

Lecture 5: Lungs

Learning objectives

By the end of the lecture the student will be able to:

- Describe the normal anatomy of lungs
- Interpret the typical appearance of chest X-ray and CT scan.
- Interpret anatomical facts with its major clinical applications

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- ✚ The two lungs are organs of respiration located within the thoracic cavity.
 - ✚ They are soft, spongy and very elastic.
 - ✚ Lie on either side of the mediastinum surrounded by the right and left pleural cavities.
 - ✚ Each lung has a half-cone shape, with a **base**, **apex**, **two surfaces** and **three borders**(Fig.5-1)
 - The **base**: concave and resting on the diaphragm.
 - The **apex**: blunt, projects above the first rib and into the root of the neck. about 1 in. (2.5 cm) above the clavicle.
 - **The three borders**
 - ⇒ The **inferior border** of the lung is sharp and separates the base from the costal surface.
 - ⇒ The **anterior** and **posterior borders** separate the costal surface from the medial surface. **The anterior** and **inferior borders** are sharp; **the posterior** border is smooth and rounded.
 - **The two surfaces**
 - ⇒ The **costal surface** lies immediately adjacent to the ribs and intercostal spaces of the thoracic wall.
 - ⇒ The **medial surface**: is divided into (**Fig. 5-2**):
 - **Posterior vertebral part**: related to the vertebral column.
 - **Anterior mediastinal part**: related to the mediastinum and contains the hilum of the lung. It shows a number of impressions that differ on the two sides (**table 1, Fig.**).

Table 1: Relations of the mediastinal surface in both lungs

Mediastinal surface of right lung	Mediastinal surface of left lung
1-Cardiac impression (related to the right atrium)	1- Cardiac impression (related to the left ventricle)
2-Superior vena cava	2-Arch of the aorta
3- Lower part of right brachiocephalic vein	3- Left subclavian artery
4- Inferior vena cava	4- Descending thoracic aorta
5-Azygos vein	5-Oesophagus
6-Oesophagus	
7-Trachea	

- **Lobes and fissures (Fig. 5-1):**

- * The **right lung** is shorter and larger than the left lung. It has three lobes (superior, middle and inferior) and two fissures (oblique and horizontal)
- * The **oblique fissure** separates the inferior lobe from the superior lobe and the middle lobe of the right lung.
- * The **horizontal fissure** separates the superior lobe from the middle lobe.
- * **Left lung** is smaller than the right lung and has two lobes (superior and inferior separated by an oblique fissure.
- * **The anterior border** of the left lung has a deep **cardiac notch**, an indentation consequent to the deviation of the apex of the heart to the left side.
- * This indentation often creates a thin, tongue-like process of the superior lobe, the **lingula**.

- **The root of each lung**

- Is a short tubular collection of structures that together attach the lung to structures in the mediastinum.
- The root is surrounded by a tubular sheath of pleura, which joins the mediastinal parietal pleura to the visceral pleura covering the lungs

- The **hilum** is on the medial surface of the lung; it is where structures enter and leave the lung.

- The **pulmonary ligament**

⇒ A thin fold of pleura projects inferiorly from the root of the lung and extends from the lung to the mediastinum (**Fig. 5-3**).

⇒ It accommodates the down-and-up movements of structures in the root during breathing.

Structures within each root and located in the hilum are:

- A pulmonary artery.
- Two pulmonary veins.
- A main bronchus,
- Bronchial vessels.
- Nerves
- Lymphatics

Generally, the pulmonary artery is superior at the hilum, the pulmonary veins are inferior, and the bronchi are posterior in position (Fig. 5-3)

