Tissue Doppler Imaging in Patients With Moderate to Severe Aortic Valve Stenosis: Clinical Usefulness and Diagnostic Accuracy

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Background: Mitral annular velocities derived from tissue Doppler imaging (TDI) complement traditional variables in the evaluation of left ventricular (LV) performance. The mitral E/E‘-ratio has been suggested as an estimate of LV filling pressures in selected subsets of patients (pts.). The diagnostic usefulness of TDI has not been studied in patients with aortic valve stenosis (AVS).

Methods: Results: 20 pts. with moderate or severe AS (aortic valve area 0.8±0.4 cm², mean pressure gradient 57±17 mmHg, age 64±11 y, AS group) and 28 asymptomatic controls (age 60±11 y, CON group) underwent assessment of ejection fraction (EF), fractional shortening (FS), and mitral E/A-ratio. TDI derived velocities (S’, E’, A’) were obtained at the septal mitral annulus. In AS pts., LV end-diastolic pressure (LVEDP) and cardiac index (CI) were derived from cardiac catheterization (results see table). In AS pts., E/E’ was significantly related to LVEDP (r=0.83, p<0.001). Derived from receiver operating characteristic curve analysis, an E/E’ < 15 mmHg with a sensitivity of 84% and a specificity of 85% (area under the curve: 0.96±0.04).

Conclusion: In pts. with moderate or severe AS, E/E’ is a reliable estimate of filling pressures. In such pts., systolic mitral annular velocities (S’, i.e. longitudinal shortening) are reduced. This seems to be counterbalanced by increased FS (i.e. radial shortening) leading to an ejection fraction and a cardiac index within the normal lower range.

* p<0.05, **p<0.01 vs. CON group.

<table>
<thead>
<tr>
<th>Group</th>
<th>EF (%)</th>
<th>FS (%)</th>
<th>E/A-ratio</th>
<th>B (cm1/mm)</th>
<th>E (cm1/s)</th>
<th>A (cm1/s)</th>
<th>E/E’</th>
<th>CI (l/min)</th>
<th>LVEDP (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CON (n=29)</td>
<td>67±8</td>
<td>50±7</td>
<td>1.2±0.26</td>
<td>8.3±1.3</td>
<td>10.2±3.0</td>
<td>10.1±2.9</td>
<td>6.5±1.5</td>
<td></td>
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<tr>
<td>AS (n=20)</td>
<td>59±11</td>
<td>62±7</td>
<td>1.1±0.79</td>
<td>5.3±1.27</td>
<td>5.2±1.7</td>
<td>8.1±2.4</td>
<td>14.4±4.9</td>
<td>2.7±0.5</td>
<td>17±6</td>
</tr>
</tbody>
</table>

866 New Technologies in Cardiovascular Ultrasound

Wednesday, March 10, 2004, 8:30 a.m.-10:00 a.m.
Morial Convention Center, Room 343

Evaluation of Left Anterior Descending Coronary Artery by High-Frequency Transchordal Echocardiography: Comparison With Simultaneous Intravascular Ultrasound Measurements

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Background: Recent investigation by using high-frequency epicardial echocardiography showed the wall thickness including adventitia in the left anterior descending coronary artery (LAD) significantly increased in thickness with the development of atherosclerosis.

Objectives: The purpose of this study was to evaluate the feasibility of high-frequency, 2-dimensional transchordal echocardiography (HF-2DTE) in the measurement of the wall thickness, the luminal diameter, and the luminal area in the LAD.

Methods: Fifteen patients underwent simultaneous HF-2DTE (HDI 5000; 5-12MHz transducer) and intravascular ultrasound (IVUS) examination (Atlantis Pro; 40MHz) during cardiac catheterization. We identified the transducer position of the IVUS by both HF-2DTE and fluoroscopy. All the measurements were done on 3 separate frames at diastole and were averaged. The wall thickness including adventitia, the luminal diameter (the major axis and the minor axis) and the lumen area in the LAD were measured by HF-2DTE, and were compared with IVUS measurements.

