

## Class 9 and 10 Notes for PHE

### Cardiovascular system examination

#### Chest pain

1. Classic exertional pain, pressure, or discomfort in the chest, shoulder, back, neck, lower jaw, or arm, upper abdomen
2. Atypical description – cramping, grinding, pricking, or tooth pain
3. Angina, myocardial infarction, or other heart issue

#### Palpitations

1. Unpleasant awareness of heart beat
2. Description – skipping, racing, fluttering, pounding, or stopping. Also may be irregular, rapidly slow down or accelerate
3. Anxious person, hyperthyroidism can have palpitations
4. Some serious arrhythmias (Dysrhythmias) like ventricular tachycardia lot of times do not produce palpitations
5. Classification of dysrhythmias (arrhythmias) can be placed in two main classes regular or irregular. Normal, slow, fast rate.
6. Diagnose – ECG (EKG)
7. Normal regular
  - a. Normal sinus rhythm: 60-100
  - b. Second degree AV block: 60-100
  - c. Atrial flutter: 75-100
8. Fast regular
  - a. Sinus tachycardia: 100-180 (exercise, fever, anxiety, caffeine, nicotine)
  - b. Supraventricular tachycardia: 150-250
  - c. Ventricular tachycardia: 110-260
  - d. Atrial flutter: 100-175
9. Slow regular
  - a. Sinus bradycardia: <60 (athlete, sleep, otherwise it is abnormal)
  - b. Second degree AV block: 30-60
  - c. Complete heart block: <40
10. Regularly irregular
  - a. Ventricular premature contractions (Ventricular bigeminy or trigeminy)
11. Irregularly irregular (no pattern at all)

- a. Atrial fibrillation
- b. Atrial flutter with varying AV blocks

## 12. Sporadic

- a. Atrial or Nodal premature contractions. Supraventricular – beat comes sooner than expected followed by pause

Shortness of breath

Swelling (edema)

1. Accumulation of excessive fluid in extravascular interstitial space. This space can absorb about 5L, can accommodate up to 10% weight gain before edema appears
2. Location, timing, setting, local or systemic
3. Cause – cardiac (right and left ventricular dysfunction), pulmonary (obstructive lung disease), nutrition/chemicals (hypoalbuminemia), position
4. Pitting edema – soft palpable swelling with increased interstitial fluid volume and retention of salt and water. Pitting after 1 to 2 seconds of thumb pressure over anterior tibia
  - a. Prolonged standing – increased hydrostatic pressure
  - b. Heart failure
  - c. Nephrotic syndrome – proteinuria that leads to hypoalbuminemia
  - d. Cirrhosis – no production of albumin
  - e. Malnutrition, malabsorption – no albumin
5. Chronic venous insufficiency – soft and pitting on pressure
  - a. Skin thickening, ulcerations, brownish pigmentation
  - b. Feet
  - c. Obstruction or incompetent valves
6. Lymphedema – initially it is soft and pitting, then it becomes indurated, hard and nonpitting. Skin is thick but no ulceration, no pigmentation

Fainting (Syncope, Blacking out)

1. Transient loss of consciousness followed by recovery. Decreased blood flow and or oxygen to the brain
2. Vasovagal syncope (common faint)
3. **Orthostatic hypotension** – going from supine to standing there is drop of SBP > 20 mm Hg, or drop DBP >10 mm Hg with 3 min of standing

4. Cardiovascular disorders
  - a. Arrhythmias
  - b. Aortic stenosis
  - c. Hypertrophic cardiomyopathy
  - d. Myocardial infarction
  - e. Massive pulmonary embolism
5. Cough syncope
6. Micturition syncope
7. Disorders that resemble syncope
  - a. Hypoglycemia
  - b. Hypocapnia due to hyperventilation

