Outline

• Simple overview of murmurs
• How to present
• Key questions
• Case examples
What comes up?

Common finals cases
Prosthetic valves
AS
MR
AR
Adult congenital heart disease
MVP
VSD/ASD

Rarer finals cases
MS
CCF without murmur
HOCM
Marfans (+AR)
Turners (+AS)
Dextrocardia
Weak pulse(s)
Normal examination
Inspection is key

• This exam can be done in 5 minutes

• Always remember the BP → it will give you a clue

• There may be a clue in the question, often you can make the diagnosis at the end of the bedside.

• Look at the arm pits, is there an PPM?

• Look for scars, look for a picc line

• Downs Syndrome (AS), Marfans Syndrome (AR, MR), Turners Syndrome + Noonan’s syndrome (co-arctation or AS), Ankylosing Spondylitis (AR)
Important points in the exam

• Collapsing pulse – this is almost diagnostic of AR in exams
• Radial – Radial delay
• Palpate the apex, if its not there feel on the right!!

• Listen to the bases of the lungs, swollen ankles → heart failure is an important negative

• Ask your patient to sit forward and listen in expiration → ~Early Diastolic murmur (this is the time to listen to the lungs)

• Ask your patient to roll to the left hand side → Mitral Stenosis
Murmurs
Auscultating

- 1\textsuperscript{st} heart sound T+M valve closing
- 2\textsuperscript{nd} Heart sound A+P valve closing
- Palpate carotid while listening

<table>
<thead>
<tr>
<th>Aortic</th>
<th>Pulmonary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tricuspid</td>
<td>Mitral</td>
</tr>
</tbody>
</table>
In simple terms:

1. Where is it loudest?

2. Systolic or diastolic?

3. Aortic Stenosis/ Mitral Regurgitation/ Metallic Valve and then the others
In simple terms:

- Aortic?
  - Systolic? Stenosis
  - Diastolic? Regurgitation

- Pulmonary?
  - Systolic? Stenosis
  - Diastolic? Regurgitation

- Mitral
  - Systolic? Regurgitation
  - Diastolic? Stenosis

- Tricuspid
  - Systolic? Regurgitation
  - Diastolic? Stenosis
# Differentials

<table>
<thead>
<tr>
<th>ESM</th>
<th>PSM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic stenosis</td>
<td>Mitral regurgitation</td>
</tr>
<tr>
<td>Pulmonary stenosis</td>
<td>Tricuspid regurgitation</td>
</tr>
<tr>
<td><em>Aortic sclerosis</em></td>
<td><em>VSD</em></td>
</tr>
<tr>
<td><em>HOCM</em></td>
<td></td>
</tr>
<tr>
<td>Aortic flow murmur</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EDM</th>
<th>MDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic regurgitation</td>
<td>Mitral stenosis</td>
</tr>
<tr>
<td>Pulmonary regurgitation</td>
<td>Tricuspid stenosis</td>
</tr>
<tr>
<td><em>Austin-Flint</em></td>
<td></td>
</tr>
<tr>
<td><em>Atrial myxoma</em></td>
<td></td>
</tr>
</tbody>
</table>
Four kinds of murmur:

<table>
<thead>
<tr>
<th>Ejection-systolic murmur (ESM)</th>
<th>Pansystolic murmur (PSM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early diastolic murmur (EDM)</td>
<td>Mid-diastolic murmur (MDM)</td>
</tr>
</tbody>
</table>
"I have examined the cardiovascular system of Mr X. Peripherally there was ___________. The apex beat was________. On auscultation, there was __________ murmur loudest in the _______ region and accentuated by *manoeuvre* and *inspiration/expiration*.

These findings are consistent with a diagnosis of ________."
This 65 year old has a diagnosis of x, this is evidenced by the following positive findings…1, 2,3. Of note there was no evidence of infective endocarditis or heart failure.
Prosthetic Valves
Prosthetic Valves

Mechanical vs. bioprosthetic
If you can hear it, it’s mechanical

**TYPES**

**Mechanical prostheses**
Ball and cage (*Starr-Edwards*)
Single tilting disc (*Medtronic-Hall, Bjork-Shiley*)
Double-tilting disc (*St Jude’s*)

**Bioprostheses**
Xenografts (porcine, pericardial)
Homografts (cadaveric)
Prosthetic Valves – In the Exam
Scars? Associated with a CABG?
Tunneled line?
Endocarditis?
Bruising?
Jaundice?
Why would someone have a valve replacement?

