HYPERTENSION/LV HYPERTROPHY

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Carotid arterial flow control in hypertensive patients - analysis by wave intensity
K. Niko1; M. Sugawara1
1Tokyo Women’s Medical University, Cardiovascular Sciences Dept., Tokyo, Japan; 2Himeji Dokkyo University, Medical Engineering Dept., Himeji, Japan

Background: Wave reflection from the head and neck augments pressure and decelerates flow in the carotid artery. Wave intensity (WI) has the potential to separate peripheral (head and neck) effects from ventricular effects on pressure and flow waves. WI is defined as the product of the time derivatives of blood pressure (P) and velocity (v): WI = (dP/dt)v. The negative value of WI indicates that the effects of reflected waves are predominant. Therefore, the integral of negative values (NA) of common carotid arterial WI in a cardiac cycle is attributed to reflection from the head and neck. To elucidate the characteristics of carotid arterial flow control in hypertensive subjects, we applied WI analysis.

Methods: We measured WI in 64 hypertensive patients (HT) (mean age 63±4 years, mean systolic/diastolic pressure 149±11/82±10 mm Hg) and 63 age-matched normal subjects (N) (mean age 63±7 years, mean systolic/diastolic pressure 121±17/77±10 mm Hg) with a noninvasive WI measuring system (SSD 6500, Aloka Co), which simultaneously measured common carotid arterial blood flow velocity and diameter change. The diameter change waveform calibrated by blood pressure by upper arm automated sphygmomanometry was used as the pressure waveform. The volume flow rate (Q) was calculated as the integral of negative values of WI and Q between HT and N (WI: 10.6±6.4 vs 8.6±3.6 mm Hg m/s, p<0.001), Q: 658±158 vs 680±178 ml/min). There was no difference in the highest values of WI and Q between HT and N. The higher NA in HT, which suggests higher reflection from the head and neck. To elucidate the characteristics of carotid arterial flow control in hypertensive subjects, we applied WI analysis.

Conclusions: Our data demonstrate that analysis of wave reflection using a modified AIx*, with timing of the reflected wave obtained from the pressure waveform, however, fully relies on the identification of characteristic landmarks on the pressure waveform that are associated with the timing of the reflected wave, such as an inflection point. We hypothesize that a more correct timing of arrival of the reflected wave (and associated calculated AIx*) can be obtained using Doppler measurement of aortic flow in conjunction with the central pressure waveform.

VASCULAR FUNCTION/AORTIC DISEASE

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Non-invasive assessment of arterial pressure wave reflection in evaluation of large artery function and cardiac load: can we do without ultrasound?
P. Segers1; E.R. Reitschel1; M.L. De Buyzere1; D. De Bacquer1; L.M. Van Borstel1; G. De Backer1; T.C. Gillebert1; P.R. Verdonck1 on behalf of: Asklepios Investigators
1Ghent University, Hydraulics Laboratory, Gent, Belgium; 2Ghent University Hospital, Cardiovascular Diseases Dept., Ghent, Belgium

Background: Early return of pressure wave reflection increases central (pulse) pressure and the load on the heart, and indices such as the augmentation index (AIx) allow quantifying the added contribution of the reflected wave to the pulse pressure. Computation of AIx, however, fully relies on the identification of characteristic landmarks on the pressure waveform that are associated with the timing of the reflected wave, such as an inflection point. We hypothesize that a more correct timing of arrival of the reflected wave (and associated calculated AIx*) can be obtained using Doppler measurement of aortic flow in conjunction with the central pressure waveform.

Methods: Carotid pressure (Pwf) and central flow (Qwf) waveforms were acquired non-invasively in 2132 apparently healthy subjects (1093 F/1039 M), aged between 35 and 55 at inclusion (a subgroup of the ‘Asklepios’ population). Pwf was obtained using applanation tonometry at the common carotid artery; Qwf was assessed from Doppler flow velocities measured in the left ventricular outflow tract, multiplied with its cross-sectional area. AIx was assessed directly from Pwf, with the timing of the inflection point (TI) detected automatically using a second order derivative algorithm. Alternatively, we used Pwf and Qwf to separate Pwf into its forward and reflected component, and the timing of the return of the reflected wave (TR) was defined as the moment where the reflected waves adds to the forward wave. AIx* was calculated.

