

The Cardiovascular Examination

Contrary to the belief of most candidates, the examination of the cardiovascular system does not end with auscultation of the precordium or the lung bases, but must include, if appropriate, relevant examination of the abdomen, lower limbs, urine and other areas. In PACES there is plenty of time to complete the examination; even though in the arena of the examination the majority of cases will focus on valvular pathology, one must also look broadly at the patient.

APPROACH TO THE PATIENT

- Introduce yourself.
- Position the patient correctly.
- Expose the patient from the waist up; a sheet can cover the chest initially if appropriate, but will have to be completely removed for a general inspection.
- Position the patient at 45°, with the head resting on enough pillows to relax the sternomastoids.
- Ask if they are at all in pain and ensure they are comfortable.
- Explain what you want to do briefly: 'I am just going to feel your pulse and listen to your heart; is that alright?' may suffice.

GENERAL APPEARANCE

- Mitral facies – pulmonary hypertension, classically mitral stenosis (MS)
- Central cyanosis
- Differential cyanosis – patent ductus arteriosus and pulmonary hypertension
- Pallor
- Dyspnoea
- Accessory muscles of respiration
- Down's syndrome – ventricular septal defect (VSD)
- Turner's syndrome – coarctation, bicuspid aortic valve (AV), aortic stenosis (AS)
- Noonan's syndrome – pulmonary stenosis (PS)
- Teeth must be examined in all cases – infective endocarditis

Hands

Check the following:

- Dilated veins and palmar erythema in CO₂ retention
- Temperature – cool peripheries associated with poor flow; hyperdynamic circulation
- Peripheral cyanosis
- Clubbing – cyanotic congenital heart disease; infective endocarditis; atrial myxoma (very rare)
- Capillary pulsation – aortic regurgitation (AR), patent ductus arteriosus (PDA)
- Osler's nodes, Janeway lesions, splinter haemorrhages – infective endocarditis
- Nail-fold telangiectases – collagen vascular disease
- Arachnodactyly – Marfan's syndrome
- Xanthomas – hyperlipidaemia.

Radial and brachial pulses

- Check the rate, rhythm and synchronicity.
- Look for radiofemoral delay.
- If the pulse is chaotic, it is usually AF.
- Character – the only aspect of character that can be reliably assessed at these pulses is a collapsing or 'waterhammer' pulse.
- Look over the brachial artery for scars from previous angiography.
- Ask to measure the blood pressure.

Jugular venous pulse

- It has three waves ('a', 'c' and 'v'), and two descents ('x' and 'y').
- By convention, it is measured with the patient lying at 45° when it is often visible just above the clavicle.
- The neck must be fully supported by pillows so the sternomastoid muscles are fully relaxed.
- The head should be turned slightly to the side and a light shone obliquely across the neck to maximise the shadows of venous pulsations.
- It is measured in vertical height from the angle of Louis (sternal angle), and is normally 3–5 cm (of water/blood).
- Alteration of the patient's position does not affect the *height* of the JVP, but will alter its *position*.

- This helps to differentiate it from the carotid pulse, along with its:
 - Site
 - Double waveform
 - Ability to be compressed and obliterated
 - Presence of the hepatojugular reflux.
- If one cannot see the waveform, the vessel may be kinked and thus one cannot reliably use the JVP as a right atrium manometer.

Abnormal JVP

- Raised in fluid overload – commonly heart failure, but also in pregnancy and overenthusiastic intravenous fluid administration
- Giant ‘v’ waves – tricuspid regurgitation (TR)
- No ‘a’ waves – AF
- Inspiratory filling (Kussmaul’s sign) – pericardial constriction (e.g. tuberculous pericarditis), tamponade (e.g. renal failure, post-MI, viral pericarditis, malignancy) and severe asthma
- Cannon waves – atrio-ventricular dissociation, commonly complete heart block and also ventricular tachycardia (VT)

Carotid pulse

Three components:

