

D (2.5, 5.0, 7.5, and 10, mcg/kg/min) to 16 patients (13 male, mean age 48 years) with severe heart failure due to idiopathic (n = 8) or ischemic (n = 8) cardiomyopathy. Resting EF averaged 25 ± 9%, MVO₂ averaged 17.5 ± 3.7 ml/kg/min. Doppler-derived LV outflow tract time-velocity integral (TVI) and cardiac output (CO) were recorded at baseline and during each stage of D, as were transmitral TVI and CO. Septal wall thickening (WT) was also calculated, as were changes in WT in response to D. All parameters were correlated with MVO₂ obtained during treadmill exercise (Naughton protocol).

Maximal CO responses to D ranged from 3.5–10.2 liters/minute. Stepwise linear regression demonstrated that of all parameters, only TVI at 10 mcg D predicted MVO₂ (r = 0.67, p = 0.009), while WT, transmitral TVI and CO, or LVOT TVI calculated at baseline or other infusion rates did not significantly add to the predictive ability of the 10 u DLV TVI measurements. We therefore conclude that (1) WT responses to low dose D do not predict MVO₂, and (2) LVO TVI determined by Doppler echo during low dose dobutamine can predict exercise MVO₂. Prognostic data is needed to determine whether this Doppler-derived left ventricular outflow measurement during low dose dobutamine infusion can be utilized instead of MVO₂ in determining the prognosis of patients with severe congestive heart failure who are unable to exercise.

4:45

763-4 Resting Echocardiography Identifies Hypertrophic Cardiomyopathy Patients with Latent Left Ventricular Outflow Obstruction

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Latent LV outflow tract (OT) obstruction has important therapeutic and prognostic implications in patients with hypertrophic cardiomyopathy (HCM). However, since its presence can not be known until it is provoked, we investigated the resting echo features of patients with latent LVOT obstruction, aiming to predict it before provocation.

Methods: 48 patients with non-obstructive HCM (resting LVOT pressure gradient (PG) <40 mmHg) challenged with amyl nitrite inhalation were studied. 23 patients (mean 51 ± 18 years) were *nonprovocable* and 25 (mean 52 ± 12 years, p = ns) were *provocable* (LVOT-PG ≥40 mmHg with amyl). Echo measurements included assessment of LV shape (asymmetric septal hypertrophy (ASH), concentric hypertrophy (CH) and prominent basal septal bulge (SB), anterior and posterior mitral leaflet length, qualitative assessment of mitral valve systolic anterior motion (SAM, 0 = none to 3 = severe), LVOT-PG, LVOT diameter at the onset of systole (DIA, cm), septal and posterior wall thickness, end-diastolic and end-systolic volume, and ejection fraction determined by Simpson's method. The angle (α, degrees) between the color Doppler-determined ejection streamline in LVOT and the LV long axis was measured to assess the magnitude of the drag force acting on the mitral valve.

Results: 12 of 16 patients (80%) with SB showed LVOT obstruction after amyl inhalation, whereas only 3 of 8 patients (38%) with ASH and 10 of 25 (40%) with CH showed obstruction (p < 0.05). Unpaired t-testing revealed the following:

| | SAM | resting PG | DIA | α |
|----------------------|-----------|------------|-----------|--------|
| <i>nonprovocable</i> | 0.5 ± 0.8 | 9 ± 4 | 2.2 ± 0.3 | 32 ± 9 |
| <i>provocable</i> | 0.9 ± 0.9 | 13 ± 9 | 1.8 ± 0.3 | 37 ± 7 |
| p value | 0.11 | 0.06 | <0.0001 | <0.05 |

The sensitivity for predicting provokable patients by combination of small LVOT diameter (≤2 cm) and large α (≥35 degrees) was 64% and the specificity was 79%. Wall thickness, leaflet length, ventricular volume, and ejection fraction did not show significant differences between two groups. Multiple stepwise linear regression analysis showed DIA and resting PG are best predictors for PG after amyl inhalation (r = 0.67, p < 0.001).

Conclusions: Non-obstructive HCM patients with 1) prominent septal bulge, 2) narrow LVOT, 3) oblique angle between the ejection flow and the LV long-axis, and 4) higher resting PG appeared to be predisposed for latent LVOT obstruction.