Results: TR was systematically larger than TI both in women (22.3±1.0 ms; mean±SEM, p<0.001) as in men (12.8±1.3 ms, p<0.001). AIx, adjusted for subject height and systolic ejection time, was higher in women than in men (117±2.0 vs 112±2.8 ms, p<0.001). In contrast, similarly adjusted AIx* yielded equal values in both (110.1±0.46 vs 110.2±0.48 ms, p=0.94). Data analysis further demonstrated that, using TR and measured pulse wave velocity, the distance to the apparent reflection site (effective length of the arterial tree) moves towards the heart with age - as anticipated - while the opposite was true when using TI.

Conclusion: Our data demonstrate that analysis of wave reflection using a modified AIx*, with timing of the reflected wave obtained from the pressure
Conclusions: and ß correlated directly with age and MBP (r: 0.35-0.63), but not with OGIS.

Methods: Eighty-one objects (age 41±12; 35 males; BMI 32±9, range 19-59 kg/m²; BP 126±15/76±10 mm Hg), free of heart disease, HBP, diabetes, dyslipidemia were studied. LV pump function (CO and EF) was assessed by 2D Echoc. Arterial mechanics was evaluated at carotid level by vascular ultrasound (Aloka SSD-5500) implemented with a double beam tracking system (2D Echo). Vascular stiffness was evaluated by the wave intensity analysis (time-dependent product of first derivatives of BP and flow), an index of LV inotropic function was obtained by the amplitude of the early-systolic peak (forward compression wave, FWC). Insulin sensitivity was estimated from plasma glucose and insulin responses to O-GTT (OGIS index).

Results: Waist to hip ratio (WH) correlated directly with MBP, CO, PWV, ß (r: 0.34-0.41, p<0.01), but not with EF and FWC. OGIS correlated inversely with WH, CO, MBP (r: -0.45 to -0.47, p<0.005) but not with stiffness. PW and ß correlated directly with age and MBP (r: 0.35-0.63), but not with OGIS. In a sex-adjusted multivariate model, age and MBP were independent predictors of stiffness (adjusted ß: 0.57). Both PW and ß were inversely related to FWC (r: -0.27 for both, p<0.05), but not to CO and EF.

Conclusions: In otherwise healthy subjects from lean to morbid obesity, visceral adiposity is associated with increase in CO, BP and carotid stiffness. Visceral adiposity and changes in systemic hemodynamics are associated with IR. Increased carotid stiffness paralleling visceral adiposity results from increased BP more than from an independent effect of IR. WR analysis, but not established indices of LV performance, discloses an unfavorable VA coupling in obesity.

Table 1

<table>
<thead>
<tr>
<th>age groups (years)</th>
<th>BETA</th>
<th>Ep</th>
<th>AC</th>
<th>AI</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;30 Mean 5.1±1.8 59.1±20.5 1.3±0.5 0.8±0.9 4.5±0.7</td>
<td>31-40 Mean 6.6±2.5 78.1±24.2 0.9±0.2 3.5±0.1 5.2±0.7</td>
<td>41-50 Mean 7.3±3.3 97.9±48.4 0.9±0.3 16.4±15.1 5.3±1.3</td>
<td>51-60 Mean 9.2±2.2 115.2±27.6 0.8±0.9 24.2±14.7 6.4±0.6</td>
<td>60+ Mean 12.4±1.7 129.3±33.2 0.6±0.9 26.6±5.9 6.8±0.9</td>
<td>p 0.002 &lt;0.001 0.004 &lt;0.001 &lt;0.001</td>
</tr>
</tbody>
</table>

Age related increase of stiffness parameters.

3-DECHO

389 Three-dimensional-contrast ultrasound in the evaluation of carotid atherosclerosis

B. Cosyns 1; M. Menassé 1; S. Velez-Roa 2; D. De Clercq 3
1CHRREC - Site De Braine, Cardiology Dept., Braine-l’alleud, Belgium
2Philips Medical System, Brussels, Belgium
3CHRREC - Site De Braine, Cardiology Dept., Braine l'alleud, Belgium

Background: The use of ultrasound (US) contrast agents in the lumen of the carotid artery permits a clear visualization of the intima-media thickness (IMT) and plaque luminal morphology (PM). 3D-US improves the understanding and the measurement of morphological abnormalities in these vessels. Although 3D is used with other techniques, it has not been studied in this setting. We studied the diagnostic value of 3D-US in carotid atherosclerosis compared to 2D-US with and without contrast.

Methods: We have prospectively studied 18 patients (mean age: 65±8; 10 male). All patients underwent an exam without contrast. Their carotid arteries baseline and after 0.5 cc bolus of Sonovue®. After scanning, 3D images were instantaneously reconstructed (figure). The images were analyzed offline (QLab, Philips®) in random order. We analyzed the PM following an usual scoring system (from 0 to 5). The IMT anterior (a) and posterior (p) were also measured.

