**Poster session 2**

**Thursday, 8 December 2005, 14:00–18:00**

**Location: Poster Area**

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**CONGENITAL AND PEDIATRIC HEART DISEASE**

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The role of two-dimensional transluminal Doppler echocardiography in establishing the site of drainage of coronary artery fistulae. Study of 20 patients

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**Background:** It is known that coronary artery fistula is a rare condition in which a communication exists between an epicardial coronary artery and a cardiac chamber or major vessel (vena cava, pulmonary veins, pulmonary artery).

The aim of the study was to assess the role of two-dimensional echocardiography (TTE) complemented by pulsed Doppler ultrasound and color flow imaging in the diagnosis of coronary artery fistula (CAF), which is usually diagnosed by coronary angiography and cardiac catheterization.

**Material and methods:** In a retrospective study over the period 1985-2005, 20 patients (pts.) with CAF were identified. The patients, aged between 8-60 years, 18 male (90%) were studied by two-dimensional TTE with pulsed Doppler and color flow imaging and by other noninvasive methods (ECG, chest radiogram, phonocardiogram, first pass radionuclide). In all the patients, the final diagnosis of CAF was made by selective coronary angiography.

**Results:** Out of 20 pts., CAF was suggested by two-dimensional TTE (Doppler and color flow) in 20 pts. (68.96%). In 12 pts. (41.37%), TTE detected significantly enlarged proximal coronary artery. In 14 pts. (46.27%) TTE gave much better delineation of the fistula and depicted the drainage site: left ventricle 2 pts., right ventricle 6 pts., pulmonary artery 4 pts., right atrium 2 pts. In a case, TTE shows color flow imaging and by other noninvasive methods (ECG, chest radiogram, phonocardiogram, first pass radionuclide). In all the patients, the final diagnosis of CAF was made by selective coronary angiography.

**Conclusions:** Our study confirmed that two-dimensional TTE (Doppler and color flow) is a good imaging investigation in suggestion of CAF in 68.96% pts., visualization the enlarged proximal coronary artery in 46.27% pts. and the site of drainage in 46.27% pts.

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Orally administered endothelin-1 antagonist bosentan for pulmonary hypertension secondary to congenital heart disease (Eisenmenger syndrome)

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**Purpose:** To evaluate safety, tolerability, clinical and haemodynamic impact of bosentan in patients with pulmonary hypertension due to congenital heart disease (Eisenmenger syndrome).

**Methods:** Twelve patients with ES (6 male, 7 female, mean age 35 ± 8.7 years) were treated with oral bosentan (62.5 mg x 2/die for the first month and then 125 mg x 2/die). Patient clinical status, liver enzymes, WHO functional class, resting oxygen saturations, 6-min walk test and transthoracic echocardiography were assessed at baseline and at 1, 3 and 6 months. Haemodynamic evaluation with cardiac catheterization was performed at baseline and at 6 month follow-up.

**Results:** At baseline 10 patients were in III and 2 in IV WHO functional class. Six had ventricular septal defect, 3 single ventricle, 2 aorto-ventricular canal, 1 truncus arteriosus. All 12 patients well tolerated bosentan, but in 2 patients we reduced the maintenance dose from 125 mg x 2/die to 62.5 mg x 2/die for a transient elevation of liver enzyme (1 patient) and transient leg oedema (1 patient). After six month therapy, oxygen saturation at rest (78.3 ± 9.3% vs 85.8 ± 6.4%; p < 0.05) and after 6-min walk test (64.4 ± 8.8% vs 73.5 ± 5.2%; p < 0.05), the distance traveled in the 6-min walk test (321 ± 101 vs 445 ± 45 m; p < 0.05) and Borg’s index (5.9 ± 1.4 vs 3.2 ± 3.3; p < 0.05) significantly improved. A significant change of total pulmonary indexed resistances (15.1 ± 1.9 vs 9.3 ± 3.8 WU, p < 0.05), arterial pulmonary indexed resistances (15.2 ± 2.7 vs 7.6 ± 1.7 WU, p < 0.05) and systemic-to-pulmonary blood flow ratio (0.7 ± 0.3 vs 1.3 ± 1.1; P < 0.05) was observed suggesting an improvement of pulmonary haemodynamics. At six month follow-up 5 patients were in II, 6 in III and 1 in IV WHO functional class.

**Conclusions:** Bosentan treatment was safe and well tolerated in adults with ES after a mid-term follow-up (6 months of oral therapy). Oxygenation, functional status and pulmonary haemodynamics of patients improved with minimal side effects. Larger clinical investigation is necessary in evaluating the role of bosentan in patients with Eisenmenger syndrome.

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Echocardiographic detection and complex therapeutic management of arrhythmias in fetal age

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**Background:** Fetal arrhythmia occurs in ~1-2% of all pregnancies. Compared with the general population, fetuses with a cardiac arrhythmia (CA) have high perinatal and neonatal mortality rates. Diagnosis and management of CA in the fetal age is crucial for the prevention of heart failure. Aim: To evaluate the management protocol of fetal CA based on prior identification of the underlying mechanism of the arrhythmias.

**Methods:** In the last two years 566 fetuses with suspicious cardiac malformation were evaluated with echocardiography in our centre. Rhythm diagnoses was done by performing M-mode, pulsed and continuous Doppler and tissue Doppler through the fetal heart so that both the ventricular and atrial activity were recorded.