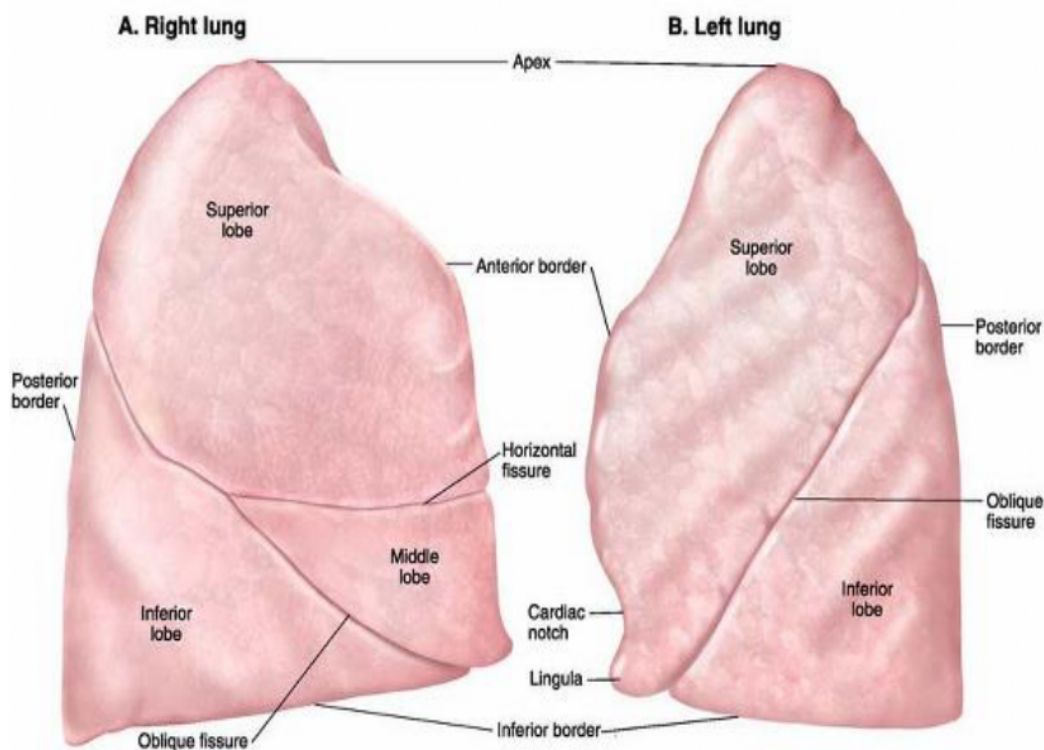


Fig. 5-1: Borders, lobes, and fissures of the lungs

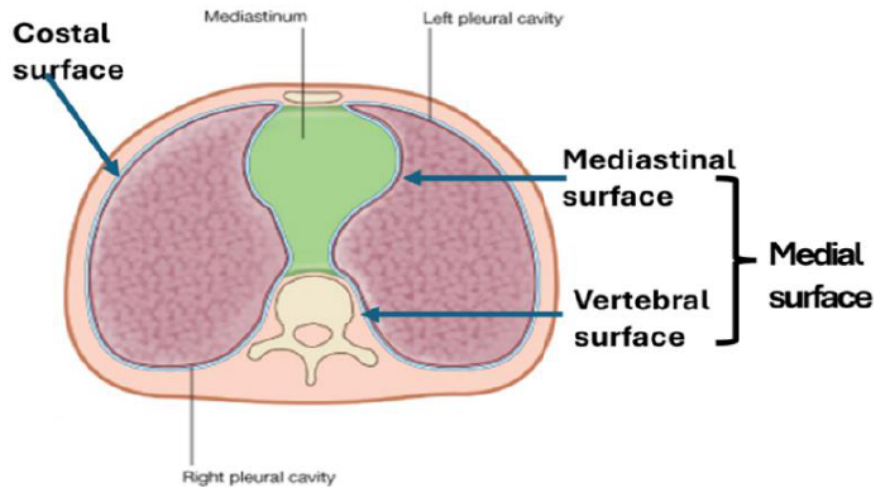


Fig.5-2: Transverse section in the thorax showing medial and costal surfaces of the lung

