Dobutamine Stress testing
In Low Flow, Low EF, Low Gradient Aortic Stenosis
Case Studies

William A. Zoghbi MD, FASE, MACC
Professor and Chairman, Department of Cardiology
Elkins Family Distinguished Chair in Cardiac Health
Houston Methodist Hospital

Flow dependence of Velocity, Gradients, & Valve Motion/Orifice

\[ \Delta P \approx 4 (V^2 - V_j^2) \]
### Aortic Stenosis

**AHA & ACC Guidelines**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jet velocity</td>
<td>&lt; 3.0 m/s</td>
<td>3.0 – 4.0</td>
<td>&gt; 4.0 m/s</td>
</tr>
<tr>
<td>Mean gradient</td>
<td>&lt; 25 mmHg</td>
<td>25 – 40</td>
<td>&gt; 40 mmHg</td>
</tr>
<tr>
<td>Valve area</td>
<td>&gt; 1.5 cm²</td>
<td>1.0 – 1.5</td>
<td>&lt; 1.0 cm²</td>
</tr>
</tbody>
</table>

**In Normal or High flow Conditions (SV > 35 mL/m²)**

Nishimura R. et al. JACC 2014

---

### Low Flow, Low EF, “Severe AS”

**Is It?**

- LVOT TVI 16 cm
  - SV 45 ml
- Peak V 2.7 m/s
  - Mean Gr 30 mmHg
  - AVA 0.7 cm²
Dobutamine Stress ECHO Protocol
in Low Flow, Low EF, Severe AS

Starting dobutamine dose of 2.5 to 5 mcg/kg/min

Increase dose 2.5 to 5 mcg/kg/min every 3-5 minutes

Maximum dobutamine dose of 20 mcg/kg/min

Infusion stopped when:
1) Maximum dobutamine dose reached (20 mcg/kg/min)
2) Positive result obtained
3) Heart rate rises 10-20 bpm over baseline or exceeds 100 bpm
4) Symptoms, blood pressure fall, or significant arrhythmias


3 types of responses

<table>
<thead>
<tr>
<th>SV &amp; LVEF</th>
<th>Gradient</th>
<th>AVA</th>
<th>Implication</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑</td>
<td>↑</td>
<td>–</td>
<td>Severe AS</td>
</tr>
<tr>
<td>↑</td>
<td>–</td>
<td>↑</td>
<td>AS not severe</td>
</tr>
<tr>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Severe CM / ?Severe AS</td>
</tr>
</tbody>
</table>
Case 1

Clinical Presentation

- 87 yo male with CAD s/p CABG, aortic stenosis, systolic HF EF 30-35%, HTN, DM, CKD III, TIA, paroxysmal AF presents with dyspnea and decompensated HF, NYHA III

- Exam: 124/59, HR 63, BMI 23 kg/m2
  - CV: RRR, +S3, II/VI SEM LSB

Echocardiogram

Parasternal  Short Axis – Aortic Valve

LVOT 1.9 cm

Vitals: BP 112/56 mmHg, HR 71 bpm
Dobutamine Stress ECHO

Parasternal  Apical 4 – Chamber

Dobutamine Stress ECHO

2 – Chamber  Short Axis

Baseline LVEF 30-34%
Peak LVEF 35-39%
Doppler

Baseline

Peak

Consistent with low-flow low-gradient severe aortic stenosis

Case 2

Clinical Presentation

86 yo M with CAD s/p CABG, aortic stenosis, systolic HF EF 25% s/p CRT-D, COPD presents with dyspnea, NYHA IV

- Exam: 108/51, HR 79, 3L O2 93%, BMI 21 kg/m2
  - CV: RRR, II/VI systolic murmur RUSB, +JVD (12 cm), decreased breath sounds, 1+ edema
Echocardiogram

