.98)
Ejection fraction (%)	61 \pm 3 (61–62)	0.98 (0.95–0.99)	0.95 (0.88–0.98)
Mass (g/m ²)	72 \pm 7 (70–73)	0.92 (0.81–0.96)	0.87 (0.71–0.94)
End-diastolic sphericity index (%)	0.33 (0.32–0.35)	0.93 (0.83–0.97)	0.86 (0.64–0.95)
Longitudinal strain (%)	-19.9 \pm 2.2 (-19.4 to -20.4)	0.94 (0.85–0.97)	0.92 (0.82–0.97)
Circumferential strain (%)	-19.4 \pm 2.1 (-18.9 to -19.8)	0.97 (0.94–0.99)	0.94 (0.85–0.97)
Radial strain (%)	57.3 \pm 6.8 (55.7 to 58.8)	0.97 (0.93–0.99)	0.94 (0.86–0.98)
Area strain (%)	-34.6 \pm 2.7 (-33.9 to -35.2)	0.97 (0.92–0.98)	0.94 (0.87–0.98)

CI, confidence interval; ICC, intraclass correlation coefficient; LV, left ventricle; SD, standard deviation.

confidence interval [CI], -31.3 to 38.1 mL; SV: $r = 0.79$, mean difference = 5.7 ± 12.3 , 95% confidence interval [CI], -18.8 to 30.2 mL; EF: $r = 0.74$, mean difference = 0.81 ± 4.3 , 95% confidence interval [CI], -7.8 to 9.5%.

Conclusion: Both the RV-specific and more generic volumetric software yielded similar 4D echo RV volume and function data in patients with ADHF. The shorter postprocessing time of the generic software should encourage use of RT 4D echo for rapid RV size and function assessment in patients with ADHF.

TISSUE DOPPLER AND SPECKLE TRACKING

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A novel mathematical based software for modeling the left ventricular myocardium

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Purpose: Currently, an echocardiogram presents the left ventricle (LV) based on images obtained from ultrasound methods. Utilizing mathematical equations, specific echocardiographic data may provide more detailed, valuable and practical information for physicians. In our project using appropriate mathematically based softwares, we have attempted to create a novel software capable of demonstrating LV model in normal hearts.

Methods: Echocardiography was performed on 70 healthy volunteers. Data evaluated included: velocity (radial, longitudinal, rotational and vector point), displacement (longitudinal and rotational), strain rate (longitudinal and circumferential) and strain (radial, longitudinal and circumferential) of all 16 LV myocardial segments. Using these data, force vectors of myocardial samples were estimated by MATLAB and LSDYNA softwares. Dynamic orientation contraction (through the cardiac cycle) of every individual myocardial fiber could be created by adding together the sequential steps of the multiple fragmented sectors of that fiber. This way we attempted to mechanically illustrate the global LV model.

Results: LV Myocardial modeling: Our study shows that in normal cases myocardial fibers initiate from the posterior-basal region of the heart, continues through the LV free wall, reaches the septum, loops around the apex, ascends, and ends at the superior-anterior edge of LV.

Conclusion: We were able to define the whole LV myocardial model mathematically based on echocardiography, by MATLAB software and LSDYNA software in normal subjects. This will enable physicians to diagnose and follow-up many cardiac diseases when this software is interfaced within echocardiographic machines.



Mathematical modeling of the myocardial LV

Mathematical modeling of the myocardium

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Increased systolic strain rate early after transcatheter aortic valve implantation

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Purpose: Transcatheter aortic valve implantation (TAVI) provides a model for studying left ventricular (LV) adaptation to abrupt afterload decrease in a setting without pericardiotomy or cardioplegia.

Methods: 19 patients (6 men, 82 \pm 6 years) were studied one day before and 5 days after TAVI of CoreValve prosthesis, using conventional and speckletracking echocardiography. In parasternal short axis (PSAX) an imaging plane apical to the base of the papillary muscles was used for circumferential and radial deformation and for rotation. Apical 4-chamber was used for longitudinal deformation analysis.

Results: Abrupt relief of severe aortic stenosis was followed by increased systolic strain rate, both circumferentially and radially in parasternal short axis and longitudinally in apical 4-chamber.

Systolic strain and rotation were not significantly increased (cfr Table). Change in heart rate or blood pressure did not correlate with and could not explain changes in any of the deformation variables.

Conclusions: Systolic function early after TAVI was characterized by increased strain rate reflecting a more rapid contraction.

	Before TAVI	After TAVI	p
Heart rate (/minute)	68 \pm 9	71 \pm 10	0.065
Systolic blood pressure (mmHg)	142 \pm 19	128 \pm 15	0.028
Diastolic blood pressure (mmHg)	79 \pm 15	63 \pm 15	0.011
LV ejection fraction	0.64 \pm 0.15	0.64 \pm 0.12	0.942
Peak gradient (mmHg)	79 \pm 26	13 \pm 8	<0.001
Circumferential systolic strain (%)	-18.4 \pm 7.6	-19.2 \pm 8.1	0.347
Circumferential systolic strain rate (%/s)	-1.34 \pm 0.43	-1.80 \pm 0.52	0.003
Time to peak circumferential syst strain rate (ms)	356 \pm 146	323 \pm 101	0.499
Radial systolic strain (%)	21.2 \pm 17.8	26.8 \pm 16.8	0.311
Radial systolic strain rate (%/s)	1.17 \pm 0.45	1.78 \pm 0.74	0.039
Rotation (degrees)	8.8 \pm 4.1	6.4 \pm 7.6	0.311
Rotation rate, systole (degrees/s)	59.4 \pm 16.2	53.5 \pm 47.6	0.807
Time to peak systolic rotation rate (ms)	370 \pm 11	304 \pm 117	0.317
Longitudinal systolic strain (%)	-12.3 \pm 4.0	-13.2 \pm 4.2	0.056
Longitudinal systolic strain rate (%/s)	-0.76 \pm 0.15	-0.96 \pm 0.28	0.017
Time to peak longitudinal systolic strain rate (ms)	387 \pm 73	325 \pm 120	0.093

Changes in LV motion following TAVI.

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Coupling heart vessels in patients with systemic sclerosis: a 2D longitudinal strain and arterial stiffness study

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Purpose: Systemic sclerosis (SSc) is an autoimmune disease with fibrosis involving heart and vessels. Impairment of longitudinal left ventricular (LV) function represents an early stage of LV systolic dysfunction occurring in SSc. Coupling between LV and vessels, particularly in the early stage of LV dysfunction, has not been properly investigated. In our study we evaluated the relationship between LV longitudinal systolic function and arterial stiffness in patients with SSc.

Methods: We studied twenty-nine patients (28 female, mean age 65 \pm 4 years) affected by SSc. A standard echocardiographic study with analysis of LV longitudinal deformation, assessed by 2D strain, was performed; therefore, stiffness parameters (Pulse wave velocity - PWV, stiffness - Beta, Arterial compliance - AC) were evaluated through the study of carotid arteries using the echo-tracking technique, provided by Aloka, Japan. All patients were subdivided in two subgroups according to the median value of longitudinal strain (LS). The Student's T test and Spearman's coefficient were used to compare variables between subgroups and to evaluate correlations between variables, respectively. A p value < 0.05 was considered statistically significant.

