MEDICAL EDUCATION RESOURCE

FAQs,MCQs and Viva Voce

Frequently Asked Questions — Lungs

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1. What are the main functions of the lungs?
? The lungs are the **primary organs of respiration**, responsible for **exchange of oxygen and carbon dioxide**, regulation of **acid-base balance**, and participation in **filtering blood** and **metabolic activities** (like conversion of angiotensin I to II).

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2. Why is the right lung larger than the left?
? The **right lung** is larger, shorter, and wider because the **liver** lies below it, elevating the diaphragm. The **left lung** is smaller due to the **presence of the heart** on that side.

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3. How many lobes are present in each lung?
?

- **Right lung:** 3 lobes — upper, middle, and lower.
- **Left lung:** 2 lobes — upper and lower, with a **lingula** representing the middle lobe.

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4. What are the fissures of the lungs?
?

- **Right lung:** Oblique and horizontal fissures.
- **Left lung:** Only oblique fissure.

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5. What is the cardiac notch?
? A deep **indentation** on the **anterior border of the left lung** below the 4th costal cartilage to accommodate the **heart**.

6. What is the lingula?

? A **tongue-like projection** from the upper lobe of the **left lung**, equivalent to the **middle lobe** of the right lung.

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7. What is the root of the lung?

? The **collection of structures** connecting the lung to the mediastinum, including bronchi, pulmonary vessels, bronchial vessels, nerves, and lymphatics.

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8. What is the arrangement of structures in the root of the lung?

?

- **Right lung:** Bronchus – Artery – Bronchus – Veins (**B-A-B-V**).
- **Left lung:** Artery – Bronchus – Veins (**A-B-V**).

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9. What are the contents of the root of the lung?

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- Principal bronchus (right: eparterial and hyparterial)
- Pulmonary artery and veins
- Bronchial arteries and veins
- Lymph nodes and lymph vessels
- Pulmonary nerve plexuses (anterior and posterior)

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10. What is the hilum of the lung?

? A **triangular depression** on the **mediastinal surface** of each lung where structures of the root enter and leave.

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11. What are the surfaces of the lung?
?

- **Costal surface:** convex, related to ribs.
- **Mediastinal surface:** concave, related to heart and great vessels.
- **Diaphragmatic surface:** concave, rests on diaphragm.

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12. What are the borders of the lung?
?

- **Anterior border:** sharp and thin.
- **Posterior border:** rounded, corresponds to vertebral column.
- **Inferior border:** separates base from costal and medial surfaces.

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13. What is the carina?
? A **cartilaginous ridge** at the tracheal bifurcation (T4 level) marking the division into right and left bronchi.
It is **highly sensitive**, and stimulation causes **violent cough**.

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14. Why are foreign bodies more often found in the right lung?
? The **right bronchus** is **shorter, wider, and more vertical**, making it a direct continuation of the trachea.

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15. What are bronchopulmonary segments?
? **Pyramidal subdivisions** of lung tissue, each supplied by its **own segmental bronchus and artery**, and separated by connective tissue septa.

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16. How many bronchopulmonary segments are there?
? **Ten in each lung**, though some may fuse in the left lung.

17. What is the surgical importance of bronchopulmonary segments?
? Each segment is **functionally and surgically independent**, allowing **segmental resection** in disease without affecting other segments.

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18. What is the blood supply of the lungs?
?

- **Pulmonary circulation:** Pulmonary arteries (deoxygenated blood) and pulmonary veins (oxygenated blood).
- **Bronchial circulation:** Bronchial arteries (nutrient supply) and veins.

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19. What is the nerve supply of the lungs?
?

- **Parasympathetic (Vagus):** Bronchoconstriction, vasodilation, secretion.
- **Sympathetic (T1–T5):** Bronchodilation, vasoconstriction, decreased secretion.

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20. What are the stages of lung development?
? **Pseudoglandular, Canalicular, Terminal sac, Alveolar.**

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21. What is the embryological origin of the lung epithelium?
? **Endoderm** of the foregut.

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22. What is the molecular regulation of lung development?
?

- **TBX4** — induces lung bud formation.
- **FGF10** — promotes bronchial outgrowth.

- **SHH (Sonic Hedgehog)** — regulates branching pattern.

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23. When does surfactant appear in fetal life?
? Around **28–32 weeks** of gestation, produced by **Type II pneumocytes**.

