Stress Echo in Mitral Valve Disease – Measurements needed for repair or surgical referral

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OUTLINE

• STRESS TESTING IN:

1. Mitral Stenosis
   - Pressure Half Time Method
   - Continuity equation

2. Mitral Regurgitation
   - Jet Area
   - Vena Contracta
   - Flow convergence or PISA method

3. Hypertrophic Cardiomyopathy (HCM)
   - Guidelines
   - Case study
Role of Stress Testing in MS

- Symptoms out of proportion to the resting hemodynamics.
- Severe lesions but no symptoms.
- Supine bike protocol or exercise.

Mitral Stenosis:
- Baseline and stress – CW Doppler across the MV and TV
- Mitral inflow is recorded with continuous wave Doppler, along with recording of tricuspid regurgitation velocity by continuous wave Doppler at rest and during exercise.
- Associated MR.

Sinus rhythm – averaged over 3-5 beats.
Afib – averaged over 3-10 beats.

Post-stress Response - MS

- **Indications for consideration of intervention in MS:**
  - Exercise induced dyspnea +
  - increase in MG to > 15 mm Hg OR PASP > 60 mm Hg
  - Minimal change in gradient with significant increase in PASP → consider lung pathology.
  - Continuity equation, not P1/2 time method should be used to calculate MVA during exercise testing.
Pressure Half Time

- Defined as the time interval in between the maximum mitral gradient in early diastole and the time point where the gradient is half the maximum initial value.
- \[ \text{MVA cm}^2 = \frac{220}{\text{PHT} \text{ msec}} \]

Mitral Stenosis – Continuity Equation

- Filling volume of diastolic mitral flow is equal to aortic stroke volume.
- \[ \text{MV Flow} = \text{Aortic flow} \]
- \[ \text{MVA} \times \text{VTI (mitral)} = \text{LVOT area} \times \text{VTI (Aortic)} \]

- Cannot be used in cases of atrial fibrillation or associated significant MR or AR.
MITRAL REGURGITATION

Stress response - MR

- Assess for worsening MR with exercise (visual inspection, doppler envelope, jet area, vena contracta, Regurgitant Volume).
- Decreased exercise tolerance.
- Increase in pulmonary pressures (PASP > 60 mm Hg).
- Assess ventricular size and function.
JET AREA

- Rapid screening of the presence and direction of jet.
- Semi-quantitative method of assessing severity.
- Affected by instrument factors, especially pulse repetition frequency (PRF) and color gain & clinical factors like BP.
- Nyquist limit (aliasing velocity) of 50-60 cm/sec, and
- Color gain that just eliminates random color speckle from non-moving regions.

Zoghbi et al; JASE 2003

VENA CONTRACTA:

- the narrowest portion of a jet that occurs at or just downstream from the orifice.
- slightly smaller than the anatomic regurgitant orifice due to boundary effects.
- Independent of flow rate and driving pressure for a fixed orifice.
- Comprised of high velocities, it is less sensitive to technical factors such as PRF compared to the jet area.

Zoghbi et al; JASE 2003
Proximal Isovelocity Surface Area (PISA) or Flow Convergence Method

- "...as blood approaches a regurgitant orifice, its velocity increases forming concentric, roughly hemispheric shells of increasing velocity and decreasing surface area."

R. Vol ml = EROA x MV VTI
Hypertrophic Cardiomyopathy (HCM)

HCM – Stress Testing

• Semi supine bicycle exercise or treadmill Bruce protocol recommended (supine bicycle preferred method).

• Standard protocol, symptom limited.

• STOP if symptoms, or LVOT gradients > 50 mm Hg, hypotension, arrhythmia.

• Also assess MR severity.

Case HCM

• 24 y/o man with HCM and SAM referred for Stress Echo.

• Prior echo 2013 : rest LVOT gradient 34 with Valsalva ; hypotensive BP response on exercise.

• Commercial driving license.
HCM - Rest

- On-table to characterize MR.
- Hyperdynamic LV systolic dysfunction at rest.

REST PWD - AUGING

REST CWD - PG 19 mm Hg

Rest PG with Valsalva 25 mm Hg.
Case HCM – exercise response

- Below average functional capacity (7 METS). 84% MPHR.
- Hypotensive BP response with exercise (SBP 154 → 98 mm Hg).
- ST depressions in inferolateral leads.
- Hyperdynamic LV function with exercise, no arrhythmias.
- At peak exercise, severe SAM with elevated LVOT gradients.

- Could not clear for driving license.
- Optimize medical therapy and then repeat stress echo to decide candidacy for ICD.

END