- **Age - Young**: Rheumatic fever, endocarditis, congenital heart disease, Severe valvular heart disease
- **Older**: Senile calcification (AS), Infection as above, Severe valvular heart disease
Prosthetic Valves - Complications

Thromboembolism
Complications of anticoagulation i.e. bleeding
Valve dysfunction (leakage, dehiscence, obstruction)

“ANY PROSTHETIC VALVE REGURGITANT MURMUR SHOULD BE REGARDED AS VALVULAR DYSFUNCTION UNTIL PROVEN OTHERWISE”

Endocarditis
Haemolysis
Mechanical vs Tissue valve

- Mechanical valves last longer
- You need to warfarinise patients with mechanical valves
- Aortic valve - INR 2.5, Mitral Valve : 3
Prosthetic Valves – In the Exam

Aortic or mitral prosthesis?
Depending on the type of valve, there will be 1 or 2 audible clicks

**Time the closing (louder) click to the heart sounds (loudest click=closing valve)**
Pacemakers are more commonly associated with AVRs
Click immediately preceding carotid = Mitral
Click following carotid = Aortic valve
Two clicks = Double valve

AORTIC

- Opening click
- Closing click

MITRAL

- Closing click
- Opening click
Presenting a AVR using the checklist:

1. The patient appears comfortable at rest and is haemodynamically stable
2. There are no peripheral stigmata of endocarditis
3. The pulse rate is 70 beats per minute, regular with normal volume and character. The blood pressure is 125/80
4. The venous pressure is not elevated
5. A prosthetic click can be heard at the bedside. On examination of the preacordium there is a midline sternotomy scar. The apex beat is undisplaced
6. There are no heaves or thrills
7. On auscultation the first heart sound is followed by a prosthetic click at the second heart sound
8. The lung bases are clear and there is no peripheral oedema
9. There is no evidence of anaemia
10. Top of my list of differentials would be an AVR, which seems to be functioning well
Questions

• Why would someone have a prosthetic valve?

• Tell me some of the complications associated with a prosthetic valve?

• What anticoagulation would you give with someone with a prosthetic valve?

• What are the causes of anaemia in a prosthetic valve?
Aortic stenosis
Aortic stenosis

• **Peripheral**: narrow pulse pressure, slow-rising pulse, “thrusting” apex beat

• **Auscultation**: Harsh ESM, radiates to carotids, first heart sound is normal and second is soft / not present

• **Loudest in**: Aortic area, leaning forward, expiration. Note Aortic Stenosis is often heard all over the praecordium.
Presentations

• The pulse rate is 60 beats per minute and regular. It is of a slow rising character. The BP is 100/80 with a narrow pulse pressure. On examination of the praecordium there is an ejection systolic murmur, heard loudest over the aortic area which radiates to the carotids. It is heard best on expiration and leaning the patient forward. The second heart sound is soft. The JVP is not elevated, the lung fields are clear, and there is no peripheral oedema nor stigmata of endocarditis. This is Aortic Stenosis, my differentials…

• This patient has a diagnosis of Aortic Stenosis as evidenced by a slow rising pulse, an ejection systolic murmur heard loudest in the aortic area which radiates to the carotids. He/she has a narrow pulse pressure with a BP of 100/80, and is in a regular rhythm. There is no evidence of heart failure or endocarditis.
Presentation tips

• Always mention relevant negatives in valvular heart disease, heart failure and endocarditis.

• Low volume pulse and slow rising pulse are signs of severe aortic stenosis but the lack of a second heart sound is most important (when assessing severity)

• Remember the left ventricle is hypertrophied, so the LV shouldn’t be displaced (unless very late on).

