ORAL SESSION

When and how to evaluate right ventricular function

Thursday, 7 December 2006, 16:30–18:00
Location: Novak

THE RIGHT HEART

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Relation between right ventricle systolic function and exercise capacity in ischaemic heart failure patients
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Aim: To evaluate dynamic changes of right ventricle (RV) systolic function by supine bicycle exercise echocardiography (ex-echo) in ischaemic heart failure (HF) patients (pts) subjected to cardiopulmonary exercise test (CPX).

Material and methods: We studied 50 adult pts (32 male and 18 female), mean age of 62.1±9.05 (46-79) years, mean left ventricle ejection fraction (LVEF) 30.3±13.4 (11-45%), mean right ventricle ejection fraction (RVEF) 36.7±12.8 (21-52%). The following baseline and ex-echo (25-Watts, 3-min increments) parameters were measured: myocardial velocity during isovolumic contraction (IVV), myocardial acceleration during isovolumic contraction (IVA) and myocardial velocity during systole (S'). Systolic tissue Doppler indices were derived from the medial and lateral border of the tricuspid annulus in the apical four chamber view. Mean values of each parameter are shown in the table 1. Peak oxygen uptake (VO2peak) was measured on CPX. Pts were divided into three groups according to the VO2peak value: group 1 (<14 ml/kg/min); group 2 (14-20 ml/kg/min) and group 3 (>20 ml/kg/min).

Results: Baseline values of IVA and S' were similar in all three groups. However, peak exercise values of IVV, IVA and S' were significantly higher in the group 3 comparing to group 1 and 2 (*p-value<0.05 between the groups).

Conclusions: Measurement of RV systolic tissue Doppler parameters by supine bicycle ex-echo is a precise method for assessing subtle changes of RV systolic function. Higher values of RV IVV, IVA and S' at the peak exercise are related to a better exercise capacity in ischaemic HF. Assessment of RV systolic function during exercise in ischaemic HF provide valuable, additional information about exercise tolerance.

Table 1

<table>
<thead>
<tr>
<th>VO2 peak (ml/kg/min)</th>
<th>&lt; 14</th>
<th>14-20</th>
<th>&gt; 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of pts</td>
<td>15</td>
<td>22</td>
<td>13</td>
</tr>
<tr>
<td>IVV rest (m/s)</td>
<td>0.06±0.03 *</td>
<td>0.05±0.02 *</td>
<td>0.11±0.02 *</td>
</tr>
<tr>
<td>IVV peak ex (m/s)</td>
<td>0.11±0.04 *</td>
<td>0.08±0.03 *</td>
<td>0.19±0.02 *</td>
</tr>
<tr>
<td>IVA rest (m/s)</td>
<td>1.77±0.98</td>
<td>1.59±0.79</td>
<td>2.87±0.93</td>
</tr>
<tr>
<td>IVA peak ex (m/s)</td>
<td>2.68±1.67</td>
<td>3.32±1.12</td>
<td>4.52±0.56 *</td>
</tr>
<tr>
<td>S' rest (m/s)</td>
<td>0.11±0.04</td>
<td>0.13±0.02</td>
<td>0.14±0.05</td>
</tr>
<tr>
<td>S' peak ex (m/s)</td>
<td>0.13±0.03 *</td>
<td>0.15±0.03 *</td>
<td>0.19±0.04 *</td>
</tr>
</tbody>
</table>

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Interest of new echocardiographic indices of RV function in idiopathic dilated cardiomyopathy
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Background: Cardiopulmonary exercise test, BNP and RV ejection fraction are useful for risk stratification in pts with idiopathic dilated cardiomyopathy (DCM).

Aim of the study: To evaluate the link between new indices of RV function derived from tissue Doppler imaging (TDI) and 2D speckle imaging (2DSI) and both functional parameters and N-terminal pro brain natriuretic peptide (NT-proBNP) in pts with DCM.

Methods: Thirty-six patients (24 M/12F, mean age: 49±15 yrs) with stable DCM referred for peak VO2 study also had complete Echo (GE Vivid VII) and NT-proBNP test. VO2 peak, anaerobic threshold and VE/VCO2 slope were calculated during cardiopulmonary exercise. Pulsed TDI was used to measure systolic maximal velocity (TDI Smax) and time-velocity integral (TDI S ITV) in the basal portion of the right (RV) ventricular free wall. We applied the new technique of 2DSI to high frame rate 2D and 2D TDI cineloops. We measured systolic velocity (2DSI Smax), displacement (2DSI D) in the basal (Bas), medium (Med) and apical (Ap) portion of RV. We also measured strain(e) by 2DSI (2DSI e) and derived from TDI data (TVIs) in each of these segments. Correlations were obtained by Spearman test, p<0.05 was considered significant.

