

## Class 7 and 8 PHE Notes

### Thorax and Lungs

Special landmarks:

1. 2nd intercostal space for needle insertion for decompression of a tension pneumothorax.
2. Intercostal space between the 4th and 5th ribs for chest tube insertion.
3. Level of the 4th rib for the lower margin of a well-placed endotracheal tube on a chest x-ray.
4. **Neurovascular structures run along the inferior margin of each rib, so needles and tubes should be placed just at the superior rib margins**
5. Note the intercostal space between the 7th and 8th ribs as a landmark for thoracentesis with needle insertion immediately superior to the 8th rib.
6. **The inferior tip of the scapula is another useful bony landmark; it usually lies at the level of the 7th rib or intercostal space.**
7. The spinous processes of the vertebrae are also useful landmarks. When the neck is flexed forward, the most protruding process is usually the vertebra of C7. If two processes are equally prominent, they are C7 and T1. You can often palpate and count the processes below them, especially when the spine is flexed.
8. The “triangle of safety” is an anatomical region in the midaxillary line formed by the lateral border of the pectoralis major muscle anteriorly, lateral border of the latissimus dorsi posteriorly, and the nipple line (4th or 5th intercostal space) inferiorly. This triangle represents a “safe position” for chest tube insertion.
9. Aspiration pneumonia is more common in the right middle and lower lobes because the right main bronchus is more vertical. For this same reason, if an endotracheal tube is advanced too far during intubation, it will more likely enter the right mainstem bronchus.

Chest Circumference.

1. Midsternal line—drops vertically along the sternum
2. Parasternal – drops vertically next to the sternal border
3. Midclavicular line—drops vertically from the midpoint of the clavicle
4. Anterior axillary line—drops vertically from the anterior axillary fold

5. Midaxillary line—drops vertically from the apex of the axilla
6. Posterior axillary line—drops vertically from the posterior axillary fold
7. Scapular line—drops from the inferior angle of the scapula
8. Paravertebral – drops next to transverse processes
9. Vertebral line—overlies the thoracic spinous processes

## Symptoms

1. Dyspnea (shortness of breath) – painless but uncomfortable awareness of breathing that is inappropriate to the level exertion.
  - a. Anxious patients may have episodic dyspnea during both rest and exercise and also hyperventilation, or rapid shallow breathing.
  - b. Respiratory and cardiovascular
  - c. Left heart failure (LVF) (MI, mitral stenosis, myocarditis) - elevated pressure in pulmonary capillaries, blood escapes into lungs- stiff lung.
    - What makes it better? Sitting, resting
    - What makes it worse? Lying down, activity
    - Any associated symptoms – cough, orthopnea, paroxysmal nocturnal dyspnea, wheezing. History of heart disease, risk factors of heart disease. Sudden or gradual
  - d. Chronic bronchitis – excessive mucus and cough (chronic productive cough for at least 3 month a year for at least 2 consecutive years) .
    - Aggravating: exertion, irritants, respiratory infection
    - Relieved by: expectorants, rest.
    - History of smoking, air pollution
  - e. COPD – (chronic bronchitis, emphysema, bronchiectasis) – slowly progressive dyspnea.
    - The degree of dyspnea, combined with spirometry, is a key component of important chronic obstructive pulmonary disease (COPD) classification systems that guide patient management
  - f. Asthma – reversible bronchial hyperresponsiveness – bronchoconstriction.
    - **Episodes of dyspnea with episode free periods**
    - Worse: allergens, irritants, cold, emotions, physical activity