• Sometimes the murmur is loudest in the apex ???!!., This is Gallavardin’s phenomenon
Aortic stenosis

- **Differentials?** Aortic sclerosis, HOCM, Pulmonary stenosis and SYSTOLIC MURMURS

<table>
<thead>
<tr>
<th></th>
<th><strong>Bicuspid valve</strong></th>
<th><strong>Calcification</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Congenital</strong></td>
<td>Downs</td>
<td>Rheumatic fever</td>
</tr>
<tr>
<td></td>
<td>Noonans/Turners</td>
<td>Infective endocarditis</td>
</tr>
<tr>
<td></td>
<td>Williams’ syndrome</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Co-arctation of aorta</td>
<td></td>
</tr>
</tbody>
</table>
Differentials

• Aortic sclerosis- overlaps with aortic stenosis
• VSD- Very loud murmur, all over praecordium, maximal at sternal edge- young
• HOCM- Younger patient, louder in pulmonary area, worse on crouching , pansystolic- young
• Pulmonary Stenosis – rare, normal second heart sound, louder on inspiration
• Mitral regurgitation if you hear it all over the praecordium (might be both).
Aortic stenosis

• How would you investigate this patient?

• History and exam: symptoms of AS (angina, syncope, dyspnoea); underlying cause

• Bedside: ECG (LVH, arrhythmia), urine dip

• Bloods: FBC, U+E, LFT, CRP

• Imaging:
  • CXR - LVH, pulmonary oedema, calcified valve
  • **Echo** - Severity and LV function

• Consider angiogram if going for surgery
Aortic stenosis

- How would you manage this patient?
  - Conservative - regular follow-up, exercise, smoking cessation etc.
  - Medical
    - Diuretics to reduce SOB and preload
    - Optimise cardiovascular risk factors (HTN, DM, cholesterol)
  - Surgical
    - Valve replacement (indications: symptomatic or dependent on severity and LVEF).
    - TAVI / balloon valvuloplasty if not a good candidate
Aortic Stenosis

**IS IT SEVERE?**
Clinical signs of severe AS
- Low volume pulse
- Slow-rising pulse
- Narrow pulse pressure
- Heaving apex
- Systolic thrill
- Reversed splitting of second heart sound
- Soft/absent A$_2$
- 4$^{th}$ heart sound
- Late systolic peaking of a long murmur
- Signs of pulmonary HTN/left heart failure

Clinical signs not reflective of severity
- Loud murmur
- Radiation to carotids

**Objective classifications of severity**
- Aortic valve area $< 1.0$ cm$^2$
- Mean pressure gradient $> 50$ mmHg
  & symptoms!
Questions?

- How would you differentiate with aortic sclerosis?
  - Normal 2nd heart sound, no radiation to carotids, normal pulse character

- What are associated conditions?
  - Rectal bleeding- colonic polyps (Heyde’s syndrome)

- What are the indications for surgery
  - See as before
Mitral Regurgitation

Peripheral: ? Signs of endocarditis, usually in AF,

Auscultation: Displaced and thrusting Apex, Pansystolic murmur loudest in the apex, radiates to axilla.

Loudest: Apex,
Pan-Systolic Murmur?

Mitral Regurgitation
Tricuspid Regurgitation
Small VSD
Aortic Stenosis
<table>
<thead>
<tr>
<th>Sign</th>
<th>Pure MR</th>
<th>Pure TR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse</td>
<td>Normal or jerky</td>
<td>Normal</td>
</tr>
<tr>
<td>JVP</td>
<td>Normal</td>
<td>Giant ‘v’ waves</td>
</tr>
<tr>
<td>Palpation</td>
<td>Apical systolic thrill</td>
<td>Parasternal systolic thrill</td>
</tr>
<tr>
<td></td>
<td>Thrusting displaced apex</td>
<td>Parasternal heave</td>
</tr>
<tr>
<td>Auscultation</td>
<td>PSM loudest in expiration</td>
<td>PSM, Carvallo’s sign, no radiation to axilla</td>
</tr>
<tr>
<td></td>
<td>Radiates to axilla</td>
<td></td>
</tr>
<tr>
<td>Hepatomegaly</td>
<td>None</td>
<td>Pulsatile hepatomegaly</td>
</tr>
</tbody>
</table>
Mitral Regurgitation