Results: All patients showed normal values of LV ejection fraction (EF) and end-diastolic/systolic volumes (EDV and ESV) [EF: 64 \pm 6%, EDV: 83 \pm 15 ml; ESV: 33 \pm 14 ml]. LS was -13.1 \pm 4.8% (median value -13.5%), whereas beta, PWV and AC were, respectively, 6.5 \pm 1.5, 9.5 \pm 4.2 m/sec and 0.77 \pm 0.41 mm²/kPa. Patients with lower LS (< 13.5%), showed a significantly increased beta (11.1 \pm 3.9 vs 8.1 \pm 4.1, p 0.04) when compared with subjects with greater LS (> 13.5%); no significant differences were found between the two subgroups regarding the other stiffness parameters (PWV: 6.9 \pm 1.5 vs 6.1 \pm 1.3 m/sec; AC: 0.7 \pm 0.2 vs 0.9 \pm 0.5 mm²/kPa, p ns for both). Furthermore a significant correlation was found between beta and LS (r 0.41, p 0.03).

Conclusions: Impaired LS may be an early sign of abnormal LV/vessels coupling related to arterial stiffness in preclinical patients with SSc. Two-dimensional strain and echo-tracking allow, non invasively, a quantitative assessment of LV function and arterial stiffness. These techniques can be considered sensitive diagnostic tools for the early identification of abnormal LV-arterial coupling.

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In patients with hypertrophic cardiomyopathy myocardial fibrosis is associated with both left ventricular and left atrial dysfunction.

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Aims: To assess left (LV) and right ventricular (RV) function by two-dimensional speckle tracking echocardiography and its relation to myocardial fibrosis in hypertrophic cardiomyopathy (HCM).

Methods: We enrolled 50 HCM patients (30 male; 47.3 ± 9.9 years) in our study. Each patient received echocardiography with modern high-end scanners (GE Medical Systems, Vivid 7, Horten, Norway). For speckle-tracking analysis of LV and RV function the dedicated software (EchoPac PC, same vendor) was used. The presence of myocardial fibrosis was detected by cardiac magnetic resonance imaging (MRI).

Results: We found a correlation of $r=0.89$ ($p<0.001$) for intra-observer variability of RV global longitudinal strain with a minor bias of $4.9 \pm 2.9\%$. With cardiac MRI 30 patients (60%) demonstrated late gadolinium-enhancement (LGE) of the LV. Of these patients only 7% had LGE of the RV. HCM patients with myocardial fibrosis had less global longitudinal LV strain in comparison to patients without myocardial fibrosis (-12.8 ± 2.2 vs. -21.1 ± 2.6 , $p<0.001$), thicker interventricular septums (23.7 ± 4.0 vs. 19.2 ± 5.1 , $p<0.001$), larger left atria (34.9 ± 7.1 vs. 23.9 ± 5.1 , $p<0.001$) and impaired diastolic function (E/A-ratio: 1.02 ± 0.22 vs. 1.15 ± 0.18 , $p<0.01$). Comparable results were found for RV function. LV and RV strain correlated with $r=0.85$ ($p<0.001$).

Conclusions: HCM is not only a disease of the LV. LGE in HCM is associated with both LV and RV dysfunction. Fibrosis seems to have a negative impact on disease progression. Although RV LGE occurs only in a minority of patients with HCM and LV fibrosis, speckle-tracking echocardiography is feasible for evaluating LV and RV remodeling in these patients.

P350
2D longitudinal strain: does it match conventional echocardiographic parameters of left ventricle performance in acute myocardial infarction?

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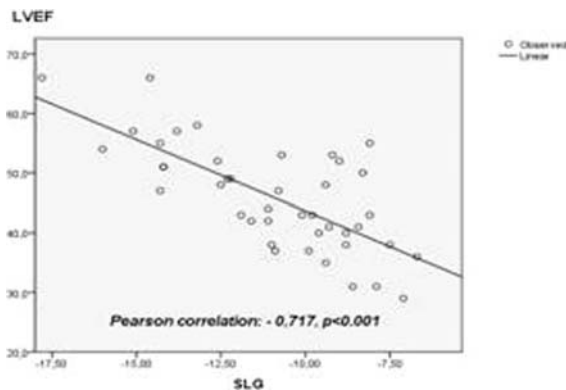
Longitudinal strain is an useful echocardiographic parameter of regional and global LV performance, being described as independent from loading conditions.

Aim: To assess the correlation between conventional echocardiographic parameters of LV function and longitudinal deformation in patients with acute myocardial infarction (AMI).

Methods: Retrospective study of 77 patients (pts) without known coronary disease, 60 men, $m=56.6 \pm 12.8$ y, with ST-elevation anterior myocardial infarction, submitted to primary percutaneous coronary intervention (PCI). A complete transthoracic echocardiogram was performed 3.7 ± 1.9 days after the PCI. LV global longitudinal strain (GLS) was obtained from apical views and left anterior descending (LAD) coronary artery flow was also assessed. By Pearson's index, we correlated with GLS: LV ejection fraction (EF), volumes, wall motion score index (WMSI), E wave deceleration time, E/E', left atrium indexed volume, pulmonary artery systolic pressure, LAD flow characteristics (peak velocity and deceleration time).

Results: The mean values of the analyzed parameters were: LV EF $47.8 \pm 8.9\%$, end systolic volume 61.1 ± 38.9 mL, wall motion score index (WMSI) 1.7 ± 0.3 , E wave deceleration time (DT) 177.0 ± 47.7 ms, E/E' 9.4 ± 3.8 , indexed left atrium volume 29.2 ± 9.5 mL/m², LAD flow peak velocity 38.4 ± 20.5 cm/s and deceleration time 444.4 ± 316.8 ms. Mean 2D LV GLS was $-11.0 \pm 2.6\%$. Significant correlation was found between GLS and LVEF ($r=0.717$, $p<0.001$), WMSI ($r=0.623$, $p<0.001$), ESV ($r=0.389$, $p=0.011$), E/E' ($r=0.346$, $p=0.025$) and LAD flow DT ($r=0.392$, $p=0.014$). LV GLS was strongly correlated with LV EF (graphic).

Conclusion: LV performance after AMI assessed by longitudinal deformation follows not only LV EF and WMSI but also a filling pattern parameter (E/E') and a coronary perfusion index.



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Predictors of early improvement of right ventricular function assessed by bidimensional speckle tracking echocardiography after transcatheter aortic valve implantation

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Introduction and objectives: Our purpose was to evaluate the predictors of improvement in right systolic ventricular (RV) function in high-risk patients with severe aortic valvular stenosis after transcatheter aortic valve implantation (TAVI).

Methods: From June 2009 to December 2010, we selected consecutive patients with severe aortic stenosis and high surgical risk who were treated with the CoreValve percutaneous aortic prosthesis and had a basal and discharge echocardiographic study with valid data for RV strain analysis by means of bidimensional speckle tracking echocardiography (2DSTE). RV systolic function was assessed by transthoracic echocardiography (TTE) with quantitative conventional parameters: tricuspid annular plane systolic excursion by M-mode (TAPSE) and tricuspid annular systolic velocity by pulsed tissue doppler imaging (Tas TDI) as well as emerging echocardiographic techniques as 2DSTE: longitudinal strain in basal RV free wall (RV strain) and TAPSE by 2DSTE (data obtained in the apical four-chambers view, with a specific software -IE33, Qlab -Philips-). Pulmonary artery systolic pressure (PASP) was also measured. TTE studies were performed before TAVI and at discharge. The improvement of RV function was defined as an increase in RV strain greater than the mean of paired differences between baseline and discharge TTE after TAVI. Univariate clinical and echocardiographic potential predictors for the improvement of RV function were analyzed.