Parasternal

Short Axis – Aortic Valve

LVOT 2.2 cm

Vitals: BP 100/53 mmHg, HR 85 bpm

Dobutamine Stress ECHO

Parasternal

Apical 4 – Chamber

Baseline 5 mcg

Baseline 5 mcg

10 mcg Peak

10 mcg Peak
Dobutamine Stress ECHO

2 – Chamber

Baseline

Baseline LVEF 25-29%
Peak LVEF 30-34%

Short Axis

Baseline

Baseline LVEF 25-29%
Peak LVEF 30-34%

Doppler

Baseline

Consistent with pseudo-severe aortic stenosis
Mild aortic stenosis

Peak Dobutamine
Case 3

Clinical Presentation
78 yo M with CAD, aortic stenosis, systolic HF EF 40%, COPD, CKD presents with dyspnea, NYHA III
• Exam: 127/51, HR 70, BMI 21 kg/m2
  – CV: RRR, II/VI systolic murmur RUSB, +wheezing, 2+ edema, +JVD

Echocardiogram

Parasternal

Short Axis – Aortic Valve

LVOT 2 cm

Vitals: BP 166/71 mmHg, HR 59 bpm
Dobutamine Stress ECHO

Parasternal

Baseline 5 mcg
9/5/17 5:25:59 0:09:49

10 mcg Peak
06/18 9:12:24

Baseline 5 mcg
10/21 10:21 0:09:13

Peak
10/21 10:22

Apical 4 – Chamber

Baseline 5 mcg
9/5/17 5:25:59 0:09:49

10 mcg Peak
06/18 9:12:24

Baseline 5 mcg
10/21 10:21 0:09:13

Peak
10/21 10:22

Dobutamine Stress ECHO

2 – Chamber

Baseline 5 mcg
9/5/17 5:25:59 0:09:49

10 mcg Peak
06/18 9:12:24

Baseline 5 mcg
10/21 10:21 0:09:13

Peak
10/21 10:22

Baseline LVEF 40-44%
Peak LVEF 50-54%

Short Axis
Doppler

Baseline

Peak Dobutamine

Consistent with moderate aortic stenosis

75M with AS & NYHA Class III Heart Failure
Is DSE Needed?

SV = 40 ml
Mn Gr = 46 mmHg
AVA = 0.40 cm²

VTI = 12.8 cm

VTI = 100 cm
4 m/s
72 yr old man with NYHA class III heart failure
- Systolic ejection murmur
- The aortic valve was calcified
- LV dilated with an EF of 20%

**Case**

72M With Class III Heart Failure

- Peak V = 2.2m/s
- Mean Grad = 11mmHg
- SV = 32 ml
- AVA = 32/47 = 0.69cm²
- D = 2.0
- EF = 20%
- VTI = 10.3
- VTI = 47
72M With Class III Heart Failure

Dobutamine infusion at 20mcg/kg/min

Pulsed Doppler- LVO

Baseline

Dobutamine

CW Aortic Valve

TVI = 10.8

Peak V = 2.8 m/s
Mean Grad = 14 mmHg
SV = 35 ml
AVA = 35/52 = 0.69cm²

Peak V = 2.2 m/s
Mean Grad = 11 mmHg
SV = 32 ml
AVA = 32/47 = 0.69cm²
Dobutamine Echo in AS with Depressed LVEF & Low Gradient

3 types of responses

<table>
<thead>
<tr>
<th>SV &amp; LVEF</th>
<th>Gradient</th>
<th>AVA</th>
<th>Implication</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑</td>
<td>↑</td>
<td>–</td>
<td>Severe AS</td>
</tr>
<tr>
<td>↑</td>
<td>–</td>
<td>↑</td>
<td>AS not severe</td>
</tr>
<tr>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Severe CM / ?Severe AS</td>
</tr>
</tbody>
</table>

Low Flow, Low EF, Low Gradient Severe AS

Low Flow Low Gradient Severe AS
MG < 40 mmHg, AVA < 1 cm², LVEF < 50%, SV < 35ml/m²

Low Dose Dobutamine Stress Echo

- MGr ≥ 40 mmHg
  - True Severe AS
- MGr < 40 mmHg & AVA ≤ 1 cm²
  - Assess Δ in flow/Gr/AVA
  - Is SV still reduced?
  - How close to “cutoff” of Severe AS?
  - Contour of AS Jet
  - Ca Score of AV (1200 W, 2000 M)
  - Pseudo Severe AS
- MGr < 40 mmHg & AVA > 1 cm²
  - Pseudo Severe AS