

The lungs

*The lung is the essential organ of respiration.

***Parts:** Each lung is cone shaped and has the following parts:

An apex , a base , 3 borders and 3 surfaces:

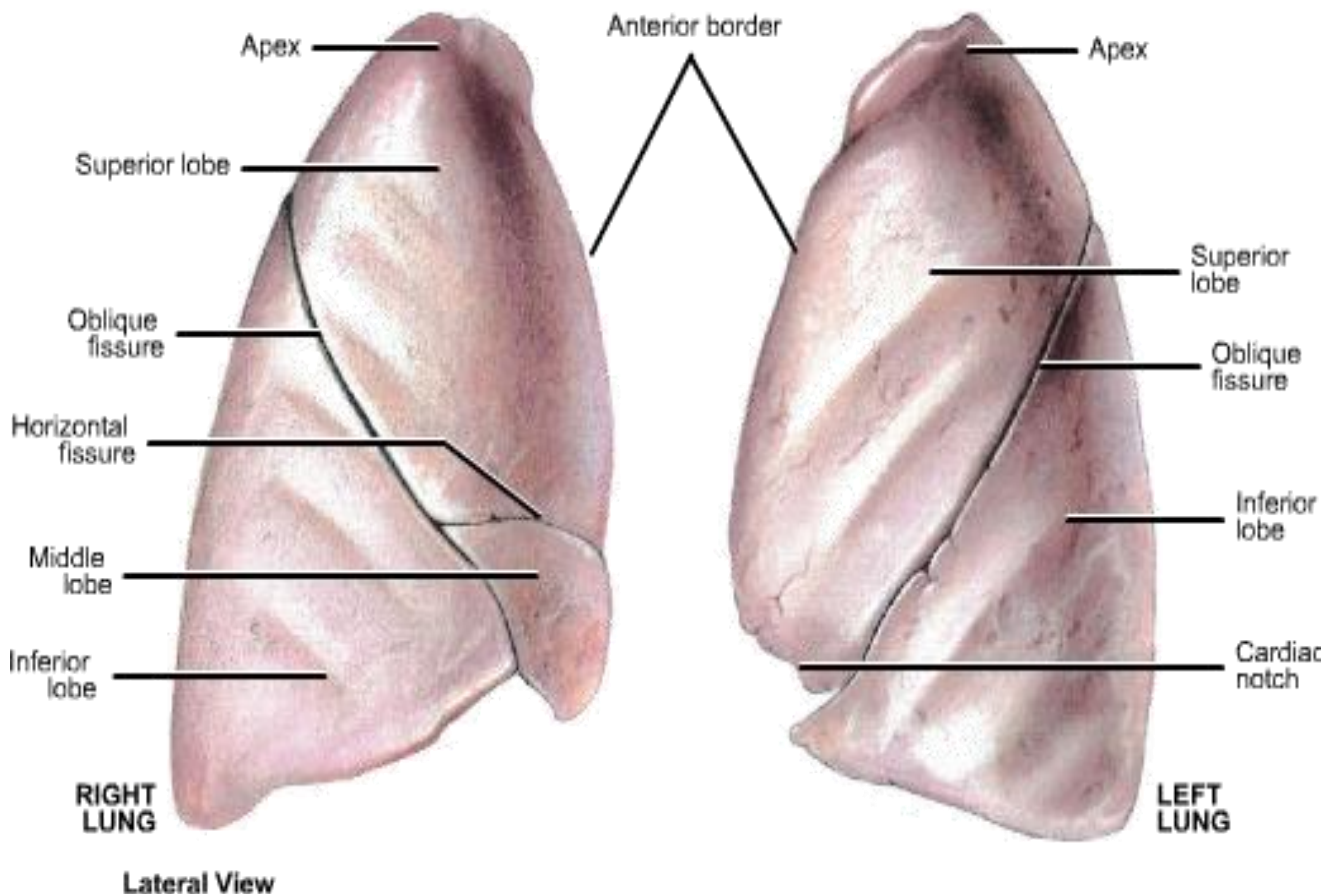
- **Apex:** is the rounded upper end, projects up in the root of the neck about one inch above the medial 1/3 of clavicle. It is covered by the cervical pleura and supra pleural membrane (*Sibson's fascia*).
- **Base** (diaphragmatic surface): is concave because it rests on the cupula of the diaphragm. The base of the right lung is more concave , related to right cupula of diaphragm which separates the this lung from the right lobe of liver. The diaphragm separates the left lung from left lobe of liver, stomach and spleen.
- **3 surfaces:**
 - a) **Diaphragmatic surface** (Base)
 - b) **Costal surface:** smooth and convex, it is related to the ribs, costal cartilages and intercostal spaces, hence the name costal surface.
 - c) **Medial surface:** divided into two parts:
 1. **Vertebral surface:** is convex and related to thoracic vertebrae , intervertebral discs , beginning of posterior intercostal vessels and nerves, the sympathetic chain and greater splanchnic nerves.
 2. **Mediastinal surface:** is concave and presents the hilum of the lung and related to the pericardium and mediastinal structures.

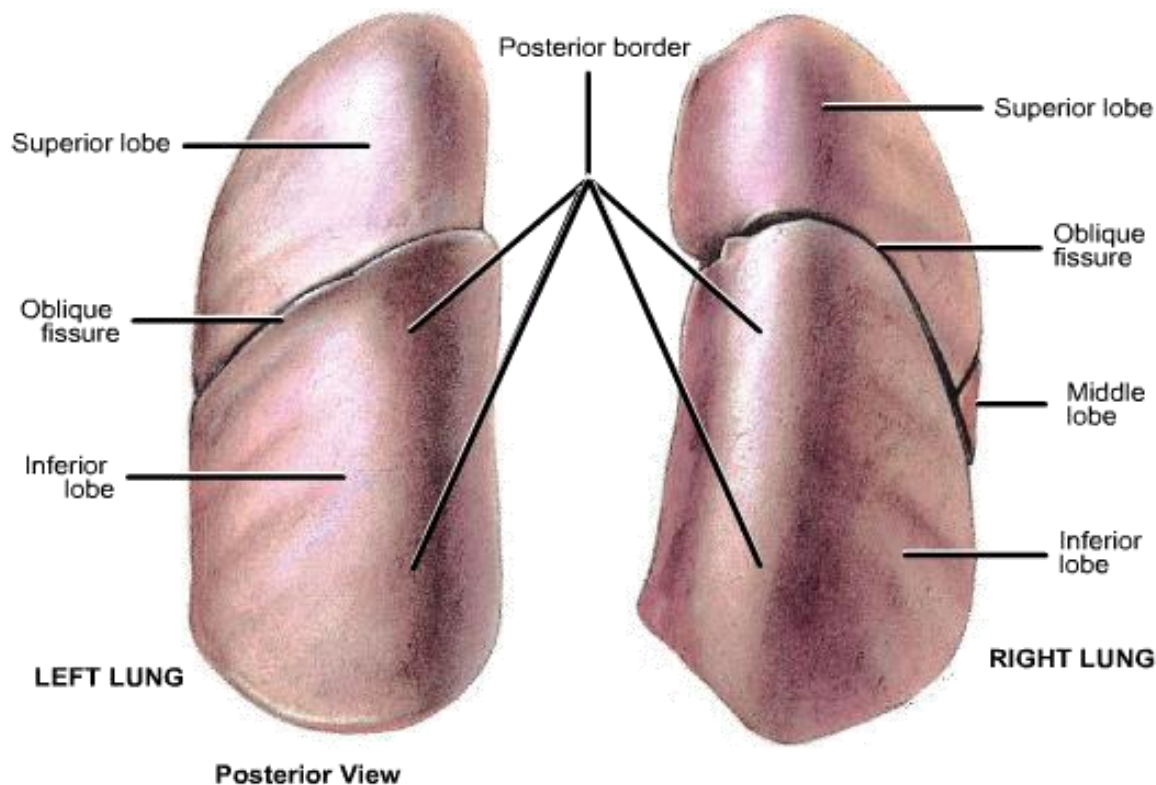
○ **3 borders:**

a) **Anterior border:** thin and sharp. It separates the costal from the mediastinal surfaces. A notch in its upper part for 1st rib is seen. *In the left lung*, the anterior border deviates to the left from the 4th to the 6th costal cartilage to form the cardiac notch, below which is the lingula.

b) **Posterior border:** rounded and fits in the paravertebral gutter. This border separates the costal from the mediastinal surface posteriorly.

c. **Inferior border:** sharp and surrounds the base of the lung.