Bronchial tree

- * The trachea bifurcates at the level of the **4th thoracic** vertebra (or sternal angle) into two **main (primary) bronchi**, one to each lung, passing inferolaterally to enter the lungs at the hila.
- * The main bronchus divides within the lung into **lobar bronchi (secondary bronchi)**, each of which supplies a lobe. On the right side, the lobar bronchus to the superior lobe originates within the root of the lung. On the left side the main bronchus is superior to the pulmonary artery where it branches within the lung itself.
- * The **lobar bronchi** further divide into **segmental bronchi (tertiary bronchi)**, which supply bronchopulmonary segments.
- * Within each **bronchopulmonary segment**, the segmental bronchi give rise to multiple generations of divisions and, ultimately, to **terminal bronchioles**. Each terminal bronchiole gives rise to several generations of **respiratory bronchioles**, and each respiratory bronchiole provides **alveolar ducts**, each of which gives rise to **alveolar sacs** lined by **alveoli**. The alveolus is the basic structural unit of gas exchange in the lung

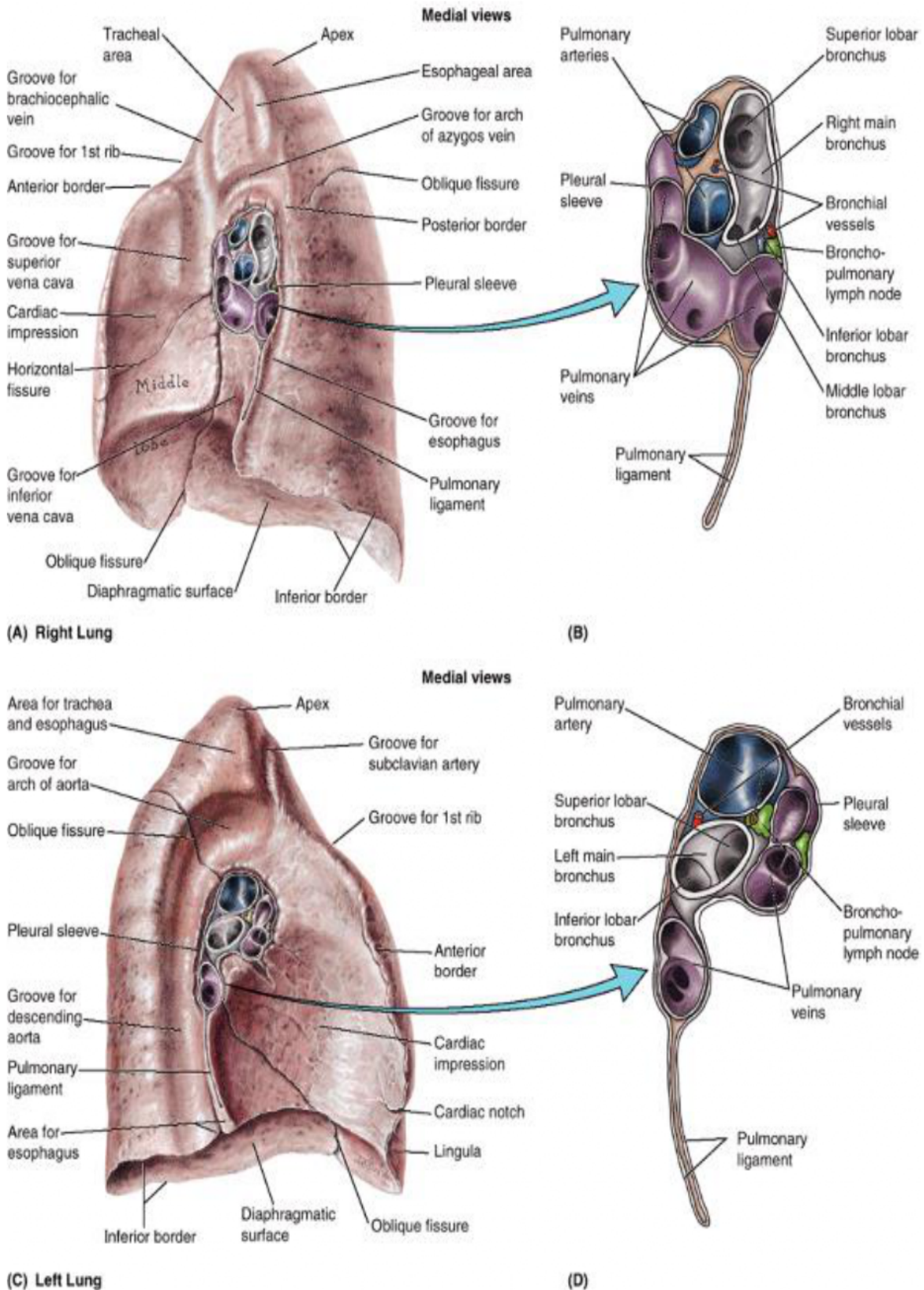


Fig.5-3: Mediastinal surfaces and hila of lungs.

Bronchopulmonary segment (Fig.5-4,5)

- It is a subdivision of a lung lobe.
- It is pyramid shaped, with its apex at the origin of the segmental bronchus and the base projected peripherally onto the surface of the lung
- It is surrounded by connective tissue septa.
- It has a segmental bronchus, a segmental artery, lymph vessels, and autonomic nerves.
- The segmental tributaries of the pulmonary vein tend to pass intersegmentally in the connective tissue between adjacent bronchopulmonary segments.
- *A bronchopulmonary segment is the smallest area of lung that can be isolated and removed surgically without affecting adjacent regions.*

⇒ There are **ten bronchopulmonary segments** in each lung some of them fuse in the left lung.

⇒ The main bronchopulmonary segments (Fig. 5-4) are as follows:

- **Right lung**

Superior lobe: Apical, posterior, anterior

Middle lobe: Lateral, medial

Inferior lobe: Superior (apical), medial basal, anterior basal, lateral basal, posterior basal

- **Left lung**

Superior lobe: Apical, posterior(apicoposterior), anterior, superior lingular, inferior lingular

Inferior lobe: Superior (apical), medial basal, anterior basal(anteromedial basal), lateral basal, posterior basal.