#### Techniques of examination

#### Key components of the Cardiovascular examination (heart)

1. Note general appearance and measure blood pressure and heart rate
2. Estimate the level of jugular venous pressure (central venous pressure)
3. Auscultate carotid arteries for bruits one artery at a time
4. Palpate the carotid arteries (pulse) – amplitude, contour, timing, and presence of thrill
5. Inspect the anterior chest wall – apical impulse (PMI), precordial movements
6. Palpate precordium for any heaves, thrills or palpable heart sounds.
7. Palpate PMI and determine its size if it is palpable
8. Auscultate S1 and S2 in six positions from base of the heart (second intercostal space) and move toward apex (fifth intercostal space). (Some move from apex to base)
9. Identify physiologic or paradoxical splitting of S2
10. Auscultation for abnormal sounds, including S3 and S4
  - a. Distinguish between systolic and diastolic murmurs, using maneuvers when needed
  - b. Timing, shape, grade, location, radiation, pitch and quality

#### Blood pressure and heart rate

1. Vital signs
2. Repeat once or twice to get better average picture of any change

3. Poor reliability of clinic blood pressure measurement
  - a. Multiple averaged measurements improve precision – using automated home or ambulatory BP readings

#### Jugular venous pressure (JVP)

1. Closely parallels pressure of right atrium (central venous pressure) – related to volume in venous system
2. Identifying JVP
  - a. Pulsation over right internal jugular vein. It is deep to SCM and is not directly visible most of the time. Place to locate this vein is in triangle created by two heads of SCM and clavicle.
  - b. > 12 years of age
  - c. JVP falls – with loss of blood or decreased venous vascular tone. JVP **increases** – **right and left heart failure**, pulmonary hypertension, tricuspid stenosis, AV dissociation, increased venous vascular tone, pericardial compression or tamponade
3. Measuring
  - a. Supine with slightly raised head to relax the neck and rotated slightly to left. Head of the bed raised to 30 degrees (45 degrees)
  - b. Identify (observe) internal jugular vein pulsation (differentiate this pulsation from carotid artery pulsation)
  - c. Lewis method – measuring internal jugular vein pulsation above the sternal angle
  - d. Measure distance between angle of Louis (manubriosternal joint/angle) and the highest point of internal jugular vein pulsation
  - e. Since right atrium is 5 cm below you will add 5 cm to your measurement (picture in the book). Normal JVP is  $3 + 5 = 8$  cm H<sub>2</sub>O
  - f. If pulse is >100 beats per minute, it is difficult to measure JVP
4. Internal jugular pulsation
  - a. Rarely palpable
  - b. Soft biphasic undulating quality, usually with two elevations and characteristic inward deflection (X decent)
  - c. Pulsation is eliminated by light pressure on the veins just above the sternal end of clavicle

- d. Height of pulsation changes with position, normally dropping as the patient becomes more upright
  - e. Height of pulsation usually falls with inspiration
  - f. (Pressure on abdomen pushes more blood to the heart and pulsation will increase)
5. Carotid pulsation
- a. Easy palpable
  - b. A more vigorous thrust with a single outward component
  - c. Pulsation is not eliminated by pressure on vein at sternal end of clavicle
  - d. Height of pulsation unchanged by position
  - e. Height of pulsation not changed by inspiration
6. What determines elevation of the patient JVP exam. The patient's volume status.
- a. The usual starting position is 30 degrees elevation of the head of the bed
  - b. Estimated that JVP between 30 to 45 degrees may be 3 cm lower than **catheter measurement** from the right mid atrium
  - c. IF you anticipate that JVP will be lower the head of the bed (sometimes to 0 degrees)
  - d. You are measuring JVP and on your measurement JVP is > 3 cm above the sternal angle or more 8 cm of total distance from right atrium – heart failure
  - e. An elevated JVP is 95% specific for increased left ventricular end diastolic pressure and low left ventricular EF (ejection fraction)
  - f. On examination you find that JVP is elevated on expiration and low on inspiration. What is the most likely cause? Obstructive lung disease

Carotid arteries (Carotid pulse = CP)

1. Auscultation – listen for bruits
  - a. Sound heard in patient with atherosclerosis of Carotid arteries
  - b. What can happen during palpation of carotid artery – dislodgement of atherosclerotic plaque – stroke
  - c. A bruit – is murmur like sound arising from turbulent blood flow in arteries (laminar flow in flow)

