Stress Echocardiography: Illustrative Cases

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DISCLOSURE

Relevant Financial Relationship(s)
None

Off Label Usage
None
Dobutamine Echo and Prediction of LV Recovery

% Sensitivity
74 89
Biphasic

% Specificity
86 68
Any improvement

Qureshi: Circ, 2/4/97
Improvement Throughout Study with Dobutamine
Biphasic Response with Dobutamine
Cases

1. Soccer coach receives a “red card”
2. Let Lord Murphy Reign
3. Bigger is not always better
4. Very Tight
5. Two for the price of one
6. Go With the Flow
Case: 51 yo male, soccer coach

- New onset chest pain while biking
- No CV risk factors
- Referred for Exercise Echo

- 12 minutes on Bruce Protocol
- 118% FAC
- 13 METS
- Fatigue
- Positive ECG
- Flat BP response: 158/92 to 160/84 mmHg
Exercise Echo

Rest  Exercise

LV  LV

4ch  2ch
Exercise Echo

Rest    Exercise

5ch

LV

SA

LV
What does the Exercise Echo show?

1. Normal
2. Inferior ischemia
3. Circumflex ischemia
4. LAD ischemia
5. Multivessel disease
Catheterization
Case: 67 yo male

- Referred for pre-op clearance for 7 cm Thoracic Aortic Aneurysm repair
- No cardiac hx (no CP, no dyspnea)
- HTN, hyperlipidemia, obesity, ex-smoker
- Sedentary lifestyle
  - exercise involves getting up from sofa to get TV remote controller
- Referred for dobutamine stress echo
Dobutamine Stress Echo
4 Ch View

Baseline

10 mcg/kg/min

LV

LV

LV

LV
Dobutamine Stress Echo
2 Ch View
Dobutamine Stress Echo
Short Axis View
What does the DSE show?

1. Normal
2. Inferior, Inferolateral Ischemia
3. Anterior ischemia
4. Apical ischemia
67 yo male pre-op for TAA repair

- Multivessel CAD, diffuse disease
  - Medical Rx
- TAA repair → 28-mm woven Hemashield graft
- Rocky post-op course; delayed extubation, afib, elevated troponin, worsening of inferolateral RWMA on echo
- d/c’d after 16 day hospitalization
- 1 yr later: dx’d with metastatic stomach CA → Hospice
70 year old male with dyspnea on exertion

• PMH
  – DM
  – HTN
  – Hyperlipidemia

• Referred for exercise echo
Exercise Echocardiogram

Rest

Immediately Post-exercise
What does the DSE show?

1. Normal
2. RCA ischemia
3. Circumflex ischemia
4. Multivessel ischemia
Exercise Echocardiogram

Rest

Immediately Post-exercise

LVEF: 60 to 50%
LV size: Dilatation
High grade stenosis of the left anterior descending and 1st diagonal coronary arteries
40 Year Old Executive Male

- “Heartburn” and eructation with exertion
- HTN
- Hyperlipidemia
- Smoker
- Referred for exercise echo
  - 6 minutes on Bruce Protocol
  - “heartburn” and positive EKG changes
Exercise Echocardiogram

LV
LV
LV
LV
Exercise Echocardiogram
What does the DSE show?

1. Normal
2. RCA ischemia
3. Circumflex ischemia
4. LAD ischemia
Cath: Post Stenting
64 yo male, engineer from Bagdad with chest pain

- Hx PTCA, DES to D1 and LAD
- ASA, Plavix, Cardiac rehab
- Returns 1 yr later; asymptomatic, but sedentary, “wants” ex echo
- ? Medication compliance
64 yo male, engineer, Hx stent to D1/LAD
64 yo male, engineer with chest pain
What does the DSE show?

1. Normal
2. RCA ischemia
3. Circumflex ischemia
4. LAD/D1 ischemia
5. Non-diagnostic study
What does the cath show?
Case

- 70 year old male
- PMH: Anteroapical MI, CABG after MI
- ICD placed: NSVT, EF 30%
- Asymptomatic for 5 years
- Now presents with CHF, NYHA class III
- Physical Exam:
  - Grade 3/6 late peaking SEM
  - Diminished carotid upstroke
  - Single component S2
2D Echo: Severe LV Dysfunction

EF: 20%
Aortic Valve

Parasternal Long-Axis  Parasternal Short-Axis
Aortic Valve Gradient

Pk Gr = 27 mmHg
Mn Gr = 14 mmHg
AVA = 0.8 cm²
Coronary Angiogram

- Occluded LAD
- 90% proximal Left Circumflex stenosis
- No significant disease in RCA
- **Viability Study:** Apical scar, all other areas viable

**Patent LIMA**

**Patent SVG to OM1**
Question

- What would you do next?
  A. Aortic valvuloplasty
  B. Refer to CT Surgery for AVR
  C. Dobutamine stress study
  D. Prayer
Dobutamine in Low Gradient-Low EF Aortic Stenosis

