Mitral Valve Stenosis: What do I need to know?
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## Severity of MS

### Table 13. Stages of MS

<table>
<thead>
<tr>
<th>Stage</th>
<th>Definition</th>
<th>Valve Anatomy</th>
<th>Valve Hemodynamics</th>
<th>Hemodynamic Consequences</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>At risk of MS</td>
<td>• Mild valve doming during diastole</td>
<td>• Normal transmitral flow velocity</td>
<td>• None</td>
<td>• None</td>
</tr>
</tbody>
</table>
| B                      | Progressive MS                                   | • Rheumatic valve changes with commissural fusion and diastolic doming of the mitral valve leaflets  
|                        |                                                 | • Planimetered MVA > 1.5 cm²                                                 | • Increased transmitral flow velocities        | • Mild-to-moderate LA enlargement   | • None                            |
|                        |                                                 | • Rheumatic valve changes with commissural fusion and diastolic doming of the mitral valve leaflets  
|                        |                                                 | • Planimetered MVA ≤ 1.5 cm²                                                 | • MVA ≤ 1.5 cm²                                | • Normal pulmonary pressure at rest  |                                   |
| C                      | Asymptomatic severe MS                          | • Rheumatic valve changes with commissural fusion and diastolic doming of the mitral valve leaflets  
|                        |                                                 | • Planimetered MVA ≤ 1.5 cm²                                                 | • (MVA ≤ 1.0 cm² with very severe MS)          | • Severe LA enlargement            | • None                            |
|                        |                                                 | • Rheumatic valve changes with commissural fusion and diastolic doming of the mitral valve leaflets  
|                        |                                                 | • Planimetered MVA ≤ 1.5 cm²                                                 | • MVA ≤ 1.5 cm²                                | • Elevated PASP > 30 mm Hg          |                                   |
| D                      | Symptomatic severe MS                           | • Rheumatic valve changes with commissural fusion and diastolic doming of the mitral valve leaflets  
|                        |                                                 | • Planimetered MVA ≤ 1.5 cm²                                                 | • (MVA ≤ 1.5 cm² with very severe MS)          | • Severe LA enlargement            | • Decreased exercise tolerance    |
|                        |                                                 | • Rheumatic valve changes with commissural fusion and diastolic doming of the mitral valve leaflets  
|                        |                                                 | • Planimetered MVA ≤ 1.5 cm²                                                 | • MVA ≤ 1.5 cm²                                | • Elevated PASP > 30 mm Hg          | • Exertional dyspnea               |

The transmitral mean pressure gradient should be obtained to further determine the hemodynamic effect of the MS and is usually >5 mm Hg to 10 mm Hg in severe MS; however, due to the variability of the mean pressure gradient with heart rate and forward flow, it has not been included in the criteria for severity.

LA indicates left atrial; LV, left ventricular; MS, mitral stenosis; MVA, mitral valve area; and PASP, pulmonary artery systolic pressure.

Nishimura RA. JACC 2014:63(22): 2438
## Severity of MS

<table>
<thead>
<tr>
<th></th>
<th>MVA cm²</th>
<th>PASP rest mmHg</th>
<th>Mean Grad mmHg*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mild</strong></td>
<td>&gt; 1.5</td>
<td>&lt;30</td>
<td>&lt; 5</td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>1.0-1.5</td>
<td>30-50</td>
<td>5-10</td>
</tr>
<tr>
<td><strong>Severe</strong></td>
<td>&lt; 1.0</td>
<td>&gt;50</td>
<td>&gt; 10</td>
</tr>
</tbody>
</table>

(very severe)  

*Sinus rhythm and HR 60-80*
Case presentation

• 26 yo woman presents at 32 weeks gestation with progressive fatigue, SOB and new PND/orthopnea.
• PMHx: heart murmur as a child
• SHx/FHx: negative
• PE: 100/62, 108, 18, afebrile, O2 sat=84%
  – 3/6 HSM apex, PMI laterally displaced, -S3
  – JVP-6cm, carotids 2+
  – Lungs: diffuse rales, Ext: no CCE
• CXR: pulmonary edema vs patchy airspace disease
LAVi = 45ml/M²
PASP = 48mmHg

Mean MVG = 17mmHg
MVA plan = 1.9 cm²
MVA PHT = 1.9 cm²
What is the real MVA?

1. Mild mitral stenosis
2. Severe mitral stenosis
3. Mixed moderate regurgitation and stenosis
4. Normal variant of pregnancy
Repeat TTE after betablockers and diuretics

Mean $\text{MVG} = 10\, \text{mmHg}$

$\text{MVA plan} = 0.8\, \text{cm}^2$

$\text{MVA PHT} = 1.04$
What happened?
Physiology of pregnancy and MVA

Figure 1. Relationship of MVA to mitral valve flow per diastolic second at various MVAs. Adapted from reference 12.


