Echocardiography in Heart Failure

Date: 9/12/99, from 14:00 to 15:30

Location: Robert Stolz A

Chairpersons:
E. Rombaut (Yvoir/BE)
S. A. Reisner (Haifa/IL)

141
Doppler tissue imaging and color M-mode of the mitral inflow in patients with left ventricular systolic dysfunction
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Doppler tissue imaging (DTI) of the mitral annulus and color M-mode of the mitral inflow have been proposed for the assessment of diastolic function because the values obtained have been considered relatively independent of the preload. The aim of this work is to analyze the linear relationship between the values obtained by these two methods and the pulsed wave Doppler of the mitral inflow, and to analyze the influence of preload in DTI and color M-mode.

Methods. Thirty seven patients with left ventricular (LV) systolic dysfunction (ejection fraction<40%) in sinus rhythm without mitral regurgitation were analyzed. Pulsed Doppler of the mitral inflow (E and A waves) and DTI of the mitral annulus (Ea and Aa waves) were analyzed. The left atrium size was measured by planimetry and the slope of the color M-mode of the mitral inflow from the four chamber apical view.

Results. We found only a modest linear relationship between A;Aa (r=0.60, SEE= 2.84, p=0.0001) and Ea/Aa (r=0.32, SEE=0.83, p=0.031). When the group was divided according to the E/A quotient into two subgroups, those with E/A<1 (diastolic dysfunction, n=18, group A) and those with E/A>1 (pseudonormalized pattern indicative of elevated preload, n=19, group B), we found a lower velocity of the Aa wave in group B: 9.8 cm/s (7.0/12.0) vs 4.0 cm/s (4.0/5.5), p=0.0002 with no change in Ea wave velocity (p=0.164). The Ea/Aa quotient tended towards pseudonormalization in group B: 0.56 (0.36/0.80) vs 1.33 (0.90/2.04), p=0.002. The atrium size was greater in group B: 18.8 cm² (18.0/20.0) vs 25.0 cm² (21.0/28.3), p=0.0003 and the E/Ea quotient, although elevated in both groups, was not statistically different (p=0.261). The slope of the color M-mode tended towards pseudonormalization in group B: 39.8 (32.0/55.0) vs 49.2 (45.5/63.0), p=0.0316. (Values are expressed as median and interquartiles 25/75. Normal values from our lab (patients matched in age and sex) are Ea/Ea: 6.9 (6.2/9.3) and color M-mode: 120.6 (96.6/138.6).

In conclusion, there is only a modest linear correlation between the values obtained by DTI of the mitral annulus and the pulsed wave Doppler of the mitral inflow. Only two parameters do not tend towards pseudonormalization in patients with left ventricular systolic dysfunction and elevated preload, the left atrium size and the E/Ea quotient.

142
The response of the restrictive left ventricle diastolic filling pattern to Valsalva manoeuvre is a predictor of remodelling after myocardial infarction
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The aim of this study was to evaluate the prognostic value of the response of restrictive transmitral inflow pattern to the standardized Valsalva manoeuvre, in patients with the left ventricle systolic dysfunction, after myocardial infarction.

Methods 31 patients EF<40% (average 31±4), who showed restrictive left ventricle diastolic filling pattern (E/A>2, DTI<150 msec) were examined in second week after the acute myocardial infarction. Mitral inflow velocities were recorded first at the end of normal expiration and then during the strain phase.

Results In 22 (71%) patients Valsalva manoeuvre induced decrease of both E and A velocity during the straining phase, but the restrictive left ventricle diastolic filling pattern remained unchanged (Restrictive pattern). In the remaining 9 (29%) patients E velocity was decreased and A velocity was either increased (7 patients) or slightly decreased (2 patients) while diastolic filling pattern was changed (E/A<2) and pseudonormalized (Improved filling pattern). Patients were followed up for 11.0±3.2 months. In patients who showed no reversion of the restrictive filling pattern during Valsalva manoeuvre, end systolic volume index ESVI increased significantly during 1 year follow up from 35±12 to 48±15 ml/m² (p<0.01) and there were 3 deaths (13.6%). In patients who showed improvement of the diastolic filling pattern during manoeuvre, ESVI increased non significantly from 34±10 to 37±10 ml/m² (NS) and there was only 1 death(11.1%,NS).