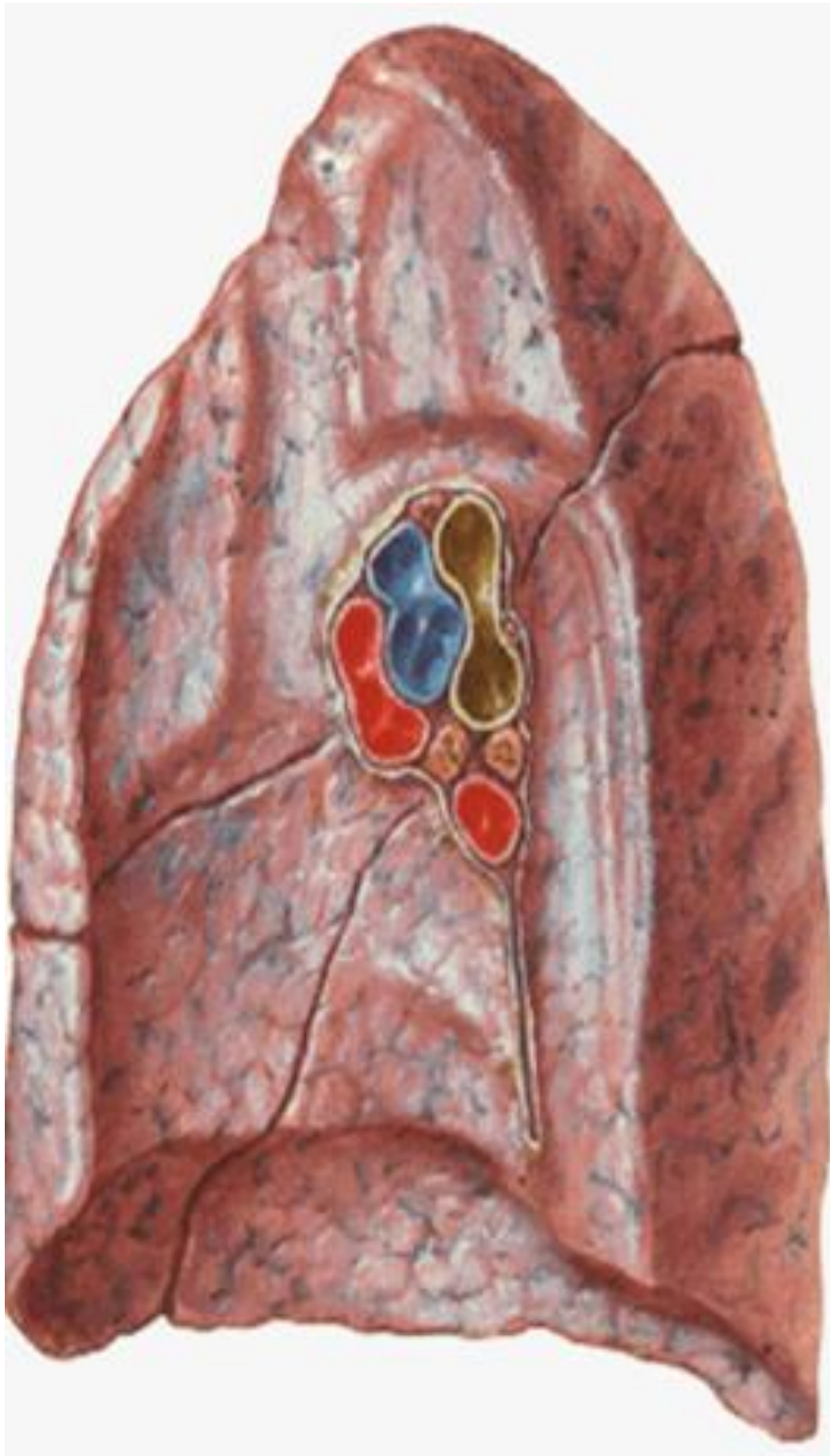




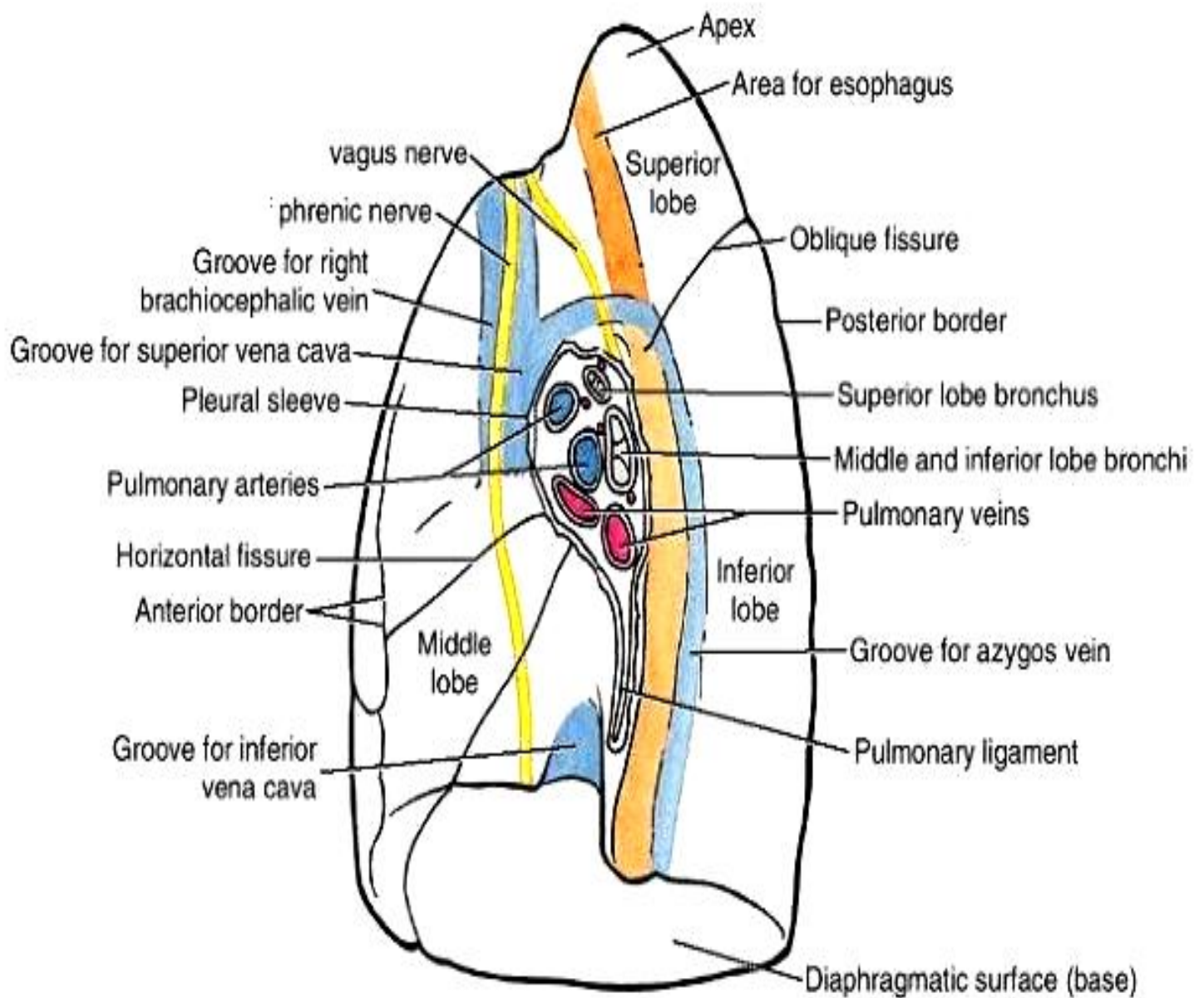
Mediastinal surface of the right lung

*The mediastinal surface of the right lung is related to the venous side of the heart i.e. the right atrium, superior vena cava and inferior vena cava.

