**CARDIOLOGY: Valvulopathies**

**Aortic Stenosis**

1. **Aetiology is age dependant**
   - Age > 70: Senile calcification (50%), rheumatic (25%), bicuspid (25%)
   - Age < 70: Bicuspid (75%), rheumatic (25%)
   - Note: Rheumatic disease - always mitral involvement

2. **Pressure load on heart -> LVH compensation**
   - ↑ severity -> cannot cope with ↑ demand due to “fixed output”
   - Risk of arrhythmias – AF/ventricular/ brady due to annulus calcification

3. **Bad prognosis when Sx develop: 50% die within next year**
   - LVF, syncope, angina, dyspnoea
   - If asymptomatic: 50% develop Sx within 5 years

4. **Indications of severity**
   - Valve area
   - Mean Gradient
<table>
<thead>
<tr>
<th>Mild</th>
<th>1.5 cm</th>
<th>&lt; 25mmHg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate</td>
<td>1.0 - 1.5cm</td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td>&lt; 1.0 cm</td>
<td>40 -50 mmHg</td>
</tr>
<tr>
<td>Critical</td>
<td>0.75cm</td>
<td>Or peak gradient &gt;75mmHg</td>
</tr>
</tbody>
</table>

5. **Indications for surgery if asymptomatic**
   - ↓ LV function (Class 1 recommendation)
   - Rapid progression
   - Heavy calcification
   - Valve area < 1cm, mean gradient >40mmHg

**Aortic Regurgitation (NEVER NORMAL)**

1. **Clinical features and management depend on time course**
   - Acute: Volume overload -> emergency surgery
     - Aortic dissection (Type 1)
     - SBE
     - Blunt trauma
   - Chronic: LV dilates then fails -> operate before Sx develop
     - Bicuspid valve
     - Rheumatic fever
     - Degeneration
     - Connective tissue disease

2. LV dysfunction worse that it appears and can be worse post surgery (unmasked)

3. Treat hypertension as it is common and ↑ afterload worsens regurgitation

4. **Indications for surgery if asymptomatic (also indicators of severity)**
   - LV dysfunction (LVEF < 50%)
   - LVESD > 50mm, LVEDD > 70mm
   - Aortic dilation (↑ risk rupture/dissection; generally consider if >45mm)
   - Aortic regurgitant width > 65% LVOT diameter
   - Flow reversal in descending aorta (diastole)
Mitral Stenosis

1. Aetiology always RHEUMATIC; rarely - parachute valve, SLE or drugs (ergots)
2. Fixed cardiac output thus poorly tolerated in pregnancy, infections

3. Indications of severity (and when to operate)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Valve area (Normal 4-6cm²)</th>
<th>PCWP (Normal &gt; 10 mmHg)</th>
<th>Mean Gradient</th>
<th>CO and Sx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>&gt;2</td>
<td>12</td>
<td>Normal</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>1.1 – 2</td>
<td>12 - 17</td>
<td>Normal, mild to moderate SOB</td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td>&lt; 1</td>
<td>&gt; 18</td>
<td>SOB at rest</td>
<td></td>
</tr>
<tr>
<td>Critical</td>
<td>&lt; 0.8</td>
<td>&gt; 20</td>
<td>&gt; 10 mmHg</td>
<td>Severe pulm HT, SOB at rest</td>
</tr>
</tbody>
</table>

Note: When valve area < 1, LA pressures > 25mmHg needed to push blood into LV

4. Valvuloplasty preferable to valve replacement
   - Suitability depends on TTE score (< 8 good): calcification, subvalvular calcification, thickening & mobility
   - Earlier intervention preferred for new AF, LA enlargement, pulmonary HT
   - Contraindication: Significant MR
   - If asymptomatic: either observe or valvuloplasty, NEVER replacement

5. Pregnancy:
   - Moderate to severe MS -> valvuloplasty prior conception
   - If develop Class III-IV Sx during pregnancy -> valvuloplasty