Results: 36 patients were included (mean age 76 ± 7 years, 18 male). All parameters of RV function increased significantly after TAVI (TAPSE 17.1 ± 2.5 mm vs 17.5 ± 2.3 , $p=0.01$, Tas TDI 12.2 ± 1.7 cm/seg vs 12.9 ± 1.7 , $p<0.001$, TAPSE by 2DSTE 15.7 ± 4.6 mm vs 17.6 ± 4.3 , $p<0.001$, RV strain $-29. \pm 6$ vs -34 ± 5 , mean of differences 4.5 ± 4 , $p<0.001$), and PASP decreased from 37 ± 9 to 29 ± 10 mmHg, $p<0.001$. The improvement in the RV function (increase in RV strain > 4.5) was related to a greater basal PSAP (41 ± 12 vs 31 ± 10 mmHg, $p=0.017$), a worse basal RV strain (-27 ± 6 vs -34 ± 3 , $p<0.001$) and a functional class III-IV (74% vs 31%, $p=0.012$), but not to left ventricular ejection fraction, severity of stenosis or another parameters of RV function.

Conclusions: In this study, the improvement of RV function after TAVI with the Core-Valve prosthesis in high risk patients with severe aortic valvular stenosis was associated with a worse basal functional class, worse RV function and higher PASP in the baseline echocardiogram.

P352
Determination of the subclinical systolic dysfunction with the speckle echocardiography method in obstructive sleep apnea syndrome patients with normal ejection fraction

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Purpose: We aimed to determine the subclinical systolic dysfunction in obstructive sleep apnea syndrome (OSAS) patients with normal EF (ejection fraction).

Method: 21 controls (G0) and 58 patients with normal EF (ejection fraction); according to the apnea-hypopnea indices (AHI); mild (AHI=5-15/G1), moderate (AHI=15-30/G2), severe (AHI>30/G3) were included. Standart echocardiography and STE (speckle tracking echocardiography) performed. The average values of all segments were calculated and expressed as the global values.

Results: The global longitudinal strain (GLS) impairment begins in the G2, the global radial (GRS) and circumferential (GCS) impairment starts in the G3. When compared with the G0, the GRS values are increased in the group 1 and 2 without statistical significance. The global systolic strain rates of the longitudinal fibers (GL-S-SR) and circumferential fibers (GC-S-SR) were began to decrease in the G2. The global radial systolic strain rate (GR-S-SR) was higher in G2 than the G0 but it was decreased in G3 (Table-1).

Conclusion: In early stages of OSAS, the longitudinal systolic dysfunction is compensated with the aggravated radial fiber function. However in this stage, the circumferential systolic function does not change. In severe OSAS patients, besides the diastolic dysfunction the all myocardial fibers have also systolic function impairment; the longitudinal and circumferential mechanics are influenced more than the radial function.

	Group 0/G0	Group 1/G1	Group 2/G2	Group 3/G3
GRS %	49,31 ± 12,7	49,52 ± 18,4	52,55 ± 13,4	37,01 ± 10,1*
GCS %	-22,63 ± -4,4	-24,29 ± -4,4	-23,39 ± -4,1	-14,13 ± -3,8†,‡
GLS %	-25,61 ± -2,3	-25,3 ± -1,7	-20,22 ± -2,4†,‡	-16,62 ± -2,5†,‡
GR-S-SR	2,3 ± 0,41	2,19 ± 0,44	2,42 ± 0,64	1,68 ± 0,5†
GC-S-SR	-1,94 ± -0,3	-1,93 ± -0,3	-1,87 ± -0,3	-0,98 ± -0,3†,‡
GL-S-SR	-1,19 ± -0,2	-1,18 ± -0,1	-1,04 ± -0,2†,‡	-0,9 ± -0,2†,‡

Strain(%) and strain rates (SR) of the groups GRS:Global Radial, GCS: Global Circumferential, GLS: Global Longitudinal strain. GL-S-SR: Global Longitudinal Systolic Strain Rate, GR-S-SR: Global Radial Systolic Strain Rate, GC-S-SR: Global Circumferential Systolic Strain Rate †: $P<0,008$ when compared with group 0 ‡: $P<0,008$ when compared with group 1* : $P<0,008$ when compared with group 2

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Is possible to determine early stage of right ventricle dysfunction in the patients with acquired immunodeficiency syndrome?

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The patient with acquired immunodeficiency syndrome (AIDS) often present the signs and symptoms of impaired left (LV) and right ventricle (RV) function. The aim of this study was to determine RV morphology and function during AIDS and analyze of relation with the time of infection and initiation of retroviral therapy.

Materials and method: We studied 41 patients HIV-positive(+), mean age (42,01 ± 28,3y), 28 men, mean time of HIV-infection-6,43 ± 14,7y. The patients had any signs and symptoms of heart failure. We analyze two groups of patients: I-without antiviral therapy (19), II-pts treated with antiviral drugs (22). Mean age was significantly lower in I group (p=.002) and significantly more of men in group I (p=.002). Time of viremia was similar in both groups. Control group was 20 healthy subjects (11men), mean age (40 ± 10,2y). M-mode, 2D, PW- and CW-doppler and TDI examination were performed. RV function was assessed by RV diameter, TAPSE (Tricuspid Annulus Systolic Excursion), FAC (Fractional Area Change) and tricuspid annular velocities using 4-ch view. Systolic velocity (S't), early diastolic velocity (E't), late diastolic velocity (A't) and strain (ε), strain rate (SR) of medial segment of RV were determined by TDI.

Results: RV diastolic area was significantly higher in I comparing with II and control groups. FAC was normal in both groups, but somewhat not significantly lower in I. TAPSE was normal in both groups, without difference. We found no difference in right atrium area. S't was normal and similar in both groups, without difference with control group. E't was slightly reduced in I comparing with control group and A't was higher in II. We observed significantly lower e of RV in I group. SR was significantly higher in the II comparing with I group, but lower that in the control group (NS). This is gentle difference in diastolic regional right ventricle function between these groups. Same difference we found analysing of stage of disease (CD4)+. E't was significantly lower and A't was significantly higher in subgroup with CD4 < 250. Same difference we state for subgroup with longer time of viremia: lower E't and higher A't with E't/A't < 1, mean time of viremia 108,8 months vs E't/A't > 1, mean time of viremia 58,9 months (p=.007). We not found significantly differences of ε and SR between these subgroups.

Conclusions: 1. Right ventricular diastolic function is slightly reduced during HIV-viremia in the patients without signs and symptoms of heart failure. 2. Tissue Doppler Imaging (TDI) is simple and sensitive tool to assess impaired RV function in patients with acquired immunodeficiency syndrome.

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Speckle tracking study in dilated ischemic and idiopathic cardiomyopathy with low ejection fraction: different ventricular and atrial impairment

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Purpose: Heart failure patients (pts) with same ejection fraction have different symptoms, morbidity and mortality.

Speckle tracking echocardiography was used to recognize ventricular and atrial myocardial function differences between ischemic and idiopathic cardiomyopathy.

Methods: 100 subjects: 25 (mean age: 62 years) pts with ischemic cardiomyopathy (group A), 25 with idiopathic cardiomyopathy (negative coronary angiography) (group B) and 50 healthy controls (group C) were studied. All pts underwent coronary angiography except controls and all had left ventricular (LV) ejection fraction (EF) ≤ 35%. By System Seven GE with TVI, atrial and ventricular diameters, volumes, EF, propagation velocity (Vp) and E/Vp ratio were measured. Pulmonary wedge capillary pressure (PWCP) was calculated by E/Ea. Bidimensional acquisitions were analyzed to measure longitudinal peak systolic ventricular (all segments), atrial (global) S and SR in apical 4 and 2-chambers views and circumferential and radial systolic S and SR in middle short axis view.