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24. What is the function of surfactant?
? Reduces **surface tension** and prevents **alveolar collapse** at the end of expiration.

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25. What happens in surfactant deficiency?
? Leads to **Neonatal Respiratory Distress Syndrome (Hyaline Membrane Disease)** in premature infants.

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26. What is the histological feature of a bronchus?
? **Pseudostratified ciliated columnar epithelium**, **cartilage plates**, and **mucous glands**.

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27. What is the histological feature of a bronchiole?
? **Simple columnar to cuboidal epithelium**, **no cartilage**, and **no glands**.

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28. What are the types of alveolar cells?
?

- **Type I pneumocytes:** Thin cells for gas exchange.
- **Type II pneumocytes:** Secrete surfactant.

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29. What are the main impressions on the medial surface of the right lung?
? **Superior vena cava, inferior vena cava, azygos vein, right atrium, oesophagus.**

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30. What are the main impressions on the medial surface of the left lung?
? **Heart (left ventricle), aortic arch, descending aorta, oesophagus.**

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31. Why is knowledge of fissures important clinically?

? Helps in locating **lung lesions**, **pleural effusions**, and **interpreting X-rays**; incomplete fissures can cause **spread of infection** between lobes.

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32. What is the clinical significance of carina?

? Its **widening or distortion** on bronchoscopy indicates **subcarinal lymph node enlargement** or **carcinoma**.

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33. What are the common sites of bronchogenic carcinoma?

? **Hilum and upper lobes** of the lungs.

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34. What is pulmonary embolism?

? Blockage of a **pulmonary artery** by a **thrombus**, usually from **deep veins of legs**.

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35. What is atelectasis?

? **Collapse of alveoli** due to airway obstruction or loss of surfactant.

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36. What is bronchial asthma?

? **Reversible airway obstruction** caused by **bronchial smooth muscle constriction** and **mucus secretion**.

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37. What is bronchiectasis?

? **Permanent dilation of bronchi** due to chronic infection or obstruction, leading to **foul-smelling sputum** and recurrent infections.

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38. What is an azygos lobe?

? A **small accessory lobe** of the right lung formed by an **aberrant azygos vein** arching over the lung apex.

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39. Why is the apex of the lung important clinically?

? It may be affected in **tuberculosis** and **Pancoast tumors**, which can invade the **brachial plexus** and **sympathetic chain**.

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40. What is Pancoast’s syndrome?

? Caused by **apical carcinoma** of lung compressing **T1 spinal nerve** and **sympathetic chain**, resulting in **Horner’s syndrome** (ptosis, miosis, anhidrosis).

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41. Which condition is caused by inhalation of dust particles?

? **Pneumoconiosis** — e.g., silicosis, asbestosis, coal worker’s disease.

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42. What is emphysema?

? **Destruction of alveolar walls** and **loss of elasticity**, causing **overinflation** of lungs and **air trapping**.

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43. What is the sentinel (Virchow’s) node and its importance?

? **Left supraclavicular node** — enlargement indicates **metastasis from bronchogenic carcinoma** or **abdominal malignancy**.

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44. Why is the knowledge of lung segments important in surgery?

? Enables **segmental resection** of diseased areas without impairing function of other parts.

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45. What are the common causes of pleural effusion secondary to lung disease?

? **Pneumonia, tuberculosis, carcinoma, or pulmonary embolism.**

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46. What is postural drainage?

? A physiotherapy technique using **gravity-assisted positioning** to drain bronchial secretions from specific lung segments.

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47. Which condition involves air in the pleural cavity?

? **Pneumothorax.**

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48. What causes hoarseness in advanced lung cancer?

? **Compression of the left recurrent laryngeal nerve** by mediastinal lymph nodes.

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49. What is the clinical significance of bronchial artery anastomosis?

? Provides **collateral circulation** in pulmonary artery obstruction and contributes to **hemoptysis** in chronic lung disease.

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50. What imaging technique is most useful for detecting pulmonary embolism?

? **CT pulmonary angiography.**

Multiple Choice Questions — Lungs (With Answers)

Here are **50 comprehensive MCQs** covering the **gross anatomy, development, histology, and clinical anatomy of lungs**, ideal for MBBS and NEET-PG revision.