**Results:** Thirty-three out of 566 fetuses showed cardiac arrhythmias (mean weeks of gestation at diagnosis: 24 ± 4.5). Two of 33 had fetal hydrops and one, despite medical therapy, died at 28 weeks. The weight at birth of survived 32 was 2600 ± 320 g. One fetus with tachycardia had a congenital heart disease (Eisenmenger syndrome). The supposed prenatal diagnosis was confirmed at the birth in 29/33 fetuses. Neutborn fetuses had tachycardia with a 1:1 AV conduction during fetal life (HR 225±25 bpm). Ten out of 19 showing a 1:1 AV conduction, had a long VA interval; the diagnosis at the birth was isthmusventricular re-entrant tachycardia (AVRT). One fetus had atrial tachycardia with a 2:1 AV conduction (atrial flutter). Six fetuses showed isolated ectopic beats. Four fetuses showed AV dissociation with a low ventricular rate (HR 42±18 bpm); in all at the birth the diagnosis of complete AV block was confirmed and two underwent pacemaker implanting (at 3 and 7 months). One, with a familiarity for long QT syndrome (LQTS),
showed a fetal tachycardia with AV dissociation; at the birth it was confirmed the 
electrophysiologic mechanism. Fetal echocardiography could clarify the electrophysiological mecha-
nism of fetal cardiac arrhythmias and guide the therapeutic approach.

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Objectively measured daily physical activity has a relation with left 
ventricular size in young children
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Introduction: Training studies in adolescents have revealed that increased expo-
sure to physical activity can give enlargement and a remodeling of the left ventri-
cle. This relationship has not been studied on a population-based level in young 
children.

Methods: This was a cross-sectional study of 248 children (140 boys and 108 
girls) aged 8 to 11 years of age, from a population-based cohort. Maturity was eval-
uated according to Tanner. Echocardiography, 2-dimensional guided M-mode, was 
performed in accordance with ASE-guidelines. Left ventricular end-diastolic diam-
eter (LVDD) and left ventricular and systolic diameter (LVSD) were measured. All 
echocardiography measurements were indexed for body surface area (BSA). Phys-
ical activity was assessed by accelerometers for 4 days. From accelerometer data 
numerus accelerations activity per day were counted. Blood pressure was measured 
in the sitting position.

Results: Acceptable accelerometer measurement was obtained in 229 children 
(92%). The physical activity was significantly higher (p<0.05) in boys compared to 
girls and in the upper compared to the lower tertile. The systolic blood pressure, 
mean arterial pressure and heart rate were significantly higher (p<0.05) in the lower 
compared to the upper tertile. When the median of the physical activity was com-
pared between sex and tertile ADL, a significant difference was found (p<0.05).

Conclusions: The result indicates that low physical activity is associated with 
lower systolic blood pressure and heart rate. The result also shows that there is a 
difference in physical activity between sex. A low physical activity may have nega-
tive influence on cardiovascular risk factors. A high physical activity is associated 
with lower systolic blood pressure and heart rate. Higher physical activity is 
associated with lower systolic blood pressure, lower blood pressure and lower 
heart rate. This suggests that heart muscle remodelling due 
the amount of daily physical activity begins early in life.

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Quantification of regional left and right ventricular deformation indices 
in normal neonates by using strain rate and strain imaging
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Background: Color Doppler myocardial imaging (CDMI) allows calculation of ei-
ther local longitudinal (L) or radial (R) Strain Rate (SR) and Strain (e). In this study we tried to determine the feasibility and reproducibility of L and R SR and e in neonates at first hours of life and define normal values.

Methods: Data were obtained in 55 normal neonates, 29 male, (mean 24±2 h) 
and in 26 female, (mean 22±1 h). We used the ASE guidelines for M-mode. There were no statistical differences between L and female neonates. Apical and parasternal views were used to quantily regional L and R SR measurements as well as myocardial velocity imaging data were obtained. The IVA was 
calculated in the LV basal lateral and RV basal free wall. Peak systolic SR and Strain 
were not different between pls and controls. IVA and deformation indices could potentially be used 
in clinical practice to detect and follow up cardiac diseases in neonates.

Aim: To determine whether IVA, SR and S could detect abnormalities in cardiac 
function in pts late after a low Ant dose treatment

Methods: We examined 56 pts aged 12±4.8 years. They had all previously 
received an Ant dose lower than 300 mg/m² (median: 240 mg/m²). Data were com-
pared to 32 age-matched normal controls. Both, standard echocardiographic mea-
surements as well as myocardial velocity imaging data were obtained. The IVA was 
measured at the LV basal lateral and RV basal free wall. Peak systolic SR and S 
were estimated both in the radial, from the inter-ventricular septum, and in the longitudinal 
from the LV lateral wall and interventricular septum.

Conclusions: See table. Additionally, end-systolic wall stress was higher, isovolu-
metric relaxation time was prolonged, LV annular motion and pulmonary vein systolic flow 
were reduced in pls compared to controls. All other standard indices of LV function 
were not different between pts and controls.
434 Assessment of ventricular desynchronization in patients with right-to-left shunting of fetal flow by strain Doppler echocardiography

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Background: Several parameters have recently been proposed to assess mechanical dyssynchrony in patients with univentricular heart. This work aims at correlating these parameters to age at surgical repair and to correlate them with the clinical findings.

Methods: Eleven patients after TOF repair (aged 17-42 years) were studied with strain Doppler echocardiography (SDE). A four-chamber view was employed for imaging TDI/SRI. Few data exist regarding the assessment of inter- and intra-ventricular dyssynchrony in patients after tetralogy of Fallot (TOF) repair in the presence of right bundle branch block.