Results: Group A and B pts showed impaired diastolic function by PW Doppler, TVI, Vp and E/Vp (group A=3,561 ± 0,66; group B=2,44 ± 0,7); they had high PWCP (group A=20,1 ± 3,66; group B=14,4 ± 5,3). Group A (S=7,6 ± 4,6%; SR=0,57 ± 0,16S-1) and B (S=14,27 ± 5,2%; SR=0,82 ± 0,4S-1) pts had lower atrial longitudinal systolic S and SR than controls (S=33 ± 7%; SR=2,37 ± 0,63 S-1). Pts showed lower ventricular radial systolic S (group A:11,69 ± 8,5%; group B:14,88 ± 9,36) and SR (group A:0,94 ± 0,33; group B:1,25 ± 0,69;) than in controls (S=46,3 ± 9,4%9; SR=1,58 ± 0,51S-1). Ventricular 2D longitudinal systolic S and SR, for each segment, were impaired in group A (average S=-6,21 ± 5,33%; SR=-0,61 ± 0,34S-1) and B (average S=-10,89 ± 6,17%; SR=-0,8 ± 0,48S-1). Ventricular circumferential S and SR were impaired in group A (S=-7,9 ± 6,24%; SR=-0,74 ± 0,26S-1) and group B pts (S=-9,86 ± 6,27%; SR=-0,87 ± 0,44S-1). An inverse correlation (r = -0,78) was found between PWCP and atrial S. Significant differences were found between group A and B pts for atrial longitudinal S and SR, ventricular longitudinal S, ventricular circumferential SR, with lower values in group A pts and for PWCP, higher in group A. Conclusions: Myocardial deformation properties are impaired in both ischemic and non ischemic heart failure pts. Ischemic pts have significant lower atrial longitudinal S and SR values and higher PCWP values. Higher PWCP values are associated with greater atrial S impairment.

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Comparison the left atrial mechanics between different techniques of two-dimensional speckle based strain in patients with atrial fibrillation

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Background: Speckle tracking measurement of left atrial (LA) strain (ε) allows evaluation of contractile, reservoir, and conduit function. We sought to compare LA ε with velocity vector imaging (VVI) and two-dimensional strain (2DS).

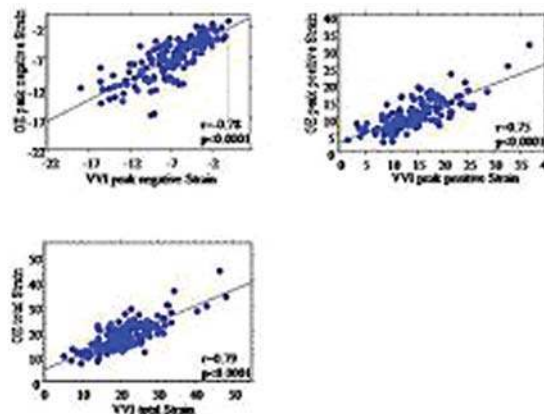
Methods: LA ε and strain rate (SR) were compared in 141 patients (62 ± 10 years) using both VVI and 2DS. Peak negative, peak positive, and total ε (corresponding to LA contractile, conduit, and reservoir function) were measured during sinus rhythm. Late negative SR (LA contraction), peak positive SR (LV systole), and early negative SR (LV early diastole) were identified during sinus rhythm.

Results: LA ε measurement was highly feasible with both VVI (93%) and 2DS (93%). Peak negative, positive and total ε correlated well (r=0.78, 0.75, 0.79), with low mean differences (Figure and Table). LA contraction, peak positive and negative SR correlated less well (r=0.74, 0.7, 0.67) with higher mean differences (Table).

Conclusion: Left atrial ε measurement is feasible with both VVI and 2DS in clinical practice. LA ε and SR measurements using VVI showed quite similar results with 2DS.

Summary of Bland-Altman limits of agreement

	ε negative	ε positive	ε total	SR late neg	SR pos	SR early neg
Mean differences (%)	0.136	3.646	3.51	-0.32	0.128	-0.113
Standard deviation	2.377	3.861	4.49	0.319	0.259	0.327



Correlation of LA ε between VVI and 2DS

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Assessment of right ventricle pre-ejection myocardial velocity and index of a global contractility in fetuses with high-output congestive heart failure using tissue doppler imaging

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Objective: Many diseases of the mother or the fetus may lead to fetal congestive heart failure (CHF) resulting in intrauterine or neonatal death. Tissue Doppler Imaging (TDI) is a relatively new method used for direct analysis of the myocardial function. The aim of this study was to analyze the myocardial function of the right ventricle (RV) in fetuses with CHF using TDI.

Methods: Myocardial function of the RV was assessed in 54 normal fetuses and 83 fetuses with high-output CHF between 27 and 39 weeks' of gestation. Detailed echocardiography combined with pulse and tissue Doppler was performed in all cases. To determine the degree of CHF, Cardiovascular Score (CVS) was evaluated on each subject. TDI data was obtained at the level of 4-chamber view by placing the sample volume at the lateral part of the tricuspid annulus. Pre-ejection myocardial velocity was assessed and index of a global contractility (Tei-index) was calculated. All measurements were averaged at 3 to 5 consecutive cardiac cycles.

Results: The CVS in fetuses with CHF ranged from 8 to 0 (mean 6 ± 1.5). This parameter strongly correlated with TDI-Tei-index (r = -0.62; p < 0.01). TDI-Tei-index was significantly higher in the group with CHF compared to normal (1.06 ± 0.11 vs. 0.53 ± 0.08, p < 0.001). In subgroup with CHF and CVS > 5 pre-ejection myocardial velocity was significantly elevated (average Z-score = 4.7). In fetuses with CVP ≤ 5 significant decrease (average Z-score = -3.4) in pre-ejection myocardial velocity was noted. This finding

was associated with poor outcome. Conclusion: Our results validate the potential clinical applicability of TDI-retrieved pre-ejection myocardial velocity and Tei-index in assessment of right ventricular function in fetuses with CHF. Further prospective studies in a clinical setting are needed to the advantageous of this approach to practice.

P357

Myocardial deformation: a new tool to diagnose acute rejection after heart transplantation

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Heart transplantation (HT) is a standard therapy for end-stage heart failure. Acute allograft rejection (AAR) is a common problem in the first year after HT and it should be diagnosed as soon as possible (preferably at a subclinical level). At present right ventricular endomyocardial biopsy remains the gold standard in diagnosing AAR. Potentially, deformation parameters are independent of overall cardiac motion and could be sensitive in detecting regional functional abnormalities induced by AAR.

Objective: To assess the potential role of strain measured by speckle tracking to identify AAR proven by endomyocardial biopsy (EMB).

Methods: We included 14 consecutive patients who were transplanted during the last year in our centre. Ten echocardiograms per patient were done the same day of EMB. We recorded images of the 4 and 2-chamber apical views as well as short axis views. We analyzed 12 individual segments for the assessment of longitudinal (long S), circumferential (circ S) and radial (rad S) strain and strain rate (SR).

Results: We analyzed 3024 segments, 5% of the segments were non-interpretable. According to the International Society of Heart and Lung Transplantation criteria, 84 biopsies had grade 0R AAR, 21 IR, and 4 IIR. Strain results are shown in the table. The only independent predictor of AAR among strain values was long R. A cut-off value of long S lower than -14% resulted in a sensitivity of 71.0%, a specificity of 70.0%, a predictive positive value of 50% and a negative predictive value of 84.4% for AAR diagnosis (AUC 0.70 CI 95% 0.54-0.80. RR 3.2, 95% CI 1.5-6.9, p 0.01).

Conclusion: All modalities of global strain were decreased in AAR group. Longitudinal global strain is the best parameter for the diagnosis probably because longitudinal fibers may be more affected at initial phases of AAR. Strain 2D imaging could be of clinical value in monitoring and diagnosing AAR and could improve patient management by reducing the number of biopsies performed.

