Not only ischemia!

- Cardiomyopathy
- Prosthetic Valve
- Diastolic Dysfunction
- Pulmonary hypertension
- Valvular Heart Disease
Not only ischemia!

- Valvular Heart Disease
- Mitral regurgitation
- Mitral stenosis
- Aortic stenosis
- Aortic regurgitation

Case 1

- 68 y.o. male
- With a history of hypertension and mitral regurgitation.
- He presented for a second opinion regarding surgical management of mitral regurgitation.
- He had no symptom during any activities.
Case 1

Moderate to severe MR

TEE
Case 1

Question 1

- 68 y.o. asymptomatic male with moderate to severe MR

Your recommendation is...

1. Surgical MV repair
2. Percutaneous MV replacement
3. Anticoagulation therapy
4. Stress echocardiography
Question 1

- 68 y.o. asymptomatic male with moderate to severe MR

Your recommendation is...

1. Surgical MV repair
2. Percutaneous MV replacement
3. Anticoagulation therapy
4. Stress echocardiography
25W

50W (peak)
**Doppler**

Pre Peak

SPAP: 37 mmHg

SPAP: 60 mmHg

**MR severity**

Pre Peak

PISA radius: 6 mm

PISA radius: 10 mm
Summary

• Exercise induced pulmonary hypertension:
  SPAP: 60 mmHg
• Significant increase in simple PISA radius
  from 6 mm to 10 mm (Severe MR)
• Good contractile reserve: EF 62→74%
• Symptom was occurred during exercise.

  Recommendation is...

Decision

Surgery (repair if low risk)
2017 updated ACC/AHA Guideline


Stress Echocardiography and Mitral Regurgitation
Exercise ESVI and Post operative EF

74 patients with severe MR who underwent exercise echocardiography and mitral valve surgery.

Prognostic Importance of Exercise-Induced Changes in Mitral regurgitation

98 consecutive patients with MR who underwent exercise echocardiography.

![Graph showing event-free survival over time with log-rank test P < 0.001.]

Predictors of outcomes in Patients with MR undergoing exercise echocardiography

196 consecutive patients with moderate to severe MR who underwent exercise echocardiography.

![Graph showing event-free survival over time with PH (-) and RV dysfunction (-) and PH (+) and RV dysfunction (+).]


Mitral regurgitation

Key Points

Exercise SE provides information about disease severity and individual outcome in MR. MR severity, SPAP, and left and right ventricular contractile reserve should be evaluated according to the clinical context. An increase by ≥1 grade in MR (from moderate-to-severe MR), an SPAP ≥ 60 mmHg, and a lack of contractile reserve (<5% increase in EF or <2% increment in global longitudinal strain) are markers of poor prognosis.

Cut off

MR grade: an increase by ≥1 grade
Systolic pulmonary artery pressure: 60 mmHg
Contractile reserve: 5% increase in EF

Case 2

- 72 y.o. female
- With a history of hypertension and mitral stenosis.
- She presented for a second opinion regarding management of mitral stenosis.
- She noted a slight fatigue.
Case 2

Wall motion: normal

Mitral stenosis

MVA: 1.7 cm²
Mitral stenosis

Mean PG: 5.7 mmHg
SPAP: 33 mmHg

Question 2

- 72 y.o. mild symptomatic female with moderate MS

Your recommendation is...

1. Cardiac CT
2. Coronary angiography
3. Cardiac MRI
4. Stress Echocardiography
Question 2

- 72 y.o. mild symptomatic female with moderate MS

Your recommendation is...

1. Cardiac CT
2. Coronary angiography
3. Cardiac MRI
4. Stress Echocardiography

Case 2
Case 2

Mean PG: 5.7 mmHg  Mean PG: 14 mmHg

SPAP: 33 mmHg  SPSP: 56 mmHg

Summary

• Exercise induced pulmonary hypertension: SPAP: 56 mmHg
• Significant increase in MV gradient from baseline of 6 to 14 mmHg
• No wall motion abnormality
• Symptom was not increased

Your recommendation is...
Decision

- Carefully periodic monitoring

2017 updated ACC/AHA Guideline
Mitral stenosis

Key Points

SE is indicated to reveal symptoms and assess haemodynamic consequences of MS—based on the gradient and SPAP increase during stress—in patients with discordance between symptoms and stenosis severity. Exercise SE is preferred for SPAP assessment. MS should be considered severe if exertion results in a mean gradient >15 mmHg and SPAP >60 mmHg.

Cut off
Mean pressure gradient: 15 mmHg
Systolic pulmonary artery pressure: 60 mmHg

Case 3

• 82 y.o. male
• With a history of aortic stenosis and coronary artery disease (post PCI to LAD).
• He noted a fatigue.
Case 3

LVEF: 25%

Case 3

RCC
NCC
LCC
Case 3

Ao-V: 3.0 m/sec
Mean PG: 24 mmHg
AVA: 0.8 cm²
Stroke volume index: 34 ml/m²

Question 3

- 82 y.o. mild symptomatic male with low gradient and low flow AS

Your recommendation is...

