Mitral Stenosis

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Etiology

- Mitral stenosis almost always is secondary to rheumatic heart disease, which leads to scarring and fibrosis of the free edges of the mitral valve leaflets.
- Fusion of the valvular commissures, progressive scarring of the leaflets, and contraction of the chordae tendineae lead to the development of a funnel-shaped mitral apparatus that can become secondarily calcified.
- Women are affected twice as frequently as men.

Symptoms

- Patients are normally asymptomatic for 20 years or more after an acute episode of rheumatic fever.
- As stenosis develops, symptoms appear, associated at first with exercise or high cardiac output states.
- Twenty percent of patients in whom the diagnosis of symptomatic mitral stenosis is made die within 1 year, and 50% die within 10 years after diagnosis, without surgical intervention.

Symptoms

- The natural history is a slow progressive downhill course with repeated episodes of:
  - Pulmonary edema
  - Dyspnea
  - Paroxysmal nocturnal dyspnea
  - Fatigue
  - Chest pains
  - Palpitations
  - Hemoptysis
  - Hoarseness due to compression of the left recurrent laryngeal nerve by a distended left atrium and enlarged pulmonary artery.

Symptoms

- Symptoms often become apparent with the onset of atrial fibrillation, and patients in atrial fibrillation are at increased risk for formation of left atrial thrombi and subsequent cerebral or systemic emboli.

Stage 1

- Mild mitral stenosis—asymptomatic with physiologic compensation.
- The normal mitral valve area is 4 to 6 cm^2. The patient can remain essentially symptom-free during the 20- to 30-year period of slow progression of stenosis until a valve area of 1.5 to 2.5 cm^2.
- At this point, moderate exercise may induce dyspnea.
- Further progression of mitral stenosis leads to increases in left atrial pressure and volume that are reflected back into the pulmonary circuit.

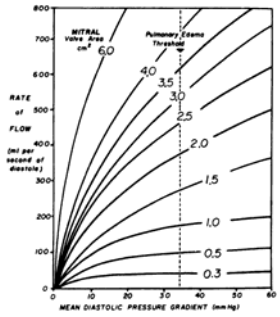
Stage 2

- Moderate mitral stenosis—symptomatic impairment.
- Valve area is between 1.0 - 1.5 cm^2, increasing symptomatology appears with only mild-to-moderate exertion.
- Severe congestive failure can be induced either by the onset of atrial fibrillation or by a variety of disease processes leading to high cardiac output states, such as thyrotoxicosis, pregnancy, anemia, or fever.
- In these conditions, the left atrial and pulmonary artery pressures suddenly rise as a result of the increased cardiac demand.

Stage 3

- Critical mitral stenosis—terminal failure.
- With a valve area less than 1.0 cm^2, a patient is considered to have critical mitral stenosis, and symptoms are present even at rest.
- Not only are left atrial pressures on the border of producing congestive failure, but cardiac output also may be reduced. Chronic pulmonary hypertension eventually leads to RV dilation.

Understanding the Physiology of the Flow Through the MV



Example

- CO: 5000 ml/min
- HR: 60/ min
- Diastolic flow time: 0.4 sec/beat which is 24 sec/min

Flow rate: 5000 ml/min/ 24 sec = 208 ml/sec

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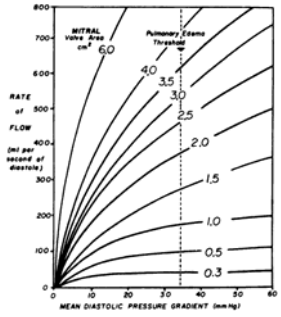

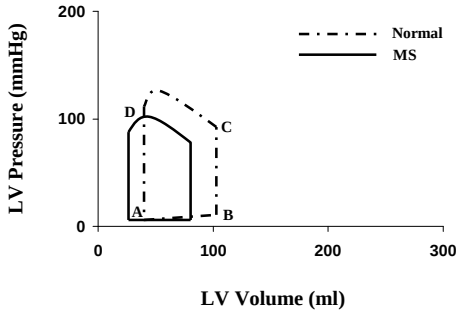

Mitral valve

- Mitral annulus size: 3-3.5 cm
- Mitral VTI: 10-13 cm
- Area: 4-6 cm^2
- Mean pressure gradient: < 2 mmHg

Mean pressure gradients (mmHg) in MS

- 2-5 mild MS
- 5-12 moderate MS
- > 12 severe MS

Mitral valve area (MVA) in MS

- >1.5 cm^2 mild MS
- 1-1.5 cm^2 moderate MS
- < 1 cm^2 severe MS

Clinical Symptoms and MVA

- Symptoms at moderate to strenous exercise 1.5-2 cm^2
- Symptoms at moderate exercise 1-1.5 cm^2
- Symptoms at rest or mild exercise <1 cm^2

Pressure half time (PHT) in ms

- 100-150 mild MS
- 150-220 moderate MS
- >220 severe MS

What is PHT?

- The time between P_{Max} and $P_{Max}/2$ on a Doppler velocity curve
- $P_{Max} = 4 \times V_{Max}^2$
- $P_{Max}/2 = 4 \times (V_{Max}/\sqrt{2})^2 = 4 \times V_{Max}^2/2$
- PHT is the time between V_{Max} and $V_{Max}/\sqrt{2}$

Rheumatic Mitral Valve

- Four features of mitral valve anatomy have been identified that correlate with the success of balloon valvotomy.
- These include valve pliability, thickening, calcification, and subvalvular involvement.
- Each of these can be quantified on a score of 0 to 4 and a total score tabulated.

Echo Score Index for Rheumatic Mitral Stenosis

Grades	Mobility	Leaflet Thickening	Subvalvular Thickening	Calcification
1	Highly mobile valve, only leaflet tips are restricted	Normal thickness (4–5 mm)	Minimal thickening just below leaflets	Single area of increased echo brightness
2	Leaflet mid and base portions have normal mobility	Mid leaflets have normal marked thickening of margins (5–8 mm)	Thickening of chordal structured extending up to one-third of chordal length	Scattered areas of brightness confined to margins
3	Valve continues to move forward in diastole	Entire leaflet is thickened (5–8 mm)	Thickening of chordal structures to the distal third	Brightness to mid portions of leaflets and leaflet margins
4	No or minimal movement forward	All leaflet tissue has marked thickening (>8–10 mm)	Extensive thickening and shortening of all chordal structures down to the papillary muscles	Extensive brightness through much of leaflet tissue

Wilkins GT, et al. Br Heart J 1988;60:299

Rheumatic Mitral Valve

- Scores above 8 represent valves less likely to be successfully treated with a percutaneous approach.
- More recent studies have suggested a disproportionate impact of calcification and subvalvular involvement on the likelihood of successful balloon valvotomy.