Results: At six months follow-up after BV implantation, patients' functional status improved by one NYHA class or more and RVFAC improved overall from 16±5 to 27±8% in patients without intravenous dyssynchrony by SDE. We found a mildly reduced SDE strain rate at rest and during exercise. The end-expiratory E-e, i.e. the time interval (calculated with the R-wave of the ECG as a reference) between the start of the mitral inflow (E) and the onset of the early diastolic relaxation (aortic valve opening), in our study was assessed.

Conclusions: TDI/SRI dyssynchrony measurements show that biventricular pacemakers should be considered in selected patients with RVFAC <60%.

435 The left ventricular early diastolic blood-to-tissue time interval is longer in normal children - than in normal elderly adults - and instead resembles that of elderly ischemic heart disease patients


Background and Purpose: To a more spherical ventricular shape with an increased end-diastolic minor/long axis ratio. The evaluation of ventricular function in patients after Fontan operation still relies on parameters requiring geometrical assumptions, which often cannot be applied in the univentricular heart. Ultrasonic strain and strain rate imaging is a new noninvasive technique able to quantify regional myocardial deformation properties. Significantly, both of these parameters are free of geometrical assumptions, which is particularly useful in hearts with abnormal shape, such as in univentricular heart. Aim of this study was to evaluate, for the first time, the regional myocardial deformation properties in patients with single ventricle before and after a Fontan operation.

Methods: We studied 20 patients after Fontan operation and 20 age-sex matched controls. All patients underwent a color Doppler myocardial study Patients after Fontan operation presented with cardiac failure and were treated with different inotropic agents

Conclusions: We demonstrated that left ventricular early diastolic blood-to-tissue time interval was longer in normal children - than in normal elderly adults - and instead resembled that of elderly ischemic heart disease patients.

436 Ventricular remodeling and function in univentricular heart: new findings from geometric and echocardiographic analyses

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Despite the advent of effective palliative therapy, in patients with univentricular heart, ventricular dysfunction remains a significant clinical problem. Single-ventricle patients often have altered left ventricular shape, which is characterized by the chronic volume overload state, that induces progressive ventricular dilatation with transition to a more spherical ventricular shape with an increased end-diastolic minor/long axis ratio. The evaluation of ventricular function in patients after Fontan operation still relies on parameters requiring geometrical assumptions, which often cannot be applied in the univentricular heart. Ultrasonic strain and strain rate imaging is a new noninvasive technique able to quantify regional myocardial deformation properties. Significantly, both of these parameters are free of geometrical assumptions, which is particularly useful in hearts with abnormal shape, such as in univentricular heart. Aim of this study was to evaluate, for the first time, the regional myocardial deformation properties in patients with single ventricle before and after a Fontan operation.

Methods: We studied 20 patients after Fontan operation and 20 age-sex matched controls. All patients underwent a color Doppler myocardial study Patients after Fontan operation presented with cardiac failure and were treated with different inotropic agents

Conclusions: We demonstrated that left ventricular early diastolic blood-to-tissue time interval was longer in normal children - than in normal elderly adults - and instead resembled that of elderly ischemic heart disease patients.

437 The prominence of the right A-V annulus as a new echocardiographic sign of Ebstein malformation: anatomical and 2d-echocardiographic correlation

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Background: The understanding of the anatomy of Atrio-Ventricular (A-V) functional area in Ebstein malformation (EM) may facilitate the echocardiographic diagnosis of this congenital cardiopathy.

Methods: We examined 8 autopsied hearts (age: 37±7 yo) with isolated adult EM to elucidate the gross morphological features of the right A-V junction. In addition, we have performed 2D and M-Mode echocardiographic exam in 27 patients (P): 15 Pts (age: 39±8.4±2 yo, 50% male) with isolated EM and 12 unselected consecutive P (age: 47±8.9±8 yo, 51% male) without echocardiography as controls. Anterolateral A-V junction was examined in 4 chambers apical or subcostal views and parasternal short-axis view.

Results: In autopsied hearts, the extent of the atrialized component of the right heart was defined as the presence of a morphologically thickened right atrial wall wider than 22.0±8.8 mm at the level of the tricuspid valve (TV) annulus, not present in normal hearts. In correspondence with this feature, the thickness of the anterolateral A-V junction in the echocardiographic exam of P with EM was increased, opposite to P. EM mean 10.4 mm (range: 7.4-16.7 mm) and control mean 7.4 mm (range: 5.8-9.6 mm). P <0.01. A-V junction was >10 mm in 66.7% of P with EM, but none in normal P (two-tailed Fisher's exact test p=0.001). For EM, specify of this sign was 100% and positive predictive value 100%.

Conclusions: In Ebstein malformation, together with the downward displacement of the tricuspid leaflets, the morphologic exam showed a previously undescribed prominent muscular crest at the A-V functional level. This crest is visualized in 2D Echocardiography as a thicker right A-V annulus. A right A-V annulus >10 mm width is a new diagnostic echocardiographic sign of Ebstein malformation.

438 Value of NT-pro BNP and Tei index for the evaluation of right ventricle after repair of Tetralogy of Fallot

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Introduction: After corrective surgery of Tetralogy of Fallot (TF) patients (pts) present with pulmonary regurgitation (PR) of variable degree, that originates right ventricular (RV) dilatation and dysfunction. These cases are evaluated usually in NYHA II, grade 3-4.

Methods: In 2004 we studied prospectively 23 adult pts (61% males) with surgical repaired TF, using the Teichholz and Tei Index. The same group was re-studied in 2006 using the Teichholz and Tei Index.