Results: 1. PM: 3D with contrast has improved intra-observer agreement compared to 2D (kappa 0.98 vs 0.89). There was a good correlation between 2D and 3D severity scores. 2. With 2D, the IMT anterior was not measurable in 80% of patients without contrast. The IMT assessment was not feasible in 3D without contrast injection. In 2D with contrast, IMTas was significantly higher than in 2D with p<0.001 and there was no correlation between IMTas and IMTps. The 3D with contrast allowed measuring the maximal IMT on each segment.

Eur J Echocardiography Abstracts Supplement, December 2006
Conclusions: 3D-contrast US improves intra-observer agreement for assessment of atherosclerosis severity compared to 2D. It allows the measurement of the maximal IMT but only in combination with contrast agents. Therefore, 3D-contrast US is a promising technique for the assessment of atherosclerosis in carotid arteries.

Material and methods: Intravascular ultrasound (IVUS) examinations were performed in 30 selected patients with CTOs who have presented an optimal angiographic effect without residual stenosis or dissection at balloon angioplasty. Group consisted of 25 males and 5 females with mean age 50 years. To evaluate the time of LAD occlusion we used the date of documented acute myocardial infarction or last, the strongest episode of stenocardiac pain. For better lesion characterization we used the classification of lesion morphology following balloon angioplasty proposed by Gerber et al. and measure circumferential distribution and percentage of lesion calcification.

Results: We observed following types of morphology in Gerber classification: Type 1 with smooth walled dilatation of concentric plaque - 2 pts (7%). Type 2 with superficial tear of concentric plaque - 17 pts (56%). Type 3 with deep tear to media - 2 pts (7%). Type 6 with smooth-walled dilatation of eccentric plaque 8 pts (27%), Type 7a with subintimal dissection of eccentric plaque 1 pt (3%). The mean percentage of calcification in all examined group was 55±21% (49% in group with type 1 and 2 and 67% with types 3-7a).

Conclusions: Despite of satisfactory angiographic effect following balloon angioplasty in patients with chronic total occlusion - the use of intravascular ultrasound showed in more than 30% of patients the complex, substantial lesions (in Gerber classification) with large degree of coronary calcification.

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Volumetric intravascular ultrasound parameters assessment of plaque development in saphenous vein grafts
P. Wiegler1, A. Flipseck1, J. Dziewiecki1, M. Trusz-Gluza1, M. Krejca1, A. Bochenek1, J. Dijkstra2, J. Reiber1
1Silesian Medical School, 1st Departemen of Cardiology, Katowice, Poland; 2Leiden University Medical Center, Leiden, Netherlands

Purpose: Recently, non-invasive imaging techniques have detected rotary blood flow in the ascending and descending aorta. Existence of this rotary blood flow and its possible relationship to ventricular torsional deformation is just starting to be explored. It has also been postulated that rotary blood flow is related to the geometry of the aorta and that the flow may be altered in certain disease states. (2)

It is also well known that there is a normal helical flow pattern in the aorta, we looked at VVI which displays the magnitude and direction of the wall as an indirect result of flow. As reported by HUP ACC 2006, VVI can be used to visualize the wall mechanics of the aorta. (1) We wanted to observe the biomechanical stresses within the aortic wall, and compare to the LV twist in a full 3D RT volume data set. Earlier wall mechanic changes may be an earlier marker of atherogenesis. It has also, been reported that coronary artery motion has potential significance in the localization of atherogenesis.

Material and methods: Simultaneous bypass angiography and IVUS study were performed in 72 aorto-coronary SVG’s implanted in 34 pts. All examinations were performed after first 2 years following CABG. Analysis concentrated on plaque development and measurement of plaque volume, luminal volume, external elastic membrane (EEM) volume (measured by tracing outer border of sonoluent zone), SVG volume (measured by tracing outer border of the whole vein graft), SVG wall volume (defined as SVG volume minus EEM volume). All volumetric parameters were measured in 25mm of SVG using QCU-CMS IVUS analytical software version 4.14, adapted to SVG analysis.

Index plaque volume/EEM volume and index plaque volume/wall volume were calculated for comparative SVG assessment. Data were analyzed for following time periods: I - 0-6 months (29 grafts), II - 6-12 months (22 grafts) and III - 12-18 months (21 grafts) after CABG.