Conclusion Restrictive filling pattern represents an advanced left ventricular diastolic dysfunction. Unimprovement of the filling pattern in response to preload reduction by Valsalva manoeuvre can detect patients with more adverse outcome after myocardial infarction.
The evaluation of the tricuspid annular plane systolic excursion provides additional independent prognostic information in patients with congestive heart failure

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Abstract
Background. The prognostic value of the ultrasound of right ventricular performance in pts with congestive heart failure (CHF) has not clarified. Methods and Results. The case series consisted of 149 pts with CHF and left ventricular ejection fraction <35%. All pts underwent right heart catheterization and an echocardiographic study which systematically included the measurement of the tricuspid annular plane systolic excursion (TAPSE) and of the right ventricular fractional area shrinkage. During a follow-up period of 24 + 14 months, 45 pts died and 7 underwent urgent heart transplantation. At the univariate analysis (Cox regression model) TAPSE<14mm was shown to be the strongest echocardiographic predictor of the death and urgent transplantation: At the multivariate analysis backward stepwise section identified a prognostic model with two parameters: NYHA class III or IV and TAPSE<14mm (p=0.001). In the subgroup of 100 pts in sinus rhythm and in whom mitral inflow Doppler variables could be measured, survival was further analyzed according to a model in which the significance parameters were included in the same order they are considered in routine clinical practice. TAPSE<14mm added significant (p<0.001) prognostic information to NYHA II III IV, left ventricular ejection fraction <20% and mitral dilatation <125ms to the Cox model. Conclusion: TAPSE is a useful parameter for the immediate prognosis of hospitalised CHF patients and should be considered in the clinical practice.

Selection of patients with dilated cardiomyopathy for permanent biventricular pacing by pulsed Doppler tissue imaging

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Abstract
The optimal pacing configuration is the one that best corrects for electromechanical asynchrony within the left ventricle. Pulsed Doppler Tissue Imaging (PDTI) was used to evaluate systolic amplitudes and timings of the basal interventricular septum (IVS), basal lateral left ventricular wall (LW), and posterior wall (PW) in 43 patients with dilated cardiomyopathy. These data were compared with the left ventricular enddiastolic diameter (LVEDD), systolic ejection fraction (EF) and ORS duration in the electrocardiogram. Positioning of PDTI sample volumes: basal segments of IVS and LW from an apically four chamber view (longitudinal motion component), basal segments of PW from the parasternal short axis view (circumferential motion component).

RESULTS: The intervals between Q-wave in the electrocardiogram and beginning of the systolic myocardial velocity profile (Q - systolic apical PW was more than 60 ms. 3 (43%) of these patients had an arrhythmic death within 3 week follow up.

CONCLUSION: The substantial number of sudden deaths observed among patients who had highly inhomogenous systolic activation in this study raises the issue of the efficacy of combined treatment with an implantable system capable of multisite pacing and defibrillation of the pulsed. Pulsed DTI technique may be the method of choice for quantification of left ventricular systolic asynchrony and thus for selection of candidates for this supplementary treatment of congestive heart failure.

Tissue harmonic three-dimensional echocardiography for accurate evaluation of improvement in left ventricular function in patients treated by biventricular pacing for severe heart failure

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Abstract
Background: Biventricular pacing (BVP) seems to improve symptoms in patients with severe heart failure (HF). However, improved cardiac function has not been documented, and optimal pacemaker lead positions have not been determined. We evaluated the effects of BVP on LV performance in patients with severe HF using tissue harmonic 3-dimensional echocardiography (3D ECHO). Methods: At present, seven patients with severe HF (NYHA class IV) scheduled for BVP are included in the study (5 males, 4 with ischemic heart disease, mean age 60 years (58-63). 3D ECHO (GE VingMed, System V) was performed prior to BVP and on the following day. Pacemaker programming and AV-delay were adjusted based on echocardiographic evaluation of diastolic filling time. A six minute walk test was made prior to BVP and after four weeks.