- Relief: avoiding aggravating factors (triggers)
- Associated: cough, wheezing, tightness of chest
- g. Diffuse interstitial lung disease (sarcoidosis, neoplasms, idiopathic pulmonary fibrosis, asbestosis) – progressive dyspnea, (Spirometry)
  - Worse: exertion
  - Better: rest
  - Associated: pleuritic chest pain, cough, sputum, fever
- h. Pneumonia – infection of respiratory bronchioles to alveoli
  - Worse: exertion
  - Better with rest
  - Associated: pleuritic chest pain, sputum, cough, fever
- i. Spontaneous pneumothorax – leakage of air into pleural cavity through blebs on visceral pleura – partial or complete collapse of the lung.
  - Sudden onset of dyspnea with pleuritic chest pain and possibly cough
  - Worse: exertion
  - Better with rest
- j. Acute pulmonary embolism – blood clot from deep veins in legs travel to lungs and obstructs blood vessel in lungs
  - Sudden onset of dyspnea, tachypnea
  - Worse: exertion
  - Better with rest
- k. Anxiety with hyperventilation – overbreathing that can lead to respiratory alkalosis and fall in arterial pressure of carbon dioxide (pCO<sub>2</sub>)
  - Better – breathing in the bag
  - Associated: sighing, lightheadedness, numbness and tingling of hands and feet, palpitation, chest pain.
- 2. Wheezing
  - a. Musical respiratory sounds that may be audible to the patient and others
  - b. Partial lower airway obstruction from secretion, and tissue inflammation, from foreign body, bronchoconstriction
- 3. Cough
  - a. Reflex response – larynx, trachea or large bronchi. Stimulus – mucus, pus, blood, external agents – allergens, dust, foreign body, cold air, hot

- air. Other – pneumonia, pulmonary edema, compression bronchi, tumors (cancers, neoplasm), inflammation or respiratory mucosa
- b. Cough also with CVS – left heart failure (LVF)
- c. Most common reason for a cough you can see in your practice – upper respiratory tract infection.
  - The most common cause of acute cough is viral upper respiratory infections. Also consider acute bronchitis, pneumonia, left-sided heart failure, asthma, foreign body, smoking, and ACE-inhibitor therapy. Postinfectious cough, pertussis, acid reflux, bacterial sinusitis, and asthma can cause subacute cough. Chronic cough is seen in postnasal drip, asthma, gastroesophageal reflux, chronic bronchitis, and bronchiectasis
- d. Dry cough and hoarseness – acute laryngitis
- e. Dry or productive cough – acute bronchitis
- f. Dry, barking cough, slight fever, malaise, headache, mild shortness of breath – viral pneumonia or mycoplasma pneumonia
- g. Productive cough with mucopurulent sputum, with blood or blood streaks, chills, high fever, dyspnea, pleuritic chest pain – acute bacterial pneumonia
- h. Chronic cough with mucoid sputum and postnasal discharge seen in posterior pharynx - postnasal drip (allergic rhinitis with or without sinusitis)
- i. Chronic productive mucoid or purulent cough (can be blood streaked or even bloody, wheezing, dyspnea, prolonged history of smoking. Cough is at least 3 month a year and is 2 or more years in duration – chronic bronchitis
- j. Chronic productive cough, with large amounts (Copious) and foul-smelling purulent sputum, blood streaked or blood, with many recurrent infection – bronchiectasis
- k. Dry or productive cough with mucoid or purulent sputum, anorexia, weight loss, fatigue, low grade fever, night sweats – pulmonary tuberculosis
- l. Productive cough with purulent foul smelling sputum, dyspnea, fever – lung abscess

- m. Cough that appears at the end of wheezing and shortness of breath attack – asthma
  - n. Chronic cough that is more prevalent at night or early in the morning, with wheezing also at night, early morning hoarseness, and repeated attempts to clear throat – GERD
  - o. Cough dry or productive with associated weight loss (unexplained), dyspnea, and history of smoking – Lung cancer
  - p. Dry cough and dyspnea on exertion, orthopnea, paroxysmal nocturnal dyspnea – LVF
  - q. Dry cough with or without hemoptysis, tachypnea, chest pain, anxiety, syncope, and possible factors that predispose to DVT - pulmonary embolism
4. Sputum
- a. Muroid – translucent, white, gray – viral infection, allergic reaction
  - b. Purulent – yellow or green – bacterial infection
  - c. Foul smelling – lung abscess, bronchiectasis
  - d. Thick tenacious sputum – cystic fibrosis
5. Hemoptysis
- a. Blood coughed up from lower respiratory tract
  - b. Blood streaked sputum or frank blood
  - c. Causes – cough and dry mucus, malignancies, bronchitis, cystic fibrosis, pneumonia. Goodpasture's syndrome, granulomatosis with polyangiitis (Wegener granulomatosis)
  - d. Life threatening: >500 ml over 24 hr, or >100 ml/hr
6. Chest pain
- a. Angina pectoris – retrosternal or across anterior chest often radiating to the shoulder, neck, lower jaw, arm and upper abdomen.
    - Pressure, squeezing, tight, heavy, burning
    - Mild to moderate that is most of the time described as discomfort that lasts 1-3 min, up to 10 min, prolonged – up to 20 min.
    - Dyspnea, nausea, sweating
    - Worse on exertion, cold, meals, stress.
    - Relieved by rest and nitroglycerine
  - b. MI - retrosternal or across anterior chest often radiating to the shoulder, neck, lower jaw, arm and upper abdomen