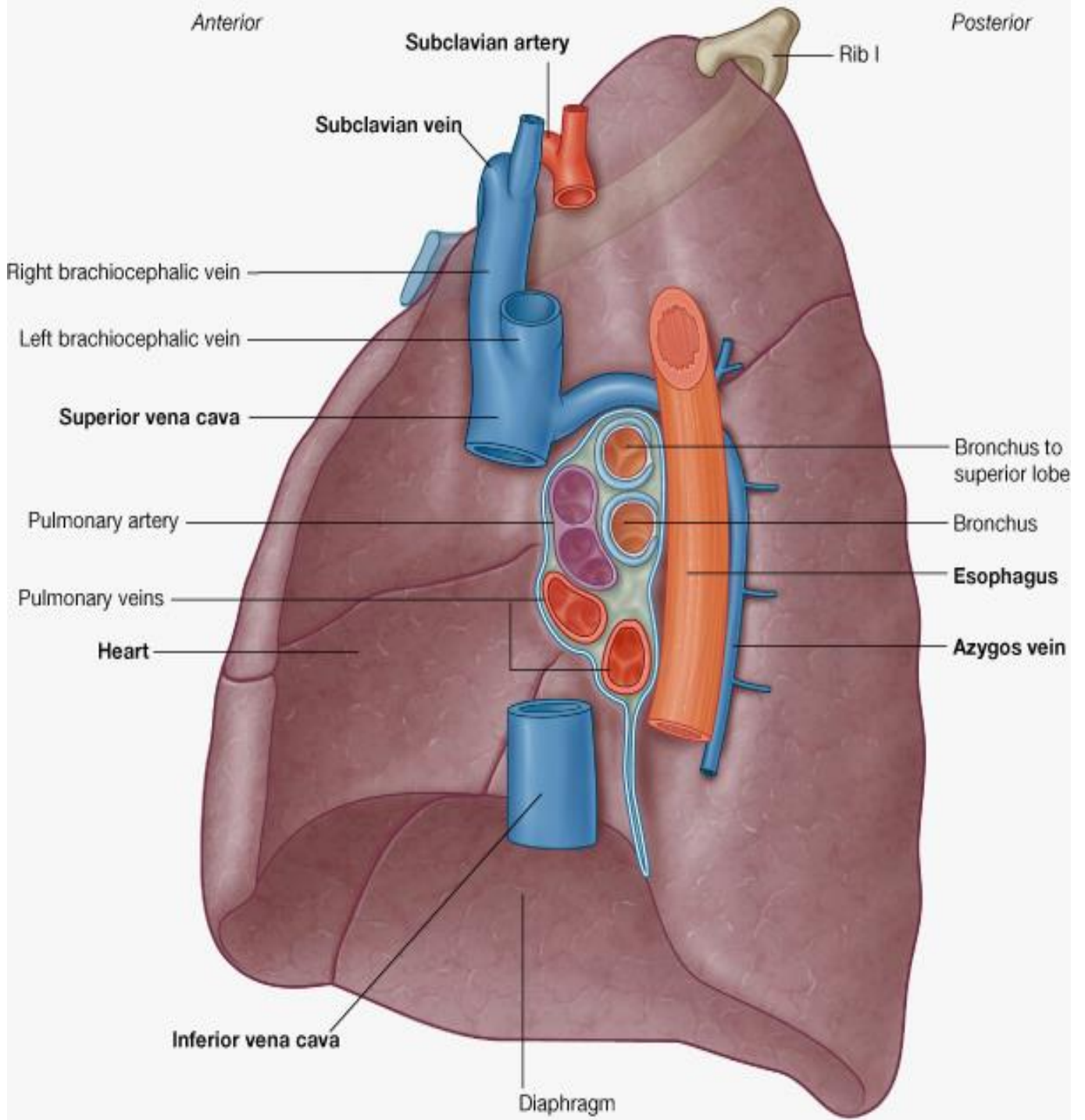
1. The most prominent feature is the **hilum** and attachment of pulmonary ligament.
2. **In front of the hilum:** is a concave cardiac impression for *right atrium*. Two vertical grooves one from above for *superior vena cava (S.V.C.)* and the other from below for *inferior vena cava (I.V.C.)*, join the cardiac impression.
3. **Behind the hilum:** is a groove for the *esophagus*. Behind the esophagus another vertical groove for the *azygos vein*.
4. **Just above the hilum:** there is a groove for the *arch of azygos*.
5. **Above the arch of azygos:** are **3 grooves**; anterior for *right brachiocephalic vein*, in the middle for *trachea* and posterior for the *esophagus*.
6. *Right phrenic nerve* passes in front of the hilum and the *right vagus* nerve passes behind the hilum.