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1. The lungs develop as an outgrowth from which embryonic structure?

a) Midgut

b) Foregut

c) Hindgut

d) Pharyngeal pouch

Answer: b) Foregut

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2. The respiratory diverticulum appears during which week of development?

a) 2nd week

b) 3rd week

c) 4th week

d) 5th week

Answer: c) 4th week

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3. The epithelium of alveoli is derived from:

a) Ectoderm

b) Endoderm

c) Mesoderm

d) Neural crest

Answer: b) Endoderm

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4. The connective tissue and cartilage of the lungs are derived from:

a) Somatic mesoderm

b) Splanchnic mesoderm

c) Intermediate mesoderm

d) Neural crest

Answer: b) Splanchnic mesoderm

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5. The molecular factor essential for lung bud initiation is:

a) FGF10

b) WNT

c) TBX5

d) HOXA13

Answer: a) FGF10

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6. The TBX4 gene is responsible for:

a) Alveolar surfactant production

b) Lung bud formation

c) Vascular branching

d) Ciliary differentiation

Answer: b) Lung bud formation

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7. The trachea develops from:

a) Dorsal wall of foregut

b) Ventral wall of foregut

c) Midgut

d) Hindgut

Answer: b) Ventral wall of foregut

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8. The tracheo-oesophageal septum separates:

a) Pharynx and oesophagus

b) Larynx and trachea

c) Trachea and oesophagus

d) Bronchi and alveoli

Answer: c) Trachea and oesophagus

9. Which stage of lung development is characterized by formation of terminal bronchioles?

a) Canalicular

b) Pseudoglandular

c) Terminal sac

d) Alveolar

Answer: b) Pseudoglandular

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10. Surfactant is secreted by:

a) Type I pneumocytes

b) Type II pneumocytes

c) Clara cells

d) Goblet cells

Answer: b) Type II pneumocytes

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11. Surfactant production begins around:

a) 20 weeks

b) 28 weeks

c) 36 weeks

d) Birth

Answer: b) 28 weeks

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12. Surfactant prevents:

a) Pulmonary embolism

b) Alveolar collapse

c) Lung fibrosis

d) Pulmonary edema

Answer: b) Alveolar collapse

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13. Deficiency of surfactant causes:

a) Pneumonia

b) Hyaline membrane disease

c) Bronchial asthma

d) Tuberculosis

Answer: b) Hyaline membrane

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14. Which is the smallest functional unit of the lung?

a) Alveolus

b) Bronchus

c) Bronchopulmonary segment

d) Pulmonary lobule

Answer: a) Alveolus

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15. The right lung has how many lobes?

a) One

b) Two

c) Three

d) Four

Answer: c) Three

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16. The left lung has how many fissures?

a) One

b) Two

c) Three

d) Four

Answer: a) One

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17. The horizontal fissure of the right lung corresponds to which rib anteriorly?

a) 3rd

b) 4th

c) 5th

d) 6th

Answer: b) 4th

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18. The oblique fissure begins at the level of which thoracic vertebra?

a) T2

b) T3

c) T4

d) T5

Answer: c) T4

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19. The cardiac notch is present in:

a) Right lung

b) Left lung

c) Both lungs

d) None

Answer: b) Left lung

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20. The lingula belongs to which lobe?

a) Right middle lobe

b) Left upper lobe

c) Right lower lobe

d) Left lower lobe

Answer: b) Left upper lobe

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21. The right bronchus is:

a) Longer and narrower

b) Shorter and wider

c) Longer and more oblique

d) Same as left

Answer: b) Shorter and wider

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22. Foreign bodies most often enter:

a) Left main bronchus

b) Right main bronchus

c) Trachea

d) Larynx

Answer: b) Right main bronchus

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23. The ridge at the bifurcation of trachea is known as:

a) Carina

b) Lingula

c) Cardiac notch

d) Crista

Answer: a) Carina

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24. The carina is situated at the level of:

a) T2

b) T3

c) T4

d) T6

Answer: c) T4

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25. Each lung has how many bronchopulmonary segments?

a) 6

b) 8

c) 10

d) 12

Answer: c) 10

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26. The bronchopulmonary segments are separated by:

a) Pleura

b) Intersegmental septa

c) Alveolar septa

d) Bronchial walls

Answer: b) Intersegmental septa

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27. Which of the following bronchi divides before entering the lung?