Results: There was a significant correlation between TDI Smax and 2DSI Smax (r=0.39, p<0.03) and between TDI S ITV and 2DSI D (r=0.532, p=0.002) in the basal portion of RV. A significant correlation between both methods of measurement of Strain was noted in all parts of RV (Bas: r=-0.492, p=0.013; Med: r=-0.773, p=0.000; Ap: r=-0.787, p=0.000). There were no significant correlations between TDI and 2DSI parameters and VO2 peak or anaerobic threshold. VE/VCO2 slope correlated with ap strain (2DSI e: r=-0.499, p=0.006). NT-proBNP correlated significantly with Ap and Med strain (2DSI e: Ap r=0.587, p=0.004, Med r=0.539, p=0.01) and RV displacement (2DSI D Ap r=0.049, p=0.049, Med r=-0.650, p=0.001, Bas r=0.812, p=0.000). There was a negative correlation between parameters of LV function and Ap 2DSI e (Simpson LVEF r=-0.516, p=0.003, LVOT ITV r=-0.530, p=0.003).

Conclusion: 2DSI and pulsed TDI applied to the RV free wall gave quite heterogeneous results regarding velocity and displacement. However, there is a good correlation between both methods of measurements of strain derived from a 2D TDI cine loop by the 2D strain software. RV apical strain showed significant correlations with both VE/VCO2 slope and NTproBNP, two markers whose combination has been shown to improve risk stratification of patients with stable CHF, and could thereby be interesting in the routine examination of patients with DCM.

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Right ventricular function and shape in patients with an isolated left bundle branch block: a comparison with healthy volunteers and heart failure patients
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Introduction: Little is known about quantitative right ventricular (RV) function and shape in patients with an asymptomatic, isolated left bundle branch block (LBBB). The purpose of this study was to evaluate RV function and shape in patients with an isolated LBBB and compare both parameters with healthy volunteers and patients with heart failure and a LBBB.

Methods: We studied 15 healthy volunteers, 15 patients with an isolated LBBB and 15 patients with symptomatic heart failure and a LBBB with 2D echocardiography and pulsed-wave Doppler. All groups were age-matched and were having sinus rhythm. Biplane LV ejection fraction, LV volumes and interventricular mechanical delay were measured. RV function was evaluated by tricuspid annular plane systolic excursion (TAPSE), pulsed-wave Doppler of the RV free wall annulus (peak Sm). Finally, RV area, RV long-axis (LAX) and tricuspid annulus diameter (ANN) during end-diastole were measured for evaluation of RV shape.

Results: See Table 1.

Conclusions: In line with the LV dysfunction, a LBBB is associated with an increased interventricular mechanical delay. In patients with an isolated LBBB, RV function and RV shape are not different from healthy volunteers. In pa-
Patients with a LBBB and heart failure, a RV dysfunction is observed. This RV dysfunction occurred in the absence of significant enlargement of the RV.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>P</th>
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</thead>
<tbody>
<tr>
<td>Healthy volunteers</td>
<td>Isolated LBBB</td>
<td>Heart Failure</td>
<td>For trend</td>
</tr>
<tr>
<td>Age, years</td>
<td>58±6</td>
<td>60±10</td>
<td>64±6</td>
</tr>
<tr>
<td>Mas, n (%)</td>
<td>7 (47)</td>
<td>9 (60)</td>
<td>9 (60)</td>
</tr>
<tr>
<td>CrSSC sec</td>
<td>19±5</td>
<td>14±5</td>
<td>15±6</td>
</tr>
<tr>
<td>LV EF, %</td>
<td>63±8</td>
<td>53±8 *</td>
<td>33±14? &lt;0.0001</td>
</tr>
<tr>
<td>LV EDV ml</td>
<td>85±31</td>
<td>134±37 *</td>
<td>192±105 ? &lt;0.0001</td>
</tr>
<tr>
<td>RV area, cm²</td>
<td>14.1±3.9</td>
<td>13.5±4.3</td>
<td>15.8±5.5</td>
</tr>
<tr>
<td>Peak Sm (cm/sec)</td>
<td>13±3</td>
<td>10±2</td>
<td>??</td>
</tr>
<tr>
<td>QRS, msc</td>
<td>91±9</td>
<td>143±15 *</td>
<td>156±41</td>
</tr>
<tr>
<td>LV EDV, ml</td>
<td>85±31</td>
<td>134±37 *</td>
<td>192±105 ? &lt;0.0001</td>
</tr>
<tr>
<td>RV LV-SmRV</td>
<td>0.029</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

569 Prognostic value of left and right ventricular involvement in patients with isolated extreme obesity and subclinical myocardial dysfunction

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Obesity is a strong predictor of cardiovascular disease and is associated with subclinical left ventricular (LV) dysfunction. The right ventricle (RV) systolic and diastolic abnormalities, in the obese patients (pts) without cardiac symptoms, are less well defined and their prognostic significance is insufficiency known. The aim of the study was to evaluate RV function and its prognostic value in otherwise healthy subjects with isolated extreme obesity.