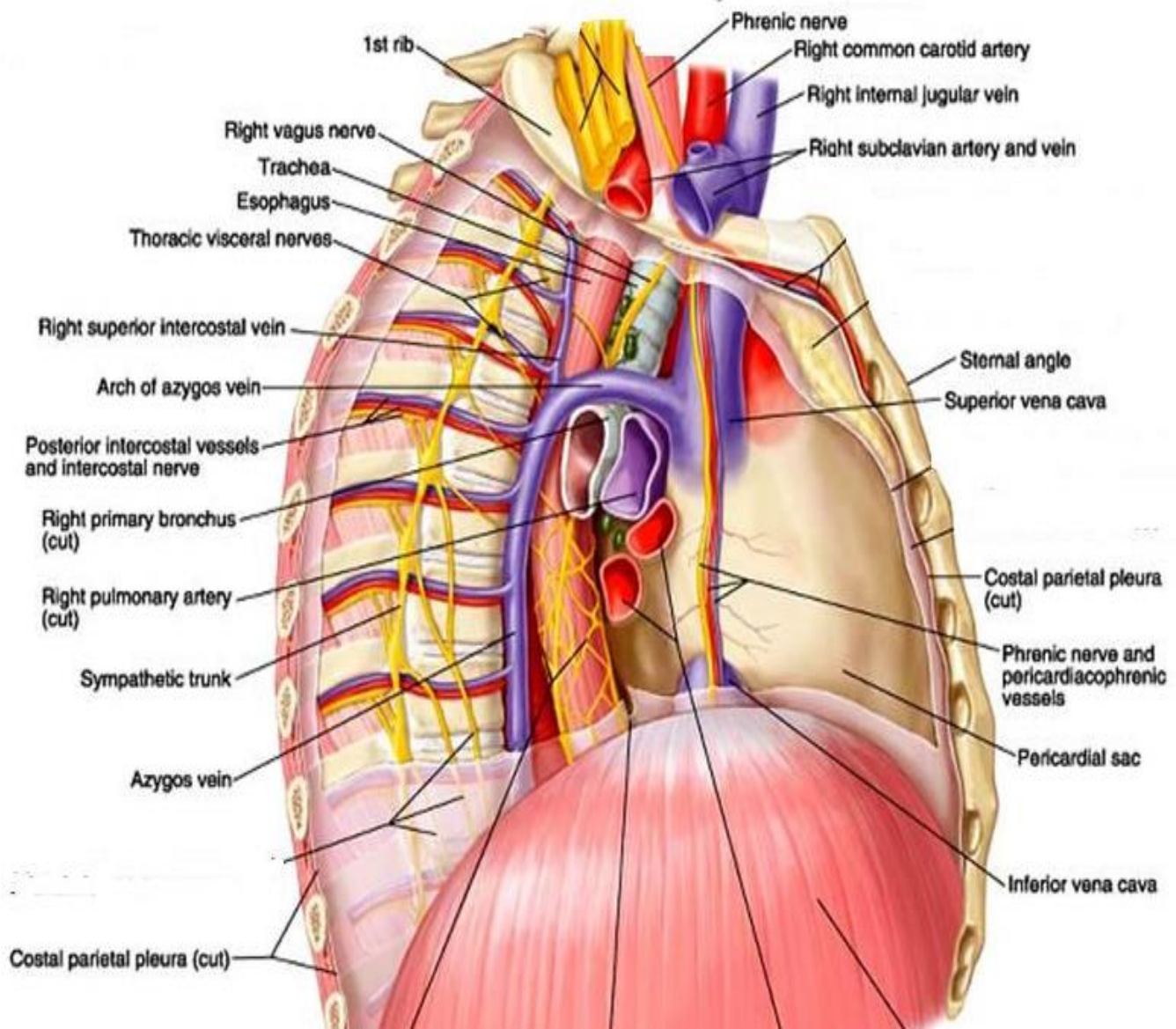


Mediastinal surface of the right lung



B



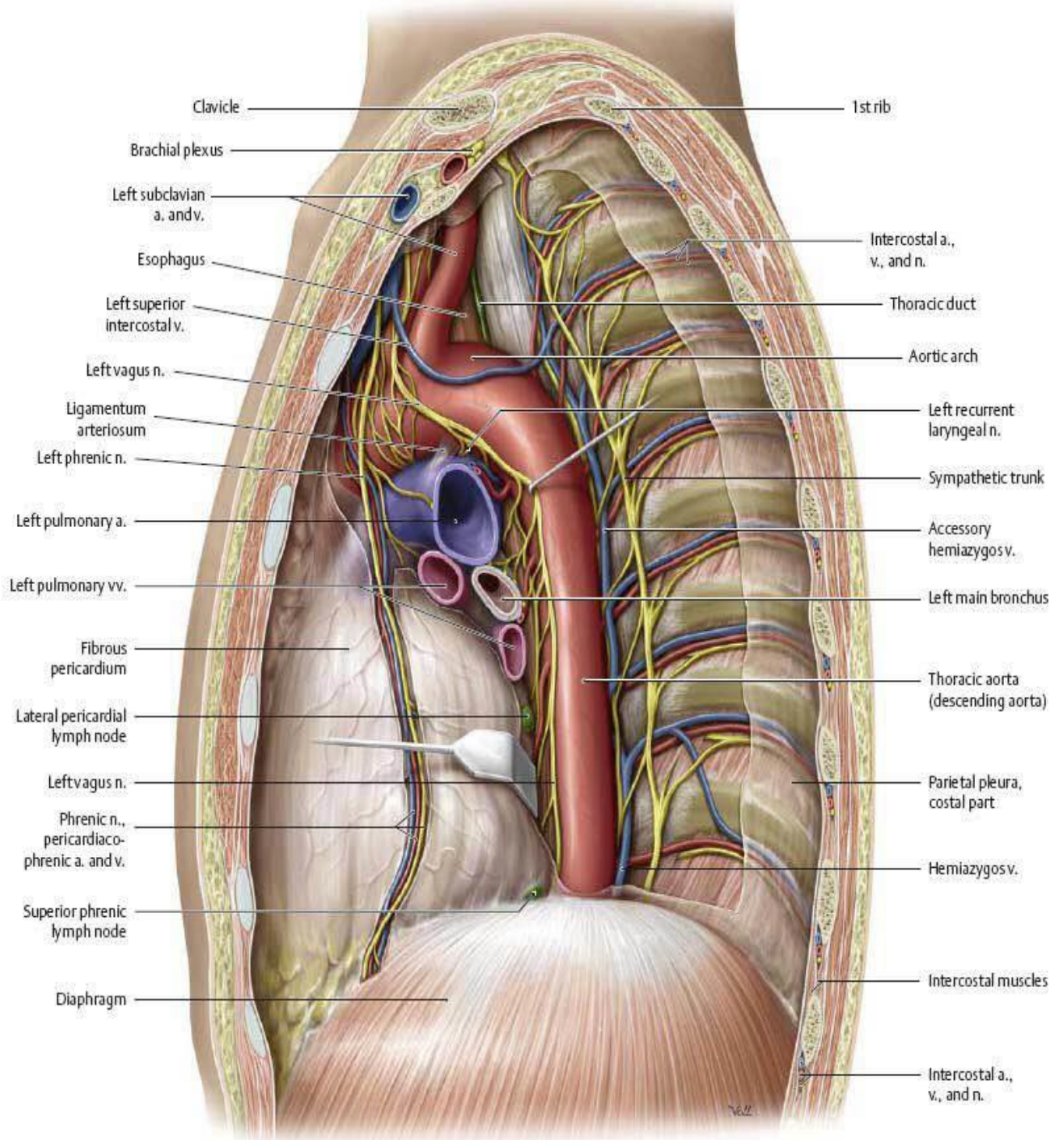


Mediastinum (right lateral view)

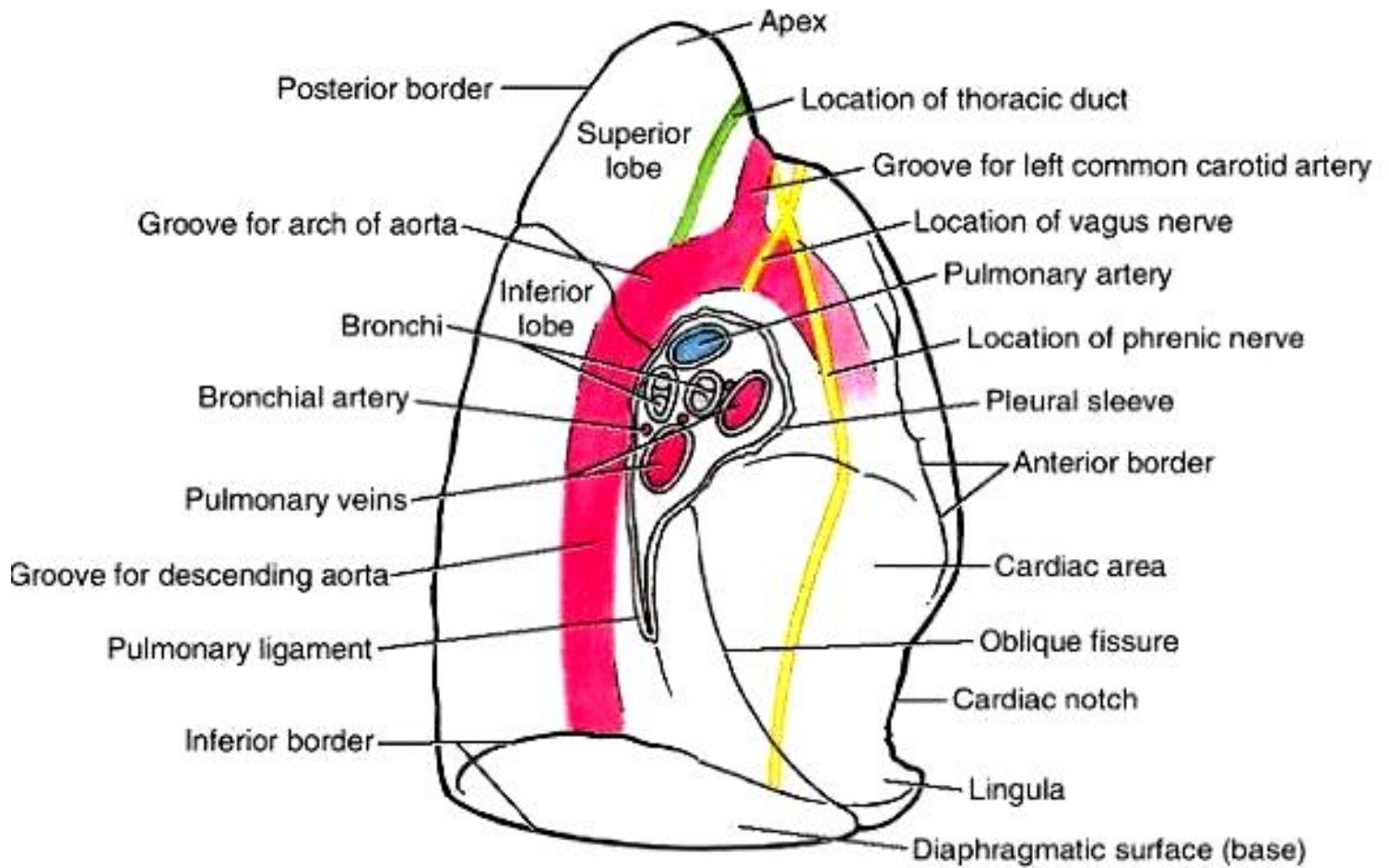
Mediastinal surface of the left lung

*The mediastinal surface of the left lung is related to the arterial side of the heart i.e. the left ventricle, aortic arch and descending thoracic aorta.