- Ask the patient to stop breathing for 10 seconds, listen with diaphragm of the stethoscope
- Place the diaphragm near the upper end of thyroid cartilage below the angle of the jaw (bifurcation of carotid artery) – reduces sounds transmitted from heart and subclavian artery
- Also can be heard behind mastoid process
- d. Other causes – tortuous carotid artery, aortic stenosis, hyperthyroidism, thoracic outlet syndrome
- 2. Palpation – upstroke amplitude, contour, thrills. Medial to SCM. Supine with head of the bed elevated to 30 degrees.
  - a. Decreased – decreased stroke volume (MI, local atherosclerosis)
  - b. Never palpate both carotid arteries at the same time. Pressure on carotid arteries can cause reflex bradycardia and drop in blood pressure
- 3. Findings
  - a. CP is small, thready (barely palpable) or weak – cardiogenic shock
  - b. CP bounding -aortic regurgitation
  - c. Carotid upstroke delayed – aortic stenosis
  - d. Thrills – vibration felt during palpation – aortic stenosis

## Pulses

1. Normal - pulse counter is smooth and rounded. Pulse pressure is approximately 30 – 40 mm Hg
2. Pulses alternans
  - a. Regular, but the force alternated between stronger and weaker.
  - b. Radial or femoral arteries best for detection
  - c. Left ventricular dysfunction
  - d. Confirm it with blood pressure cuff
    - Alternating loud and soft Korotkoff sounds or a sudden doubling of the sounds as the cuff pressure declines
3. Paradoxical pulse (Pulsus paradoxus)
  - a. Pulse variates during respiration
  - b. Greater than normal systolic blood pressure drop during inspiration – Cardiac tamponade
  - c. Acute asthma, COPD

- d. Blood pressure cuff. Difference between sounds is normally no greater than 3 to 4 mm Hg
- e. Difference between levels of > 10 mm Hg constitutes paradoxical pulse
- 4. Small weak pulse – upstroke may feel slowed, the peak prolonged
  - a. Heart failure
  - b. Hypovolemia
  - c. Severe aortic stenosis
  - d. Increased peripheral resistance – exposure to cold
- 5. Bisferiens pulse – increased arterial pulse with double peak detected during moderate compression.
  - a. Aortic stenosis or regurgitation
  - b. Hypertrophic cardiomyopathy
- 6. Large bounding pulse – pulse pressure is increased and pulse feels strong and bounding. The rise and fall may feel rapid, the peak brief.
  - a. Increased stroke volume
  - b. Decreased peripheral resistance
  - c. Fever
  - d. Anemia
  - e. Hyperthyroidism
  - f. Aortic regurgitation

## Arterial Pulses

1. Arterial pulses are palpable in arteries lying close to the body surface.
  - a. The brachial artery at the bend of the elbow just medial to biceps tendon
  - b. The radial artery on the lateral flexor surface at the wrists
  - c. The ulnar artery on the medial flexor surface at the wrist
    - Vascular arches interconnect radial and ulnar arteries.
  - d. Abdominal aorta in epigastrium
    - Same as carotid artery auscultate for bruits before palpation
    - Not palpable – celiac trunk, superior and inferior mesenteric arteries
  - e. The femoral artery just below inguinal ligament, midway between ASIS and the symphysis pubis
    - Auscultation for bruits
  - f. The popliteal artery, deep in the knee, posterior surface

- g. The posterior tibial artery, behind the medial malleolus of the ankle
- h. The dorsalis pedis on the dorsum of the foot just lateral the extensor tendon of big toe

#### Common or concerning symptoms

1. Pain and/or swelling of legs and arms (PAD)
2. Cramping in legs on exertion and relief by rest (intermittent claudication)
3. Cold, numbness, pallor, or discoloration in the legs, hair loss
4. Abdominal, flank or back pain

#### Peripheral artery disease (PAD) warning sings

1. Fatigue, aching, numbness, pain that limits activity (legs)
2. Erectile dysfunction
3. Poorly healing wounds of the legs
4. Any pain at rest in legs or feet
5. Abdominal pain after meals and associated food fear and weight loss

#### Symptom location can suggest level of obstruction

1. Buttock, hip – aortoiliac
2. Genitalia as erectile dysfunction – aortoiliac: pudendal
3. Thigh: common femoral or aortoiliac
4. Upper calf: superficial femoral
5. Lower calf: popliteal
6. Foot: tibial or dorsalis pedis