Rahimtoola. Circ. 2005
PHT is less flow dependent than gradients

Fig. 5-28. Changes in pressure half-time and mean diastolic pressure drop with exercise in 37 patients with mitral stenosis or combined stenosis and regurgitation. A moderate decrease in pressure half-time occurs with exercise (from 190 to 160 ms; P < 0.001), whereas the simultaneous increase in pressure drop is more pronounced (from 7.6 to 16 mm Hg).

Hatle L. Doppler 1983
MVA: EAE/ASE recommendations

• INTEGRATED or COMBINED assessment
  – Mean gradients
  – Pressure half time MVA
  – Planimetry MVA

• Secondary assessment
  – Continuity equation
  – Pisa

• Supporting data
  – PASP and LA size
  – Anatomy and structure
Mitral Valve Gradients

• Easy to obtain
  – Tips: trace outer edge
  – grey scale
• Mean not peak gradients
  – Peak, driving pressure
  – Coorelate with invasive
    • Nishimura JACC 1994.
• Dependent upon flow:
  – Heart rate
  – Cardiac output
  – Regurgitation
Simultaneous LA and LV pressure tracings

Short RR interval
Higher gradient

Longer RR interval
Lower gradient

Kern, Hemodynamic Rounds. 1993 Uptodate
Pressure half time

- Easy and reproducible
  - Tips: linear slope
  - Longer RR interval

- MVA=220/PHT
  - Derived from Gorlin eq
  - Correlates with anatomic MVA
MVA in MS: pressure half time

- Dependent on other factors
  - Net LV-LA compliance
  
  \[
  MVA = 11.6 * C_{\text{net}} * \sqrt{MGP}
  \]

  - chronic increase in pressure, decrease in compliance
  - >2-3+AR
    - Shortens PHT, overest MVA
  - ASD
    - Shortens PHT, overest MVA
  - Diastolic dysfunction
    - *elderly

Thomas JD Weyman AE. JACC 1987
MVA in MS: planimetry

• Anatomic MVA
  – Gold standard

• Independent of conditions
  – **Tips**: scan plax to find smallest orifice
  – Zoom, mid diastole
  – Biplane & 3D
    • Fusion of commissures
      • Zamorano JACC 2004
      • Sebag AJC 2005

• Limitations:
  – Calcified valves
  – Windows & experience

Salcedo JASE 2009
MVA: planimetry
MVA in MS: continuity equation
level 2 recommendation

• MVA=$\prod r^2 \left(\frac{VTI_{ao}}{VTI_{mv}}\right)$

• Conservation of mass
  – SV across LVOT

• Caveats:
  – Cannot use in AI/MR
  – Effective MVA, 15% smaller than anatomic
  – Coefficient of discharge
MVA in MS: PISA

PISA Radius 1.3 cm

19.6 cm/s

RA LA RV LV

Angle $\alpha$

First alias

Mitral leaflets

$$MVA = 2\pi r^2 \times \frac{\alpha}{180 \text{ degrees}} \times \frac{v_a}{v_p}$$
MVA in MS: Supportive Data

- Pulmonary pressures
  - <30 mild
  - 30-50 mod
  - >50 severe
- LA size
- Anatomy
  - 3D commissural fusion
  - M-mode
  - Block Weyman score
- AV and TV involvement
MVA in specific situations

- ASD and AI
  - MVA PHT is overestimated, graded fashion
- After PBMV
  - PHT unreliable
- Congenital/parachute valve
- After MV repair
- Mixed valvular disease
MVA after MV repair:
PHT intraop TEE correlated with postop TTE

25 MVR patients. Maslow JCTVA 2010
MVA after MV repair: 3D and PHT

Hoole EJE 2008
MVA in combined MS and MR

- Mean mitral diastolic gradient 10mmHg
- NOT MS
- High forward stroke volume due to 4+ MR
- Moderate MR and MS
  - Severe symptoms
MVA in Mitral Stenosis: This is what I need to know!

- INTEGRATED assessment
  - Planimetry 2D & 3D
  - PHT
  - Mean gradients
- Secondary assessment
  - CE or PISA
- Supporting data
  - PASP and LA size
- Special situations
  - PMBV, MV repair
Thank you for your attention!
Case 2:
What is wrong with this valve?
St Jude MVR with intermittent obstruction
Congenital MS “parachute” MV
CO, HR and TPR in Pregnancy

30-50% ↑ in cardiac output
10-20% ↑ in heart rate

30-50% ↓ in peripheral resistance

Poppas A. Circ. 1997; 95: 2407