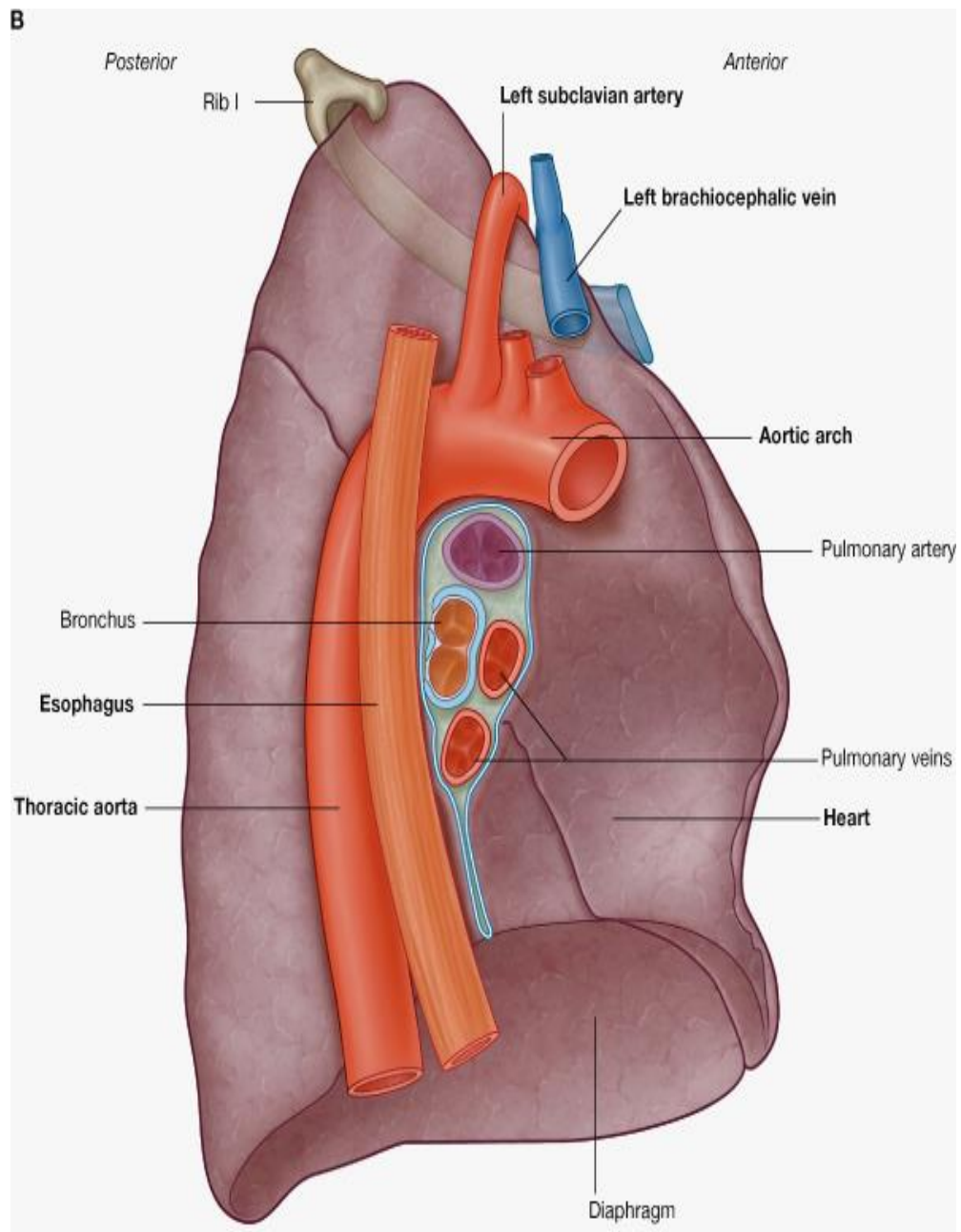
1. The **hilum** and the attachment of pulmonary ligament are the most prominent features of the mediastinal surface.
2. **In front of the hilum:** there is a cardiac impression for *left ventricle*.
3. **Behind the hilum:** a broad vertical groove for the *descending aorta* is seen. A faint groove for the lower end of the *esophagus* is noted in front of lower part of the groove of descending aorta,
4. **Above the hilum; :** there is a groove for *the arch of aorta*.
5. **Above the aortic arch:** there is an anterior groove for *left common carotid artery* and a posterior groove for *left subclavian artery*.
6. *The left phrenic nerve* passes in front of the hilum and the *left vagus nerve* passes behind the hilum.



B Left lateral view, parasagittal section. *Removed:* Left lung and parietal pleura. *Revealed:* Posterior mediastinal structures.







Mediastinal surface of the left lung

Root of the lung

* **The root of the lung** are structures that enter or leave the hilum of the lung. These structures connect the medial surface of the lung to the heart and trachea.

***Site:** it lies opposite the 5th -6th - 7th thoracic vertebrae.

***Contents of the root:**

A. 3 major structures

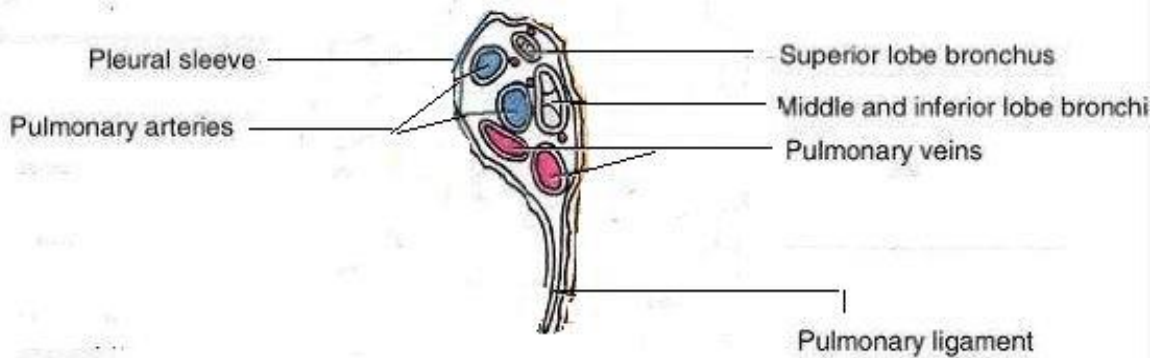
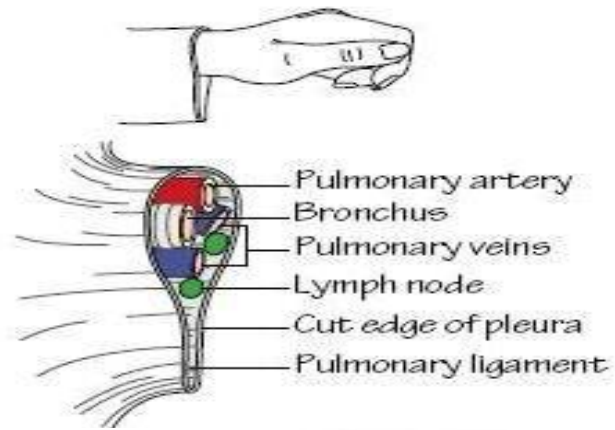
1. ***The main bronchus:*** is the most posterior structure. In the right lung another small bronchus is seen "epiarterial bronchus". In the left lung, only one bronchus is seen.
2. ***Pulmonary artery:*** carries deoxygenated blood from the heart to the lungs. In the right lung it lies anterior to the bronchus while in the left lung it lies above the main bronchus.
3. ***Two pulmonary veins:*** carry oxygenated blood, from the lung to the left atrium. The superior pulmonary vein is most anterior structure (in front of the pulmonary artery) while the inferior pulmonary vein is the lowermost structure.

B. 3 minor structures:

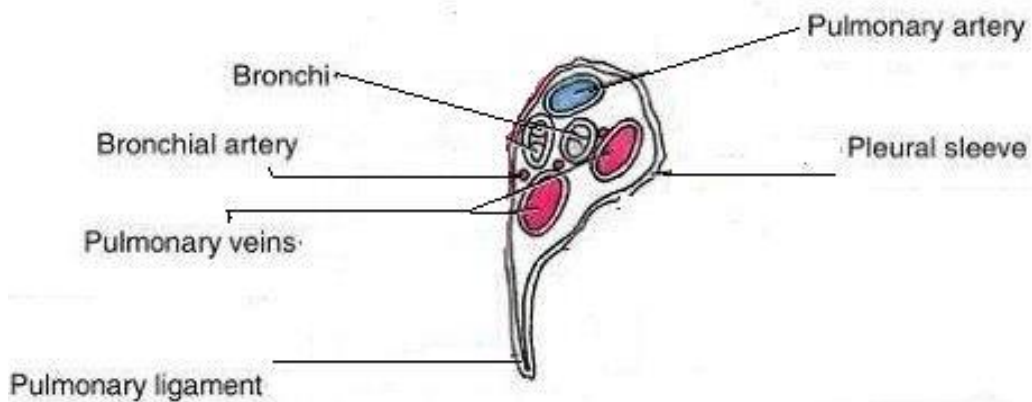
1. Bronchopulmonary lymph nodes
2. Pulmonary plexus of nerves (anterior and posterior)
3. Bronchial vessels (one bronchial artery in the hilum of right lung and two bronchial arteries in the left lung).

N.B. The root of the lung is surrounded by a sleeve (tube) of pleura which is prolonged downwards to form the pulmonary ligament which acts as a dead space allowing distention of the pulmonary veins during increased venous return.

Root of the lung



Hilum of the right lung



Hilum of the left lung

Surface anatomy of the lung

a. Apex of the lung: represented by a curved line extending from the sternoclavicular joint to the junction between the medial 1/3 and lateral 2/3 of the clavicle with its highest point reaching **2.5** cm above medial 1/3 of clavicle.

*Surface anatomy of the lung borders :

1) Anterior border:

- **Right lung:** the line passes downwards and medially from the sternoclavicular joint till angle of Louis in the midline then vertically down till level of 6th sternocostal junction.
- **Left lung:** the line passes downwards and medially from the sternoclavicular joint till angle of Louis in the midline , then vertically down till 4th costal cartilage, then curves to left about 1/2 inch lateral to left border of sternum forming the cardiac notch, then passes downwards and medially till the 6th sternocostal junction.