1. AVR
2. TAVI
3. Exercise echocardiography
4. Dobutamine echocardiography
Question 3

- 82 y.o. mild symptomatic male with low gradient and low flow AS

Your recommendation is...

1. AVR
2. TAVI
3. Exercise echocardiography
4. Dobutamine echocardiography

Chart
Dobutamine 20y

EF: 30%
Mean PG: 41 mmHg
AVA: 0.82 cm²
Stroke volume index: 44 ml/m²
ΔSV: 23%

Case 3

Pre

Peak
### Chart

- **Classical Low-Flow, Low-Gradient AS**
  - LVEF < 50%
  - AVA < 1.0 cm²
  - MPG ≤ 40 mmHg

- **Low-Dose Dobutamine-Stress Echo**
  - ΔSV ≥ 20%
  - ΔSV < 20%

- **LV Flow Reserve**
  - MPG ≤ 40 mmHg
  - LVEF > 50%
  - AVA ≥ 1.0 cm²

- **True-Severe AS**
  - Pseudo-Severe AS
  - True-Severe AS
  - Indeterminate AS

### Summary

- 82 y.o. mild symptomatic male with low flow low gradient AS

- **Preserved contractile reserve:**
  - SVi 34→42 ml/m² (ΔSV > 20%)

- **True severe AS**

Your recommendation is...
Decision

Intervention
(surgical AVR or TAVI)

Aortic stenosis (low gradient)

Key Points
In classical low-flow, low-gradient AS with reduced LVEF, a low-dose dobutamine SE is recommended to: (i) assess LV flow reserve, which is helpful for surgical risk stratification and (ii) differentiate true-from pseudo-severe AS, which is key for guiding the decision to perform AVR. In paradoxical low-flow, low-gradient AS with preserved LVEF, exercise or dobutamine SE may also be used to differentiate true- from pseudo-severe AS.

LV flow reserve
True AS or pseud-severe AS

Problem of AVA in low gradient AS

Projected AVA

Projected AVA


<table>
<thead>
<tr>
<th>All</th>
<th>Baseline</th>
<th>During LPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR, beats/min</td>
<td>64 ± 9</td>
<td>66 ± 8</td>
</tr>
<tr>
<td>Systolic BP, mm Hg</td>
<td>133 ± 20</td>
<td>132 ± 22</td>
</tr>
<tr>
<td>Stroke volume, ml</td>
<td>52 ± 18</td>
<td>57 ± 25</td>
</tr>
</tbody>
</table>

Projected AVA

DOB-AVA$_{proj}$: 1.11 cm$^2$

Projected AVA

**LPP-AVA\textsubscript{proj}: 1.08 cm²**

- Baseline
- LPP

- Peak velocity
- LVOT flow
- LVOT diameter

Event free survival (%)

**Normal flow - low gradient**

- Number at risk
  - NF-LG: 47, 43, 33, 21, 7
  - LF-LG: 32, 28, 20, 14, 9

- Months: 5, 10, 15, 20, 25

- Event free survival (%)
  - Normal flow - low gradient
  - Low flow - low gradient

- p = 0.18

**Event free survival (%)**

- LPP-AVA\textsubscript{proj} ≥ 0.72
  - Number at risk
    - AVA\textsubscript{proj} ≥ 0.72: 35, 28, 20, 11
    - AVA\textsubscript{proj} < 0.72: 36, 25, 15, 5

- Events: 35, 28, 20, 11

- Months: 5, 10, 15, 20, 25

- p < 0.001

Management of Low gradient AS

LOW GRADIENT AS
AVA<0.6cm², AVA<0.6 cm²/m², MG<40mmHg

STEP 1: CONFIRM ACCURACY OF MEASUREMENTS

STEP 2: IDENTIFY TYPE OF LOW GRADIENT AS

«CLASSICAL» LOW-FLOW
LOW-GRADIENT

«PARADOXICAL» LOW-FLOW
LOW-GRADIENT
+ Symptoms

NORMAL-FLOW
LOW-GRADIENT
+ Symptoms

STEP 3: CONFIRM PRESENCE OF SEVERE AS

Assess valve morphology by TTE/TEE:
Severe valve thickening / calcification

DOBUTAMINE STRESS ECHO
MG≥50 mmHg (AVA≥0.6cm²)
Projected AVA ≥0.6cm²
Indexed Projected AVA ≥0.5cm²

PRELOAD STRESS ECHO
Projected AVA ≥3.6cm²
Indexed Projected AVA ≥0.55cm²

MSCT: Modified Agatston method
AVC ≥2000 in men, ≥100 in women

SEVERE AS:
AVR Indicated (Class I or IIa)
Aortic regurgitation

Very few data in this field.

Key Points

In AR, SE is used to assess symptoms, exercise tolerance, and the LV response to stress but not the valve disease severity. A lack of contractile reserve is associated with post-operative LV dysfunction.

Contractile reserve (>5% change in LVEF)

Take Home Message

Stress echocardiography is...

• Documenting functional capacity
• Determining severity of valve disease
• Timing of intervention
• Determining Prognosis
Thank you for your attention!!