- “True” severe AS
  - ↑ SV, ↑ transvalvular gradient; No change in calculated AVA
    - remains in severe range
- “Pseudo” severe AS
  - ↑ SV and ↑ AVA; No significant Δ transvalvular gradient
### Pseudo Aortic Stenosis

**Baseline**
- Stroke volume: 30 → 60 cc
- Mean gradient: 13 → 19 mmHg
- Dimensionless Index = 0.19

**Dobutamine**
- Stroke volume: 30 → 60 cc
- Mean gradient: 13 → 19 mmHg
- Dimensionless Index = 0.31

**AVA**
- AVA: 0.8 cm² → 1.3 cm²

True Low Gradient/Low EF Aortic Stenosis

Baseline

Dobutamine

Stroke volume

40 → 60 cc

Mean gradient

25 → 40 mmHg

AVA = 0.7 cm²

Dimensionless Index = 0.22

Dimensionless Index = 0.23

Low-Output, Low-Gradient Aortic Stenosis in Patients With Depressed Left Ventricular Systolic Function

The Clinical Utility of the Dobutamine Challenge in the Catheterization Laboratory

Rick A. Nishimura, MD; J. Aaron Grantham, MD; Heidi M. Connolly, MD; Hartzell V. Schaff, MD; Stuart T. Higano, MD; David R. Holmes, Jr, MD

Background—Although aortic valve replacement can be performed at an acceptable risk level in selected patients with left ventricular systolic dysfunction and low-output, low-gradient aortic stenosis, not all patients presenting with these hemodynamics will benefit from the operation. Some patients may have only mild aortic stenosis, despite a small calculated valve area. We report on the clinical utility of diagnostic dobutamine stimulation during cardiac catheterization in these diagnostically challenging patients.

Methods and Results—Thirty-two patients with low-output, low-gradient aortic stenosis and an ejection fraction <40% had dobutamine infusion in the catheterization laboratory. On the basis of the results of the dobutamine test, 21 patients underwent aortic valve replacement. All patients with a final aortic valve area ≤1.2 cm² at peak dobutamine infusion and a mean gradient of >30 mm Hg were found to have severe calcific aortic stenosis at operation. In the 15 patients in whom contractile reserve was identified during dobutamine challenge (increase in stroke volume >20%), 1 patient died perioperatively (7% mortality) and 12 patients were alive in New York Heart Association class I or II status at follow-up.

Conclusions—In patients with left ventricular systolic dysfunction and aortic stenosis with a low output and a low mean gradient, dobutamine challenge may aid in selecting those who would benefit from an aortic valve operation. (Circulation. 2002;106:809-813.)
In pt with LV systolic dysfunction and AS with a low output and a low MG, **dobutamine** challenge may aid in selecting those who would benefit from an AV operation.

*Circulation* 2002; 106: 809-813

Nishimura: *Circulation*, 2002
Low Gradient Aortic Stenosis

Monin et al - Circulation 2003; 108:319-24

- 136 AS pt - AVA 0.7, MG 29 mmHg
- LV contractile reserve assessed by DSE
  - Present in 92 (Group I)
  - Absent in 44 (Group II)
Kaplan-Meier Survival Estimates by Group and Treatment

Operative Mortality 5%

Group I
Valve replacement

Operative Mortality 32%

Group II
Valve replacement

Group I
Medical treatment

Group II
Medical treatment

Pt survival (%)

Follow-up (mo)
### Case:

**Results of Dobutamine Stress Echo**

<table>
<thead>
<tr>
<th></th>
<th>V1 TVI (cm)</th>
<th>V2 TVI (cm)</th>
<th>AVA (cm²)</th>
<th>Peak/Mean AV Gradient (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline</strong></td>
<td>13</td>
<td>47</td>
<td>0.86</td>
<td>25/14</td>
</tr>
<tr>
<td>5 mcg/kg/min dobutamine</td>
<td>14</td>
<td>47</td>
<td>0.93</td>
<td>25/14</td>
</tr>
<tr>
<td>10 mcg/kg/min dobutamine</td>
<td>15</td>
<td>53</td>
<td>0.88</td>
<td>31/16</td>
</tr>
<tr>
<td>20 mcg/kg/min dobutamine</td>
<td>15</td>
<td>53</td>
<td>0.88</td>
<td>33/17</td>
</tr>
</tbody>
</table>

* No significant change in EF during study
Change in LVEF after AVR
Severe AS with low EF

Influence of Contractile Reserve in Low-gradient AS

• Absence of CR related to ↑ operative mortality, but it does not predict the absence of LVEF recovery in pt surviving AVR

• These data further support the concept that surgery should not be contraindicated on the basis of absence of CR alone

Take Home Points

• Dobutamine stress testing is helpful in low gradient-low EF AS
  • Importance of contractile reserve
  • “True AS” vs “Pseudo” AS

• Absence of contractile reserve substantially increases operative mortality with AVR in low EF-low gradient AS
  • But if patients survive, EF improves and outcome good
Thank You!
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