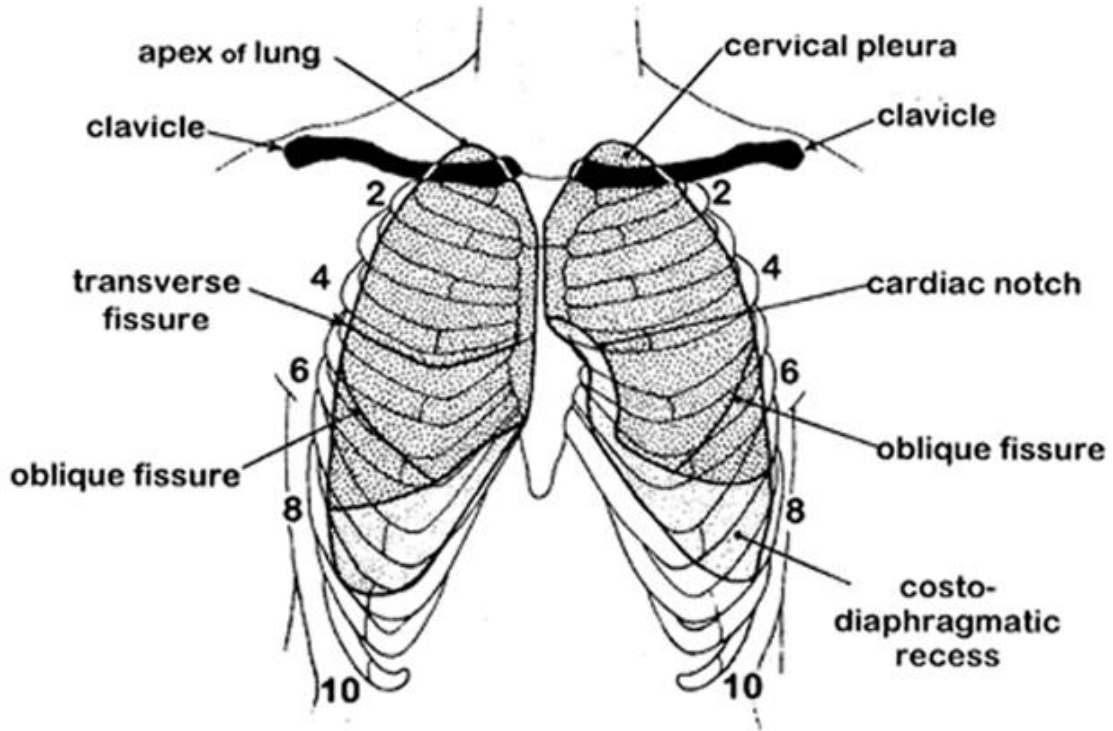
2) **Lower border:** is a curved line around the chest wall starting from the 6th sternocostal junction, it passes along the following points;

- 6th rib in mid clavicular line.
- 8th rib in mid axillary line.
- 10th thoracic spine, close to vertebral column.

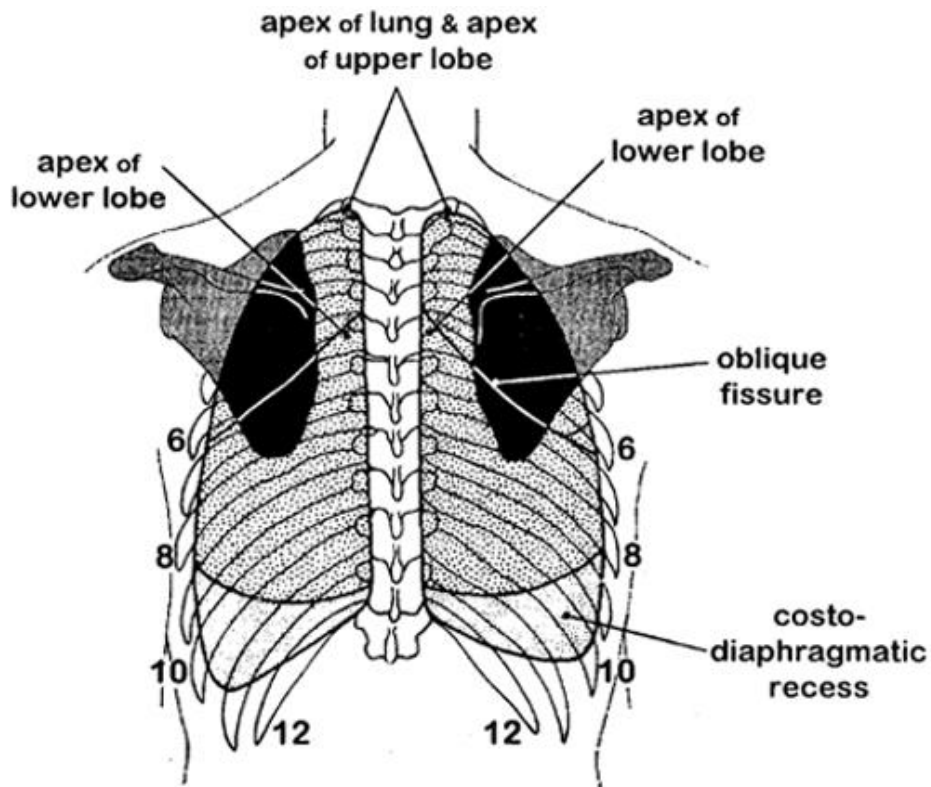
3) **Posterior border:** a vertical line connects the apex at sternoclavicular junction meet the lower border at level of 10th thoracic spine.

*Surface anatomy of the Fissures :

1. **Oblique fissure:** present in both lungs between upper and lower lobes. It is represented by a line connect a point 3 cm lateral to T₃ spine with a point 3cm from midline at level of 6th costal cartilage
2. **Horizontal or transverse fissure:** present in right lung only. It is represented by a horizontal line drawn at 4th costal cartilage till it meets the oblique fissure at the 6th rib in the midaxillary line. It separates the upper from the middle lobe.



The surface anatomy of the two lungs and two pleurae from front



Surface anatomy of the two lungs and two pleurae from behind

The Bronchopulmonary segments

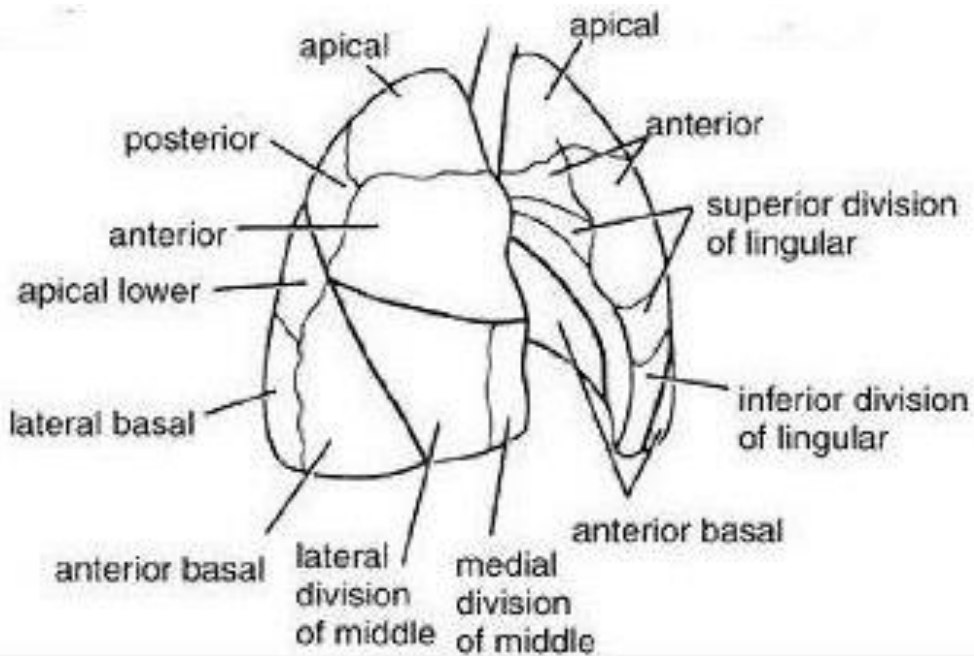
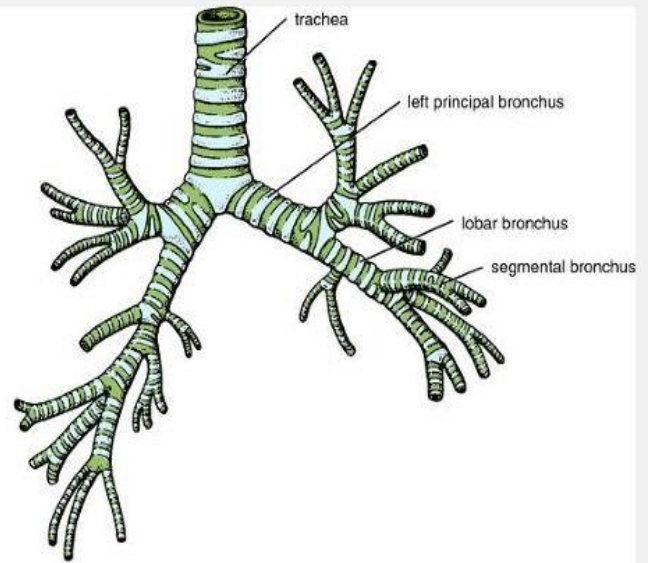
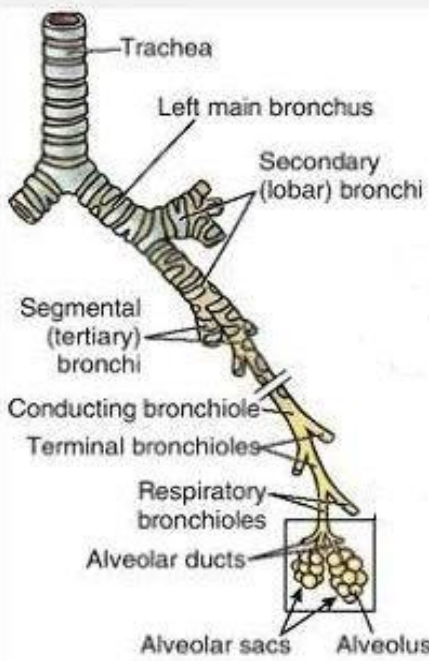
- The bronchopulmonary segment is the structural, functional and surgical respiratory unit of the lung.
- It is a pyramidal area of the lung, which has its apex at the hilum and its base at the lung surface. **Each segment** contains tertiary (segmental) *bronchus*. The segmental bronchus is accompanied by a tertiary branch of the *pulmonary artery*, but the tributaries of the *pulmonary veins* run in the connective tissue between adjacent bronchopulmonary segments (**intersegmental**) and drain adjacent segments . Each segment has its own *lymphatic vessels* and *autonomic nerve supply*.
- **Formation:**
 - The trachea at the level of angle of Louis gives 2 main (primary) bronchi. The right one gives 3 secondary [lobar] bronchi, one for each of the 3 lobes. The left gives only two secondary [lobar] bronchi, one for each of the 2 lobes of the left lung.
 - From the right 3 lobar bronchi arise 10 tertiary or segmental bronchi :[3 for the upper , 2 for the middle and 5 for the lower lobes].
 - From the left 2 lobar bronchi arise 8-10 tertiary bronchi [4-5 for the upper and 4-5 for the lower lobes].
- **They are :**