Mitral Regurgitation

1. Clinical features and management depend on time course:
   - Acute: Volume overload -> Emergency surgery
     - Ischaemia: papillary muscle dysfunction/ rupture
     - SBE
     - Spontaneous flail leaflet in MVP
   - Chronic: Well tolerated -> Compensate with LA enlargement
     - MVP
     - Dilated cardiomyopathy (functional)
     - Rheumatic
     - Others: congenital, ergot drugs, SBE, ischaemia

2. Indications of severity

<table>
<thead>
<tr>
<th>Grade</th>
<th>Area of Doppler jet (Relative to LA)</th>
<th>EROA (PISA method)</th>
<th>Regurg vol</th>
<th>Regurg fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>20 – 40%</td>
<td>&gt; 0.40 cm²</td>
<td>&gt; 60mL</td>
<td>&gt; 55%</td>
</tr>
</tbody>
</table>

Note: LAP falsely ↓ jet size, LVP falsely ↑ jet size

3. Operate before LVEF < 60% and LVESD > 45mm
4. Repair preferable to replacement: better outcome and no need anticoagulation
Tricuspid Valvulopathies

1. Never operated on singly, always in conjunction with other valve replacements

2. **Tricuspid stenosis is rare**
   - Only real cause is rheumatic disease
   - There will be no signs of pulmonary HT
   - ↑ JVP with giant a waves & slow y descent; diastolic murmur louder on inspiration
   - RVF and hypotension

3. **Tricuspid regurgitation is very common**
   - Functional (Pulmonary HT and RVF with dilated cardiomyopathy)
   - Others: (TRI-REG)
     - TVP (with MVP)
     - Rheumatic heart disease
     - IVDU with SBE
     - RV infarction (papillary muscle)
     - Ebsteins anomaly
     - Great impact of steering wheel trauma
   - ↑ JVP with cannon V waves and pulsatile liver
   - In severe: hepatic vein flow reversal

Pulmonary Valvulopathies

1. **Pulmonary stenosis**
   - Aetiology:
     - Congenital +/- tetralogy of Fallot
     - Carcinoid syndrome (rare)
   - RVF and SOBOE
   - Giant a waves, late peaking systolic murmur, no ejection click, S4
   - Valvuloplasty only for symptomatic and severe disease (gradient 40->80mmHg) BUT contraindicated if concomitant TR/PR

2. **Pulmonary regurgitation (uncommon)**
   - Aetiology:
     - Trivial found on TTE (physiological)
     - Post correction of Tetralogy of fallot
       - Late risk of tachy-arrhythmias & sudden cardiac death
     - Pulmonary HT
     - IVDU & SBE
     - Congenital absence of valve
   - Graham Steele murmur: ↑ pitch decrescendo murmur louder on inspiration
   - Mx depends on cause, usually replacement

Quickly on rheumatic heart disease:
- Group A streptococcal THROAT infection, *not skin*
- Demonstrate recent infection (and):
  - ↑ ASOT titres or +ve throat culture/ rapid Ag test
- 2 major (OR) 1 major, 2 minor criteria (Jones)
  - Major: pancarditis, Sydenham’s chorea, subcutaneous nodules, erythema marginatum and migrating polyarthritis (large joints)
  - Minor: fever, arthralgias, ↑CRP/ESR, ↑PR interval
Uptofate Study Summary

Treat with penicillin for 10 days (if allergy: use erythromycin)
ABx prophylaxis (penicillin) till age 20 – usually 10 years post episode (recurs usually within 2 years)

Echo Essentials
3 main concepts:
1. **Valve morphology** (bicuspid/thickening/Ca²⁺/prolapse/vegetations)
2. **M- Mode** (ice-pick/ kebab view)
   - HOCM
     - Septum thickness > 1.2cm
     - Gradient between LV and Ao ↓
     - SAM (systolic anterior movement of mitral valve)
   - Aortic aneurysm (operate if > 55mm OR ↑ by >5mm per year)
   - LVH (normal wall thickness < 1.1cm)
   - LV dilation (normal LV size 5.5 – 5.6 cm)
   - LA dilation (normal < 4cm)
   - Mitral stenosis
     - ↓ valve opening
     - ↓ EF slope
     - Anterior movement of posterior leaflet
3. **Doppler findings**
   - Mean gradient (∆P = 4V²) – (peak gradient not used)
   - Area (usually given in question, derived by continuity equation)