P358

The effect of myocardial fibrosis on left ventricular torsion / twist in patients with non-ischemic dilated cardiomyopathy: a cardiovascular magnetic resonance imaging and echocardiography study

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Purpose: LV rotation, twist, and torsion are important aspects of the cardiac performance. Rotation of the LV apex relative to the base is related to the myocardial contractility, furthermore, the potential energy stored by LV twist during the systolic phase is rapidly released during LV untwisting and constitutes an important determinant of diastolic suction and diastolic function. Myocardial fibrosis can be also identified as late gadolinium enhancement (LGE) areas with cardiac magnetic resonance (CMR) studies. However, there is limited information about the association of myocardial fibrosis and left ventricular rotational parameters.

Methods and Results: Twenty-two patients with nonischemic DC (NDC) and sinus rhythm and LV EF < 40% were enrolled. LV regional deformation, twist and untwist rate were measured using two-dimensional speckle tracking imaging (2D-STI) method. Myocardial fibrosis identified as late gadolinium enhancement (LGE) areas with CMR. Myocardial fibrosis severity defined by calculation of MR-index. The patients were sub-grouped into two groups based on the absence (LGE-) and presence (LGE+) of fibrosis. LV regional deformation were similar whereas LV rotational parameters were significantly different between two groups. LGE+ patients have significantly greater basal systolic rotation, significantly lower apical systolic rotation, Torsion and Torsion/LV length values than patients in LGE-. Untwist rate were similar. Torsion/LV length was moderately correlated with LVEF and MR-index. Linear regression analysis revealed that only MR-index (OR: 1.53, 95% CI: 2.9-3.06, P = 0.02) was independent correlated factors of Torsion/LV length. Sixteen patients had normal directions of both basal (negative) and apical (positive) systolic rotations. Interestingly and significantly contrary to LGE- subjects, 5 patients with LGE+ had opposite (negative) apical systolic rotation. Compared with patients with the normal direction of apical systolic rotation, those with negative apical systolic rotation had significantly greater NT-proBNP values (1547 ± 945 pg/ml vs 389 ± 303 pg/ml, p=0.007), basal systolic rotation (-6.78 ± 1.21 degree vs -3.06 ± 2.2 degree, p < 0.001), lower apical systolic rotation (-3.71 ± 3.64 degree vs 4.36 ± 2.81 degree, p < 0.001), Torsion (3.07 ± 3.44 degree vs 7.43 ± 2.72 degree, p=0.04), Torsion/LV length (0.35 ± 0.51 degree/cm vs 0.95 ± 0.38 degree/cm, p=0.05), MR-index (0.66 ± 0.20 vs 0.95 ± 0.06, p=0.03).

Conclusion: Detection of myocardial fibrosis can be a useful indicator for the evaluation of LV mechanics and NDC patients with LV fibrosis have impaired LV systolic Rotation and Torsion parameters.

AAR and strain/SR values

	Long S	Long SR	Radial S	Radial SR	Circ S	Circ SR
AAR (n=25)	-13.3 ± 3.5	-1.2 ± 0.6	17.8 ± 5.9	1.6 ± 0.7	-16.2 ± 2.9	-1.3 ± 0.4
Not AAR (n=84)	-15.9 ± 3.7	-1.1 ± 0.2	22.8 ± 9.1	1.4 ± 0.5	-18.3 ± 3.8	-1.3 ± 0.4
P	0.005	NS	0.016	NS	0.03	NS

long = Longitudinal S = strain SR = strain rate. circ = Circunferencial.

P359

Dyssynchrony assessment with tissue doppler imaging does not predict long-term response to cardiac resynchronization therapy: a prospective single-center study

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Purpose: The aim of the present study was to assess long-term effects of CRT and to value the role of pre-CRT left ventricular (LV) dyssynchrony by tissue Doppler imaging (TDI) in predicting response.

Methods: We enrolled 51 patients undergoing CRT between December 2009 and April 2011. All patients were investigated with Minnesota Living with Heart Failure Questionnaire (MLHFQ), ECG, echocardiography including TDI and implant control. We collected pre-implantation instrumental and clinical data for all patients, 34 of which were subsequently recalled for a follow-up 3 months later and 16 patients for a follow-up 1 year later. Interventricular dyssynchrony was considered as an aortopulmonary pre-ejection delay >40 ms. Intraventricular dyssynchrony was measured by TDI velocity curves and defined as septal-lateral wall delay >60ms. An increase of LVEF >10% defined an echo response whereas the improvement of at least 1 NYHA class defined clinical response.

Results: In the whole population, the short-term significant effects at 3 months follow-up were:

- An improvement in mean EF (from 25.5 ± 5.3 % to 34.3 ± 7.3 %; p<0.001)
- A reduced width of spontaneous QRS (p=0.007)
- An improvement in clinical performance, as assessed by a reduction of mean NYHA class (p<0.001) and a decreased MLHFQ score (p=0.009)
- An inverse left ventricular remodeling, as shown by reduced diastolic (from 72 ± 8 mm to 67 ± 10 mm; p=0.019) and systolic diameters (from 62 ± 10 mm to 55 ± 11; p=0.041)
- An improvement in Holter monitoring parameters, as denoted by a slower mean 24 hours cardiac frequency (p = 0.003) and better SDANN (p=0.020) and footprint (from 27 ± 9% to 36 ± 8%, p=0.034).

At 1 year follow-up, main benefits remained significant:

- EF improvement (+7.8% from baseline; p<0.001)
- Spontaneous QRS width shortening (-18.2 ms from baseline; p=0.048)
- NYHA class reduction (p=0.001) and MLHFQ improvement (-22.5 from baseline; p=0.006).

Among the whole population, 17% were full non-responder, 29% were only clinical responders and 54% were both echo and clinical responders. Both clinical and echocardiographical responses were not significantly associated with interventricular dyssynchrony and intraventricular dyssynchrony (all p = ns).

Conclusions: After only 3 months, CRT was associated with an improvement in quality of life and left ventricular function and was able to significantly modify the sympathetic-parasympathetic interaction to the heart. After 1 year, most of these benefits persisted; however, pre-implantation dyssynchrony assessment did not predict long-term clinical or echo response.

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Assessment of left ventricular rotation during isovolumic contraction phase in acute myocardial infarction in relation to myocardial transmural and functional recovery

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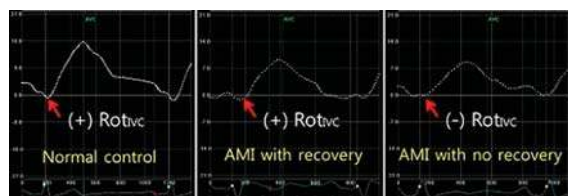
Backgrounds: During isovolumic contraction (IVC) phase, transitional counterdirectional deformations occur. This is because IVC starts along the subendocardial myocardium. Our purpose was to test the hypothesis that the presence of initial clockwise rotation of LV apex during IVC phase (RotIVC) is associated with myocardial transmural and functional recovery in patients with acute anterior myocardial infarction (AMI).

Methods: Thirty-six subjects were enrolled (24 patients with first episode of ST-segment elevation AMI, and 12 age-matched controls). AMI patients were selected prospectively who had successful primary PCI on the LAD only and showed akinetic apical segments and normal basal segments. Two-dimensional speckle tracking and cardiac magnetic resonance imaging were performed. The LV basal and apical rotation and LV twist were obtained. The presence of RotIVC of LV apex was determined. Quantification of transmural extent of delayed enhancement (DE) was assessed by <50% and ≥50%

myocardial wall thickness. Myocardial functional recovery was defined as improved wall motion at 6-month follow-up.