Results: In 2004 we studied prospectively 23 adult pts (61% males) with surgical repaired TF, using the Teichholz and Tei Index. The same group was re-studied in 2006 using the Teichholz and Tei Index.

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Abstracts
The mean calculated Tei was of 0.21±0.15 (0.01 to 0.41). Mean NT-proBNP value was 299.34−542.2 pg/ml, being normal in 44% of pts.

Results: LV deformation showed a significant reduction in peak systolic e in both segments in the second exam (53±15 vs. 46±9% p=0.00; compared to the first. LV L deformation had similar change, showing significant reduction in peak systolic e in all segments in different walls (septum, lateral, inferior and anterior). In basal and apical segments of the lateral wall, the systolic e was also reduced (8±3% vs. 5.9±2% p=0.02). End diastolic e was also reduced in the basal and apical portions of the inferior wall. Systolic SR showed reduction just in basal and apical segments of the lateral wall and in the mid portion of the inferior wall (R1.9±0.5 s^−1 vs. −1.7±0.3 s^−1 and SR-1.6±0.4 s^−1 vs. −1.7±0.2 s^−1) p=0.03. Longitudinal SRI values of the right ventricle, including early and late diastole were significantly higher in the first exam compared to the second.

Conclusions: Decrease in LV peak systolic e in the second exam was probably due to the increase of preload and decrease of the preload. In the lower intial values of deformation indices were probably due to increased afterload caused by physiological pulmonary hypertension and/or immunocontractile properties of the RV itself.

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Adult patients with patent arterial septal defect: BNPs and cardiopulmonary exercise test in the evaluation of exercise capacity in patients over 30 years of age.

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Introduction: Adult patients (P) with arterial septal defect (ASD) describe their physical performance as normal, it may be due to local decease to close the defect. Subjective perception of physical fitness does not fully relate to clinical status. The study aimed to determine exercise capacity using cardiopulmonary exercise test and BNP levels in adult asymptomatic P with ASD.

Material and methods: 36 P (25F, aged 44±7,8 yrs., with patent ASD II were studied. Controls: 25 healthy individuals (15F), aged 45±6,6 (±1.4) yrs. Exercise capacity and diastolic dimension of LV (EF) and right ventricle (RV), exercise fraction of left ventricle (EF), right ventricular end-systolic pressure (RVSP) was measured, pulmonary to systemic perfusioon Qp:Qs was calculated. Exercise test (modifed Balke protocol) was performed on a treadmill, at rest when forced vital capacity (FVC), tidal volume (VT), minute ventilation (VE), forced expiratory volume (FEVI), and peak oxygen consumption (peak VO2) VE/VO2 slope were measured.

PLasma BNP was measured by immunometric assay (Shinonora BNP kit).

Results: 31 P (91%) classified as NYHA I, 5 P (14%) as NYHA II. BNP levels in P group were higher than in controls (60±6;49,3 yrs.; 32±6;4,25 yrs., p=0.02). Following parameters are decreased in studied group when compared to controls: peak VO2: 22±5.1 vs.4.6 ml/min (p=0.0001); MaxHR: 159±7,2 vs.21,0 bpm (p=0.01); peak BPsys: 155±3;19,5 mmHg (p=0.0003); VE: 59±17,9 I/min (p=0.0008); RQ: 1,03±0,06 (p=0,01); FVC: 3,4±5,9 (p=0.0059); VFVC: 90,4±18,9% (p=0.0002); VT: 1,6±0,5 (p=0.008); FEV1: 2,6±0,7 (p=0.01); FEVI: 81,8±18,7% (p=0.0002); FEV25−75%: 2,9±0,9 (p=0,01). VE/VO2 was higher in study group than in controls 31,34−6,6 (p=0,01) and exceeded 34 in 5 P (14%).

The negative correlations were found between: peak VO2 and Qp:Qs (p=0.04); peak VO2 and RVSP (p=0.09); RV and RImax (p=0.02); FEVI and RV (p=0.04); FEVI and RVSP (p=0.01); RV and RVSP (p=0.04) exercise duration and Qp:Qs (p=0.03); BNP and RV (p=0.04); BNP and VO2 (p=0.07). The positive correlations were shown between: VE/VO2 and Qp:Qs (p=0.098), HR max and peak VO2 (p=0,005), BNP and RV (p=0.00) BNP and Qp:Qs (p=0.03).

Conclusions: 1. Exercise capacity is significantly reduced in ASD adults, contrary to the high subjective perception of their fitness.

Reduction exercise capacity results from decreased cardiac output due to altered anatomy of the heart and functional lung pathologies consequent to enhanced pulmonary blood flow.

3. Lower BNP levels in these P appear to result from right ventricular volume overload.

4.42 Atrial septal defect or interatrial communication?

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Background: In English language literature any interatrial communication is named as an atrial septal defect (ASD). However, the precise nature of atrial septal, as visible from inside of the right atrium, includes only the flap valve and muscular wall of the fossa ovalis. The studies on ASDs in the English language are focused only on their interrelations and classifications. Transoesophageal echocardiography (TEE) is ideally suited to perform a comprehensive atrial septal examination.

