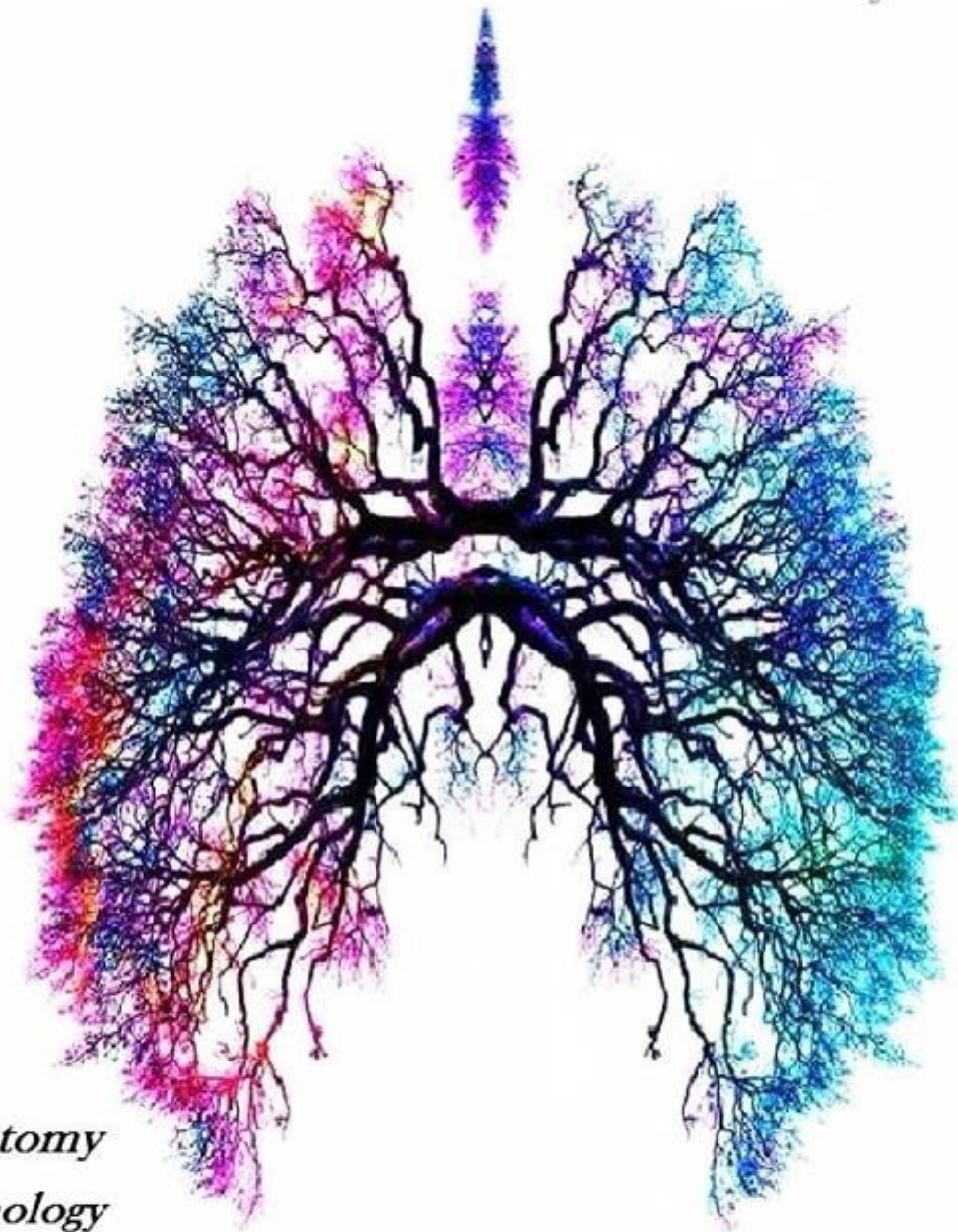


RESPIRATORY SYSTEM

Cover by: *Aseel Khatib*



- Anatomy*
- Pathology*
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- Pharmacology*
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- PBL*

Dr Name: Dr. Al Mutaseb

Lecture # 6 (4-anatomy)

Done By: Esraa Odah

Sheet

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Other



Trachea, Lungs and pleura

1)-Trachea:

It's a continuation of the larynx. Starts at the level of C6 (lower border of cricoid cartilage) and ends at T4 (sternal angle), gives left and right main bronchi. Its length is about 5 inches (12 or 13 cm) and its diameter is the diameter of your index (1 inch). But In children or infants it's very narrow and equals the diameter of a pencil. It contains: C-shaped hyaline cartilages. They are (16-20) cartilages. However, it's absent posteriorly and replaced by the Trachealis muscle (smooth muscle) and connective tissue. Imagine if it was cartilaginous posteriorly, it will press on the esophagus and block the bolus movement downward through the esophagus. Hyaline cartilages is important to keep the trachea always open for passage of air.