5:00

763-5 Provocation of Latent Left Ventricular Outflow Tract Gradients with Amyl Nitrite and Exercise in Patients with Hypertrophic Cardiomyopathy

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In pts with hypertrophic cardiomyopathy (HCM) who have obstructive symptoms without significant resting outflow tract gradients, amyl nitrite may be used to provoke latent obstruction. However, the provocative effect of after-load reduction may not be comparable to a more physiologic method such as symptom-limited exercise stress testing. This study compared the ability

of amyl nitrite and exercise testing to provoke outflow tract gradients in the same pts. Sixty-one pts (age 49 ± 17y, 43 male) with non-obstructive HCM (septal thickness 19 ± 5 mm, resting outflow tract gradient 15 ± 14 mmHg) underwent echocardiography at rest, following amyl nitrite inhalation, and after maximal exercise. Twenty-six pts (43%) remained without significant inducible gradients (<50 mmHg) after either provocation, 17 (28%) became inducible after both stressors, 7 (11%) after exercise only, and 11 (18%) after amyl only. Although obstruction increased to similar levels after amyl nitrite (50 ± 38 mmHg) and after symptom-limited exercise (49 ± 39 mmHg), gradients induced by exercise and amyl correlated poorly (r = 0.54). Gradients were the same with both stressors in 15 patients (EQ group), greater with exercise in 26 (EX group), and greater with amyl in 20 patients (AM group). Differences between amyl and exercise were unrelated to drug therapy.

| | EQ (n = 15) | EX (n = 26) | AM (n = 20) | p |
|----------------------------------|-------------|-------------|-------------|--------------------|
| Age (ys) | 37 ± 15 | 47 ± 17 | 61 ± 9 | p < 0.001 EQ vs AM |
| Septum (mm) | 21 ± 5 | 20 ± 6 | 17 ± 3 | p < 0.01 EQ vs AM |
| Ex HR (% predicted) | 73 ± 23 | 96 ± 9 | 82 ± 16 | p < 0.001 EQ vs EX |
| Exercise RPP (×10 ³) | 21.4 ± 8.2 | 33.9 ± 7.7 | 24.3 ± 8.5 | p < 0.001 EQ vs EX |
| Amyl gradient (mmHg) | 40 ± 39 | 37 ± 33 | 76 ± 34 | p < 0.001 EQ vs AM |
| Ex gradient (mmHg) | 40 ± 39 | 67 ± 42 | 33 ± 25 | p < 0.03 EQ vs EX |

Conclusion: Over 50% of pts with non-obstructive HCM at rest have inducible gradients which may explain intermittent symptoms. Measurement of gradients after AM and EX should be included in the assessment of pts with HCM with suspected latent outflow obstruction. Pts with a preponderant AM response are older and have less hypertrophy. EX is particularly indicated in younger patients without AM-induced gradients.

5:15

763-6 Septal Myectomy for Hypertrophic Cardiomyopathy: Echocardiographic Predictors of Postoperative Outcome

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Although septal myectomy (SM) reduces the left ventricular outflow tract (LVOT) pressure gradient and relieves symptoms in the majority of patients with severe hypertrophic cardiomyopathy (HCM), there remains a subset of patients who will continue to have residual limiting symptoms.

In order to determine whether echo/Doppler (ECHO) can predict outcome after surgical treatment of HCM, we analyzed the clinical and ECHO characteristics of 47 consecutive HCM patients aged 20 to 70 years (mean 47 ± 15 years, M:F = 1:1) undergoing isolated SM from 1986 to 1992 for NYHA class 3 or 4 symptoms. Preoperative symptoms included dyspnea (100%), angina (64%), near syncope (62%), and syncope (23%).

At postoperative follow-up (12 ± 4 months), there was marked overall improvement; 94% were NYHA class 1 or 2. Persistent symptoms were dyspnea (55%), angina (15%), and near syncope (15%). By multivariate analysis of all clinical and ECHO parameters, only the preoperative ECHO variable of hypertrophy pattern (diffuse hypertrophy ≥15 mm versus septal localization ± anterolateral extension) emerged as an independent predictor of residual dyspnea postoperatively (p = 0.05). Variables not predictive included peak rest and provoked LVOT gradient, ejection time, mitral regurgitation severity, mitral flow velocity curves, left atrial volume, and left ventricular mass index.

Conclusions: With the successful relief of LVOT obstruction by SM, most HCM patients experience significant improvement in symptoms of angina, near syncope, and syncope. The morphological characteristic of diffuse (concentric) left ventricular hypertrophy is a superior predictor of residual postoperative dyspnea as compared to Doppler parameters. This diffuse hypertrophy may be indicative of severe diastolic filling abnormalities which are unchanged by SM.

TUESDAY PM