The 10 segments of right lung :

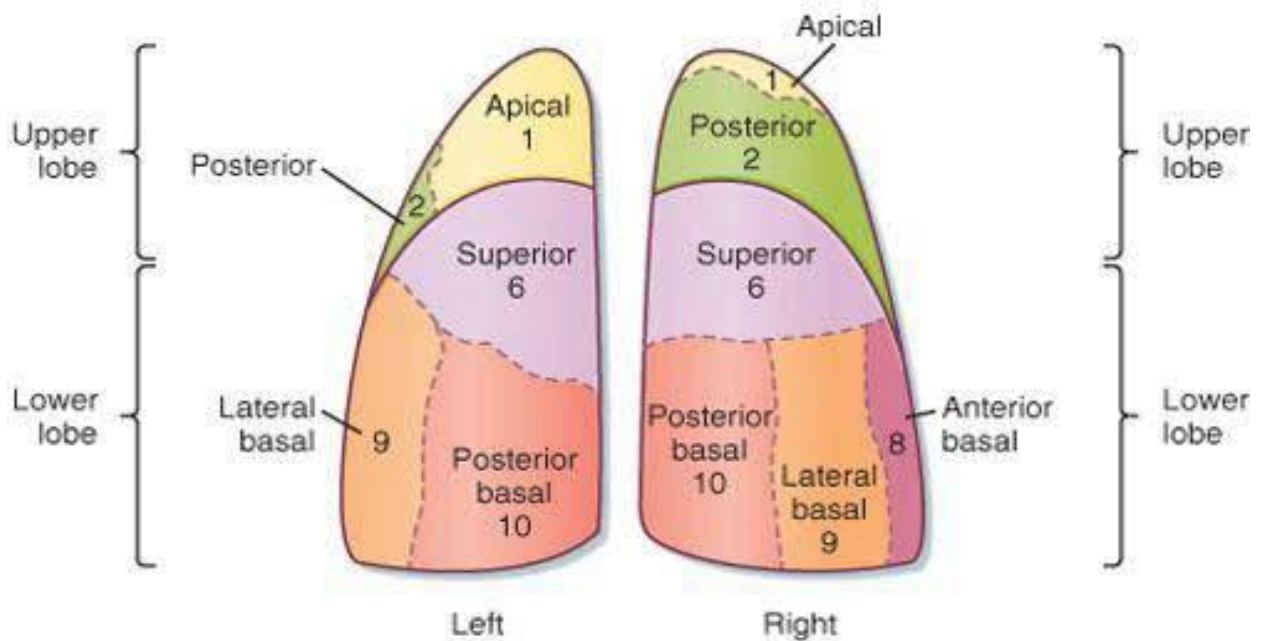
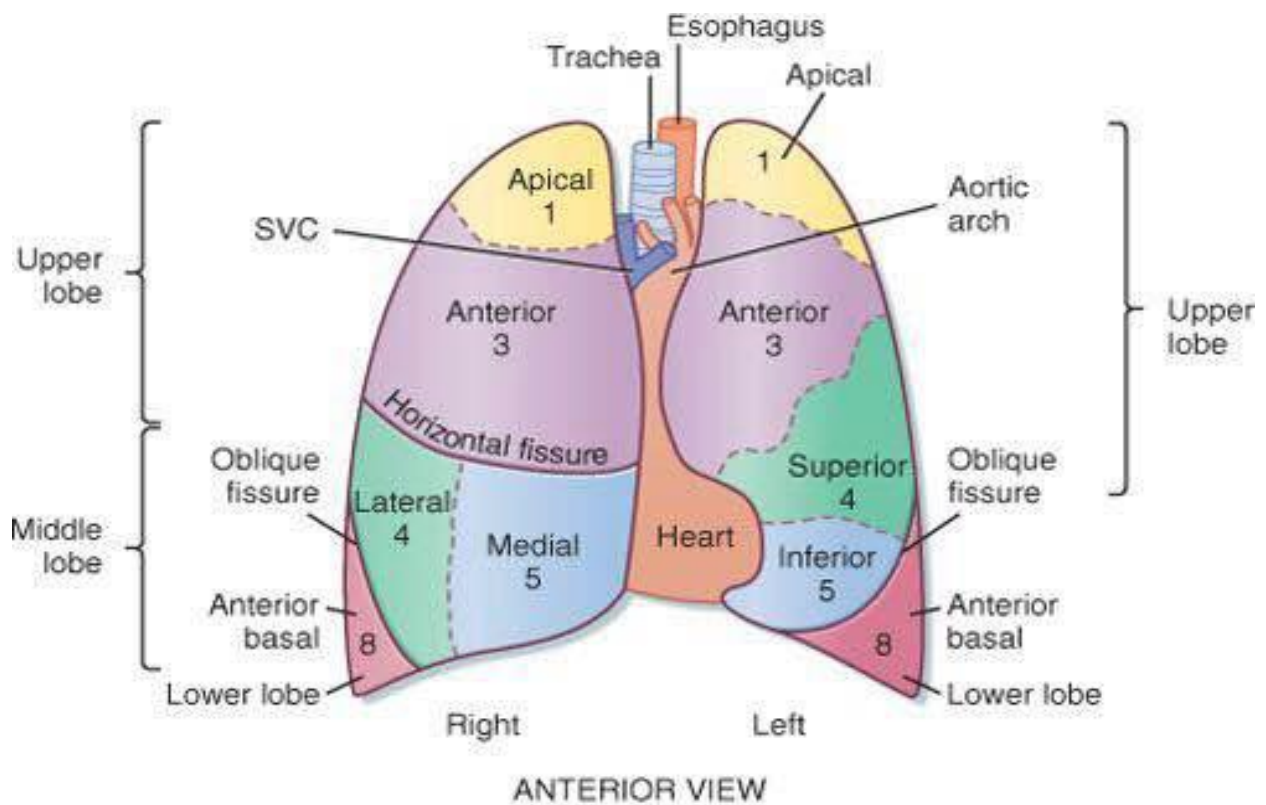
- Upper lobe : apical , posterior and anterior
- Middle lobe: lateral and medial.
- Lower lobe: superior , anterior basal, posterior basal , lateral basal, and medial basal.

The 8- 10 segments of left lung:

- Upper lobe: apical , posterior, anterior, superior lingular and inferior lingular.
- Lower lobe: superior , anterior basal, posterior basal , lateral basal and medial basal.