a) Left principal bronchus

b) Right principal bronchus

c) Segmental bronchus

d) Terminal bronchiole

Answer: b) Right principal bronchus

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28. The pulmonary artery in the right lung root lies:

a) Above the bronchus

b) Below the bronchus

c) Between two bronchi

d) Behind the bronchus

Answer: c) Between two bronchi

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29. The pulmonary veins in both lungs lie:

a) Above bronchi

b) Anterior and inferior to bronchi

c) Posterior to bronchi

d) Between bronchi and arteries

Answer: b) Anterior and inferior to bronchi

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30. The bronchial arteries supply:

a) Alveoli

b) Bronchial walls

c) Pleura

d) Heart

Answer: b) Bronchial walls

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31. The lymph from the lungs drains first into:

a) Tracheobronchial nodes

b) Bronchopulmonary (hilar) nodes

c) Paratracheal nodes

d) Deep cervical nodes

Answer: b) Bronchopulmonary (hilar) nodes

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32. Nerve supply to the lungs is via:

a) Phrenic nerve

b) Vagus and sympathetic nerves

c) Intercostal nerves

d) Recurrent laryngeal nerve

Answer: b) Vagus and sympathetic nerves

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33. Parasympathetic stimulation of lungs causes:

a) Bronchodilation

b) Bronchoconstriction

c) Vasoconstriction

d) Dryness of airway

Answer: b) Bronchoconstriction

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34. Sympathetic stimulation causes:

a) Bronchoconstriction

b) Bronchodilation

c) Secretion increase

d) Vasodilation

Answer: b) Bronchodilation

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35. The pulmonary veins carry:

a) Oxygenated blood

b) Deoxygenated blood

c) Lymph

d) Mixed blood

Answer: a) Oxygenated blood

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36. The pulmonary arteries carry:

a) Oxygenated blood

b) Deoxygenated blood

c) Lymph

d) Mixed blood

Answer: b) Deoxygenated blood

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37. The most common site of lung abscess formation is:

a) Apex of lung

b) Posterior segment of upper lobe

c) Anterior basal segment of lower lobe

d) Lingula

Answer: b) Posterior segment of upper lobe

38. In aspiration pneumonia, the most commonly affected area is:

a) Apical lobe

b) Middle lobe

c) Posterior basal segment of lower lobe

d) Anterior segment

Answer: c) Posterior basal segment of lower lobe

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39. The most common site for primary tuberculosis is:

a) Apex of lung

b) Middle lobe

c) Lower lobe

d) Lingula

Answer: a) Apex of lung

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40. Pancoast's tumor affects which structure?

a) Carina

b) Brachial plexus and sympathetic chain

c) Phrenic nerve

d) Vagus nerve

Answer: b) Brachial plexus and sympathetic chain

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41. The hallmark of emphysema is:

a) Fibrosis

b) Loss of alveolar elasticity

c) Collapse of lung

d) Pleural effusion

Answer: b) Loss of alveolar elasticity

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42. Hoarseness of voice in lung cancer is due to:

a) Phrenic nerve injury

b) Compression of left recurrent laryngeal nerve

c) Vagus nerve irritation

d) Right recurrent laryngeal nerve compression

Answer: b) Compression of left recu

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43. The apex of the lung extends above the clavicle by:

a) 1 cm

b) 2.5 cm

c) 3 cm

d) 5 cm

Answer: b) 2.5 cm

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44. The root of the lung lies opposite which vertebrae?

a) T2–T4

b) T4–T5

c) T5–T7

d) T7–T9

Answer: c) T5–T7

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45. The azygos lobe is a feature of:

a) Left lung

b) Right lung

c) Both lungs

d) Fetal lungs only

Answer: b) Right lung

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46. The costodiaphragmatic recess is deepest in:

a) Midclavicular line

b) Midaxillary line

c) Scapular line

d) Vertebral line

Answer: b) Midaxillary line

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47. The most common cause of pulmonary embolism is:

a) Fat embolism

b) Thrombus from deep veins of legs

c) Amniotic embolism

d) Air embolism

Answer: b) Thrombus from deep veins of legs

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48. Which cell type lines most of the alveolar surface?

a) Type I pneumocytes

b) Type II pneumocytes

c) Clara cells

d) Goblet cells

Answer: a) Type I pneumocytes

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49. The main histological difference between bronchi and bronchioles is:

a) Presence of glands in bronchioles

b) Absence of cartilage and glands in bronchioles

c) Ciliated epithelium absent in bronchioles

d) Goblet cells absent in bronchioles

Answer: b) Absence of cartilage and glands in bronchioles

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50. In chest X-ray, the horizontal fissure of the right lung corresponds to which rib level?

a) 3rd rib

b) 4th rib

c) 5th rib

d) 6th rib

Answer: b) 4th rib

iva Voce — Lungs (Comprehensive MBBS-Level Discussion)

Q1. What are the main functions of the lungs?