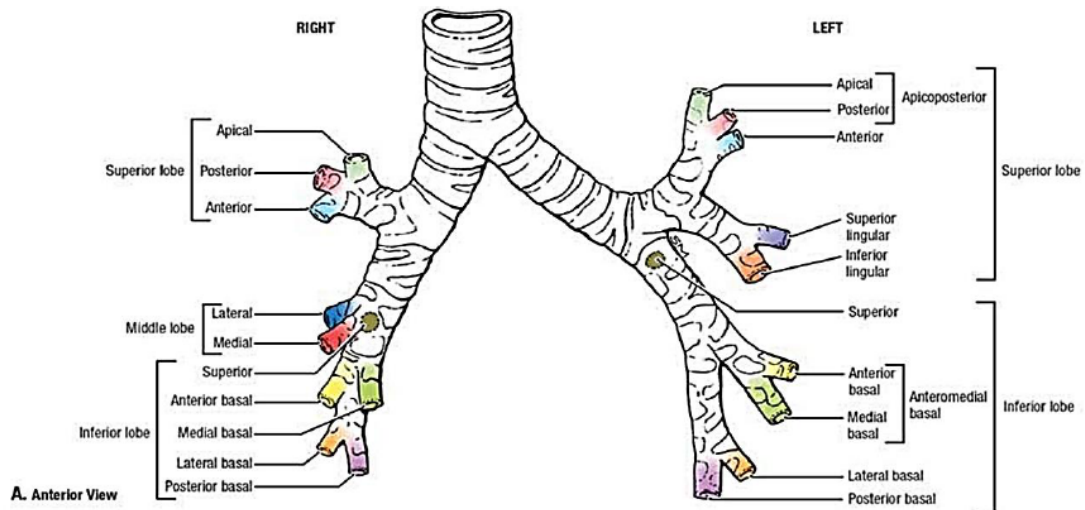


Fig.5-4 : Segmental bronchi and bronchopulmonary segments

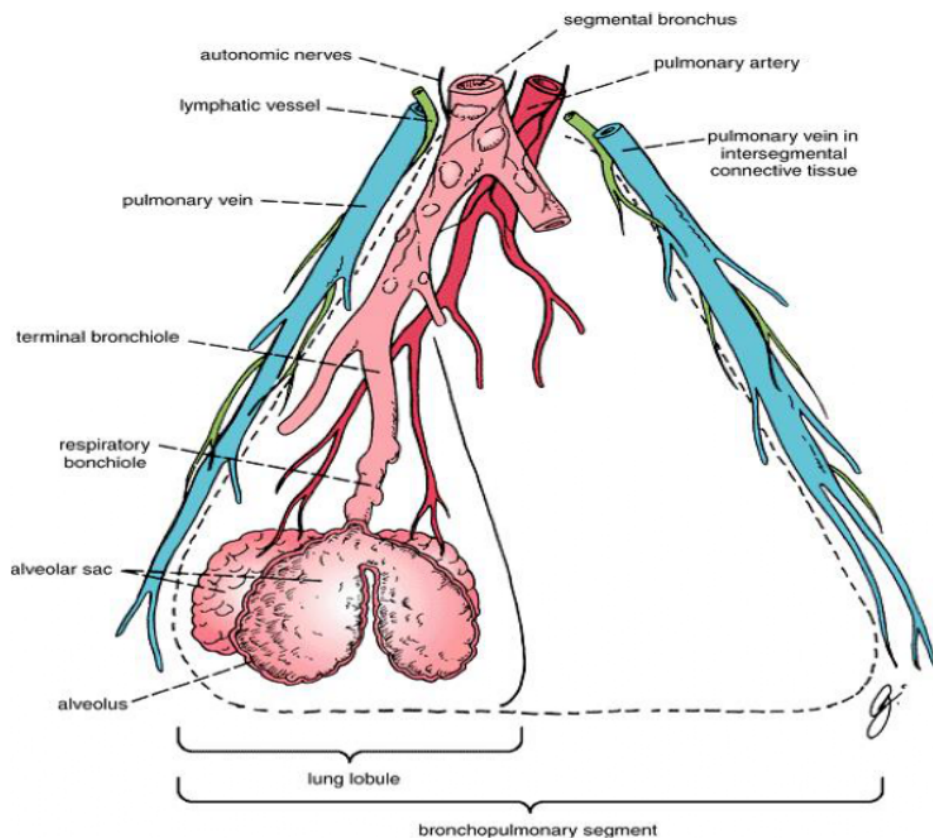


Fig. 5-5: A bronchopulmonary segment and a lung lobule. Note that the pulmonary veins lie within the connective tissue septa that separate adjacent segments

Blood Supply of the lungs and visceral pleura

- The bronchial arteries and veins constitute the 'nutritive' vascular system of the lung and visceral pleura. They interconnect within the lung with branches of the pulmonary arteries and veins.
- **On the right side a single right bronchial artery** arises from the third posterior intercostal artery or from the upper left bronchial artery.
- **On the left side: Two left bronchial arteries** arise directly from the thoracic aorta.
- The **bronchial veins** drain into the azygos vein on the right or into the left superior intercostal vein or hemiazygos vein on the left.
- The right and left pulmonary arteries originate from the **pulmonary trunk** and carry deoxygenated blood to the lungs from the right ventricle of the heart. On each side a **superior pulmonary vein** and an **inferior pulmonary vein** carry oxygenated blood from the lungs back to the left atrium of the heart.

Nerve supply of the lungs and visceral pleura

- The visceral pleura and the lung are supplied by **the anterior pulmonary plexus and posterior pulmonary plexus**. These plexuses lie anteriorly and posteriorly to the tracheal bifurcation and main bronchi.
- These plexuses originate from the sympathetic trunks and vagus nerves.
- Note that visceral efferents from:
 - ✚ The vagus nerves constrict the bronchioles.
 - ✚ The sympathetic system dilate the bronchioles.