Other important formulae:
Fractional shortening FS = (LVEDD – LVESD) / LVEDD
(Normal is 0.3 – 0.4)

Ejection fraction = 2 × FS × 100%
(Normal > 60%)

CO = HR × SV
CO is cardiac output
SV is stroke volume = LVEDV – LVESV usually (unless there is regurgitation)

Quickly on types of prosthetic valves:
- Autograft (Ross procedure)
- Allograft
- Mechanical (durable but need anticoagulation)
- Bioprosthetic (no need anticoagulation but lifespan about 10 years)

Quickly on ABx Prophylaxis for IE (Revised AHA Guidelines 2007)
- Based on HIGH RISK candidates and HIGH risk procedures (eg needing to penetrate gingival tissues or periapices of teeth)
- No longer recommended for MVP, GIT or GU procedures
- High risk candidates: previous IE, congenital heart disease with prosthetic material 6/12 post OR unrepaired, cardiac transplant with valvulopathy, prosthetic valves
- Amoxicillin 2g oral 30-60 min pre-procedure
1) 2004P2Q70
A 45-year old asymptomatic man returns for follow-up. He was diagnosed 10 years ago with aortic regurgitation due to a congenital bicuspid aortic valve. He has never had endocarditis.

Which one of the following echocardiographic profiles most strongly indicates the need for aortic valve replacement?

<table>
<thead>
<tr>
<th></th>
<th>LVEDD (mm)</th>
<th>FS [0.30-0.40]</th>
<th>LA size (mm) [&lt;40]</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>70</td>
<td>0.3</td>
<td>60</td>
</tr>
<tr>
<td>B</td>
<td>75</td>
<td>0.4</td>
<td>40</td>
</tr>
<tr>
<td>C</td>
<td>70</td>
<td>0.25</td>
<td>45</td>
</tr>
<tr>
<td>D</td>
<td>65</td>
<td>0.45</td>
<td>50</td>
</tr>
<tr>
<td>E</td>
<td>75</td>
<td>0.35</td>
<td>55</td>
</tr>
</tbody>
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LVEDD Left ventricular end-diastolic diameter
LVEDD Left ventricular end-systolic diameter
FS Fractional shortening = (LVEDD – LVESD)/LVEDD
LA Left atrial

2) 2003P2Q78
The severity of pulmonary hypertension can be determined using continuous wave Doppler measurements of the velocity of tricuspid regurgitation. This method uses the Bernoulli equation which states that \( \Delta P = 4v^2 \) (where \( \Delta P \) = instantaneous pressure gradient and \( v \) = velocity across the valve).

There is tricuspid regurgitation with a peak velocity of 4 metres/second and a mean velocity of 3.5 metres/second. Assuming right atrial pressure is 5 mmHg, the best estimate of the peak right ventricular systolic pressure (± 2 mmHg) is:

A. 50 mmHg
B. 55 mmHg
C. 60 mmHg
D. 65 mmHg
E. 70 mmHg

3) FRACP2002P2Q36
A patient presents with NYHA Class 3 dyspnoea associated with long-standing mitral stenosis. Assuming left ventricular function is normal and mitral valve area is less than 1.0cm\(^2\), which haemodynamic profile is most likely to be associated with a poor outcome if the patient has mitral valve replacement?