? Exchange of gases (O? uptake and CO? elimination), regulation of blood pH, phonation assistance, and metabolic functions such as activation of angiotensin I to II.

Q2. What is the position and shape of each lung?

? Each lung is **conical**, with an **apex** projecting into the neck above the clavicle and a **concave base** resting on the diaphragm. The **right lung** is larger, shorter, and wider; the **left**

lung is smaller and narrower due to the heart.

Q3. Why is the right lung larger than the left?

? The **liver** elevates the right diaphragm making the lung shorter but broader; the **heart** occupies more space on the left, reducing lung size there.

Q4. How many lobes and fissures are in each lung?

?

- **Right lung:** 3 lobes (upper, middle, lower) with 2 fissures (oblique + horizontal).
- **Left lung:** 2 lobes (upper, lower) with 1 fissure (oblique only).

Q5. What is the cardiac notch and lingula?

? The **cardiac notch** is an indentation on the anterior border of the left lung for the heart.
The **lingula** is a tongue-like projection of the left upper lobe, equivalent to the middle lobe of the right lung.

Q6. Name the borders of each lung.

? **Anterior (thin), posterior (thick, rounded), and inferior (sharp) borders.**

Q7. What are the surfaces of the lungs?

? **Costal surface** (convex, facing ribs), **medial/mediastinal surface** (concave, facing heart and mediastinum), and **diaphragmatic surface** (concave, resting on diaphragm).

Q8. What structures form the root of the lung?

? Principal bronchus (two in right, one in left), pulmonary artery, two pulmonary veins, bronchial vessels, lymphatics, and pulmonary plexuses bound by pleura.

Q9. How are the structures arranged in the root of each lung?

? **Right lung:** Bronchus–Artery–Bronchus–Veins (**B-A-B-V**)
Left lung: Artery–Bronchus–Veins (**A-B-V**)

Q10. What is the hilum of the lung?

? The **medial surface depression** where structures of the root enter and leave.

Q11. What is the difference between right and left principal bronchi?

? Right is **shorter (2.5 cm), wider, and more vertical (25°)**; left is **longer (5 cm), narrower, and more oblique (45°)**—hence foreign bodies commonly lodge in the right.

Q12. What is the carina?

? A cartilaginous ridge at the tracheal bifurcation (T4 level) that is **extremely sensitive**, triggering the **cough reflex** when stimulated.

Q13. What are bronchopulmonary segments?

? Pyramidal subdivisions of lung tissue, each supplied by a **segmental bronchus and artery**, drained by intersegmental veins, and separated by connective-tissue septa—functionally independent.

Q14. How many bronchopulmonary segments exist in each lung?

? Usually **ten in each lung**, though some fuse in the left lung.

Q15. What is the surgical importance of these segments?

? Allows **segmental resection** in localized disease without compromising other segments.

Q16. What is the blood supply of the lungs?

?

- **Pulmonary arteries** — deoxygenated blood for gas exchange.
- **Pulmonary veins** — oxygenated blood to left atrium.
- **Bronchial arteries** — nutritional supply to bronchial walls.

Q17. What is the nerve supply of the lungs?

? **Parasympathetic (vagus):** bronchoconstriction, vasodilation, secretion.

Sympathetic (T1–T5): bronchodilation, vasoc

Q18. What is the lymphatic drainage of the lungs?

? Superficial (subpleural) and deep plexuses drain into **bronchopulmonary ? tracheobronchial ? paratracheal ? deep cervical** nodes ? thoracic or right lymphatic duct.

Q19. Which part of the lung is most affected by tuberculosis?

? **Apex**, owing to its high oxygen tension.

Q20. What are the common impressions on the right lung?

? SVC, IVC, right atrium, azygos vein, and oesophagus.

Q21. What are the impressions on the left lung?

? Heart (left ventricle), arch and descending aorta, oesophagus, and thoracic duct.