Results: Thirteen patients showed recovery and 11 patients showed no recovery. There was no significant difference of LV rotation and twist between patients with recovery and patients with no recovery. All controls showed RotIVC. Eleven of 13 patients with recovery, but none of 11 patients with no recovery showed RotIVC. Eleven of 12 patients with $DE < 50\%$ and one of 12 patients with $DE \geq 50\%$ showed RotIVC. For prediction of myocardial functional recovery, the presence of RotIVC had sensitivity and specificity of 92% and 83%, respectively.

Conclusion: The presence of RotIVC is related to the myocardial transmural and thus can provide information regarding functional recovery in patients with AMI.



Presence of RotIVC

P361

Intra- and interatrial dyssynchrony enhanced by right atrial appendage pacing

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Purpose: Right atrial (RA) appendage pacing may prolong atrial conduction time (ACT). The present study aimed to investigate if cumulative percentage of RA appendage pacing (Cum%AP) can enhance intra- and interatrial dyssynchrony in patients with normal ejection fraction after one year pacing.

Methods: Patients who are undergoing dual chamber pacemaker implantation due to symptomatic bradycardia were enrolled. Patients with left ventricular ejection fraction $< 45\%$ and permanent atrial fibrillation were excluded. Cumulative percentage of right ventricular apical pacing (Cum%VP) and Cum%AP at one-year follow was recorded. Full Doppler echocardiography studies were performed before pacemaker implantation and one year follow up. ACT and peak atrial velocities (Sm-la, Em-la and Am-la) were measured. Intra- and interatrial dyssynchrony were calculated.

Results: We enrolled 110 patients with mean age of 70.5 ± 11 years. High Cum%AP of more than 75% (Cum%AP $> 75\%$) (n=27) over one year were compared to those with low Cum%AP of less than 25% (Cum%AP $< 25\%$) (n=43) according to the interquartile range of distribution. There was no significant difference in Cum%VP between these two groups (75.8 ± 38.0 vs. $91.1 \pm 24.0\%$, $p=0.069$). Atrial velocities were significantly lower and ACT of both RA and left atrial (LA) were more prolonged in patients with Cum%AP $> 75\%$ than those with $< 25\%$ (all $p < 0.05$). Intra and interatrial dyssynchrony was more obvious in patients with Cum%AP $> 75\%$ (RA dyssynchrony: 23.4 ± 21.5 vs. 10.6 ± 10.3 ms, $p=0.007$; LA dyssynchrony: 22.3 ± 12.2 vs. 9.5 ± 6.2 ms, $p < 0.001$; interatrial dyssynchrony: 53.9 ± 29.7 vs. 19.7 ± 17.3 ms, $p < 0.001$). In the whole cohort, Am-la correlated negatively with LA dyssynchrony ($r = -0.450$, $p < 0.001$) and interatrial dyssynchrony ($r = -0.227$, $p = 0.018$). Interatrial dyssynchrony was correlated with Cum%AP ($r = 0.617$, $p < 0.001$) but not with Cum%VP ($r = -0.058$, $p = 0.548$).

Conclusions: RA appendage pacing causes atrial conduction delay with intra- and interatrial dyssynchrony.

MAGNETIC RESONANCE IMAGING

P362

Comparison of right ventricular parameters between canarian wrestling and endurance athletes by cardiac magnetic resonance.

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Background: Cardiac Magnetic Resonance Imaging (CMR) is a gold standard for measure and volume quantification of right ventricle (RV). Aim of our study was to compare RV remodeling, as assessed by CMR in group of endurance athletes (EA), strength athletes (SA) and control. SA were athletes from Canarian wrestling, originally from Canary Islands.

Methods: A population of 52 athletes (25 EA and 27 SA) and 16 sedentary controls, all of them males, underwent CMR for assessment of RV end-diastolic volume (EDV), systolic volume (ESV) and stroke volume (SV), which were normalized to body surface area, and ejection fraction (EF). CRM was performed with 3 Teslas General Electrics MRI and off line measures with Report Card software. RV volumes was calculated in short axis view from base to apex.

Results: General data table 1. EDV was larger in EA than SA (107 ± 13 ml/m² vs 91 ± 12 ml/m²; $p < 0.001$) and controls (83 ± 12 ml/m²; $p < 0.001$). No significant differences were identified between SA and controls. Also, ESV was larger in EA and SA (48 ± 9 ml/m² vs 44 ± 8 ml/m² respectively) versus control (35 ± 8 ml/m²; $p < 0.05$). No significant differences were identified between EA and SA in ESV. Greater SV was measured in EA (58 ± 9 ml/beat) than SA (48 ± 7 ml/beat) and controls (49 ± 6 ml/beat) $p < 0.001$. No significant differences were identified between controls and SA in SV. EF was lower in SA than controls ($59 \pm 5\%$ $p = 0.001$). No significant differences were seen between EA ($55 \pm 5\%$) and SA ($52 \pm 6\%$) in EF. Conclusion: This is the first study that analyzes RV of Canarian Wrestling (SA) with CMR. In our study EA showed greater RV remodeling as assessed by CMR than SA and controls. However, EF remained within normal limits in all groups.

General data

	EA(25)	SA(27)	Control(16)
Age	29.4 \pm 3.1	28.3 \pm 4.6	28.7 \pm 2.7
Heart rate (bpm)	57.3 \pm 11.8	63.5 \pm 12.2	65.1 \pm 5.9
Systolic blood pressure	118 \pm 11*	127.7 \pm 12.6	118.3 \pm 8.3
Diastolic blood pressure	70.8 \pm 7.7*	79.9 \pm 6.6	76.2 \pm 4.8
Body surface area	1.8 \pm 0.11 [#]	2.3 \pm 0.19*	2.06 \pm 0.19 [#]
Years training	9.6 \pm 6.3*	16.8 \pm 6.5	-
Hours per week	16.1 \pm 7.7*	10.5 \pm 4.2	-

* $p < 0.05$ between EA and SA; $\$ p < 0.05$ between SA and controls; $\# p < 0.05$ between EA and controls.

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Feasibility of dynamic assessment of 3D tricuspid annulus morphology by magnetic resonance imaging

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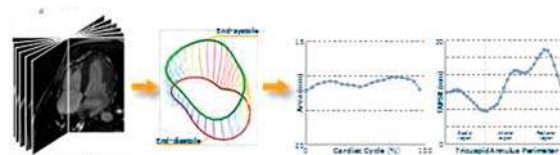
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Purpose: Cardiac magnetic resonance (CMR) is considered the reference technique for the evaluation of right ventricular function. Nevertheless, the assessment of tricuspid valve morphology using CMR is intrinsically limited due to its 2D nature. Our purpose was to test the feasibility of a new approach to study the evolution of tricuspid annulus (TA) morphology through the cardiac cycle.

Methods: Ten healthy subjects (age 31 ± 10 yrs) were enrolled in the study. CMR imaging (1.5 T, spatial resolution 0.74 mm, slice thickness 6 mm) of 18 long-axis planes, evenly rotated of 10° along the axis ideally passing through the center of TA (Figure, left), was performed using SSFP sequences (20 frames per cardiac cycle). Custom software was developed: in each plane, TA points were manually identified at end-systole and end-diastole, and then automatically tracked based on the normalized cross-correlation between subsequent frames. As a result, a 3D model of TA in each frame and several parameters considered: area, height, minimum and maximum diameters, and the peak systolic excursion along the TA perimeter.

Results: Feasibility of both acquisition and post-processing was 100%. CMR acquisition took about 3 minutes, while TA analysis 10 minutes including manual correction when needed. The position of the automatically tracked TA points was visually judged by an expert cardiologist, resulting accurate in 87% of the cases. A representative example of the obtained parameter is shown in the figure.

Conclusions: We demonstrated analysis of TA morphology through the cardiac cycle is feasible and accurate, requiring minimal manual interaction. This approach could serve as a starting point for studying the physiologic dynamic of TA, with potential benefits in patient evaluation and surgical planning.