1. Haemodynamically stable/ appearance
2. Peripheral stigmata of endocarditis
3. Pulse rate/rhythm/volume/character
4. JVP
5. Scars & Apex
6. Thrills/heaves
7. HS 1 + 2 (3/4)
9. Lung fields and oedema
10. Anything else that is obvious??
11. The diagnosis is/ at the top of my differential/ my differential would include…
Heart failure
Heart failure

- **Peripheral**: SOB, cool peripheries, cyanosis, pitting oedema, ascites

- **Auscultate**: S3, bibasal creps, wheeze
CCF Without a Murmur

Annoying station!
Make sure you:
  Look for any scars of heart surgery/grafting
  Measure/ask for the blood pressure
  Listen carefully to the lung bases
  Look at the level and distribution of oedema
  Do not make up sounds you can’t hear…
One investigation is paramount (ECHO)
Heart failure

“I have examined the cardiovascular system of Mr X. He was short of breath at rest. Peripherally he was cold and had evidence of cyanosis in his hands, as well as some pedal oedema. On auscultation, there were bibasal crepitations.

These findings are consistent with a diagnosis of heart failure.”
Heart failure

- **How would you investigate this patient?**
  - History and exam: fatigue, dyspnoea, PND, orthopnoea
  - Bedside: ECG (ischaemia, hypertrophy, AF)
  - Bloods: FBC, U+E, BNP
  - Imaging: CXR, **Echo**
Heart failure

- **How would you manage this patient?**
  - Conservative - regular follow-up, exercise, smoking cessation etc.
  - Medical Acute vs Chronic
    - ACEi + B-blocker
    - Diuretics (loop and spironolactone)
    - Digoxin
    - Optimise cardiovascular risk factors (HTN, DM, cholesterol)
  - Surgical - cardiac resynchronisation therapy, left ventricular assist device (LVAD) or heart transplant
CCF

Causes of Heart Failure:
- Coronary artery disease
- Chronic pressure overload
  - HTN
- Obstructive valvular disease
- Chronic volume overload
  - Regurgitant valvular disease
  - Shunting (VSD/ASD, extracardiac)
- Dilated cardiomyopathy
- Chronic arrhythmias
- Pulmonary heart disease (e.g. cor pulmonale)
- High-output states
- Heart failure with preserved ejection fraction
  - HCM
  - Restrictive cardiomyopathy
- Fibrosis
Others for your learning
Mitral Valve Prolapse

A cause of Mitral Regurgitation
1° (commonest) or 2° (Classically Marfan’s)
Associated with some specific signs:
   Mid-systolic click
   Late systolic cruscendo-decruscendo murmur
   Loudest at LLSE
As it becomes more severe, clinically resembles MR
Mitral Stenosis

1. Miss Y appears comfortable at rest and is haemodynamically stable
2. There are no peripheral stigmata of endocarditis
3. The pulse rate is 60 beats per minute, irregular, of normal volume and character
4. The JVP is not elevated
On examination of the precordium,
5. The apex beat is undisplaced and has a tapping quality
6. There are no heaves or thrills
7. On auscultation, the first heart sound is loud, the second heart sound is normal. There is an opening snap in early diastole
8. Followed by a MDM at the apex, loudest in expiration with the patient in the left lateral position
9. The lung bases sound clear and there is no peripheral oedema
10. The diagnosis is mitral stenosis without features of heart failure
Tetralogy of Fallot (TOF or "Tet")

- Aorta Shifted to Right
- Opening Between Ventricles
- Mitral Valve
- Tricuspid Valve
- Pulmonary Valve
- Right Ventricular Outflow Obstruction

Red: Oxygen-rich Blood
Blue: Oxygen-poor Blood
Purple: Mixed Blood

AO = Aorta
PA = Pulmonary Artery
LA = Left Atrium
RA = Right Atrium
LV = Left Ventricle
RV = Right Ventricle
Tetralogy of Fallot (TOF or "Tet")