Q22. What are the four stages of lung development?

? **Pseudoglandular (5–17 wks), Canalicular (16–25 wks), Terminal sac (24 wks–birth), Alveolar (birth–8 yrs).**

Q23. From which germ layers are the lungs derived?

? **Endoderm** (epithelium) and **splanchnic mesoderm** (muscle, cartilage, connective tissue).

Q24. When does surfactant appear?

? Around **28–32 weeks** of gestation.

Q25. What is the function of surfactant?

? **Reduces surface tension** in alveoli, preventing their collapse during expiration.

Q26. Which cells secrete surfactant?

? **Type II pneumocytes.**

Q27. What is the main histological difference between bronchus and bronchiole?

? **Bronchi** possess cartilage plates and glands; **bronchioles** lack both.

Q28. Name the two types of alveolar cells and their functions.

? **Type I:** gas exchange; **Type II:** surfactant secretion.

Q29. What is the respiratory membrane?

? A thin barrier between alveolar air and blood: alveolar epithelium + fused basement membranes + capillary endothelium.

Q30. What is the significance of negative intrapleural pressure?

? Keeps lungs inflated against the chest wall, preventing collapse.

Q31. Why are foreign bodies more often found in the right lower lobe?

? Because the **right bronchus** is vertical and wider; gravity directs objects into **posterior basal segment**.

Q32. What is bronchogenic carcinoma?

? Malignant tumor arising from **bronchial epithelium**, strongly linked to smoking; commonly located near the **hilum**.

Q33. How does bronchogenic carcinoma cause hoarseness of voice?

? By compressing the **left recurrent laryngeal nerve** as it loops under the aortic arch.

Q34. What is bronchiectasis?

? **Irreversible dilation** of bronchi due to chronic infection and wall destruction, usually in **lower lobes**.

Q35. What is pulmonary embolism?

? Blockage of a pulmonary artery by a **thrombus** from the deep veins of the legs.

Q36. What is pneumothorax?

? Air in the **pleural cavity** causing lung collapse; may be spontaneous, traumatic, or tension type.

Q37. What is atelectasis?

? **Collapse of alveoli** due to airway obstruction or surfactant deficiency.

Q38. What is emphysema?

? **Permanent enlargement of air spaces** with destruction of alveolar walls, leading to air trapping and poor gas exchange.

Q39. What is Pancoast's tumor?

? Apical carcinoma of lung invading **brachial plexus (T1)** and **sympathetic chain**, producing **shoulder pain and Horner's syndrome**.

Q40. What is Horner's syndrome?

? Triad of **ptosis, miosis, and anhidrosis** from sympathetic interruption, often due to apical lung tumor.

Q41. What is pulmonary infarction?

? **Wedge-shaped necrosis** of lung tissue following pulmonary embolism; apex toward hilum, base toward pleura.

Q42. What is an azygos lobe?

? An accessory lobe of the **right lung** formed when the azygos vein arches over the apex, creating an extra fissure—radiologically benign variant.

Q43. What is neonatal respiratory distress syndrome (NRDS)?

? Seen in premature infants from **surfactant deficiency**, causing alveolar collapse and formation of **hyaline membranes**.

Q44. What is pleural effusion secondary to lung disease?

? Accumulation of fluid in pleural cavity due to pneumonia, carcinoma, or heart failure; obliterates costodiaphragmatic recess.

Q45. What is postural drainage?

? A physiotherapy technique that uses gravity to drain mucus from specific bronchopulmonary segments.

Q46. What is the sentinel (Virchow's) node and its importance?

? **Left supraclavicular lymph node**—its enlargement indicates metastasis from thoracic or abdominal malignancy, especially lung cancer.

Q47. What are the histological layers of an intrapulmonary bronchus?

? Epithelium (pseudostratified ciliated), lamina propria, smooth muscle, submucosa with glands, cartilage plates, adventitia.

Q48. What is the function of Clara cells?

? Present in terminal bronchioles; **detoxify harmful substances** and **secrete components of surfactant**.

Q49. Why does left lung infection occasionally spread to pericardium?

? The **mediastinal pleura** and **pericardium** are closely related on the left side, allowing inflammatory extension.

Q50. Why is understanding lung anatomy important clinically?

? It guides **bronchoscopy, radiological interpretation, thoracic surgery, and emergency procedures** such as **chest tube insertion**.