The TEE examinations performed to 36 patients (mean age 37±16 years, 10 males and 16 females) diagnosed with "non-septum" ASD were retrospectively reviewed to assess the true atrial septum involvement in the heart defect.
Results: In 9 patients with octamer primum ASD the deficiency was located in the muscular atrioventricular septum that normally separates the right atrium and left ventricle. As mitral annulus shifted towards the level of the tricuspid annulus in most cases, the communication became interatrial but outside the confines of true atrial septum in patients with supero-sinus venous syndrome TEE showed a defect in the easterstal wall that normally separates the left atrium and right upper pulmonary vein from the superior vena cava. This deficiency unrocted the right upper pulmonary vein compelling it to drain into the superior vena cava which occurred the intact atrial septum in 3 patients with inferior variety of sinus venosus. The two defect TEE showed a defect in the wall of the inferior vena cava which continued directly into the posterior border of the left atrium. The intact nature of the oval fossa could be demonstrated. Finally, TEE revealed a deficiency in the wall of the left atrium unroofing the coronary sinus in one patient diagnosed with a coronary sinus type of ASD.

Conclusion: In patients with non-seucndum type of ASD the defect is located outside the confines of the oval fossa or its muscular borders. TEE examination provides precise definition of true atrial septum and septal boundaries. Thus, these heart defects should be properly re-classified as interatrial communications instead of atrial septal defects.

443 Reduced right ventricular deformation in children with severe pulmonary regurgitation after tetralogy of Fallot correction is associated with reduced exercise capacity
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Background: Chronic pulmonary regurgitation (PR) after repair of tetralogy of Fallot (TOF) is associated with progressive RV dilatation resulting in RV dysfunction. Little information is currently available on the effect of chronic PR on RV function during childhood and its relationship with exercise tolerance.

Methods: Right ventricular function was assessed using tissue Doppler echocardiography and cardiac magnetic resonance imaging (MRI) in 40 post-operative TOF patients (age 11.1±3.3 years) with low-prassured right ventricle and varying degrees of PR. Regional ventricular deformation parameters of peak systolic strain rate (SR) and end-systolic strain (S) were calculated using color Doppler myocardial imaging. Right ventricular regurgitant fraction (RFR) was quantified using MRI velocity mapping. Exercise capacity was evaluated by measuring peak oxygen uptake (VO2).

Results: Severe pulmonary regurgitation (PRF > 30%) was noted in 22 patients, mild to moderate (PRF = 30% - 50%) in 18 patients. RV end-diastolic volume and stroke volume were both significantly increased compared to normal values and correlated significantly with the PRF (r = 0.56, p = 0.01). RVEF was significantly lower compared to normal values (56.1±8.3% vs. 65.1±8.6%, p = 0.001) and correlated inversely with the amount of PR (r = -0.42, p = 0.01). There was strong negative correlation between the PRF and the RVEF (r = -0.87, p < 0.001). In patients with severe PR, RV systolic deformation indices were significantly lower compared to patients with mild to moderate PR; SR -1.29±0.23 vs. -1.56±0.46, p = 0.02; S -17.0±4.3% vs. -24.6±7.1%, p = 0.001. In addition, a significant correlation was found between peak VO2 and SR (r = 0.51, p = 0.001).

Conclusions: In children after TOF correction, severe PR is associated with reduced systolic RV functional parameters as measured by tissue Doppler echocardiography and cardiac MRI. These decreased RV deformation indices correlate significantly with impaired maximal aerobic exercise capacity. Tissue Doppler and cardiac MRI provide the clinician with sensitive quantitative measures of RV function that should be serially followed to better facilitate optimal timing of interventional strategies designed to preserve long term ventricular function and exercise performance in TOF patients.

444 A shift from circumferential to longitudinal contraction in the left ventricle supporting the pulmonary circulation
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Background: Adaptive changes in the left ventricle (LV) supporting the pulmonary circulation were characterized by strain Doppler echocardiography in patients operated for transposition of the great arteries (TGA) with atrial switch.

Methods: The study group comprised 14 TGA patients aged 18.4±0.9 years (mean±SD), operated as infants a.m. Senning, with clinical and non-invasive findings without remark. LV ejection fraction was 53±10% measured by MRI. The two control groups encompassed eight healthy subjects aged 26.8±4.1 years and eight, 26.7±4.4 years operated in neonatal period and at older age using atrioventricular septal defect closure or septal defect closure, respectively.

Results: In the TGA patients, LV longitudinal strain was higher and circumferential strain was lower than in the healthy controls (23.3±3.6% vs. 16.7±2.1%, p=0.001, and -17.1±2.3% vs. -26.4±3.8%, p<0.001, respectively). Corresponding differences were found between the TGA patients and operated controls (Figure). Moreover, there were no significant differences between the two control groups, ruling out that the findings in the TGA patients merely represented a postoperative effect.

Conclusion: The LV adapts to the reduced pressure load of the pulmonary circulation by increased systolic longitudinal shortening and decreased circumferential contraction.

445 Comparison of the left ventricular function in children successfully operated for aortic coarctation in neonatal period and at older age using atrial and atrioventricular septal defect imaging
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The aim of the study was an assessment of systolic and diastolic left ventricular function in children after the successful repair of aortic coarctation performed in neonatal period and at the later date. The study group comprised 27 children (mean age: 13.7±3.4 years) after the successful repair of aortic coarctation participated in this study. They were divided into: Group I of 14 children aged 8.1±1.69 years operated in neonatal period and Group II of 13 children aged 6.7-17.9 years operated at the older age. In Group I the mean age of the surgery was 8.3±1.5, 11 days and mean follow-up 13.2±1.45 years. In Group II, 8.62±1.45 years and 8.41±0.57 years respectively. Control group consisted of 18 healthy children. In all children the echocardiographic examination with color TDI of septal and lateral left ventricular wall was performed. Following TDI parameters for mid segments of septal and lateral wall were quantified: longitudinal systolic (SRs), early (Sre) and late (Sra) systolic strain rate and maximal strain (Ss) based on offline analysis. Moreover Sre/Sra index was calculated. The results presented in the table below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRs (s^-1)</td>
<td>1.97±0.69</td>
<td>2.03±0.71</td>
<td>2.01±0.78</td>
</tr>
<tr>
<td>Sre (s^-1)</td>
<td>2.02±0.72</td>
<td>1.96±0.79</td>
<td>1.54±0.47</td>
</tr>
<tr>
<td>Sra (s^-1)</td>
<td>1.57±0.59</td>
<td>1.29±0.54</td>
<td>1.28±0.54</td>
</tr>
<tr>
<td>Ss (%)</td>
<td>26.8±3.9</td>
<td>27.6±4.6</td>
<td>27.8±4.6</td>
</tr>
</tbody>
</table>