Material and methods: 42 subjects of either gender (mean age 35.3±4.1 years) with a BMI>25 kg/m² who were free of hypertension, diabetes, dyslipidemia and organic heart disease were compared with 28 control pts matched for age and sex with a BMI<25 kg/m². An echocardiographic study, including pulsed-wave tissue Doppler imaging (TDI) was performed in all pts. Systolic (Sm) and diastolic velocities (Em, Am) of the LV and RV were measured by TDI at the mitral at the respectively at the tricuspid annulus. Myocardial performance indexes (MPI) were calculated for LV and RV by using TDI derived isovolumic contraction time, isovolumic relaxation time and ejection time.

Results: We found a significant correlations between SmLV-SmRV, EmLV-EmRV, MPILV-MPIRV, but not between AMLV-AmRV. During 4 years follow up, 12 pts (28.5%) developed heart failure (HF), as assessed clinically and by reduction of the 6 min walk distance. MPILV and MPIRV both predicted the development of HF, with a sensitivity of 91% and a specificity of 80% for a cut-off value of 0.425 and respectively with a sensitivity of 83% and a specificity of 67% for a cut-off value of 0.355.

Conclusions: Healthy subjects with isolated extreme obesity could have subclinical left and right ventricular dysfunction. Left and right ventricular myocardial performance index seem to be useful to assess prognosis in these pts, by predicting the development of heart failure.

570 Average segmental Tei index is a better estimate of the right ventricular performance than the tricuspid annular Tei index: a comparison with cardiac magnetic resonance imaging

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Purpose: Tissue Doppler (TD) derived Tei index from the tricuspid annulus has been shown to be a clinically useful parameter for the evaluation of global right ventricular function. Our objective was to test the hypothesis that tissue Doppler (TD) derived average segmental Tei index would provide a better estimate of the RV performance than the tricuspid annular Tei index.

Methods: A heterogeneous group of patients (n=30, mean age 55±20 years) underwent standard echocardiography and TD imaging followed by cardiac magnetic resonance (CMR) imaging. Pulsed wave TD derived Tei index from the septal leaflet tricuspid annular junction, ½ basal and ½ apical segments of the RV free wall and from the anterior leaflet tricuspid annular junction from the apical 4 chamber view were calculated and averaged. Segmental and average Tei indices were compared to RVEF calculated by CMR.

Results: Group mean RVEF was 44±14% (range 19-71%) by CMR. Tei indices from all regions correlated significantly with the RVEF calculated by CMR. However average Tei index had a stronger correlation with the RVEF than any individual segmental Tei index (Table). A cut-off average Tei index of <0.70 had a 83% sensitivity and 75% specificity (p<0.001) to predict RVEF >45% by CMR.

Conclusion: Right ventricular TD derived average segmental Tei index provides a better estimate of the RV performance than the Tei index obtained from the tricuspid annulus.

571 Importance of the echocardiographic evaluation of right ventricular function in patients with AL amyloidosis

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Aims: Although patients with AL amyloidosis often show signs of congestive heart failure, only few studies have evaluated the alterations of right ventricular (RV) geometry and function in such patients. This study has been prospectively designed to assess the significance of RV dysfunction in AL amyloidosis.

Methods and results: 74 pts with biopsy proven AL amyloidosis and cardiac involvement underwent thorough a complete echocardiographic evaluation: a tricuspid anular plane systolic excusion (TAPSE) <17 mm was taken as marker of RV dysfunction. Plasma NT-proBNP determination were performed in all cases. The average follow-up was 19 months and 7 pts died during this period. RV function was normal in 60 pts and reduced in 14 pts. Patients with RV dysfunction had thicker left ventricular (LV) walls (13 vs 11 mm at the posterior wall, p<0.01 and 15 vs 13 mm at the septum, p=0.08) lower LV end-diastolic volumes (71 vs 22 ml, p<0.01), lower LV ejection fraction (52 vs 61%, p<0.01) and more frequently a restrictive LV filling pattern (57% vs 9%, p<0.01). RV dimensions and RV free wall thickness were not significantly different in th 2 groups, suggesting that RV dysfunction is indirectly caused by the elevation if the pulmonary artery pressures determined by the restrictive physiology of the left ventricle. A thicker interventricular septum and a reduced TAPSE were the echocardiographic parameters associated with higher NT-proBNP levels (p<0.01). Higher plasma NT-proBNP levels and TAPSE <17 mm were associated with poor survival.

Conclusions: In patients with AL amyloidosis, RV dysfunction is associated with more severe involvement of the left ventricle and with higher plasma levels of NT-proBNP, but, most of all, it portends poor prognosis.