MITRAL VALVE STENOSIS: QUANTITATIVE METHODS

Robert A. Levine, MD
Judy Hung, MD
MITRAL STENOSIS

- Diagnosis
- Quantification
- Management
Diastolic mitral leaflet doming concave toward the LA is seen in:

1. Only rheumatic MS
2. Rheumatic and calcific MS
3. Rheumatic and congenital MS
4. Rheumatic MS, and AI with flow impinging on the MV
Rheumatic MS
MITRAL STENOSIS

• Diagnosis
• Quantification
• Management
Pressure Gradient
Assessment of Mitral Stenosis

- Mitral valve area measurement
  - $> 1.5\text{ cm}^2$ - Mild
  - 1.1 to 1.5 cm$^2$ - Moderate
  - $< \text{ or } = 1.0\text{ cm}^2$ - Severe
Quantification of Mitral Valve Area

- Direct Planimetry
- Pressure Half-Time
- Continuity / PISA
Martin and Stamm
Real-Time 3D: Biplane Feature

Sebag AJC 2005
Quantification of Mitral Valve Area

- Direct Planimetry
- Pressure Half-Time
- Continuity / PISA
P1/2: Nonlinear Slope
A patient has mitral stenosis with an E-wave deceleration time of 1000 milliseconds. What is the mitral valve area?

1. 0.22 cm\(^2\)
2. 0.75 cm\(^2\)
3. Depends on cardiac output
4. 1.5 cm\(^2\)
PHT = 29% of total deceleration time (DT)

MVA = 220 / Pressure half time

MVA = 750 / Deceleration time
MITRAL PRESSURE HALF-TIME

Comparison of Formulations

- **Empirical formulation:**
  \[ T_{1/2} = \frac{220}{MVA} \]

- **Theoretical derivation:**
  \[ T_{1/2} = \frac{11.6 \ C_n \sqrt{P}}{c_c \ MVA} \]

- $T_{1/2} = \text{mitral half-time (ms)}$
- $MVA = \text{anatomic valve area (cm}^2\text{)}$
- $C_n = \text{mean net LA and LV compliance (cm}^3/\text{mmHg)}$
- $P = \text{peak LA-LV pressure gradient (mmHg)}$
- $c_c = \text{coefficient of contraction (about 0.78)}$

James Thomas
Transmitral E-wave deceleration time varies most consistently with which physiological parameters?

1. Directly with mitral valve area, directly with ventricular stiffness
2. Directly with mitral valve area, inversely with ventricular stiffness
3. Inversely with mitral valve area, directly with ventricular stiffness
4. Inversely with mitral valve area, inversely with ventricular stiffness
Rheumatic Mitral Valve Stenosis: Case
Rheumatic Mitral Valve Stenosis

MVA by Planimetry = 1.2 cm²
Rheumatic Mitral Valve Stenosis

MVA by $P^{1/2}t = 1.6 \text{ cm}^2$
45-year-old woman with mitral stenosis, dyspnea and fatigue
MV AREA = 1.8
Dilated, hypokinetic LV
MVA = 750 / Deceleration time
= 750 / 660 = 1.14 cm²
Take Home Message

• Rely on planimetry, esp. biplane

• Pressure half time area can be falsely elevated because of noncompliant (stiff) LA or LV, AI (at least moderate), or ASD.
Quantification of Mitral Valve Area

- Direct Planimetry
- Pressure Half-Time
- Continuity / PISA
AREA = Flow rate / velocity
PISA Method

MVA = Peak Flow/Peak MS velocity

Leonardo Rodriguez
\[ v = 38 \text{ cm/sec} \]

\[ r = 1.06 \text{ cm} \]

\[ \alpha = 110^\circ \]
Peak flow rate = \( 2\pi r^2 v \left( \frac{\alpha}{180} \right) \)

\[
r = 1.06 \text{ cm}
\]

\[
v = 38 \text{ cm/sec}
\]

\[
\alpha = 110^\circ
\]

Peak flow rate = 164 cm\(^3\)/sec

MVA = Peak flow rate / Peak velocity

\[
= \frac{(164 \text{ cm}^3/\text{sec})}{(200 \text{ cm/sec})}
\]

\[
= 0.82 \text{ cm}^2
\]
Can we apply the continuity equation as we do across the aortic valve?
CONTINUITY EQUATION

\[ \text{MV Area} = \frac{\text{Forward flow}}{\text{Velocity}} \]

\[ = \frac{\text{Systolic flow (AV, PV)}}{\text{Mitral CW time-velocity integral}} \]

- No important MR
- No important AR (PR)
MITRAL STENOSIS

• Diagnosis
• Quantification
• Management
Commissural splitting

0.7 cm²

2.4 cm²
METHODS

Echocardiography

BEFORE PMV:
Echocardiographic Examination

- Standard Views
- Echocardiographic Score of Valve Morphology:

  Mobility       0 - 4
  Thickening     0 - 4
  Calcification  0 - 4
  Sub-Valvular   0 - 4

  Total          0 - 16
Echo score < 8 associated with greater success of percutaneous mitral valvuloplasty
Mitral Stenosis - Low Echo Score - 4

Mobility = 1
Thickening = 1
Calcification = 1
Subvalvular = 1
Rheumatic Mitral Valve Stenosis
High Echo Score-11

Mobility = 2
Thickening = 2
Calcification = 3
Subvalvular = 4
DON’T DO IT!

- Calcific MS
- Moderate MR
- High score
- LA thrombus
- Likely to tear
- Severe TR
Event Free Survival Rate After PMV Among 318 Patients With Mild, Moderate and Severe TR.

Alik Sagie, JACC
MITRAL STENOSIS

• Diagnosis
• Quantification
• Management