Conclusions: 1. Increased Sre and decreased Sra/Sra reflect impaired left ventricular diastolic function in children after successful repair of aortic coarctation of all age groups. 2. The left ventricular diastolic dysfunction is more prominent in children successfully operated for aortic coarctation at older age than in neonatal period. 3. Hyperkinesis of left ventricle after the surgical treatment of aortic coarctation is observed in children operated in post-neonatal period.

446 Is echocardiography a good exam to predict the fate of the patent ductus arteriosus in preterm infants?
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Background: Clinical diagnosis of patent ductus arteriosus (PDA) in preterm infants is a difficult task. Echocardiography (ECHO) has been the method of choice, but so far it is limited to evaluate the severity of the shunt, and to predict spontaneous closure or the need for drug therapy or surgery regarding its closure. The aim of
this study was to determine an echocardiographic parameter which could predict the functional severity of PAH.

**Methods:** 45 ECHO of 23 proventricular (15 male) were reviewed. The mean of gestational age was 28.9 weeks, mean weight 1.2 kg, and mean age at the exam 14.2±3.6. The following ECHO parameters were measured: diameters of left atrium (LA), aorta (AO) and PDA, the ratio of AO/A, PDA/A and PDA/weight, the pattern of PDA flow by Doppler, the PDA peak systolic and diastolic velocities, the ratio of peak systolic/diastolic velocities, and the presence of patent foramen ovale (PFO). Patients were divided into two groups: GI: 6 with spontaneous closure and GII 17 who needed treatment (endothelium or surgical closure). We reviewed the first and the last exam before the closure of the PDA and all the parameters were compared between the two groups.

**Results:** In the first exam, the incidence of patent foramen ovale was higher in GI than in GI (Fisher’s Test, p<0.05) but there was no difference between the groups regarding the other ECHO parameters. In the last exam, the PDA/A ratio was higher in GI than GII (Mean-Whitney, p<0.01), but no difference between the groups was found in relation to the other parameters.

**Conclusion:** The presence of a patent foramen ovale and the PDA/AO ratio could be useful in predict the need of treatment in proventricular in patients with PDA. Further studies with a larger number of patients are necessary to establish the real value of these results.

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**The value of right atrial and right ventricle function in predicting cardiopulmonary capacity in patients with atrial septal defect**

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**Introduction:** The assessment of prevalence and type of associated vascular anomalies was associated with biventricular dysfunction, and frequently associated with neuromuscular disorders (NMD). Initially described in children and young adults, LVHT has been found also in elderly. Aim of the study was to assess the age-dependency of clinical, echocardiographic (LVHT) and echocardiographic findings, and whether it differs according to the neurologic diagnosis.

**Methods and Results:** In 66 patients LVHT was diagnosed echocardiographically between June 1985 and December 2004 (21 females, 65 male, age 14 - 94 years, mean 52±14 years). All patients underwent baseline cardiologic investigation and were invited for a neurologic investigation. A specific NMD was diagnosed in 12 (38%) (metabolicopathy, n=4; Leber’s hereditary optic neuropathy, n=2; myotonic dystrophy, n=2; Bardet-Biedl syndrome, n=1; cutaneous dystrophy, n=1), a MMD of unknown etiology in 32, the neurologic investigation was normal in 15 and 20 refused. Clinically, axonopathy (39%), cardiomyopathy (31%), hemodynamic failure (43%), heart failure (25%) were associated with increased age. Among ECG findings left bundle branch block was associated with increased age (p<0.05), long QT (p=0.03). Echocardiographically, elderly patients had larger left ventricular end-diastolic area (LVEDA) (p<0.05), a lower left ventricular fractional shortening (p<0.05) and more often valvular abnormalities (p<0.05, p<0.05) than younger patients. No age-dependency was detected regarding location and extension of LVHT and the neurologic diagnosis.

**Conclusion:** There is no age-typical pattern of LVHT regarding, clinical, echocardiographic and neurologic findings. Echocardiographers should be aware of this cardiac abnormality when investigating patients of any age.

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**Adult patients with Ebstein anomaly-cardiopulmonary exercise test and natriuretic hormone type B**

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**Introduction:** Ebstein anomaly is characterized by displacement of part of tricuspid valve in the direction of space of the heart and inappropriate attachment of valves to the ventricular wall resulting in significant decrease in right ventricular function and tricuspid regurgitation.

**Aim of the study** was the estimation of physical capacity measured with spiroergometry and plasma BNP level in adult patients (P) with Ebstein syndrome and its possible correlation with echocardiographic index of anatomical progression of the malformation.