- Pressure, squeezing, tight, heavy, burning
- Mild, moderate to severe that last 20 min to several hours.
- Dyspnea, nausea, sweating, nausea, and vomiting, weakness
- Worse on exertion, cold, meals, stress
- Relieved – not relieved by rest or regular dose of nitroglycerine
- c. Pericarditis – retrosternal or left precordial may radiate to the tip of the left shoulder.
  - Sharp knife like, severe
  - Worse: breathing, changing position, lying down, swallowing
  - Relieved by sitting and leaning forward
- d. Aortic dissection – anterior or posterior chest pain radiating to the neck, back, or abdomen.
  - Ripping, tearing, very severe, abrupt onset and early peak. Persistent for hours or more
  - Dyspnea, syncope, hoarseness, hemiplegia, paraplegia
- e. Parietal pleura (pleuritic pain) – pneumonia pneumothorax, pleural effusion, pulmonary embolism
  - Sharp knife like
  - Worse – deep inspiration, coughing, movements of the trunk
  - Accumulations of pleural fluid, or pleural effusions, may be transudates, seen in heart failure, cirrhosis, and nephrotic syndrome, or exudates, seen in numerous conditions including pneumonia, malignancy, pulmonary embolism, tuberculosis, and pancreatitis.
  - Irritation of the parietal pleura produces pleuritic pain with deep inspiration in viral pleurisy, pneumonia, pulmonary embolism, pericarditis, and collagen vascular diseases.
- f. Chest wall – skin, musculoskeletal structures, nerves – costochondritis (anterior rib area by the cartilage)
  - Stubbing, sticking, aching, dull
  - Herpes zoster = shingles – burning type of pain in intercostal spaces
  - Radiating pain – neck (cervical arthritis), esophagus (GERD) , stomach (Gastritis, ulcer) , gallbladder (cholecystitis)
- g. Panic and anxiety attack
- 7. Daytime sleepiness, snoring, and disorders of sleep

- a. Snoring – sleep apnea (breathing cessation for 10 seconds or more) – patient awakes with choking sensation, or morning headache
- b. Obstructive sleep apnea – daytime sleepiness, fatigue, snoring

### Physical examination

1. Inspection, palpation, percussion and auscultation

### Techniques of examination

1. Survey respiration – rate, rhythm, depth, effort, and any sight of respiratory distress
  - a. Begin by observing the patient for signs of respiratory distress.
  - b. Assess the respiratory rate for tachypnea (>25 breaths/min).
  - c. Inspect the patient's color for cyanosis or pallor. Recall earlier relevant findings, such as the shape and color of the fingernails.
  - d. Cyanosis in the lips, tongue, and oral mucosa signals hypoxia. Pallor and sweating (diaphoresis) are common in acute coronary syndromes and heart failure. Clubbing of the nails occurs in bronchiectasis, congenital heart disease, pulmonary fibrosis, cystic fibrosis, lung abscess, and malignancy.
  - e. Listen for audible sounds of breathing. Is there audible whistling during inspiration over the neck or lungs?
  - f. Audible high-pitched inspiratory whistling, or stridor, is an ominous sign of upper airway obstruction in the larynx or trachea that requires urgent airway evaluation.
  - g. Inspect the neck. During inspiration, is there contraction of the accessory muscles, namely the SCM and scalene muscles, or supraclavicular retraction? During expiration, is there contraction of the intercostal or abdominal oblique muscles? Is the trachea midline?
  - h. Accessory muscle use can signal increased ventilatory requirements due to airways and/or parenchymal lung disease or respiratory muscle fatigue. Lateral displacement of the trachea occurs in pneumothorax, pleural effusion, and atelectasis.