Results: The first neointimal formation was observed 64 days post CABG. In period I (neointimal) formation was observed in 12 cases (41%) with average plaque volume of 32.26 mm³, in 8 cases (36%) in period II (average plaque volume: 35.99 mm³ and in 15 cases (71%) in period III with average plaque volume: 38.09 mm³. Index plaque volume/EEM volume in periods I, II and III were 0.10, 0.10, and 0.16 respectively. Index plaque volume/ SVG wall volume in periods I, II and III were 0.15, 0.14, and 0.20 respectively. The plaque volume increase was 3 mm³ per 6 months.

Conclusion: Intravascular ultrasound in vivo showed rapid plaque development in SVG during the first 18 months after CABG. During the first year plaque can be visualized in about 40% of implanted grafts.

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Evaluation of interventricular asynchrony before and after cardiac resynchronisation therapy (CRT) in patients with congenital heart defects (CHD) by means of Tissue Doppler Echocardiography (TDE)
R. Schuck1, R. Rentzsch2, M.Y. Abd El Rahman3, M. Yegitbasi1, B. Peters2, F. Berger1, H. Abdull-Khalil1
1Deutsches Herzzentrum Berlin, Berlin, Germany; 2Universitätsklinikum des Saarlandes, Klinik für pediatrische cardiology, Homburg/ Saar, Germany; 3University of Cairo, Clinic for Pediatric Cardiology, Cairo, Egypt

Purpose: To evaluate the interventricular asynchrony before and after CRT in CHD patients with cardiac defects (CHD).

Background: Identification of Patients with heart failure, who may benefit from CRT is still challenging, due to the limitations of conventional methods and the heterogeneous morphologies in congenital heart disease. TDE-derived maximal Strain allows quantitative assessment of regional myocardial function, as well as the time interval to maximal deformation allowing measurement of interventricular delay between RV and LV.

Patients and methods: 20 Patients with CHD (ISTA 3, DORV 1, TOF 3, L-TGA 5, D-TGA 1) and DCM (n=7) underwent conventional Doppler- as well as TDE-examination (Vingmed, Vivid 7) before, immediately after CRT, and during a follow-up period of six months. In an apical four chamber view using high frame rates (180-250 bps) strain (%) was analysed. The time interval from peak Q in the parallel recorded ECG, to the maximum of systolic deformation, in accordance with previously marked aortic valve clo-
Cardiac resynchronization therapy (CRT) by correction of intra- and interventricular asynchrony, reverse the adverse remodeling of left ventricle (LV), leading to the reduction of LV volume and the improvement of its systolic function. However, there is a little data about the influence of CRT on the systolic function of the right ventricle (RV).

**Aim:** The echocardiographic assessment of RV systolic function parameters in patients with RV impairment before and during CRT.

**Methods:** We observed 29 patients (pts) with dilated cardiomyopathy (M/F 2:1, aged 57±8; ischemic-35%) and with subclinical signs of RV failure: maximal systolic velocity of RV wall in inflow during the isovolumetric contraction time (ICT vel) was 3.4±2 cm/s. The baseline (before CRT) and in mid-term follow-up (in 3 month of CRT) parameters were: NYHA 3±0.4 vs 2.05±0.5 (p=0.001), QRS 185±29 ms vs 163±33 ms (p=0.037), NT-proBNP 2594±1712 pg/ml vs 1390±1112 (p=0.024), max. oxygen consumption 13.1±3.7 ml/kg/min vs 15.9±4.6 (p=0.003), interventricular asynchrony (the difference between RV and LV ejection preperiod) 69.1±16 ms vs 22±12 ms, respectively. We evaluated the global systolic function of LV (aortic valve velocity time integral - AO VT, end-diastolic and systolic volume - EDV, ESV, ejection fraction - EF) and RV (pulmonary valve VTI - PV VTI, fraction of area change - FAC, RV diastolic and systolic area - RVAd, RVAs) and regional indexes of RV contractility (ICTvel). The pts were examined at baseline, in the 3rd day (optimization - opt), 1st, and 3rd month during CRT.

**Results:** are presented in table.  

**Conclusion:** CRT has proved to reverse the unfavorable remodeling of LV and to improve the systolic function of RV. The greatest improvement of RV functional parameters was claimed directly after the pacemaker implantation.