Schematic of TA 3D reconstruction

COMPUTED TOMOGRAPHY

P364

Relationship between hemodynamic severity of aortic valve stenosis measured by dopler echocardiography and aortic valve calcification measured by computed tomography

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Background: Recent studies suggested that quantification of calcification (Ca) in the region of aortic valve (including cusps, annulus and aortic root) by multidetector computed tomography (CT) may be useful to corroborate aortic stenosis (AS) severity. The

objectives of this study were: 1) to examine the relationship between hemodynamic AS severity and the extent of Ca measured by 128-slice dual-source CT (DSCT) within aortic valve cusps, annulus, and root, 2) to determine cut-off values of valve Ca to identify severe AS and 3) to determine whether and how the valve phenotype (i.e. bicuspid vs. tricuspid) affects this relationship.

Methods: 80 consecutive patients with AS underwent: 1) Doppler echocardiography to measure peak aortic jet velocity, transvalvular gradient, aortic valve area (AVA), and systemic arterial compliance (SAC=stroke volume index/pulse pressure) and 2) DSCT to measure Ca volumetric score (CVS) at the level of: i) cusps, ii) annulus and iii) aortic root adjacent to annulus. A global CVS was calculated by adding these 3 regional scores. Receiver operator characteristic (ROC) analysis was performed to determine optimal cut-off values to identify severe AS defined by an $AVA < 1\text{cm}^2$ and $AVAI < 0.6\text{cm}^2/\text{m}^2$.

Results: There was good correlation between mean gradient and aortic cusps CVS ($r=0.69, p<0.0001$), a weak correlation between gradient and aortic annulus CVS ($r=0.22, p=0.05$) and no correlation with aortic root CVS. Correlation with gradient was not improved when using the sum of aortic cusps and aortic annulus CVSs ($r=0.67$) or global CVS ($r=0.66$). Aortic root CVS correlated only with SAC ($r=-0.34, p=0.008$). Correlation between gradient and aortic valve cusps CVS or global CVS were much stronger in patients with tricuspid valve ($r=0.81$ and $r=0.75$) than in those with bicuspid valve ($r=0.48$ and $r=0.53$). Area under the ROC curve for identification of severe AS was 0.76 in whole cohort, 0.82 in patients with tricuspid valve and 0.55 in patients with bicuspid valve. Cut-off value of aortic cusps CVS providing the best percentage of correct classification (81%) in whole cohort was 1.37cm^3 , which corresponded to 1440 Agatston units.

Conclusion: These findings suggest that the main determinant of the hemodynamic severity of AS is Ca deposit within aortic valve cusps and that calcium deposit in aortic annulus or root have negligible impact on valve hemodynamics. Valve Ca volumetric scoring by DSCT may be helpful to corroborate stenosis severity in AS patients, particularly in those with low flow, low gradient. However, the performance of DSCT was inferior in patients with bicuspid valve.

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Pulmonary edema evaluation by lung ultrasound in intensive care: comparison with computed tomography.

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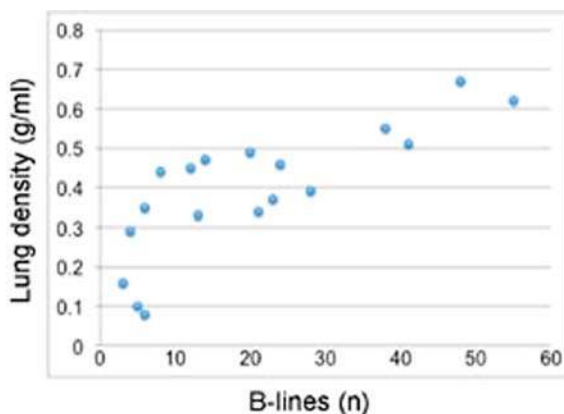
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Purpose: For many years the lung has been considered off-limits for ultrasound. However, it has been recently shown that lung ultrasound (LUS) may represent a useful tool for the semiquantification of pulmonary edema, by the evaluation of B-lines (also called ultrasound lung comets). Our aim was to compare the ability of LUS to quantify the degree of pulmonary edema in critically ill patients, compared to the gold standard chest computed tomography (CT).

Methods: Eighteen patients admitted to the Intensive Care Unit (4 females, mean age 69 ± 7 years), who underwent a clinically-driven chest CT, were evaluated by LUS within a few hours. Semi-quantitative LUS assessment of pulmonary edema was performed by determining the number of B-lines with a linear 10 MHz probe, scanning on both right and left hemithoraxes, as previously described. Lung weight (LW), lung volume (LV) and lung physical density (LD) were calculated from CT scans using an ad hoc software.

Results: A significant, good correlation was found between the number of B-lines and LW ($R=0.67, p<0.05$). A stronger correlation was found between the number of B-lines and LD ($R=0.82, p<0.01$, see figure), that further increases if the LD of only the first 7 mm of subpleural lung tissue is considered ($R=0.85, p<0.01$).

Conclusions: Lung ultrasound is a reliable tool for the evaluation and quantification of pulmonary edema in critically ill patients. Compared to chest CT, it is less expensive, can be easily performed and repeated at bedside, and does not employ ionizing radiation.



MISCELLANEOUS

P366

Mapping myocardial fiber orientation using echocardiography-based shear wave imaging- comparison with histology and diffusion tensor imaging

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Cardiac disease, such as hypertrophic cardiomyopathy, is often accompanied by myocardial fiber disarray. Echocardiography has been of significant use for the clinical diagnosis of the cardiac function but not for the measurement of myocardial fiber structure yet. In this study, we thus proposed a novel ultrasound-based shear wave imaging (SWI) method to noninvasively assess myocardial fiber orientation, in comparison with histology and diffusion tensor imaging (DTI).

Fresh porcine myocardial samples ($n=6; 20 \times 20 \times 30\text{mm}^3$) were studied in vitro. Known in physics, shear wave propagates faster along than across the fibers. SWI is such a technique that utilizes focused ultrasound beams to generate shear waves propagating at velocities between 1 and 10 m/s in different directions with respect to each fiber layer throughout the entire myocardial thickness (10-25 mm). A prototype ultrasound scanner equipped with an 8 MHz linear array probe was employed. The fiber angle at each myocardial depth was determined by the shear wave propagation direction where the maximum shear wave speed occurred. Fiber angles were defined between -90° and 90° with 0° denoting fibers aligned with the local circumferential axis of the heart. Both the myocardial sample and the ultrasound probe were secured in a customized device compatible with the magnetic resonance imaging scanner (7T, Bruker) to assure imaging co-registration. In DTI, diffusion was encoded in six directions. A total of 270 diffusion-weighted images ($b = 1000\text{ s}^2/\text{mm}$, $FOV=30\text{mm}$, Matrix size= 64×60 , $TR=9\text{ s}$, $TE=19\text{ ms}$, 24 averages) and 45 b0 images were acquired in 13 h and were further analyzed using a freeware, MedInRIA. Histology with H&E staining was performed and analyzed using optical microscopy to measure the transmural fiber orientation.

The transmural fibers in the in vitro porcine mid-anterior myocardial region assessed by SWI gradually oriented from $+80^\circ$ (upper-right to bottom-left) at the endocardium to -50° (upper-left to bottom-right) at the epicardium. This result was not only in good agreement with the literature but also well correlated with histology ($r^2=0.91 \pm 0.02, p<0.001$). Moreover, good correlation between SWI and DTI fiber angle estimates was found ($r^2=0.83 \pm 0.01, p<0.0001$).