#### Techniques of examination

1. Arms: Inspect for size, symmetry, swelling, venous patterns, color
2. Palpate the upper extremity – radial, brachial
3. Abdomen: palpate inguinal lymph nodes, abdominal aorta – auscultate and palpate
4. Lower extremities - Inspect for size, symmetry, swelling, venous patterns, color
  - a. Palpate – femoral, popliteal, posterior tibial and dorsalis pedis
5. Carotid artery
6. Blood pressure in both arms and if needed in both legs



### Grading of the pulses

1. 3+ bounding
2. 2+ brisk, expected (normal)
3. 1+ diminished, weaker than expected
4. 0 absents, unable to palpate

Patient presents with unilateral calf and ankle swelling. What it is suggestive of?

1. DVT, chronic venous insufficiency , incompetent venous valves, lymphedema

Patient presents with bilateral edema of feet and legs?

1. Heart failures, cirrhosis, nephrotic syndrome

### Pitting edema scale

1. 1+ barely detectable impression
2. 2+ slight indentation; 15 seconds to rebound
3. 3+ deeper indentation; 30 seconds to rebounds
4. 4+: >30 seconds to rebound

Patient presents with painful, swollen leg, **tenderness over femoral vein**. What is possible cause of this presentation.

1. Iliofemoral thrombosis

**Homan sign** – discomfort behind the knee with forced dorsiflexion of the foot.

Ankle-Brachial Index (ABI) – ratio of blood pressure measurement in foot and arm. This test looks for arterial stenosis. In which one of these patients you would perform ABI

1. Patient presents pain in legs, claudication, numbness, weakness, weak or absent dorsalis pedis and posterior tibialis pulse, pallor or distal extremities

**The Allen test** – compares patency of the ulnar and radial arteries.

1. Patient makes tight fist with one hand, compress radial and ulnar arteries
2. Next patients opens the hand. The palm is pale
3. Release your pressure over ulnar artery. If ok palm flashes within 3 to 5 seconds

4. If testing radial artery, release radial artery and hold pressure on ulnar

Extremities are warm and without edema, No varicosities or stasis changes.

Calves are supple and nontender. No abdominal and femoral bruits. Brachial, radial, femoral, popliteal, dorsalis pedis (DP) and posterior tibial (PT) pulses are 2+ and symmetric

## Heart

### Positioning the patient

1. The patient should be supine, with head of the bed raised to 30 degrees.
2. To assess the PMI and extra heart sounds – S3 and S4 – left lateral decubitus position (brings ventricular apex closer to chest wall)
3. Aortic regurgitation – sit up and lean forward and exhale

### Sequence of Patient position in the Cardiac Examination

1. Supine with head elevated to 30 degrees – after examining JVP and carotid pulse, inspect and palpate the precordium: the second right and left intercostal spaces, RV, and LV, including the apical impulse. Auscultation with diaphragm of the stethoscope
2. Left lateral decubitus – palpate the apical impulse to assess its diameter. Listen to apex with **bell** of the stethoscope to hear S3 and S4.
3. Supine, with the head elevated 30 degrees – listen at the second right and left intercostal spaces (base), move the stethoscope towards the apex at fourth intercostal, fifth intercostal spaces.
4. Sitting, leaning forward, after full exhalation – listen down the left sternal border and at the apex with diaphragm

Inspection – look for apical impulse (PMI), ventricular movements.

Palpation of chest wall – thrill, heave, palpable S1, S2, S3, and S4. Apical impulse (PMI), pulmonic area, and aortic area.

1. Patient with thick wall (obesity) or increased AP diameter is less useful
2. Heaves – sustained impulses that rhythmically lift your fingers – if present consider ventricular enlargement, ventricular aneurysm

3. Thrills – vibration sensation (next auscultate for murmurs)
4. A brief early to mid-diastolic impulse represents palpable S3
5. Outward movement just before S1 is palpable S4
6. Apical impulse/Point of maximal impulse (PMI)
  - a. Ask patient exhale fully and stop breathing (hold exhale)
  - b. Fifth/fourth intercostal space and the midclavicular line
  - c. Diameter, 2 cm or less (
  - d. Pregnancy (or any reason of high left diaphragm) – can shift impulse up and to the left
  - e. Lateral displacement towards anterior axillary line – ventricular dilation (heart failure, cardiomyopathy, thoracic deformities)
  - f. No apical impulse – large pericardial effusion
  - g. PMI is forceful, terminates quickly, hyperkinetic – hyperthyroidism, anemia, volume overload
  - h. >3 cm left ventricular enlargement
7. Palpation of RV at left third, fourth and fifth intercostal spaces
  - a. Patient with COPD – RV impulse can be palpated high in epigastric area