Results: The LAD was visualized in all patients. Six of the fifteen studies (40%) were of less than optimal quality for measurements and excluded from the analysis. There were significant correlations in the wall thickness (0.41±0.07 vs. 0.37±0.77mm; n=10, p<0.01), the luminal diameter (the major axis: 2.41±0.96 vs. 2.32±0.57mm; n=10, p<0.01), and the lumen area (3.27±1.27 vs. 4.05±2.06mm²; n=8, p<0.01) between HF-2DTE and IVUS.

Conclusion: HF-2DTE was feasible and reliable in the measurements of the wall thickness, the luminal diameter, and the lumen area in the LAD.

866-7 Objective Detection of Stress-Induced Myocardial Ischemia Using Quantitative Analysis of Contrast Echocardiographic Parametric Perfusion Images

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Parametric imaging of myocardial perfusion has been recently developed to facilitate contrast echocardiographic diagnosis of myocardial ischemia. Since the standard visual interpretation of parametric images is subjective, we developed a technique for automated detection of perfusion defects based on quantitative segmental analysis of parametric images. This technique was applied to images obtained in patients undergoing perfusion stress testing and the results compared with coronary angiography.

Methods: Apical 4, 3 and 2 chamber images were obtained at rest and during dipyridamole stress in 18 pts with suspected coronary disease who were referred for coronary angiography. Flash-echo technique was used during infusion of Definity (10 ml). Post-flash images were analyzed (QLab, Philips) to obtain for each pixel the standard contrast replenishment model parameters A and J, and to generate parametric images of J and A. Each parametric image was divided into 6 segments, and mean pixel value (MPV) calculated for each segment. Changes in MPV from rest to stress were used to automatically detect stress-induced perfusion defects. ROC analysis was used to optimize (1) the threshold for MPV stress-to-rest ratio, and (2) the minimal number of abnormal segments, required for the diagnosis of ischemia using coronary stenosis >70% as the "gold standard." LAD and non-LAD territories were analyzed separately. Results: MPV and non-LAD stenosis >70% was found in 8 and 10 patients, respectively. During stress, MPV was lower than at baseline in most segments predicted by angiography in 6/8 and 8/10 pts, respectively. The optimal MPV stress-to-rest ratio threshold was 0.8 and 0.85, for the LAD and the non-LAD territory, respectively. The optimal number of segments below threshold for accurate detection of stress-induced ischemia was found to be 3. With these settings, the sensitivity, specificity and accuracy of the automated detection of ischemia were 63, 75 and 69% in the LAD, and 67, 100 and 75% in the non-LAD territory.

Conclusion: Automated quantitative analysis of contrast echocardiographic parametric perfusion images is feasible and may be useful for objective detection of myocardial ischemia.

866-8 Assessment of Left Ventricular Torsional Deformation by Doppler Tissue Imaging: A Validation Study Using Tagged Magnetic Resonance Imaging

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Background— Left ventricular (LV) torsional behavior is believed to be a sensitive index for LV performance, but difficult to measure. The present study was designed to evaluate accuracy of a novel method using Doppler tissue imaging (DTI) for quantifying the LV torsion using tagged magnetic resonance imaging (MRI) as a reference. Methods and Results— Thirteen patients (age 60±14y) underwent DTI and tagged MRI studies. Images of the LV were obtained at 3 short-axis levels and in long-axis by both methods to assess LV torsion. We calculated LV rotation (degrees) by integrating the rotational velocity, which were determined from the septal and lateral region’s DTI velocity after correcting by the LV radius. LV torsion was defined as a difference in the LV rotation between apical and basal level. LV rotational and torsional profiles throughout systole and early diastole obtained by DTI were compared with those derived by tagged MRI at isochronal points (6 to 11 points). The rotational and torsional profiles by DTI significantly correlated with those by tagged MRI for LV rotation in apical, mid, and basal level; R = 0.89, 0.84, and 0.79, and for LV torsion, R = 0.90, p < 0.0001 for all data).

Conclusions— The present study has validated the ability of DTI to assess LV torsional deformation against MRI tissue tagging. This novel method may promote noninvasive quantification of the LV torsional behavior in clinical settings.