### Table 1

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Area diastolic (cm²)</th>
<th>Area systolic (cm²)</th>
<th>FAC (%)</th>
<th>ICTvel (cm/s)</th>
<th>PVVTI (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>base</td>
<td>17.4±4.0</td>
<td>13.1±4.4</td>
<td>18.9±10.0</td>
<td>3.4±1.9</td>
<td>14.7±5.4</td>
</tr>
<tr>
<td>opt</td>
<td>17.1±5.8</td>
<td>10.5±5.2**</td>
<td>43.6±11.6</td>
<td>5.0±2.8**</td>
<td>17.2±4.5**</td>
</tr>
<tr>
<td>1m</td>
<td>18.7±5.1</td>
<td>15.2±5.4**</td>
<td>36.5±13.4</td>
<td>4.5±3.2</td>
<td>17.2±5.3**</td>
</tr>
<tr>
<td>3m</td>
<td>18.6±5.1</td>
<td>10.1±4.6**</td>
<td>47.7±15.9</td>
<td>3.9±3.2</td>
<td>18.1±5.4**</td>
</tr>
</tbody>
</table>

*p<0.05 vs baseline; **p<0.005 vs baseline

### Table 1 continuation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>EDV bpline (ml)</th>
<th>ESV bpline (ml)</th>
<th>LV EF bpline (%)</th>
<th>AVTI (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>base</td>
<td>283±71</td>
<td>217±63</td>
<td>23.5±8.0</td>
<td>19.9±5.6</td>
</tr>
<tr>
<td>opt</td>
<td>262±80*</td>
<td>198±62*</td>
<td>24.7±7.4</td>
<td>20.2±4.7</td>
</tr>
<tr>
<td>1m</td>
<td>263±82**</td>
<td>163±60**</td>
<td>30.2±8.7**</td>
<td>25.7±4.6</td>
</tr>
<tr>
<td>3m</td>
<td>252±74*</td>
<td>178±62**</td>
<td>29.1±6.7**</td>
<td>21.4±4.6</td>
</tr>
</tbody>
</table>

*p<0.05 vs baseline; **p<0.005 vs baseline

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**CONGENITAL HEART DISEASE**

### 395

Ventricular interaction in pressure and volume overloaded right ventricles

L. Coats,1,2 K. Janagarajan,2 S. Khamdabkone,2 M. Turner,2 G. Riley,2 D. Pellerin,1,2 P. Bonhoeffer,2 J. Marek,2

1Great Ormond Street Hospital For Children, C/O Pa To Dr P Bonhoeffer, London, United Kingdom; 2The Heart Hospital, Echocardiography Dept., London, United Kingdom; 3Great Ormond Street Hospital for Children, Cardiothoracic Unit, London, United Kingdom; 4Bristol Royal Inflammatory, Cardiology Dept., Bristol, United Kingdom

Background: Percutaneous pulmonary valve implantation (PPVI) can be used to treat suitable patients pulmonary regurgitation or right ventricular outflow tract obstruction (RVOTO). This procedure results in an early improvement in ventricular performance and clinical parameters. The beneficial effect of PPVI on left ventricular behaviour is not fully understood. The aim of this study was to compare the different effects of right ventricular pressure and volume overload on inter-ventricular synchrony and left ventricular performance.

**Methods:** We studied 23 consecutive patients with PR (peak gradient <49 mm Hg and PR grade =2 on echo) and 24 with RVOTO (peak gradient >49 mm Hg and PR grade <2 on echo), who underwent successful PPVI. 2D/issue Doppler echo and a 12 lead ECG were performed before and 1 day after intervention. Inter-ventricular delay (IVD) was calculated as the difference between left ventricular pre-ejection phase (LV PEP) and right ventricular pre-ejection phase (RV PEP) from pulsed wave Doppler recordings in the outflow tracts.

**Results:** At baseline, LV ejection time was longer in the RVOTO group (374.0±38.3 vs. 338.0±32.5 ms, p=0.001) and correlated well with RVOT gradient (r=0.492, p<0.001). In contrast, RV PEP was unaffected by load but was strongly associated with QRS duration (r=0.620, p<0.001). QRS duration tended to be more prolonged in the PR group (142.4±26.1 vs. 130.2±35.3 ms, p=0.300). After PPVI, RV ejection time fell in both groups (RVOTO: from 376.3±37.3 to 332.8±29.1 ms, p=0.001, PR: from 338.5±32.5 to 310.2±32.7 ms, p<0.001). Relief of PR resulted in prolongation of the RV PEP (81.6±17.9 vs. 103.4±25.6 ms, p<0.001) and a marked change in IVD (from 7.1±1.6 to -25.1±27.1 ms, p<0.001), which was not reproduced following relief of RVOTO. In addition, relief of PR resulted in a fall in the LV PEP/ET ratio (from 0.33±0.09 to 0.28±0.07, p=0.024) and an improvement in LV stroke volume (62.4±23.9 to 77.8±28.5, p=0.017), which was less evident following RVOTO relief.