- i. Also observe the shape of the chest, which is normally wider than it is deep. The ratio of the anteroposterior (AP) diameter to the lateral chest diameter is usually 0.7 to 0.75 up to 0.9 and increases with aging.
  - j. The AP ratio may exceed 0.9 in COPD, producing a barrel-chest appearance, although evidence of this correlation is conflicting.
2. Inspect the posterior chest – deformities, muscle retraction, lag
  - a. Standing in a midline position behind the patient, try to visualize the underlying lobes and compare the right lung field with the left, carefully noting any asymmetries. Note the shape of the chest such as a barrel chest or and how the chest moves, including the following:
    - Deformities or asymmetry in chest expansion
    - Asymmetric expansion occurs in large pleural effusions.
    - Abnormal muscle retraction of the intercostal spaces during inspiration, most visible in the lower intercostal spaces
    - Retraction occurs in severe asthma, COPD, or upper airway obstruction.
    - Impaired respiratory movement on one or both sides or a unilateral lag (or delay) in movement
    - Unilateral impairment or lagging suggests pleural disease from asbestosis or silicosis; it is also seen in phrenic nerve damage or trauma.
3. Palpate the chest – tenderness, bruising, respiratory expansion, fremitus pectoralis)
  - a. As you palpate the chest, focus on areas of tenderness or bruising, respiratory expansion, and fremitus.
  - b. Intercostal tenderness can develop over inflamed pleurae, costal cartilage tenderness in costochondritis.
  - c. Identify tender areas. Carefully palpate any area where the patient reports pain or has visible lesions or bruises. Note any palpable crepitus, defined as a crackling or grinding sound over bones, joints, or skin, with or without pain, due to air in the subcutaneous tissue.
  - d. **Tenderness, bruising, and bony “step-offs”** are common over a fractured rib. Crepitus may be palpable in overt fractures and arthritic joints; **crepitus and chest wall edema are seen in mediastinitis.**



- e. Assess any skin abnormalities such as masses or sinus tracts (blind, inflammatory, tube-like structures opening onto the skin).
  - f. Although rare, sinus tracts suggest infection of the underlying pleura and lung (as in tuberculosis or actinomycosis).
  - g. **Test chest expansion.** Place your thumbs at about the **level of the 10th** ribs, with your fingers loosely grasping and parallel to the lateral rib cage. As you position your hands, slide them medially just enough to raise a loose fold of skin between your thumbs over the spine. Ask the patient to inhale deeply. Watch the distance between your thumbs as they move apart during inspiration and feel for the range and symmetry of the rib cage as it expands and contracts. This movement is sometimes called **lung excursion**. Unilateral decrease or delay in **chest expansion** occurs in chronic fibrosis of the underlying lung or pleura, pleural effusion, lobar pneumonia, pleural pain with associated splinting, unilateral bronchial obstruction, and paralysis of the hemidiaphragm.
  - h. Palpate both lungs for symmetric tactile fremitus. Fremitus refers to the palpable vibrations that are transmitted through the bronchopulmonary tree to the chest wall as the patient is speaking and is normally symmetric.
4. Percuss the chest – sound of resonance – flat, dull, resonant, hyperresonant, tympanic
- a. Percussion is one of the most important techniques of physical examination of the chest. Percussion sets the chest wall and underlying tissues in motion, producing audible sound and palpable vibrations. Percussion helps you establish whether the underlying tissues are air-filled, fluid-filled, or consolidated. The percussion blow penetrates only **5 to 7 cm into the chest**, however, and will not aid in detection of deep-seated lesions.
  - b. Flat – soft intensity, high pitch, short duration, (normal over thigh, large pleural effusion)
  - c. Dull – medium intensity, medium pitch, medium duration, (normal over liver, consolidation in lung)
  - d. Resonant – loud intensity, low pitch, long duration, (normal lung, simple bronchitis)