We have demonstrated that ultrasound-based SWI was capable of mapping transmural fiber orientation and provided measurements comparable to histology and DTI. In vivo feasibility of SWI in mapping the fiber orientation is being examined. SWI may serve as a new diagnostic tool for the evaluation of myocardial structure and its associated cardiac pathologies.

P367

Does selective LV lead placement during mini-thoracotomy CRT device implantation optimize response rate compared to the transvenous approach? An echocardiographic study of LV reverse remodelling

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Background: Cardiac resynchronization therapy has become a ratified and established therapy for heart failure to reduce both the morbidity and mortality of the condition, but with a high rate of non-responders which rises up to 30%. In the majority of patients transvenous CRT device placement is preferred, however in some cases mini-thoracotomy is employed as an alternative approach. In this study we followed up and compared patients with CRT devices placed by the transvenous or mini-thoracotomy approach.

Methods: Following current CRT guidelines criteria patients were selected and further qualified for device implantation based on the presence of markers of intraventricular (the septal flash) and/or atrio- and/or inter-ventricular dyssynchrony.

Based on the CRT device implantation approach, patients were divided in two groups: 18 patients implanted transvenously (VENOUS: 9F/9M, 59 ± 10 years) and 15 patients implanted via mini-thoracotomy (MINI: 6F/9M, 55 ± 14 years). In the second group, echocardiographically guided LV lead placement was performed, seeking for the optimal lead position. Echocardiographic assessment including Doppler myocardial imaging was performed pre-CRT implantation as well as 6-months after the procedure. Furthermore, echo guided CRT optimization was performed in the second month post-implantation. Clinical response was defined as a reduction in NYHA class > 1 , while a reduction of LV end-systolic volume (LVESV) $\geq 10\%$ defined volume response.

Results: Clinical response was noted in all patients at 6-months follow-up. Echocardiographic data revealed volume response in all MINI patients, which was absent in 33% of the VENOUS group and in 24% of overall patients. A significant reduction in LVESV was measured in the MINI group (MINI pre/post: 202/139 ml, $p=0.01$; VENOUS pre/post: 226/189 ml, $p=NS$). The average change in LVESV was 18% and 33% in the VENOUS and MINI groups, respectively. In both groups EF increased significantly (MINI pre/post: 21/35%, $p<0.0005$; VENOUS pre/post: 23/29%, $p=0.03$).

Conclusion: In our study group, clinical response was noted in all patients while volume response was considerably superior after CRT implantation via mini-

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Table Effects of bosentan in Fontan patients

	TTE cardiac output(mL)		TTE EF(%)		TTE Collaps VCI (%)		NYHA class		NT-pro-BNP(ng/L)		Mental QoL	
	BL	3 mo	BL	3 mo	BL	3 mo	BL	3 mo	BL	3 mo	BL	3 mo
T	4420 ± 1767	4170 ± 1135	54 ± 12	48 ± 12	32 ± 24	30 ± 18	1,7 ± 0,8	1,4 ± 0,6	342 ± 289	468 ± 323	45 ± 11	50 ± 7
U	4821 ± 1160	5121 ± 1236	55 ± 9	48 ± 5	27 ± 13	22 ± 11	1,8 ± 0,6	1,6 ± 0,5	396 ± 432	300 ± 318	51 ± 6	51 ± 7

T; treated, U; untreated, BL; baseline, TTE: transthoracic echocardiography, EF: ejection fraction; mo; months, ng/L; nanogram/liter; mL; milliliter, NYHA; New York heart association, BL; baseline, QoL; quality of life; VCI: vena cava inferior.

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The role of bosentan in fontan patients: increase of cardiac output?

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Purpose: Low pulmonary vascular resistance (PVR) is crucial to patients with a Fontan circulation. Increase of the PVR will result in a decrease of lung flow and cardiac output. Plasma endothelin-1 level, a vasoconstrictor which increases PVR, is elevated in patients with Fontan circulation. We aimed to determine whether bosentan, an endothelin-1 receptor antagonist, increases cardiac output in Fontan patients by reducing the PVR.

Methods: The study is a prospective, multicenter randomized open label trial. Patients were assigned to six months bosentan treatment or three months without treatment followed by six months of bosentan treatment. The current analysis evaluates results of the first three months. Aside of cardiac output on trans-thoracic echocardiography (TTE), were NYHA functional class, NT-pro-BNP level and SF-36 quality of life (QoL) scores endpoints.

Results: We included 32 patients (mean age 32 ± 9 years, 59% male, 86% NYHA I-II). There was no significant difference in change of mean cardiac output, ejection fraction, NYHA functional class or QoL physical axis scores between treated and untreated patients (Table). In addition, qualitative ventricular function by 'global eyeballing' was unchanged. NT-pro-BNP levels were not significantly increased in the treatment group and were decreased in the untreated group. Whereas QoL mental axis scores improved at three months follow up for treated patients, no improvement was seen for untreated patients.

Conclusion: This preliminary data shows subjective benefit of bosentan treatment in Fontan patients, which was not accompanied by objective improvement. However, the treatment effect may need time to emerge in this ongoing study.

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Elastic properties of aorta in b-thalassemia major patients.

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Purpose: Elastic properties of the aorta in b-thalassemia (B-T) major patients, plays role in development of cardiac dysfunction by affecting afterload. Few studies exist about that issue. We assessed the aorta distensibility, aortic stiffness and pulse wave velocity using echo applications in pts with B-T.

Methods: We studied 28 pts (33.53 ± 8.39 years) and 18 age matched controls (31.5 ± 8.19 years) Exclusion criteria were age >45, rhythm other than sinus, smoking, mean hemoglobin < 8.5 g/dl, systolic left ventricle dysfunction, systemic and pulmonary hypertension, diabetes mellitus and thyroid disease. Blood pressure was measured. Aortic systolic (AoS), diastolic (AoD) diameters were calculated by M-Mode. Aortic distensibility and stiffness index were calculated by 2x(AoS-AoD)/(SAP-DAP)xAoD and ln(SAP/DAP)/(AoS-AoD)/AoD. PW-D (PWD) tracings of ascending and descending aortas recorded. From R of QRS to onset of PWD aortic flow, time 1 (T1) in ascending aorta and time 2 (T2) in descending aorta were measured accordingly. Aortic length (AOL) was measured from Two-D and defined as distance from PWD sample volume in descending aorta to ascending aorta adjacent to right pulmonary artery. The following calculations were used: transit time (TT)=t2-t1 and PWVr=AOL/TT (m/s). Standard M-mode, PWD and TDI mean septal-lateral mitral annulus velocities measurements were also obtained (EF, LVEDD, LVESD, IVS and PW thickness, Left atrial diameter, Emax, Amax, DT, IVRT, IVCT, PASP and Sm, Em, Am).

Results: Differences between classic echo indices were observed between pts and controls for EF(64.53 ± 7.4 vs 69 ± 2.2 respectively, p=0.46), Left atrial diameter (37.5 ± 4 vs 34.6 ± 2.5 respectively, p=0.004), PASP (25 ± 7.7 vs 13 ± 7.1 respectively, p=0.000), Emax (99.6 ± 15.3 vs 88.7 ± 15.2 respectively, p=0.028) and Em (11.7 ± 3.8 vs 14.2 ± 3.2 respectively, p=0.032). Indices of aorta properties in table.

Conclusions: PTs with B-T, except from differences in classic echo indices which are known from previous studies, have altered elastic properties of the aorta like distensibility maybe as a result of iron load of the aorta wall.

Elastic properties of aorta

	Patients(n=28)	Controls(n=18)	p
Distensibility	2.33 ± 1.7	3.43 ± 1.8	0.01
Aortic Stiffness	3.6 ± 0.51	3.3 ± 0.56	0.09
PWVr	7.4 ± 5.21	6.34 ± 4.7	0.44