ORAL PRESENTATIONS

Stress echo in heart valve disease

Friday, 9 December 2005, 14:00–15:30
Location: Giotto

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Valve resistance variation during exercise in aortic stenosis
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Introduction: Echocardiographically derived maximal aortic gradient (maxG), mean aortic gradient (MG) and aortic valve area estimates, at rest and in left lateral decubitus, provide a reasonable estimate of aortic stenosis severity. More recently, aortic valve resistance (VR) and Doppler velocity index (DVI) have gained worldwide acceptance in the evaluation of patients with aortic stenosis. Stress echocardiography has also proved useful as a tool in the assessment of aortic stenosis severity.

Purpose: To prospectively evaluate the influence of upright dynamic exercise in Doppler derived echocardiographic variables used to assess aortic stenosis severity.

Methods: From a total of 30 patients (pts) we acquired quality imaging in 26 (86%), mean aged 70±6 years (age range, 53 to 81 years), 16 were men. Pts had a mean vacular area of 0.93±0.32cm² (0.54 to 1.69cm²). We calculated maxG, MG, VR and DVI in the upright position (UP), while already in the treadmill and at rest.

Results: Upright dynamic exercise significantly influenced all variables used in aortic stenosis severity evaluation besides DVI (indirect measure of effective valve area). 3. The results of our study suggest that, in order to understand its physiopathology, comprehensive assessment of valvular disease might be further improved with the acquisition of dynamic variables during treadmill upright exercise.

Conclusions: 1. Some pts with aortic stenosis develop significant end-systolic intraventricular gradient without hypotension. The maxG in UP was 44±19 mmHg and 70±31mmHg at peak workload (p<0.01); the MG in UP was 25±13 mmHg and 40±18 mmHg at peak workload (p<0.01); the VR in UP was 181±93 dynes s cm⁻⁵ and 213±97 dynes s cm⁻³ at peak workload (p<0.05); the DVI in UP was 0.31±0.10 and 0.32±0.10 at peak workload (p=NS).

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Right ventricular contractile and diastolic reserve in patients with mitral stenosis: is stress echocardiography necessary to evaluate the hemodynamic burden? A tissue Doppler study
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Clinical manifestations are subjective and may be misleading in mitral stenosis. Pulmonary capillary wedge pressure (PCWP) is an important decision making criteria in the management of patients with mitral stenosis. Aim: RV contractile and diastolic reserve by tissue Doppler (TD) during dobutamine challenge could be used to estimate PCWP non-invasively in mitral stenosis.

Methods: We studied 30 subjects (10 males, mean age 41±17). Fifteen with mitral stenosis and fifteen controls. RV contractile reserve was evaluated under dobutamine challenge at a maximum dose of 20μg/kg/min. Conventional 2D echocardiography and pulsed wave TD interrogation of the tricuspid annulus at the RV free wall were performed at baselines and during dobutamine infusion. All subjects underwent left and right heart catheterization.

Results: Mean mitral valve area was 1.27±0.4cm² with a mean gradient of 9.4±5mmHg in patients. At baseline none of the investigated RV parameters significantly differed between patients and controls neither did they correlate with PCWP. Under dobutamine challenge IVA, IVC, As, and RV fractional area change were significantly less and IVRT was significantly longer in patients than in controls (p<0.001, p<0.05, p<0.03, p=0.004 respectively). IVA had the strongest correlation with PCWP (r=0.85, p<0.001) and a cut-off value of 1mm/m² predicted PCWP>18mmHg with 100% sensitivity and 87% specificity (p<0.0001).

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Relation between stroke volume changes and hemodynamic response during exercise in patients with severe mitral stenosis and few or no symptoms
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Background: Exercise induced changes in transmirtal gradient and systolic pulmonary artery pressure are well documented in patients with mitral stenosis(MS) However, contribution of exercise induced left ventricular systolic volume (SV) changes to the hemodynamic response remains unclear.

Purpose: To study the relations between SV changes and the hemodynamic parameters during exercise Doppler echocardiography (ED) in patients with severe MS and no or few symptoms.

Methods: 30 patients (22 females, aged 52±13 yrs, sinus rhythm: 26) with severe MS (MVA=1.24±0.17 cm²) and few or no symptoms (NYHA III: 8/22), were prospectively studied during symptom limited ED (20 Watts increase every 3 minutes). SV, mean MG and sPAP were measured at each level of exercise.

Results: During exercise, SV increased from 57±11 mmHg at rest to 64±13 mmHg (p<0.0001) at peak exercise(mean increase: 12±8%). sPAP increased from 34±6 mmHg at rest to 60±11 mmHg (p<0.0001). MG increased from 7±2mmHg at rest to 25±7 mmHg at peak exercise (p<0.0001). Exercise was stopped in 10 pts because of dyspnea and in 20 pts because of fatigue. Patients were classified in 2 groups according to SV changes during exercise. SV increased by >or=12% in 12 pts (Gp 1) and by <12% in 18 pts (Gp 2). At rest, no difference was observed between the 2 groups as regards MVA, sPAP and MG. Peak heart rate and blood pressure at peak stress did not differ in the 2 groups. Gp 2 showed higher rate of
increase of MG and sPAP during exercise (Table 1). Patients who stopped exercise due to dyspnea (n=10) had a significantly lower increase in SV during exercise (4±4 vs 16±3; p<0.01).