Lymphatic drainage of the lung (Fig.5-6)

Superficial, or subpleural, and deep lymphatics of the lung drain into nodes called **tracheobronchial lymph nodes** around main bronchi and along the sides of the trachea.

Efferent vessels from these nodes drain into the **right** and **left bronchomediastinal trunks**. These trunks drain directly into **the right lymphatic trunk** or **thoracic duct**.

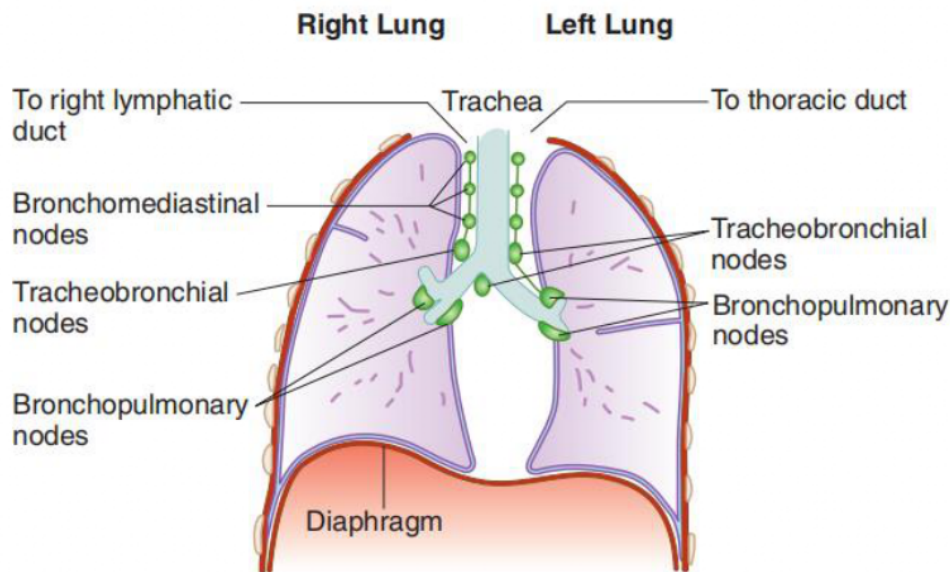


Fig.5-6: Lymph drainage of the lung.

The surface anatomy of the lung(Fig.4-7)

- The **apex of the lung** is represented by a point 1 in. (2.5 cm) above the junction of the medial and intermediate thirds of the clavicle.
- The **anterior border of the right lung** begins from the apex and extends behind **the sternoclavicular joint** and runs downward, almost reaching **the midline** behind the **sternal angle**. It then continues downward vertically until it reaches the **xiphisternal joint**.
- The **anterior border of the left lung** has a similar course, but at the level of the **fourth costal cartilage** it deviates laterally and extends for a variable distance beyond the lateral margin of the sternum to form the **cardiac notch**. The anterior border then turns sharply downward to the level of **the xiphisternal joint**
- **The lower border of the lung** follows a curving line, which crosses

- ⇒ the **6th rib** in the **midclavicular line** and
- ⇒ the **8th rib** in the **midaxillary line**, and
- ⇒ reaches the **10th rib** adjacent to the vertebral column posteriorly.

- **The posterior border** of the lung extends downward from the **spinous process of the 7th cervical vertebra** to the level of the **10th thoracic vertebra** and lies about **1.5 in. (4 cm) from the midline**.
- **The oblique fissure** of the lung can be indicated on the surface by a line drawn from the root of the spine of the scapula obliquely downward, laterally and anteriorly, following the course of the **sixth rib to the sixth costochondral junction**. In the left lung the upper lobe lies above and anterior to this line; the lower lobe lies below and posterior to it.
- In the **right lung**, the **horizontal fissure**, may be represented by a line drawn horizontally along the **fourth costal cartilage** to meet the oblique fissure in the **midaxillary line**. Above the horizontal fissure lies the upper lobe and below it lies the middle lobe; below and posterior to the oblique fissure lies the lower lobe

The orientations of the oblique and horizontal fissures determine where clinicians should listen for lung sounds from each lobe.