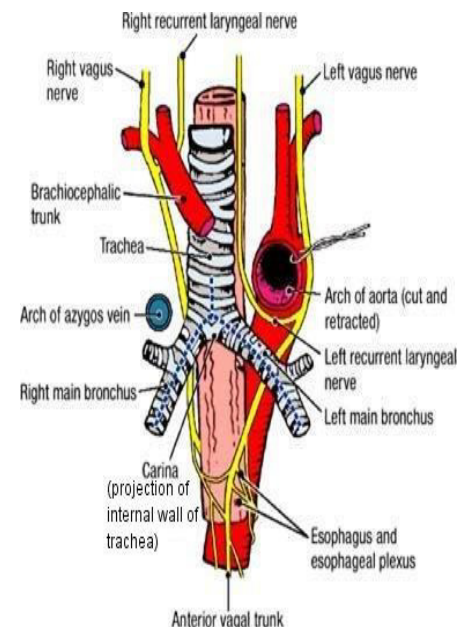
The Relations of the trachea:

A) Anterior relations:

- 1) Arch of aorta: begins anteriorly then goes to the left.
- 2) Thyroidisthmus: in front of second, third and fourth tracheal rings.
- 3) Remnants of the thymus gland: it's located behind the sternum.
- 4) The origin of Brachiocephalic artery then goes to the right side.
- 5) Manubrium sterni: the 1st part of the sternum.

b) Left side relations:

- 1) Arch of Aorta & descending Aorta.
- 2) Lt. Subclavian + Lt. common carotid arteries.
- 3) Lt. Phrenic, Lt. Vagus nerves coming from the neck to the chest,
 - Lt. Phrenic: goes **Ant.** to the hilum of the lung.
 - Lt. Vagus: goes **post.** to the hilum of the lung.
- 4) Lt. Main bronchus



**c) Right side relations:**

- 1) Brachiocephalic artery: - originates from the Aortic arch and goes to the right side.
- 2) Rt. subclavian, Rt. common carotid arteries.
- 3) Rt. Phrenic, Rt. Vagus nerves:
 - Rt. Phrenic: goes Ant. to the hilum of the lung.
 - Rt. Vagus: goes post. to the hilum of the lung.
- 4) Rt. main bronchus.
- 5) Azygos arch: from vena azygos and ends in SVC

D) Posterior relations:

- 1) Esophagus.
- 2) **Left** recurrent laryngeal nerve:
 - begins in the chest, and ascends upward to the neck.
 - ascends between the trachea and the esophagus.

>>Note: Right recurrent laryngeal nerve: found in the root of the neck, so it doesn't have a relation with the trachea as the left.

3) The thoracic duct: the main lymphatic duct start in the abdomen from cisterna chyli (sac of lymph in upper part of abdomen below the diaphragm) in the beginning this duct found on the right side but at the level of T5 it deviated to the left and posterior to the trachea.

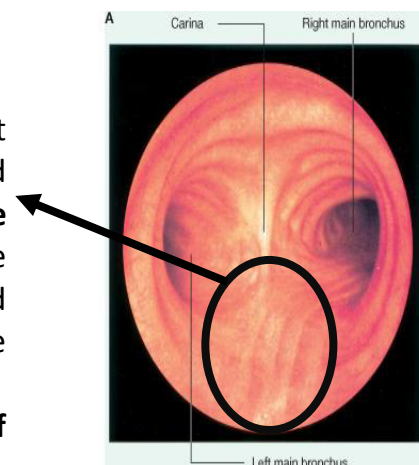
✓ **The carina:**- it's cartilage covered by mucosa at the region where the trachea ends (at T4) and bifurcates into Right and Left main bronchi. It's **the most sensitive** part of the trachea. So when someone swallows a foreign body that enters the trachea and reaches the carina, this region will be irritated and the person begins to cough continuously.

Note: In deep inspiration it descends to the level of **6th thoracic vertebra**

after that it returns to T4 .moves from T4 and T6.

✓ Tracheotomy (tracheostomy) & intubation:

- Where can we put the tube inside the trachea?



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1- High: above the isthmus of thyroid gland.

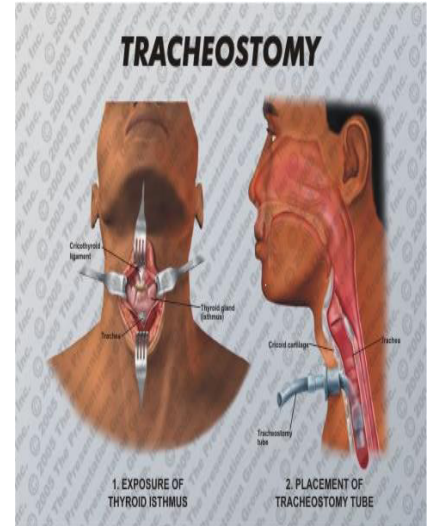
The isthmus of the thyroid gland: - it lies **ant.** to the 2nd, 3rd and 4th tracheal rings. Above it, there is the 1st tracheal ring and the space between the 1st and 2nd rings. So we can put the tube through this space.