- e. Hyperresonant – very loud intensity, lower pitch, longer duration (COPD, Pneumothorax)
- f. Tympany– loud intensity, high pitch, longer duration (gastric air bubble, large pneumothorax)
- 5. Auscultation – breath sounds, adventitious sounds, transmitted voice sounds
  - a. Before beginning auscultation, ask the patient to cough once or twice to clear mild atelectasis or airway mucus that can produce unimportant added sounds.
  - b. Bedclothes, paper gowns, and even chest hair can generate confusing crackling sounds that interfere with auscultation. For chest hair, press harder or moisten the hair.
  - c. Like auscultating over clothing, air movement through a partially obstructed nose or nasopharynx can also introduce abnormal sounds.
  - d. Vesicular – inspiration last longer than expiration, soft and low pitch expiratory sound
  - e. Bronchovesicular – inspiration and expiration are almost equal, expiration sound intermediate pitch and intensity
  - f. Bronchial – expiration last longer than inspiration, can have a gap between
  - g. Tracheal – inspiration and expiration are almost equal. Loud and high pitched.

#### Respiration rate

1. Which one of these is current range of normal breathing rate
  - a. 10 -18
  - b. 12-18
  - c. 12-20**
  - d. 14-16
  - e. 10-20
2. Bradypnea – slow breathing, Tachypnea – fast breathing
3. Cyanosis of lips, tongue, oral mucosa = hypoxia
4. Clubbing – lung cancer, bronchiectasis, pulmonary fibrosis, abscess
5. Inspect the neck – positions of trachea, SCM and scalenes participation in breathing

- a. Lateral displacement of trachea – pneumothorax,, pleural effusion, atelectasis
- 6. Shape of the chest – lateral dimension of the chest is greater than anteroposterior (AP) dimension (diameter). Ratio: 0.7-0.9. Ratio can increase with age
  - a. Normal  $LD > AP = 0.7-0.9$
  - b. Barrel chest – there is increases in AP diameter. Ratio can exceed 0.9. – Emphysema (COPD)
  - c. Traumatic flail chest – multiple rib fractures – paradoxical chest movement – on inspiration injured area of the chest caves inward and expiration moves outward
  - d. Funnel chest (Pectus excavatum) – depression in the sternum. Can affect lungs, heart, blood vessels.
  - e. Pigeon chest (Pectus carinatum) – sternum displaced anteriorly, costal cartilages are depressed. AP diameter increases.
  - f. Thoracic kyphoscoliosis – abnormal spinal curvatures and vertebral rotation deform the chest
- 7. Types of respiration
  - a. Normal: 12-20 times/min in adult, in infant it can be up to 44
  - b. Rapid shallow breathing – tachypnea - restrictive lung disease, pleuritic chest pain, elevated diaphragm, salicylate intoxication
  - c. Rapid and deep breathing – hyperpnea/hyperventilation – exercise, high altitude, sepsis, anemia, hypoxia (midbrain or pons), respiratory acidosis
    - Kussmaul breathing – systemic acidosis
  - d. Slow breathing – bradypnea – drug induced respiratory depression, uremia, increased intracranial pressure
  - e. Cheyne-Stokes breathing – periods of deep breathing increasing in depth and followed by periods of apnea. Normal in child, during sleep. Heart failure, uremia, drugs, brain injury
  - f. Ataxic breathing (Biot breathing) – irregular – regular breathing that stops sudden for short interval. Meningitis, respiratory depression, brain injury
    - Also known as Biot's respirations, cluster breathing is characterized by groups, or clusters, of rapid, shallow breathing. This is followed by periods of apnea. It differs from Cheyne-Stokes respiration in that it

does not feature cycles of deep breathing, or gradual alternations in breathing patterns.

- g. Sighing respiration – breathing interrupted (punctuated) by frequent sighs – hyperventilation syndrome
- h. Obstructive breathing – expiration is prolonged – asthma, chronic bronchitis, COPD

## Physical findings in conditions

### Normal

1. Trachea in midline
2. Chest expansion – symmetrical
3. Tactile fremitus – present and symmetrical (normal)
4. Percussion – resonant
5. Breath sounds – vesicular, over large bronchi bronchovesicular or bronchial and tracheal over trachea
6. Adventitious sounds – none, may be some inspiratory crackles at the bases of the lungs
7. Transmitted voice sounds – normal, ee sounds like ee, whispered words not heard or faint