- Percussion wave – the shock wave transmitted up the elastic wall of the artery
- Tidal wave – the forward-moving column of blood follows the percussion wave and is normally palpable separately
- Dicrotic notch – occurs with aortic valve closure

Abnormal carotid pulse

- Large volume collapsing – very brisk upstroke then rapid diastolic run-off from the aorta – AR, PDA, thyrotoxicosis, pregnancy and sepsis/fever
- Anacrotic – slow-rising with delayed percussion wave and sometimes a palpable judder (the anacrotic notch) on the upstroke, in AS
- Bisferiens – mixed aortic valve disease with significant regurgitation
- Judder on the upstroke – the percussion wave is followed by a pronounced tidal wave, thus a jerky pulse, in hypertrophic cardiomyopathy (HCM)
- Alternans – alternating large and small beats in very poor LV function, e.g. failure, AS, dilated cardiomyopathy

PALPATION

Apex beat and cardiac pulsations

- Displaced but not enlarged in pectus excavatum or scoliosis.
- Normally located at the fifth intercostal space in the mid-clavicular line; measure it from the angle of Louis; palpable but does not lift the finger off the chest.
- If abnormal decide whether it is:
 - Volume-loaded – mitral regurgitation (MR), aortic regurgitation (AR) or atrial septal defect (ASD)
 - Hyperdynamic, laterally displaced – ‘thrusting’
 - Pressure-loaded – AS, hypertension (HT) or HCM as long as the LV function is good
 - Forceful, minimally displaced – ‘heaving’
 - Lateral and diffuse – left ventricular failure (LVF), dilated cardiomyopathy (DCM)
 - Double-impulse (palpable atrial systole) – HCM.
- Lay the flat of the hand along the left sternal edge to feel for the sustained pressure of a left parasternal heave – RV hypertrophy of any cause, e.g. pulmonary stenosis (PS), cor pulmonale, ASD.
- Palpate each valve area in turn with the flat of the fingers, for palpable heart sounds and thrills:
 - Palpable in forceful closure
 - S₁ – MS
 - P₂ – pulmonary HT
 - S₁ and S₂ – thin patients with tachycardia.

Thrills

- Aortic area – AS
- Left sternal edge – VSD or HCM
- Apex – MR (often due to ruptured chords)
- Pulmonary area – PS
- Subclavicular area – subclavian artery stenosis
- Occasionally a diastolic thrill:
 - At the apex in MS
 - Left sternal edge in AR

AUSCULTATION

Listen to each valve area in turn and then the carotids.¹

Heart sounds

- The valve sounds are all low frequency in health, best heard with the bell of the stethoscope.
- Any added sounds – murmurs, snaps, clicks or rubs.
- Radiation from the valve areas.
- M_1 and A_2 are louder than and precede T_1 and P_2 ; the split is wider in inspiration.
- The split is reversed in AS, left bundle-branch block (LBBB) (e.g. IHD), RV pacing.
- S_2 is single in a large VSD; fixed and wide in an ASD.
- S_3 – pathological over 30 years of age, when due to rapid filling, e.g. MR or VSD, or a dilated LV with a high LV end-diastolic pressure (LVEDP), e.g. post-MI (associated with a poor prognosis) or DCM.
- S_4 – occurring at the end of diastole in HT, AS, PS, HCM or after an MI; it disappears in AF.

Murmurs

- Innocent – ejection systolic, between LSE and PV, occasionally apical; no thrill, added sounds, or cardiomegaly; normal ECG, CXR and echo.
- Pathological:
 - Organic – valvular, subvalvular
 - Functional – dilated valve ring or increased flow.
- Individual murmurs are discussed in their relevant sections.
- Loudness can be graded as 1–4 for diastolic murmurs and 1–6 for systolic or, more helpfully, ‘just audible’, ‘soft’, ‘moderate’ and ‘loud’.
- Classify as to:
 - Site,
 - Radiation,
 - Timing, and
 - Behaviour with respect to respiration and movement and effort if necessary.