- RV hypertrophy
- Overriding aorta
- Malaligned VSD
- Obstruction to RV outflow

Labels:
- AO = Aorta
- PA = Pulmonary Artery
- LA = Left Atrium
- RA = Right Atrium
- LV = Left Ventricle
- RV = Right Ventricle

Blood Types:
- Oxygen-rich Blood
- Oxygen-poor Blood
- Mixed Blood
Tetralogy of Fallot – Palliative Procedure

**Modified Blalock-Taussig Shunt**

“Artificial conduit made between the systemic and pulmonary circulations”

PTFE graft from [subclavian artery](https://en.wikipedia.org/wiki/Subclavian_artery) to a side branch of the [pulmonary artery](https://en.wikipedia.org/wiki/Pulmonary_artery)

Originally: Developed as a stand-alone palliative procedure

Now: Used only in the most severe variants (i.e. with complete pulmonary atresia) or as a bridging procedure
Tetralogy of Fallot – Total Surgical Repair

Early and complete repair is now preferred
1 or 2 stages
Involves closure of the VSD and relief of the RV outflow obstruction
Usually performed within the 1st year of life
Tetralogy of Fallot – The Adult Patient

1. **TOF Corrected With B-T-S:**
   - Cyanosis & clubbing
   - Unilateral weak upper limb pulses (+ BP)
   - Thoracotomy scar
   - To-an-Fro continuous murmur of shunt
   - Murmur of aortic regurgitation

2. **Totally Corrected TOF:**
   - No cyanosis, may be clubbing
   - Median sternotomy ± thoracotomy scar
   - Murmurs of PR or TR
   - (Features of residual RVOTO)

2. **In both, look for signs of:**
   - Right-heart failure
   - Arrhythmias (AF, ICD/pacemaker scar)
   - Inherited syndromes
**VSD**

1. The patient looks well
2. No peripheral stigmata of endocarditis
3. The pulse is 70 bpm and regular, normal volume and character
4. The JVP is not elevated
5. The apex beat is undisplaced
6. There is a **parasternal thrill**
7. On auscultation, heart sounds 1 and 2 are normal
8. There is a **loud PSM heard all over** the precordium, loudest at the LLSE
9. Lung bases are clear. There is no pedal oedema
10. -
11. The diagnosis is VSD with a left-to-right shunt.

**ASD**

1. The patient looks well
2. No peripheral stigmata of endocarditis
3. The pulse is 70 bpm and regular, normal volume and character
4. The JVP is not elevated
5. The apex beat is undisplaced
6. There is a **systolic thrill** at the ULSE
7. The first heart sound is normal. There is **wide fixed splitting of the 2nd heart sound**
8. There is an **ESM at the ULSE**
9. Lung bases are clear. There is no pedal oedema
10. -
11. The diagnosis is ASD with a left-to-right shunt.
Eisenmenger’s syndrome

Don’t panic!
Focus on the basics:

HALLMARKS are:
1. Central cyanosis
2. Pulmonary hypertension

Look for cyanosis & clubbing

High JVP with giant Vs
Parasternal heave
Peripheral oedema
± murmurs of PR and Test on inspiration!
Eisenmenger’s syndrome

Don't panic! Focus on the basics:

CAUSES ARE:
1. ASD
2. VSD
3. PDA

Their murmurs have disappeared!

BONUS ROUND:
Differential cyanosis and clubbing -> PDA
Single 2nd heart sound -> VSD
HOCM

Affects 0.2 % of the population
Genetically heterogenic
  AD, but over 200 mutations
Phenotypically heterogenic
  All have inappropriate myocardial hypertrophy
  Commonest is asymmetrical septal hypertrophy
  25 % have LV Outflow tract obstruction
  Fewer have Systolic anterior motion of (anterior) mitral valve leaflet
1. The murmur of **LV out flow tract obstruction**
   - Ejection crescendo-decrescendo
   - After HS1 or in mid-systole
   - Loudest between LSE and apex
   - Radiates up the sternal border
   - No radiation to carotids
   - Diminished by valsalva, squatting, β-blockers
   - Increased by standing, nitrates, diuretics

2. The murmur of **SAM**
   - Less common
   - Additional pan-systolic murmur (MR)
   - Loudest at apex
   - Radiates to axilla
   - May ‘merge’ with LVOTO murmur

1. + 2. = pansystolic murmur all over the precordium
1. Haemodynamically stable/appearance
2. Peripheral stigmata of endocarditis
3. Pulse rate/rhythm/volume/character
4. JVP
5. Apex
6. Thrills/heaves
7. HS 1 + 2 (3/4)
9. Lung fields and oedema
10. Anything else that is obvious??
11. The diagnosis is/ at the top of my differential/ my differential would include...