<table>
<thead>
<tr>
<th>Cardiac Output</th>
<th>Mean Right Atrial Pressure</th>
<th>Right Ventricular Pressure (systolic/diastolic)</th>
<th>Mean Pulmonary Artery Pressure</th>
<th>Mean Pulmonary Capillary Wedge Pressure</th>
<th>Pulmonary Vascular Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>L/min (3.0-6.0)</td>
<td>mmHg (&lt;5)</td>
<td>mmHg (&lt;25/&lt;5)</td>
<td>mmHg (&lt;20)</td>
<td>mmHg (&lt;15)</td>
<td>Wood Units (&lt;4)</td>
</tr>
<tr>
<td>A</td>
<td>5.0</td>
<td>5</td>
<td>55/5</td>
<td>35</td>
<td>20</td>
</tr>
<tr>
<td>B</td>
<td>4.0</td>
<td>3</td>
<td>70/2</td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>C</td>
<td>2.5</td>
<td>5</td>
<td>55/5</td>
<td>35</td>
<td>10</td>
</tr>
<tr>
<td>D</td>
<td>2.0</td>
<td>1</td>
<td>35/1</td>
<td>23</td>
<td>10</td>
</tr>
<tr>
<td>E</td>
<td>3.5</td>
<td>8</td>
<td>65/8</td>
<td>35</td>
<td>25</td>
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4) FRACP2002P2Q65
A 55 year old man presents with acute pulmonary oedema. 5 years ago, he had undergone a mitral valve replacement with a bileaflet tilting disc valve (St Jude's) for mixed mitral valve disease. He has been well with normal exercise tolerance prior to the day of admission.

Examination on admission reveals tachypnoea, sinus tachycardia 110/minute, BP 105/60 mmHg, elevated JVP +5cm and bilateral lung crepitations throughout. His INR is 1.9 (desired range 2.0 -3.5). CUE are normal. The cardio-thoracic ratio on CXR is normal but the presence of APO is confirmed. TTE reveals that one of the prosthetic valve leaflets is not moving and there is increased flow rate in diastole across the valve orifice (2m/second).

What is the most appropriate course of action?
A. Administration of IV streptokinase
B. Administration of IV heparin
C. Administration of IV antibiotics
D. Addition of anti-platelet agent
E. Immediate mitral valve replacement

5) FRACP2001P1Q1

A 47yo woman with overt thyrotoxicosis is found to have aortic stenosis. Which one of the following features, if present in this woman is most likely to indicate the need for aortic valve replacement?
A. A peak systolic left ventricular aortic pressure gradient of 60mmHg
B. The presence of NYHA class III angina
C. A resting heart rate > 120/min
D. An aortic valve orifice area of 0.9cm2
E. The presence of concomitant moderate aortic regurgitation

6) FRACP2003P2Q46

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<td>40</td>
</tr>
<tr>
<td>C. 70</td>
<td>0.25</td>
<td>45</td>
</tr>
<tr>
<td>D. 65</td>
<td>0.45</td>
<td>50</td>
</tr>
<tr>
<td>E. 75</td>
<td>0.35</td>
<td>55</td>
</tr>
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7) FRACP2004P1Q29
A patient with aortic regurgitation has the following haemodynamic measurements:

Cardiac output (CO) 7.5L/min
Heart rate (HR) 75/minute
Left ventricular end-diastolic volume (LVEDV) 200Ml
Left ventricular end-systolic volume (LVESV) 50Ml

The regurgitant fraction is defined as the ratio of the regurgitant volume to the total volume flowing through the valve with each beat. The regurgitant fraction in this patient is:

A. 25%
B. 33%
C. 50%
D. 67%
E. 75%

8) FRACP2002P2Q94
A 35 year old woman has increasing breathlessness on exertion. Her cardiac silhouette is slightly enlarged on a chest X ray and an ECG demonstrates sinus rhythm.

The continuous wave Doppler flow signal through the mitral valve inflow tract (shown above) is most consistent with which one of the following?

A. Severe pulmonary hypertension (cor pulmonale)
B. Aortic stenosis
C. Mitral regurgitation
D. Mitral stenosis
E. Aortic regurgitation

Other TTE images to know: Refer to Ix of Medicine Weekend (Liz Jones page 5)

Answers:
1) C 5) D
2) E 6) C
3) C 7) B
4) E 8) D