### Left side heart failure

1. Percussion – resonant
2. Trachea – midline
3. Breath sounds – vesicular
4. Adventitious sounds – **late inspiratory crackles**
5. Tactile fremitus – normal
6. Transmitted voice sounds – normal

### Chronic bronchitis

1. Percussion – resonant
2. Trachea - midline
3. Breath sounds – vesicular
4. Adventitious sounds – none, possible scattered coarse crackles in early inspiration, possible wheezes or rhonchi
5. Tactile fremitus – normal

6. Transmitted voice sounds – normal

#### Lobar pneumonia (consolidation)

1. Trachea – midline
2. Percussion – dull over affected area
3. Breath sounds – bronchial over involved area
4. Adventitious sounds – late inspiratory crackles over involved area
5. Tactile fremitus – increased over involved area
6. Transmitted voice sounds – egophony: ee heard as aa, bronchophony: spoken words louder and whispered pectoriloquy: spoken words clear and louder

#### Partial lobar obstruction (atelectasis)

1. Percussion – **dull** over airless area
2. Trachea – **may shift towards involve side**
3. Breath sounds - absent
4. Adventitious sounds - none
5. Tactile fremitus – absent
6. Transmitted voice sounds – absent

#### Pleural effusion

1. Percussion – **dull or flat**
2. Trachea – **shift towards unaffected side**
3. Breath sounds – decreased to absent. **Bronchial on top of large effusion**
4. Adventitious sounds – none, possible pleural rub
5. Tactile fremitus – decreased to absent, **increased towards the top of large effusion**
6. Transmitted voice sounds – decreased or absent, may be increased on top of large effusion

#### Pneumothorax

1. Percussion - **hyperresonant**
2. Trachea – **shift towards the unaffected side**
3. Breath sounds – decreased or absent
4. Adventitious sounds – none, **pleural rub**

5. Tactile fremitus – decreased to absent
6. Transmitted voice sounds

## COPD

1. Percussion – normal (chronic bronchitis), diffusely hyperresonant in (Emphysema)
2. Trachea – **midline**
3. Breath sounds – decreased to absent, with delayed expiration (emphysema)
4. Adventitious sounds – none, or crackles, wheezes, rhonchi of associated chronic bronchitis
5. Tactile fremitus – decreased
6. Transmitted voice sounds - normal

## Asthma

1. Percussion – resonant to diffusely hyperresonant
2. Trachea – midline
3. Breath sounds – often obscured by **wheezing**
4. Adventitious sounds – **wheezes**, possible crackles
5. Tactile fremitus – decreased
6. Transmitted voice sounds - normal

## Adventitious sounds

1. Crackles – discontinuous nonmusical sounds that can be early inspiratory and late inspiratory crackle. Small distal airways pop open after deflation. Less likely associated with secretions.
  - a. **Fine** – softer, higher pitched and more often. Heard from mid to late inspiration. **Change according to body position.** Pulmonary fibrosis (Velcro rales), interstitial pneumonitis, interstitial fibrosis
  - b. **Coarse** – have a popping sound, start early in inspiration, last through expiration (biphasic). **Can be heard anywhere and do not change with body position.** Low frequency and longer duration. Due to boluses of gas passing through the airways as they open and close. COPD, asthma, pneumonia, LHF

2. Wheezes – continuous musical sounds that occur during rapid airflow when bronchi are narrowed. Can be inspiratory, expiratory, or biphasic. Can be localized or generalized. If obstruction worsens wheezing becomes more silent until disappears. Silent chest in severe asthma.
3. Rhonchi – variant of wheezing but lower pitched, may disappear with coughing. More associated with secretions
4. Stridor – continuous, high frequency, high pitched, musical sound produced by the narrowing of upper respiratory tract. Epiglottitis, anaphylaxis, foreign body
5. Pleural rub (pleural friction rub) – discontinuous, low frequency grating sound. Biphasic nonmusical sound. Biphasic best heard in axilla and at the bases of the lung.
6. Mediastinal crunch (Hamman sign) – precordial crackles synchronized with heartbeat and not the respiration. Best heard in the left lateral position. Caused by air entering mediastinum and causing mediastinal emphysema. Produces severe central chest pain. Due to blunt trauma, pulmonary disease, rapid ascent in diving, childbirth, recreational drugs, tracheobronchial injury.