1. Younger patient
2. Peripheral stigmata of endocarditis
3. AF? Jerky pulse? Double carotid impulse?
4. Prominent a waves
5. Double apical impulse, heaving
6. Systolic thrill at LLSE
7. ?Fourth heart sound
8. **ESM at LLSE**, not radiating to carotids +/- **PSM at apex** radiating to axilla
9. The lung bases sound clear. There is no peripheral oedema
10. ?ICD in situ
11. The diagnosis is hypertrophic cardiomyopathy
Inherited Syndromes

MARFAN

TURNER*
**“Marfanoid body habitus”**

**General inspection**
- Tall Stature
- Disproportionately long limbs

**Hands**
- Arachnodactyly (Thumb & wrist signs)

**Face**
- High-arched palate
- Blue sclerae

**Precordium**
- Kyphoscoliosis
- Pectus excavatum

**To complete your examination**
- Check for joint hyperextensibility
- Check for pes planus
- Assess mental status
- Perform fundoscopy (ectopia lentis)

**Common heart problems**
- Aortic root dilatation (70-80%)
- Aortic regurgitation
- Aortic dissection
- Mitral valve prolapse

**Investigations to consider**
- Echocardiography
- Fibrillin-1 gene testing
- X-ray hips (protrusio acetabulae)
- MRI spine (dural ectasia)
45 XO Females

**General inspection**
- Short stature (ask pt. to stand)

**Hands**
- Nail dysplasia
- Short 4th metacarpals
- Wide carrying angle (cubitus valgus)

**Face & neck**
- High-arched palate
- Webbed neck

**Precordium**
- Square (shield-like) chest
- Widely spaced nipples

**To complete your examination**
- Check the blood pressure
- Eye examination for strabismus, cataracts, nystagmus
- Assess thyroid status; check for goitre
- Look for complications of diabetes
- Look of complications of osteoporosis (scoliosis, evidence of fractures)

**Common Heart Problems**
- Aortic stenosis (bicuspid valve)
- Coarctation of aorta
- Hypertension

**Investigations to consider**
- Echocardiogram
- Hormone testing (FSH, LH)
- TFTs for hypothyroidism
- Glucose testing
- Renal ultrasound (horseshoe)
- Ophthalmology
Weak Pulses

Weak radial pulse? No other findings? What do you do?
Check the other radial pulse
Radio-radial delay
Radio-femoral delay
Any scars?
Measure the blood pressure
Weak Pulses

Differential diagnosis for a weak/absent radial pulse:
  Examination technique
  Cardiovascular compromise
  Post-procedures
    Radial artery harvesting
    Cardiac catheterisation through radial artery
    Radial arterial line
  Embolic
    As in AF

Atherosclerotic
  Aortic dissection
  Brachial/axillary artery occlusion
  Subclavian steal syndrome

Vasculitis
  Takayasu’s arteritis
  Giant cell arteritis

Structural
  Cervical rib syndrome
  Thoracic outlet syndrome
Summary

1. Reviewed the structure of cardiovascular examination
2. Raised awareness of the relevant physical signs
3. Became familiar with the commonest long station cases
4. Formed a structure for presenting at the end of your cardiology long station OSCE
Useful References used here

Form a nerd herd
Ask Dr Clarke website (free)
OHCM
Medical Short Cases for Med. Students – by Robert et al.
Clinical Medicine for the MRCP PACES: Volume 1
Core Clinical Skills – by Mehta and Iqbal
Littmann heart sounds CD
A plethora of courses including OSCE aid
And don’t forget… utilise your time on the wards!