Bronchopulmonary Segments



Koeppen & Stanton: Berne and Levy Physiology, 6th Edition.
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***Blood supply of lungs:**

1. ***Right bronchial artery***: comes from 3rd right posterior intercostal artery .
2. ***Two left bronchial arteries***: come from descending aorta. Bronchial artery carries arterial blood along the bronchial wall to the lung.
3. ***Two right bronchial veins***: end in vena azygos.
4. ***Two left bronchial veins***: end in superior hemiazygos vein.

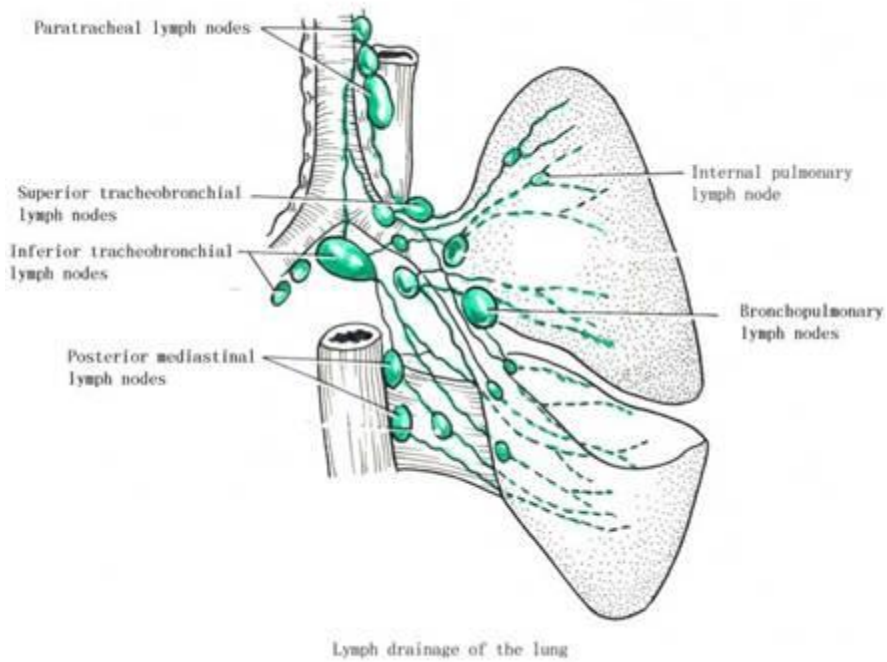
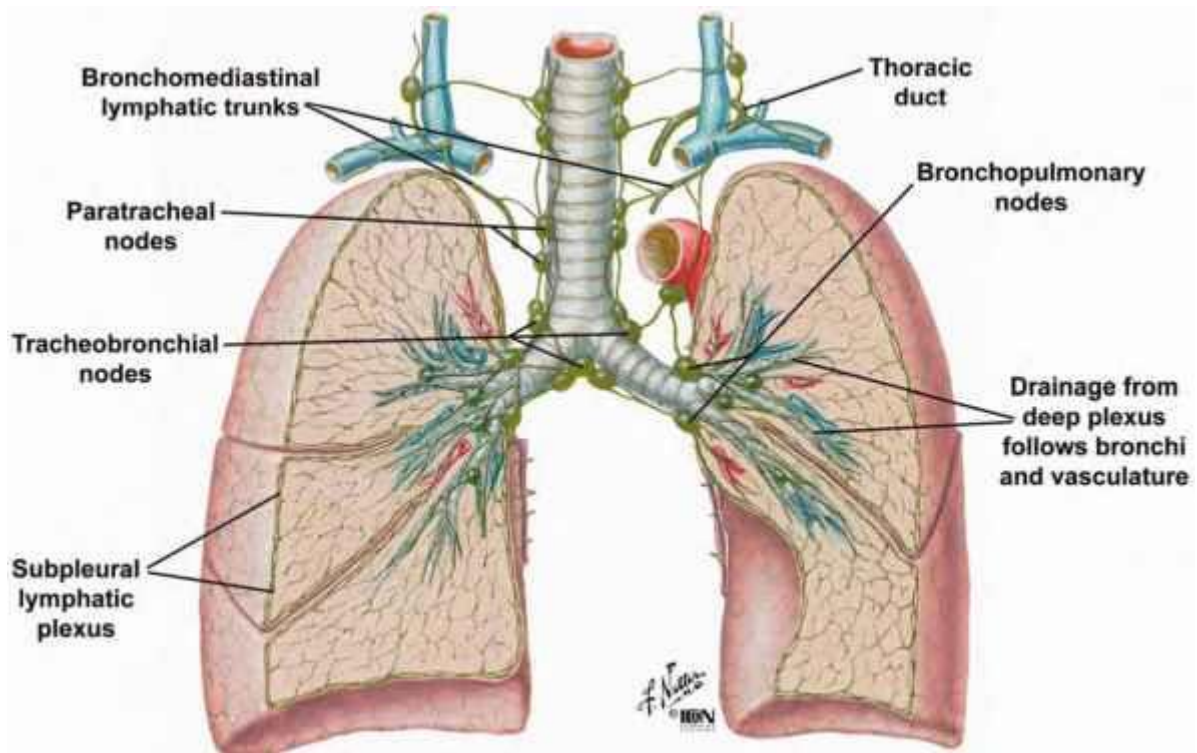
***Lymphatic drainage:**

The lung parenchyma drains into ***bronchopulmonary*** lymph nodes in the root of the lung then to the ***tracheobronchial*** lymph nodes at the bifurcation of the trachea , to the ***paratracheal*** lymph nodes , to the ***mediastinal lymph trunk*** which ends in the braciocephalic vein on the right side or thoracic duct on the left side.

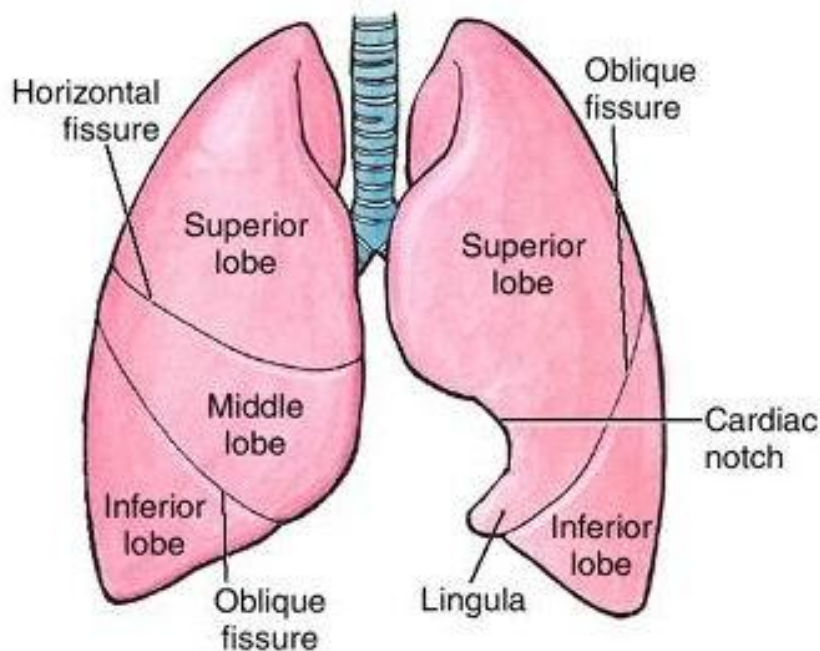
***Nerve Supply of the Lungs**

The lungs are supplied by autonomic fibers from the ***pulmonary plexuses*** (anterior and posterior) situated in front and behind the hilum of the corresponding lung. Each plexus composed of sympathetic and parasympathetic fibers,

The sympathetic efferent fibers arise from the ***2nd -5th thoracic sympathetic ganglia*** while the parasympathetic efferent fibers arise from the ***two vagi***. The sympathetic fibers produce bronchodilatation and vasoconstriction but the parasympathetic fibers produce bronchoconstriction and vasodilatation and increased mucous secretions.



Comparison between Right & Left lungs



| | Right lung | Left lung |
|-------------------------------------|--|--|
| Size ,shape | Larger, wider and shorter. | Smaller, thinner and longer. |
| Weight | 625 grams | 550 grams |
| Cardiac notch & Lingual | No cardiac notch. No lingula. | Has a cardiac notch. Has a lingula. |
| Fissures | Has two fissures (oblique & transverse) | Has one fissure (oblique) |
| Lobes | Has three lobes : upper, middle & lower | Has two lobes : upper & lower. |
| Bronchus | Has two bronchi in hilum | Has one bronchus in hilum |
| Bronchopulmonay segments | 10 bronchopulmonary segments. | 8-10 bronchopulmonary segments. |

*** Applied anatomy :**

1. Excision of diseased lung tissues may be **segmentectomy , lobectomy or pneumonectomy** according to the extent of the pathology .

Pulmonary veins and arteries