**Material and method:** 21 P were studied: 24-63 years (mean 40,3 years). Control group: 19 healthy persons: 24-63 years (mean 41,3 years). VO2 Max 21,9-1-5,4 ml/kg/min vs 33,64-8,3 ml/kg/min (p=0,0001), peak VO2 145,74-14,4 mmHg vs 171,14-23,3 mmHg (p=0,0003), VE 71,34-17,0 liters/min vs 86,43-17,0 liters/min (p=0,0001). Plasma natriuretic hormone type B was higher in patients (P) with Ebstein syndrome (p<0.0001) and did not differ significantly between EGE groups.

**Conclusion:** There was higher plasma BNP level in adult patients with Ebstein anomaly compared to healthy persons. No age-dependency was detected regarding location and extension of LVHT and the neurologic diagnosis.

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**Age-dependency of cardiac and neuromuscular findings in left ventricular noncompaction**

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**Background:** Left ventricular hypertrophy (noncompaction/LVHT) is a cardiac abnormality characterized by prominent trabeculations and intertrabecular recesses, and frequently associated with neuromuscular disorders (NMD). Initially described in children and young adults, LVHT has been found also in elderly.

**Aim of the study** was to assess the age-dependency of clinical, echocardiographic (LVHT) and echocardiographic findings, and whether it differs according to the neurologic diagnosis.

**Methods and Results:** In 86 patients LVHT was diagnosed echocardiographically between June 1985 and December 2004 (21 females, 65 male, age 14 - 94 years, mean 52±14 years). All patients underwent baseline cardiologic investigation and were invited for a neurologic investigation. A specific NMD was diagnosed in 12 (30%) (metabolicopathy, n=4; Leber’s hereditary optic neuropathy, n=2; myotonic dystrophy, n=2; Bardet-Biedl syndrome, n=1, a MMD of unknown etiology in 32, the neurologic investigation was normal in 15 and 20 refused. Clinically, axonopathy (39%), cardiomyopathy (31%), hemodynamic failure (43%), heart failure (25%) were associated with increased age. Among ECG findings left bundle branch block was associated with increased age (p<0.05). Echocardiographically, elderly patients had larger left ventricular end-diastolic area (LVEDA) (p<0.05), a lower left ventricular fractional shortening (p<0.05) and more often valvular abnormalities (78% versus 38%, p=0.03). Echocardiographically, left ventricular end-diastolic area (LVEDA) was higher in patients with increased age (p<0.05).

**Conclusion:** There was no age-typical pattern of LVHT regarding clinical, echocardiographic and neurologic findings. Echocardiographers should be aware of this cardiac abnormality when investigating patients of any age.

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**Echocardiographic parameters of right atrial and right ventricle function in predicting cardiopulmonary capacity in patients with ASD.**

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**Aim of the study** was estimation of physical capacity measured with spiroergometry and plasma BNP level in adult patients (P) with Ebstein syndrome and its possible correlation with echocardiographic index of anatomical progression of the malformation.

**Material and method:** 45 ECHO of 23 preterm infants (15 male) were reviewed. The mean gestational age was 28.9 weeks, mean weight 1.2 kg, and mean age at the exam 14.2±3.6. The following ECHO parameters were measured: diameters of left atrium (LA), aorta (AO) and PDA, the ratio of AO/A, PDA/A and PDA/weight, the pattern of PDA flow by Doppler, the PDA peak systolic and diastolic velocities, the ratio of peak systolic/diastolic velocities, and the presence of patent foramen ovale (PFO). Patients were divided into two groups: GI: 6 with spontaneous closure and GII 17 who needed treatment (endothelium or surgical closure). We reviewed the first and the last exam before the closure of the PDA and all the parameters were compared between the two groups.

**Results:** In the first exam, the incidence of patent foramen ovale was higher in GI than in GI (Fisher’s Test, p<0.05) but there was no difference between the groups regarding the other ECHO parameters. In the last exam, the PDA/A ratio was higher in GI than GII (Mean-Whitney, p<0.01), but no difference between the groups was found in relation to the other parameters.

**Conclusion:** The presence of a patent foramen ovale and the PDA/AO ratio could be useful in predict the need of treatment in proventricular in patients with PDA. Further studies with a larger number of patients are necessary to establish the real value of these results.
3. BNP levels are higher comparing to healthy individuals, but not correlate with this echocardiographic gradients of the disease severity.

451 Evaluation of right ventricular function in patients with post-operative pulmonary regurgitation by transesophageal echocardiography

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Background: We explored the accuracy of transesophageal strain Doppler echocardiography in detecting RV dysfunction in patients (pts) with postoperative tetralogy of Fallot (T/ToF) and hemodynamically significant pulmonary regurgitation (PR).

Methods: Transesophageal echocardiography with TDI and strain capabilities was performed in 14 pts aged 13-45 years who had repair of T/ToF 12 age- and sex-matched subjects with no signs of heart disease were selected as normal controls (CTR). A thorough esophageal, low esophageal and transthoracic scanning was performed. The ratio of PR jet width measured by color Doppler to the infundibulum diameter was used to quantify the severity of PR (ratio > 50% = moderate to severe PR). Right ventricular ejection fraction (EF), fractional shortening (FS), and tricuspid flow filling parameters (E/A ratio, DT) were determined. Offline analysis of the myocardial velocity data sets was performed using dedicated software. Velocity and strain traces from right ventricular free wall at 3 levels (basal, mid cavity, and apical) were processed in the esophageal 4-chamber view. Systolic and diastolic TDI values (Sw, Ew, Aw), peak systolic strain and systolic and diastolic strain rate values were determined.