**Conclusion:** RV ejection time is directly related to afterload whilst RV PEP is more closely influenced by electrical activation. Relief of PR has important effects on inter-ventricular synchrony and a measurable effect on LV performance. Further investigation will help develop a better understanding of the electrical and mechanical components of this improvement.

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**THE RIGHT HEART**

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Right ventricular ultrasonic tissue indices in atrial septal defect. Can they reflect an increased pulmonary flow?

M. Kowalski,1 E. Kowalski,1 P. Hoffman1

1Institute Of Cardiology, Warsaw, Poland

**Background:** Regional myocardial function of the right ventricle (RV) is poorly characterized both in normal settings and in pathology. It is interesting to know whether the indices of RV regional deformation are altered by volume overload and to what extent they can reflect an increased pulmonary flow.

**Methods:** 28 subjects (25 F, 3M) (age 15-72 yr) with atrial septal defect (ASD) were studied. Among them 25 had ASD II, 2 ASD sinus venosus type and one had an isolated anomalous pulmonary venous connection to right atrium (the average Qp/Qs for the group was found as 2.05±0.90). The data on regional deformation recorded for ASD patients were compared to the ones obtained from age and sex matched healthy individuals. To calculate regional systolic and diastolic Strain Rate (SR) and maximal strain (S), GE Echocap 2D was applied. The data were averaged out of three consecutive heart cycles.

**Results:** The maximal S recorded for the apical RV segments (api) was higher in ASD patients when compared to normals (-36% vs -28%, respectively; p<0.01). Similarly, regional systolic SR recorded for the same api territory was increased (2.16 1/s vs -1.52 1/s, respectively; p=0.02). There was a significant correlation between systolic RV api S and Qp/Qs as well as between systolic RV api SR and Qp/Qs (fig. 1).  

**Conclusion:** In adults with ASD, the ultrasonic tissue indices are altered in the apical RV segments. Both S and SR recorded from these segments are substantially higher when compared to the corresponding data obtained from normals. The larger volume overload is associated with reduced S and SR in apical RV segments.
CONGENITAL HEART DISEASE

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Do elderly patients benefit from transcatheter closure of atrial septal defect? M. Pieculewicz 1; P. Podolec 1; T. Przewlocki 1; M. Hawlany 1; P. Wilkolek 1; L. Tomkiewicz-Fajak 1; G. Kopec 1; W. Tracz 1; 1Cracow, Poland

Objective: To evaluate the outcomes of transcatheter closure of secundum atrial septal defect (ASD) using Amplatzer Septal Occluder (ASO) in elderly patients.

Material and methods: Consecutive 35 adult pts over 50 years (25 F, 10 M) with a mean age of 61.2±15.9 (50-89) yd with ASD who underwent transcatheter closure of ASD were analyzed. All patients had an isolated secundum ASD with pulmonary to systemic blood flow ratio, Qp:Qs: 2.56±1.6 (1.5-3.43).

Quality of life (QoL) was measured using the SF36 questionnaire (SF36q).

Results: The ASO device was successfully implanted in all pts (procedure time 37.2+/-4.1 (14-51) minutes, fluoroscopy time 10.1+/-7.9 (5-40) minutes).

The defect echo diameter was 17.6+/-.5 (8-32) mm. The diameter of the implanted devices ranged 13-36 mm.

After 6 months of ASD closure, all the pts showed a significant improvement of exercise capacity. 7 QoL parameters (except mental health) improved at 6 months follow-up compared to their baseline data. The right ventricular di- mension decreased in 77 pts (77.1%), the atrium right dimension decreased in 29 (65.8%) (Table 1).

Conclusions: Transcatheter closure of secundum ASD in elderly patients is a safe and effective procedure, with excellent short-term follow-up results. Closure of ASD in elderly patients caused significant improvement of exercise capacity as well as improvement of quality of life measured by SF36q questionnaire.

In six months observation right heart pressure overload signs were diminished in most of the elderly patients.

| Table 1 |
| Parameter | Before ASD closure | 6 months after ASD closure | p value |
| Time of exercise (min) | 9.2±4.1 | 12.9±4.1 | <0.001 |
| VO2peak (ml/kg/min) | 8.2±3.3 | 11.5±1.5 | <0.001 |
| SF36q scale 0-100 | 20.3±19 | 84.2±26.3 | <0.001 |
| The right atrium area cm2 | 24.1±1.1 | 19.5±1.1 | <0.001 |
| The right atrium area cm2 | 19.9±1.2 | 13.9±1.0 | <0.001 |

THE RIGHT HEART

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Electrical and structural reverse remodeling after transcatheter closure of atrial septal defects in adults O.H. Balint 1; T. Szil-Torok 1; C.S. Liptai 1; L. Kornyel 1; L. Ablonzci 1; A. Szatmari 1; A. Temesvari 1

1Hunagarian Institute of Cardiology, Cardiology Dept., Budapest, Hungary

Long standing atrial septal defects (ASD) results in electrical and structural remodeling of the atria susceptible for supraventricular tachyarrhythmias. The aim of this study was to evaluate the reverse remodeling of the atria after transcatheter closure of ASD.