Results: Changes in LV volumes are shown in the table. Six minute walking distance increased from 333 m (220-370) to 440 m (370-470), p<0.05. After four weeks, all of the patients had improved at least one NYHA class.

Table

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Before BVP</th>
<th>After BVP</th>
<th>p-value</th>
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</thead>
<tbody>
<tr>
<td>Ejection fraction (%)</td>
<td>18 (9-23)</td>
<td>30 (24-37)</td>
<td><strong>&lt;0.01</strong></td>
</tr>
<tr>
<td>Stroke vol. (ml)</td>
<td>78 (61-110)</td>
<td>128 (77-183)</td>
<td>0.05</td>
</tr>
<tr>
<td>Stroke vol. (ml)</td>
<td>425 (222-553)</td>
<td>509 (275-553)</td>
<td>0.005</td>
</tr>
<tr>
<td>Stroke vol. (ml)</td>
<td>357 (171-476)</td>
<td>293 (148-394)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Stroke vol. (ml)</td>
<td>361 (171-476)</td>
<td>293 (148-394)</td>
<td>&lt;0.05</td>
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</tbody>
</table>

Conclusion: Tissue harmonic 3D ECHO documented major improvement in LV performance following BVP. Potentially, 3D ECHO can be used as guidance for achievement of optimal pacemaker lead position.

Improved diagnostic accuracy to evaluate post-revascularization outcome of LV by sequential nuclear imaging and dobutamine echocardiography


Background: Both thallium-201 SPECT and low-dose dobutamine echocardiography (LDDE) can identify viable myocardium. However, prediction of improvement of LVEF post-revascularization remains suboptimal with either technique due to the relatively low specificity of thallium-201 and low sensitivity of LDDE. This study was undertaken to develop an optimal testing strategy for prediction of post-revascularization functional outcome.

Methods: 66 patients (LV EF 33±6%) underwent LDDE and thallium-201 SPECT (rest-redistribution or 4-hour delayed imaging) before surgical revascularization. Dysfunctional segments with thallium-201 activity > 50% or with contractile reserve on LDDE were considered viable. LV EF was assessed before and 3 months post-revascularization. Four different testing strategies were explored. In strategy #1, only the thallium-201 SPECT results were used, whereas in strategy #2 only the LDDE data were used. In strategy #3, 27/66 (41%) patients with an intermediate likelihood of viability on thallium-201 (5-9 viable segments) underwent LDDE. In strategy #4, 20/66 (30%) patients with an intermediate likelihood of viability on LDDE (2-4 visible segments) underwent thallium-201 SPECT.

Results: Receiver operator characteristic curve analysis showed that the optimum criteria to predict improvement (≥5%) in LV EF after revascularization were ≥6 viable dysfunctional segments (using a 16-segment model) on thallium-201 and 24 segments on LDDE. The sensitivities, specificities and diagnostic accuracies of the 4 strategies were as follows:

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Sensitivities</th>
<th>Specificities</th>
<th>Diagnostic Accuracies</th>
</tr>
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<tbody>
<tr>
<td>#1</td>
<td>63%</td>
<td>65%</td>
<td>74%</td>
</tr>
<tr>
<td>#2</td>
<td>63%</td>
<td>84%</td>
<td>77%</td>
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<tr>
<td>#3</td>
<td>72%</td>
<td>92%</td>
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<tr>
<td>#4</td>
<td>76%</td>
<td>84%</td>
<td>80%</td>
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</table>

Conclusion: Sequential testing by thallium-201 SPECT and LDDE in a subgroup of patients with an intermediate likelihood of viability by either test enhances accuracy to predict improvement of post-revascularization LV EF.