MITRAL STENOSIS

Joanne Cusack
BSE Breakdown

- Recognition of rheumatic mitral stenosis
- Qualitative description of valve and sub-valve calcification and fibrosis
- Measurement of orifice area by planimetry
- Factors favouring successful balloon valvuloplasty
- Doppler assessment of mean and end-diastolic gradient
- Doppler assessment of area by 'pressure half-time': technique and limitations
- Role of exercise echocardiography in assessing the change in transmitral gradient and pulmonary systolic pressures with exercise, as decision aid in the timing of surgery/balloon valvuloplasty
Use of Echo

- Allows confirmation of diagnosis
- Assessment of severity
- Analysis of valve anatomy
Parasternal long axis
Parasternal short axis
Apical four chamber
Apical three chamber
Apical two chamber
Mitral Stenosis

- Narrowing of the mitral valve
- Restricts the flow of blood through the valve
- Back pressure which builds up behind the narrowed valve can cause various problems and symptoms
- The more severe the narrowing, the more serious the problems
Causes

- Rheumatic
  Inflammation of the valve develops (through exposure to streptococcus) which can cause permanent damage and lead to thickening and scarring years later

- Congenital
  Hypoplasia of mitral valve, commissural fusion, double orifice mitral valve, shortened or thickened chordae, parachute mitral valve

- Degenerative severe annular calcification
Symptoms

- Dyspnoea
- Syncope
- Angina
- Chest infections
- Haemoptysis
Assessment

- Appearance of valve
- Mitral valve orifice area
- Severity of stenosis
- Severity of mitral regurgitation
- Suitability for balloon valvuloplasty
Appearance of stenotic valve

- Thickening with restricted mobility, mainly of leaflet tips, leading to a characteristic diastolic doming of mobility pattern, especially of the anterior leaflet (known as the ‘hockey stick’)

- Diastolic doming due to tethering of the leaflets by retracted and fused chordae tendinae and commissural fusion
Methods for Assessing the Mitral Valve

- Planimetry
- Pressure half-time
- Mean gradient
Measurement of mitral valve orifice area by planimetry

- Measurement should be taken in the parasternal short axis view at the echocardiographic slice showing the smallest orifice area.
- Make sure section not oblique - the measurement plane should be perpendicular to the mitral orifice.
- Do not planimeter the chordae which, if thickened, can mimic the orifice.
- Use colour flow Doppler as a guide for the orifice if not obvious from 2-D image.
Mitral Valve Area severity ranges

- Normal 3 - 5 cm$^2$
- Mild > 1.5 cm$^2$
- Moderate 1 - 1.5 cm$^2$
- Severe < 1 cm$^2$
Planimetry

- Most accurate method for quantitating mitral stenosis - considered the reference measurement
- Advantage - it is not influenced by accompanying mitral regurgitation or shunt defects.
- Limitations - dropout of echoes from areas of calcification, the influence of gain settings and unreliability following balloon valvuloplasty.
Doppler assessment of area by pressure half-time method

- The time required for the mitral diastolic pressure to fall by 50%
- Mitral valve area is calculated as:

\[
\frac{220}{\text{pressure half time (msec)}}
\]
Limitations of pressure half-time method

- Influenced by left ventricular filling
- The presence of mitral regurgitation, aortic regurgitation and atrial septal defects may alter the validity of this technique
Doppler assessment of mean gradient

- Calculated as an average gradient across the mitral valve
- Measured by tracing around diastolic inflow Doppler signal
- More reliable and reproducible by using continuous wave and increasing the sweep speed during measurement of the gradient
# Severity of Mitral Stenosis

<table>
<thead>
<tr>
<th></th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Planimetred orifice area (cm²)</strong></td>
<td>&gt; 1.5</td>
<td>1.0 – 1.5</td>
<td>&lt; 1.0</td>
</tr>
<tr>
<td><strong>Pressure half-time (msec)</strong></td>
<td>&lt; 150</td>
<td>150 – 200</td>
<td>&gt; 200</td>
</tr>
<tr>
<td><strong>Mean gradient (mmHg)</strong></td>
<td>&lt; 5</td>
<td>5 – 10</td>
<td>&gt; 10</td>
</tr>
<tr>
<td><strong>PA systolic pressure (mmHg)</strong></td>
<td>25</td>
<td>25 – 35</td>
<td>&gt; 35</td>
</tr>
</tbody>
</table>
PA Systolic Pressure

- Calculated using short form Bernoulli equation:

\[ \Delta P = 4 V^2 + \text{RA pressure} \]

(Where \( V \) is peak velocity of TR jet)
Estimation of RAp through IVC

<table>
<thead>
<tr>
<th>Diameter on expiration (cm)</th>
<th>Collapse on inspiration (%)</th>
<th>Pressure estimate (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2</td>
<td>complete</td>
<td>0 - 5</td>
</tr>
<tr>
<td>&lt; 2</td>
<td>&gt; 50</td>
<td>5 - 10</td>
</tr>
<tr>
<td>&gt; 2</td>
<td>25 - 50</td>
<td>10 - 15</td>
</tr>
<tr>
<td>&gt; 2</td>
<td>&lt; 25</td>
<td>15 - 20</td>
</tr>
</tbody>
</table>
Right heart

- Mitral stenosis obstructs blood flow into the LV
- Left atrial pressure increases in proportion to the severity of the stenosis
- This, in turn, restricts pulmonary venous return to the left atrium, elevating pulmonary vascular and, consequently, right heart pressures.
- As a compensatory mechanism, pulmonary vasoconstriction occurs. The RV pressure increases resulting in RV hypertrophy
- Elevated pulmonary pressure can progress to fixed pulmonary hypertension
- Eventually, the RV fails...
Balloon Valvotomy

- Procedure performed under local anaesthetic in Cardiac Catheterisation Lab
- Inter-atrial septum puncture required
- ‘Inoue’ balloon inflated with guided fluoroscopy
- Optimal result when both commissures are fused and non-calcified
Criteria for Valvotomy

- Thickening largely confined to leaflet tips
- Good mobility of anterior leaflet
- Little chordal involvement
- No more than mild MR
- No left atrial thrombus present
- No commissural calcification
Wilkin’s Score

- The thickening, mobility, and calcification of the mitral leaflets as well as of the chordal involvement can be assessed and scored from 1 (mild) to 4 (severe).
- The lowest score is 4, the highest is 16.
- A score <8 predicts feasibility and short and long term success of balloon valvuloplasty, defined as an increase in valve area of > 50%, valve area >1.5cm², and < 2 + MR.
Inoue Balloon
Calcified Postero-medial Commissure

Calcified Antero-lateral Commissure
Complications

- Atrial Fibrillation
- Heart failure
- Blood clot in the left atrium (more likely if atrial fibrillation present)
- Endocarditis (damaged valves are more prone to infection than normal valves)
Other Considerations

- Severe aortic regurgitation (this can shorten mitral valve pressure half-time)
- Right ventricular function
- Intra-atrial thrombus
Reporting Mitral Stenosis

- Appearance of valve
- Severity of stenosis
- Mitral regurgitation
- Right-sided pressure and right ventricular function
- Amenability to balloon valvuloplasty
- Other valves
Role of exercise echocardiography

- Baseline pictures acquired to assess severity
- Peak exercise pictures acquired

Information:
- Doppler assessment
- Does PA pressure increase?