Objective: To determine the effects of transcatheter closure of ASD’s on electrical and structural remodeling.

Methods: Thirty-seven patients after successful device closure of ASD’s were studied. Patients (mean age: 40±17 yrs) were assessed by 12-lead electrocardiography, treadmill exercise test, as well as symptom-limited treadmill exercise tests with respiratory gas exchange analysis (Bruce protocol) and transhoracian color Doppler echocardiographic study.

Results: The right atrium area cm2 19±1.12 13.9±1.2 <0.0001

Conclusions: Transcatheter closure of ASD can induce reverse remodeling of atrial structure.

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Long axis dysfunction and tricuspid regurgitation relate to ventricular fibrosis in adults with systemic right ventricle and complete transposition of the great arteries D. Prat 1; S.V. Babu-Narayan 1; K. Dimopoulos 1; G. Diller 1; O. Goktekin 1; P.J. Kilner 1; M.A. Galzouls 1; W. Li 1

1Policlinico G.B. Rossi, Cardiology Dept., Verona, Italy; 2Royal Brompton Hospital, Adult Congenital Heart Unit, Cardiology Dept., London, United Kingdom; 3Imperial College, Adult Congenital Heart Unit, Cardiology Dept., London, United Kingdom

Following Mustard procedure (atrial redirection surgery) for complete transposition of the great arteries, the right ventricle remains the systemic ventricle. Patients are at increasing risk of late ventricular dysfunction and sudden cardiac death with time. Symptoms and structural changes of the great arteries who had undergone the Mustard procedure were evaluated with echocardiography and late gadolinium enhancement cardiac magnetic resonance (CMR). Long axis function was particularly studied with the use of tissue Doppler imaging (TDI) and M-Mode.

Results: Of the 22 patients, 10 had CMR findings suggesting the presence of myocardial fibrosis (45%). Patients were divided into two groups according to the presence or absence of myocardial fibrosis in the systemic right ventricle. Patients presenting right ventricular fibrosis were older (26/18 years; p<0.01) were older at the time of surgery (3 vs 0.5 years; p<0.01) and were more symptomatic than patients without signs of fibrosis (NYHA Class ≥2/12; p=0.01). Patients with myocardial fibrosis had decreased total long axis excursion both of the systemic ventricular free wall (10±2.4 vs 14.1±3.0 mm; p<0.01) and septum (9.6±2.0 vs 13.3±2.8 mm; p<0.01).

In the same way, myocardial fibrosis related to a decreased peak systolic velocity of the systemic ventricular free wall (4.2±1.2 vs 6.0±1.1 cm/s; p<0.01) and Septum (3.8±0.8 vs 4.8±1.1 cm/s; p<0.05).

The systolic velocity of the sub-pulmonary ventricle and the diastolic velocities of both ventricles did not correlate with the presence of fibrosis. Patients with myocardial fibrosis had worse systolic myocardial ventricular systolic function (p<0.01), and bigger systemic ventricular dimensions (p<0.05). All patients with fibrosis had tricuspid regurgitation (10/ 10 vs 4/12; p=0.01).

The presence of tricuspid regurgitation (7 mild) related to impaired long-axis function of the systemic ventricular free wall (11.3±3.4 vs 15.9±2.8 mm; p=0.01) and decreased right ventricular ejection fraction evaluated with CMR (49.2±17.6 vs 62.5±6.3%; p=0.05).

Conclusions: Long-axis dysfunction, assessed by M-Mode or TDI, related the presence of myocardial fibrosis in patients with systemic right ventricle after Mustard operation. This relationship suggests that there may well be
more extensive subendocardial pathophysiological changes resulting in long axis dysfunction. The presence of tricuspid regurgitation, even mild, seems to be related to myocardial fibrosis and adverse ventricular function.

CONGENITAL HEART DISEASE

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Interventricular septal function in patients with systemic right ventricle
E. Pettersen ; T. Helle-Valle ; H.J. Smith ; K. Andersen
1Rikshospitalet University Hospital, Cardiology Dept., Oslo, Norway

Background: In patients with transposition of the great arteries (TGA) operated with atrial switch, the right ventricle (RV) supports the systemic circulation. The aim of the present study was to investigate whether the interventricular septal function in this setting differs from normal.