¹ Candidates should understand there are a number of acceptable routines in auscultation of the heart. Examiners will often have their own preference and may ask you to explain your method. However, as long as you are clear as to why you are following your particular routine, you are unlikely to be penalised.

Lung bases

- Need to be examined for oedema.

ABDOMEN

An examination of the cardiovascular system in PACES may well stop at the lung bases. However, it may be necessary to examine for:

- Hepatomegaly – if TR is suspected
- Splenomegaly – if infective endocarditis is a possibility
- Abdominal aortic aneurysm – elderly patient, but unlikely to be the focus of the case
- Renal bruits – if macrovascular disease suspected.

PERIPHERY

- Palpate the peripheral pulses.
- Examine for peripheral oedema (firm pressure for up to 30 seconds against the tibia 6 cm above the medial malleolus).

DIP THE URINE

1. MITRAL STENOSIS

Points in the examination

- Left thoracotomy scar
- Malar flush (mitral facies)
- Chaotic ('completely irregular' or 'irregularly irregular' are alternative terms) low-volume pulse
- JVP normal height, prominent 'v' wave (if tricuspid regurgitation secondary to right ventricular hypertrophy (RVH))
- Undisplaced tapping apex; left parasternal heave (if RVH)
- Loud S_1 , opening snap, mid- to late-diastolic, rumbling, low-frequency murmur, at the apex, best heard in the left lateral position, radiating to the axilla; accentuated by exertion

Severe disease

- Short duration between S_1 and opening snap
- Longer duration of diastolic murmur
- Severity of dyspnoea

Aetiology

- Rheumatic valvular disease is by far the commonest cause – Lancefield Group-A streptococci cell wall antigens crossreact with the heart valve structural glycoproteins causing inflammation and then commissural fusion
- Non-rheumatic disease – very rare, e.g.:
 - Congenital – mucopolysaccharidoses
 - Endomyocardial fibroelastosis
 - Malignant carcinoid

Differential diagnosis

- Inflow obstruction:
 - Left atrial (LA) myxoma
 - Ball-valve thrombus
- Austin Flint murmur – associated with aortic regurgitation (AR), collapsing pulse, volume-loaded ventricle, and early diastolic murmur (EDM) at the left sternal edge (LSE)

Symptoms

- Dyspnoea on exertion, orthopnoea and PND as secondary pulmonary hypertension develops; pulmonary oedema may be precipitated by AF, pregnancy, exercise, a chest infection or anaesthesia
- Fatigue – because of the low cardiac output in moderate to severe stenosis
- Haemoptysis:
 - Alveolar haemorrhage
 - Bronchial vein rupture
 - Pulmonary infarction because of the low cardiac output and immobility
 - Bloody sputum, with chronic bronchitis due to bronchial oedema
- Systemic emboli occur in 20–30% of cases, e.g. cerebral, mesenteric, saddle or iliofemoral
- Chest pain – RVH with normal coronaries
- Palpitations and paroxysmal AF
- Right heart failure with TR and hepatic angina, ascites and oedema
- Dysphagia – from left atrial enlargement
- Infective endocarditis is unusual

Investigations

- ECG – AF, or if in sinus rhythm P mitrale; RVH; low voltage in V1; progressive right ventricular hypertrophy (RAD)
- CXR – splaying of the carina; double right heart border (enlarged left atrium); convex left heart border
- Echocardiography – necessary for differential diagnosis and to calculate the valve area
- Catheter – not initially, unless previous valvotomy, other valve disease, prior to surgery, angina or valve calcification on the CXR

Management

- Medications
- Digoxin ± verapamil or β -blocker – if AF
- Diuretics
- Warfarin if previous emboli; prosthetic mitral valve; low output with right heart failure; AF; moderate MS and no appendectomy
- The decision to intervene is based upon symptoms (NYHA grades 3–4) or a valve area of $<1 \text{ cm}^2$; options are valvuloplasty or surgery (closed or open commissurotomy or MV replacement)