### Table 1

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<th>MG</th>
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**Conclusion:** In patients with severe MS and no or few symptoms, changes in SV during EE are related (1) to hemodynamic changes during exercise and (2) to limiting symptoms at peak exercise. Absence of increase in SV during EE is associated with a higher increase in MG and sPAP during exercise.

### 847 Pulmonary artery systolic pressure evaluation during exercise in mitral stenosis. Clinical implications

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**Introduction:** Pulmonary artery systolic pressure (PASP) is a fundamental expression of the severity of mitral stenosis (MS) and of utmost importance in the hemodynamic assessment of MS patients (pts). The European Society of Cardiology established indication for treatment (pulmonary hypertension, surgical valvuloplasty or valve replacement) when PASP rises above 60 mmHg on exertion.

**Purpose:** To evaluate the hemodynamic response of PASP in mildly symptomatic pts with MS using Doppler echocardiography during treadmill stress testing (ST).

**Methods:** From a group of 43 pts referred to our echo lab we studied 41 pts mean aged 50 ± 9.3 years (age range 35 to 70 years), 34 were women. All pts were in normal sinus rhythm. All pts underwent complete standard echocardiogram in left lateral decubitus (LLD) including calculation of functional mitral area using pressure half-time (MA), mitral mean gradient (MMG) and pressure gradient between the right ventricle and the right atrium (RV/RAG) in pts with tricuspid regurgitation (TR) (Figure 1). We also calculated stroke volume (SV) and cardiac output (CO), MMG and RV/RAG were again evaluated after pts were placed in upright position. Stress treadmill testing was then started using the modified Bruce protocol and the same measurements (MMG, RV/RAG, SV, CO) were recorded through the test and for analysis purpose they were measured and registered at peak workload (PW) (before treadmill exercise testing termination). In 4 pts the tricuspid regurgitant signals were not quantifiable.

**Results:** For analysis and follow-up purpose we divided MS pts in two groups: pts whose RV/RAG at peak workload was below 60 mmHg (group A, 17 pts; mean RV/RAG 48±5.2mmHg) and pts whose RV/RAG at peak workload was above 60 mmHg (group B, 20 pts; mean RV/RAG 79±9.0mmHg) with significant differences in relation to MVA, SV and functional capacity. The mean follow up period of 3 years revealed that from 20 pts in group B, 12 underwent valvuloplasty, 6 underwent mitral valve replacement for a mechanical prosthetic valve and 2 were maintained on medical therapy. From the 17 pts in group A, four were referred for mitral valvuloplasty and the remaining was maintained on medical therapy.

**Conclusions:** 1. Stress echocardiography during treadmill testing was feasible and yielded quantifiable tricuspid regurgitant signals in most MS patients. 2. Mitral stenosis pts who developed moderate to severe PASP during exercise have poorer functional capacity. 3. Stress echocardiography during treadmill testing might provide valuable information for patients' management.

### 848 Can mitral valve anatomy predict ischemic mitral regurgitation?

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**Background:** Ischemic mitral regurgitation (MR) results from left ventricular remodeling, leaflet tethering and annular dilatation. We have previously shown underdetermination of ischemic MR by preoperative transesophageal echocardiography (TEE) and worsening of ischemic MR with fluid and vasopressor challenge during intra-operative transesophageal echocardiography (TEE). This can be viewed as a "stress test" for the mitral valve (MV). The aim of this study was to determine whether pre-operative resting MV anatomy can predict the severity of stress-induced ischemic MR.

**Methods:** MV anatomy on preoperative TEE was correlated with MR severity during intra-operative TEE in 30 pts with varying degrees of ischemic MR undergoing coronary bypass with or without MV surgery. Intra-operative TEE was performed after fluid infusion (if pulmonary wedge pressure <15mmHg) and phenylephrine aiming at systolic BP of 160 mmHg. Measurements of MV anatomy included anterior leaflet concavity area towards the left atrium (CA), tenting area (between MV leaflets and annulus) and annulus diameter determined from the long axis view (usually parasternal). MR severity was quantified using the PISA method and measurement of the effective regurgitant orifice area (EROA) and the regurgitant volume (RV). Sensitivity and 43-41% specificity for clinically significant peak stress MR (EROA >0.4 cm² and RV >30cc). Concavity area >0.4 cm² detected 4/6 pts with severe MR (EROA >0.4 cm² and RV >60cc) with 100% (24/24) specificity.

**Results:** CA, tenting area and MV annulus diameter correlated moderately with EROA and RV at peak stress (Table). Concavity area >0.15 cm² had 56% - 54% sensitivity and 43-41% specificity for clinically significant peak stress MR (EROA >0.4 cm² and RV >30cc). Concavity area >0.4 cm² detected 4/6 pts with severe MR (EROA >0.4 cm² and RV >60cc) with 100% (24/24) specificity.

**Conclusion:** 1. MV leaflet anatomy correlated moderately well with the severity of stress-induced ischemic MR. 2. The findings support the role of leaflet tethering as a cause of ischemic MR. 3. The clinical utility of MV anatomy in predicting stress-induced MR may, however, be limited to extreme cases of leaflet concavity. In other cases intra-operative TEE with optimal loading may be necessary.