#### Percussion

1. Can percuss to find the left ventricular border. From axillary line towards midclavicular line

#### Auscultation

1. Heart sounds and murmurs, dysrhythmias
2. The diaphragm – high pitched sounds – S1, S2, murmurs of aortic and mitral regurgitation, pericardial friction rubs. Push firmly against the chest
3. The bell – low pitched sound – S3, S4, murmur of mitral stenosis. Apply bell lightly. Apex then move medially along the lower sternal border
  - a. If you push too hard with bell it will stretch the skin and work as a diaphragm.
4. Pattern of auscultation
  - a. Starting at the base and moving towards the apex
  - b. Right second intercostal space – aortic valve (S2 is louder than S1)
  - c. Left second intercostal space – pulmonic valve (S2>S1)

- d. Third or fourth intercostal space just left to sternal border – tricuspid valve ( $S1 > S2$ )
- e. Left Fifth intercostal space in the midclavicular line – mitral valve ( $S1 > S2$ )
- f. Listen to splitting – can be normal
  - Expiratory splitting – valvular abnormalities
  - Persistent splitting – delayed closure of pulmonic valve or early closure of aortic valve
- g. A2 and P2 intensity.  $A2 > P2$  (comparing right and left S2 at second intercostal space)
  - $A2 < P2$  = pulmonary hypertension
- h. Extra sounds – S3, S4 (in athletes S3 and S4 is normal)
- i. Systolic and diastolic murmurs

## Murmurs

Systolic m – can be normal, or valvular disease

1. Mid-systolic, pansystolic
2. Mid-systolic: function murmurs and can be changed by maneuvers – sitting, standing, Valsalva maneuver.
  - Starts after S1 and ends before S2 ( $S1$  gap murmur gap S2)
3. Pansystolic – starts with S1 and stops at S2 (has no gaps)
  - a. Regurgitation
4. Early or late

Diastolic – valvular heart disease

1. Early – starts immediately after S2 without gap, fades before next S1
2. Mid-diastolic – starts short after S2 and fades before next S1

Murmur shapes

1. Crescendo – grows louder
2. Decrescendo – grows softer
3. Crescendo-decrescendo - rises and then falls in intensity
4. Plateau – same intensity throughout

Systolic grade

1. Grade 1/6 – softer in volume than S1 and S2, faint

2. Grade 2/6 – Equal to volume of S1 and S2
3. Grade 6/6 – louder than S1 and S2, with thrill, may be heard with stethoscope entirely of the chest

#### Diastolic grade

1. Grade 1/4- Barely audible
2. Grade 2/4 – faint but immediately audible
3. Grade 3/4 - Easily heard
4. Grade 4/4 – Very loud

Where would you hear the murmur caused by aortic valve issues the best? Right second intercostal space

Pitch of Murmur – high, low and medium

A medium pitched, grade 2/4, blowing decrescendo diastolic murmur, best heard in the fourth left intercostal space, with radiation to the apex (aortic regurgitation)

#### Maneuvers (to change murmurs)

1. Standing and squatting
  - a. Prolapsed mitral valve
  - b. Hypertrophic cardiomyopathy (decreased intensity during squatting) or aortic stenosis
2. Valsalva Maneuver
  - a. Forcible exhalation against closed glottis after full inspiration, causing increased intrathoracic pressure.
  - b. Systolic blood pressure increased (strain phase), sharp decreased below baseline as the strain phase is maintained, followed by both blood pressure drop. Fourth stage – overshoot of blood pressure (reflex sympathetic activation)
3. Isometric hand grip – increased the **systolic** murmur of **mitral regurgitation**, pulmonic stenosis and ventricular septal defect and **diastolic murmur of aortic regurgitation**
4. **Aortic stenosis – systolic murmur**
5. **Mitral stenosis – diastolic murmur**