Results: Three pts presented with severely distal RV and decreased fractional area change for progressive pulmonary insufficiency due to an outflow patch and were excluded from analysis. 11 pts with dilated RV and normal fractional area change were analysed. E/A ratio was lower in pts than in CTR (p=0.009). Peak systolic strain and systolic and diastolic strain rate were also reduced in pts compared to CTR (p=0.001). E/A ratio and DT were not different among the two groups. No correlation was found between E/A ratio, DT, and severity of PR. A highly significant relationship was shown between early diastolic SR and degree of PR (r=0.79, p=0.001).

Conclusion: In adolescent and adult pts after repair of T/ToF, TEE is recommended to assess morphofunctional details especially when transthoracic images are limited by paucity of acoustic windows. In the presence of hemodynamically significant pulmonary regurgitation, strain Doppler echocardiography can detect RV systolic-diastolic impairment not shown by conventional echo-Doppler echocardiography.

452 Left ventricular false tendons and innocent heart murmurs of childhood

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Left ventricular false tendons are considered as insignificant findings during routine echocardiographic evaluation.

Aim: To evaluate whether false tendons are implicated in the pathogenesis of innocent heart murmurs of childhood.

Methods: 100 children (mean age 7.4 + 3.6 yrs, range 1-16 yrs) were consecutively enrolled from the outpatient population of the Pediatric Cardiology Unit. Exclusion were patients with structural heart disease (including mitral valve prolapse), anemia and febrile disease. During a detailed echocardiographic evaluation the presence and location of left ventricular false tendons was documented. Blood flow through all valves and left ventricular outflow tract (LVOT) was measured and TDI measurements on septal mitral valve annulus were performed. Patients were divided into two groups according to the presence or absence of the typical vibratory murmur, by an experienced pediatric cardiologist.

Results: 61 of the children had an innocent murmur. The prevalence of false tendons was 88% and 61% in patients with and without murmur respectively (p=0.004) and their presence was associated with a 4.70 R (95% CI 1.5-14) for murmur. The total number and location of false tendon were significant predictors of murmur, particularly if located in LVOT (20.8 OR for murmur, p<0.0001). Patients with murmurs also had significantly higher blood flow velocities in LVOT (0.9 vs 0.83 m/s), pulmonary artery (0.98 vs 0.96/m/s) and a higher transmural E wave (1.06 vs 0.98 m/s).

Conclusions: The presence of false tendons, especially if multiple and located in the left ventricular outflow tract in association with increased blood flow velocities, might contribute to the pathogenesis of innocent heart murmur of childhood.

453 Adults with total correction of tetralogy of Fallot-cardiopulmonary exercise testing and plasma BNP levels

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Introduction: Despite long term good results after total correction of tetralogy of Fallot (ToF) those patients (P) reach lower exercise capacity in comparison to healthy subjects.

Aim: Evaluation of exercise capacity with cardiopulmonary exercise test (CPET) and serum BNP levels in adults after correction of ToF and their relation with ventricular function assessed by echocardiography.

Material and methods: We studied 63 pts (31M) aged mean 27.7±7.1 yrs, operated at the mean age 7.4±5.1yrs, mean 20.7±7.5yrs ago. The controls: 28 intact subjects (13M), mean aged 28.7±5.1 yrs. On echo low and right ventricular end diameters (LV, RV); right ventricular ejection fraction (RVEF), left ventricular ejection fraction (LVEF), right ventricular systolic time (RVT), right ventricular end systolic pressure (RVEP), right ventricular outflow tract obstruction (RVOTO), pulmonary regurgitation (PR) were measured. The maximal CPET was performed (measurements of ventilatory parameters during rest and modified Bruce protocol). The forced vital capacity (FVC), minute ventilation (VE), first second forced expiratory volume (FEV1), maximum and peak oxygen uptake (VO2peak and VO2peak), carbon dioxide production (VCO2), stroke volume (SV) were assessed. Plasma BNP levels were measured by immunoradiometric assay (Shionoria BNP kit).

Results: The P reached the following parameters higher then controls: RV diameter: 4.5±6 vs, 29.5±3.1 mm (p=0.0001), RVOT (m/s): - 227.4±63.4 vs 110.2±10.5 m/s (p=0.0001), VE/CVO2 - 36.6±6.5 vs 29.7±4.7 m/m (p=0.004). The P reached the following parameters lower then controls: VO2 peak: 24.9±5.7 vs 38.6±7.8 ml/kg/min (p=0.0001), peak VO2: 1.8±0.6 vs 2.9±0.9 ml/kg/min (p=0.0001), VE - 60.1±19.5 vs 114.4±38.2 l/min (p=0.0001), FVC - 3.7±0.9 vs 4.9±1.1 l (p=0.001), BNP - 34.9±26.8 vs 11.5±6.5 pg/ml (p=0.0001), Negative correlations were found between BNP and VO2peak (p=0.003), peak VO2 (p=0.002), VE (p=0.001), VT (p=0.007), and FVC (p=0.038). Positive correlations were found between BNP and FVC (p=0.005) and RVOTO (p=0.01). Relations were shown between neither BNP and EF nor LV diastolic function parameters. In P with at least 1° BNP VO2peak of 58.6±11.9% was lower than in P without VO2 peak (69.7±12.2%, p=0.0005), BNP levels did not differ significantly between those groups.

Conclusions: 1. Exercise capacity of adults after correction of ToF is reduced, particularly in P with IP.

2. BNP levels are elevated in this group of P indicating close relation to exercise capacities parameters.

3. Higher BNP levels in those P appear to result from right ventricular volume overload.