Methods: Fourteen TGA patients aged 18.4±0.9 years (mean±SD) operated at infants a. m. Senning and 14 healthy controls aged 27.4±1.2 years were studied. Longitudinal and circumferential septal shortening as determined by strain at the mid ventricular level were measured by tissue Doppler imaging and magnetic resonance imaging (MRI) tagging, respectively. Also, basal and apical peak systolic septal rotation in the transverse plane were assessed by MRI tagging using the left ventricular (LV) centre of gravity as a reference point. The basal and apical levels were chosen because in the normal LV, ventricular rotation is clockwise at the base and counterclockwise at the apex while hardly present at the mid ventricular level. Strain, however, is uniformly distributed in the normal LV.

Results: There was no significant difference in longitudinal or circumferential septal strain between the TGA patients and the controls (table 1). Both apical and basal rotation were significantly less in the TGA group than in the controls (negative values represent counterclockwise rotation, positive values clockwise rotation).

Conclusions: Interventricular septal shortening does not differ from normal in the setting of a systemic RV, while septal rotation is decreased.

<table>
<thead>
<tr>
<th>Strain (%)</th>
<th>Controls</th>
<th>TGA patients</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longitudinal</td>
<td>-18.9±2.6</td>
<td>-19.5±3.3</td>
<td>NS</td>
</tr>
<tr>
<td>Circumferential</td>
<td>-20.0±3.0</td>
<td>-18.5±3.6</td>
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</table>

402
Dobutamine stress echocardiography is feasible, efficacious, and safe in the estimation of right ventricular reserve in patients with repaired Tetralogy of Fallot
S. Brili ; N. Alexopoulos ; C. Chrysohoou ; J. Barbetseas ; J. Karamitros ; S. Massias ; I. Stamatopoulos ; C. Stefanidis
1Athens Medical School, Hippokration Hospital, 1st Cardiology Dept., Athens, Greece

Background: The longstanding pulmonary regurgitation in patients with repaired Tetralogy of Fallot results in right ventricular (RV) failure. The estimation of RV function and reserve in these patients is of great importance, especially for the determination of the proper timing for pulmonary valve replacement. Tissue Doppler Imaging (TDI) of the tricuspid annulus has been proved a valuable tool in the investigation of these patients. Dobutamine stress echocardiography in low doses detects the reserve of cardiac myocytes to increase contractility. At this study we aimed at examining the feasibility, efficacy, and safety of dobutamine stress echocardiography in the evaluation of RV reserve in patients with repaired Tetralogy of Fallot, and to compare them with controls.

Methods: We studied 20 patients with repaired Tetralogy of Fallot (age 27.9±8.1 years, 18.8±4.2 years after surgery) and 20 age- and gender-matched controls with TDI Doppler at the tricuspid annulus during dobutamine stress echocardiography. TDI measurements were made at baseline and at the peak of 3 min dobutamine infusion rates of 10 and 20 µg/Kg/min.

Results: All patients had pulmonary regurgitation (5 mild, 12 moderate, 3 severe) and tricuspid regurgitation (mild to moderate). As expected, patients had decreased TDI velocities at baseline compared to controls (Sa, 8.2±1.0 vs 15.9±2.1; Ea, 8.8±3.0 vs 14.9±3.8; Aa, 5.8±1.8 vs 13.2±1.9, p<0.001 for all). Although all patients and controls increased the Sa during dobutamine stress echocardiography, the percentage increase of Sa (Sa%) was less in patients compared to controls (41.5±11.1 vs 56.8±17.4, p<0.01), denoting decreased RV systolic reserve. None of the patients or the controls had any adverse event, such as paroxysmal atrial tachycardia, ventricular tachycardia, or hypotension, during dobutamine stress echocardiography.

Conclusions: Dobutamine stress echocardiography is feasible, efficacious, and safe in the detection of RV reserve in patients with repaired Tetralogy of Fallot and may help in the evaluation and follow up of these patients in order to determine the optimum timing for pulmonary valve replacement.

Table 1

<table>
<thead>
<tr>
<th>Strain (%)</th>
<th>Controls</th>
<th>TGA patients</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longitudinal</td>
<td>-11.5±3.7</td>
<td>-5.5±3.8</td>
<td>0.0006</td>
</tr>
<tr>
<td>Basal</td>
<td>3.9±2.1</td>
<td>0.6±2.7</td>
<td>0.003</td>
</tr>
</tbody>
</table>

Eur J Echocardiography Abstracts Supplement, December 2006