2- High: below the isthmus of thyroid gland. - in the space between the 5th and 6th rings.

3- Low tracheostomy: suprasternal. In emergency cases just pierce the trachea suprasternal by Sharp object between the rings of trachea, it might cause bleeding from some vessels found there like: inferior thyroid vein, anterior jugular vein, jugular arch and thyroid ima artery. Even if the bleeding has occurred it is not a problem because the patient needs to inflate his lungs.

✓ Intubation

- 1) Intratracheal intubation (endotracheal tube): from oral cavity > inlet of the larynx > between vocal cords (rima glottides) > trachea.



When do we put endotracheal tube?

1- in operation, the patient is under anesthesia

2- in emergency room when the patient has air way obstruction especially

Above true vocal cord.

2) Below the larynx:
Transverse incision.

In certain case like cancer of larynx which leads to excessive mucus secretion
So we use this tube for respiration and suction of fluids and mucus.

2) The Bronchi.

- The Rt. main bronchus: wider, more vertical with the trachea and shorter (about 1 inch).

- The Lt. main bronchus: narrower, more horizontal and longer (2 inches and may reach 3 inches).

These differences are clinically important, why? - When someone inhales or swallows a foreign body that enters the trachea, it will always go the Rt. bronchus; it's more vertical and wider. So when a doctor uses the bronchoscope, he always insert it in the Rt. Bronchus to find the foreign body, because it will **commonly** be there.

99% go to Rt. Bronchus, 1% go to Lt. Bronchus when a patient sleeps on his left side.



>>Bronchi have pieces of cartilage so it is always open.

>>The Bronchial tree.

- There are:

*1ry bronchi: Rt. and Lt. main bronchi, extra pulmonary.

* 2ry bronchi: intrapulmonary,(lobar bronchi) according to the lobe of the lung

Rt. Lung >> 3 lobes:upper, middle, lower

Lt. Lung>> 2 lobes: upper and lower

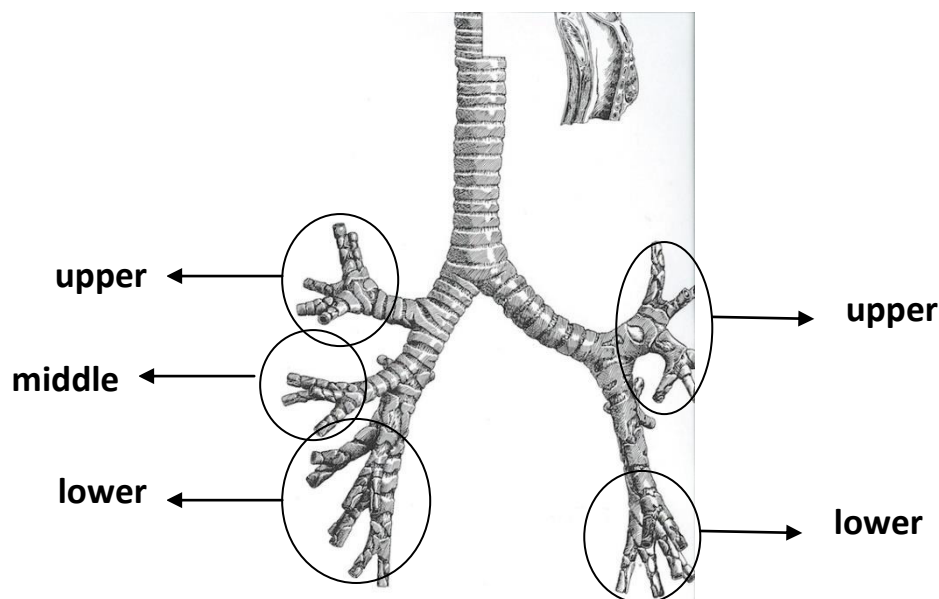
Lobes according to the fissures:

Rt. Lung >> 2 fissures: horizontal and oblique

Lt. Lung>>one fissure: oblique

>>So we have 3 bronchi on the Rt. Lung >>upper, middle, lower.

And 2 bronchi on the Lt. Lung>>upper and lower



*3ry bronchi: Intrapulmonary, (segmental bronchi) which supply bronchopulmonary segments

✓ **bronchopulmonary segments:**

1-It's pyramidal in shape: has apex directed toward hilum and base directed toward surface of the lung.

2-Each segment has its own blood vessels, nerves and lymphatics.



3-start with a segmental bronchus contain cartilage after that give terminal bronchiole then respiratory bronchioles.

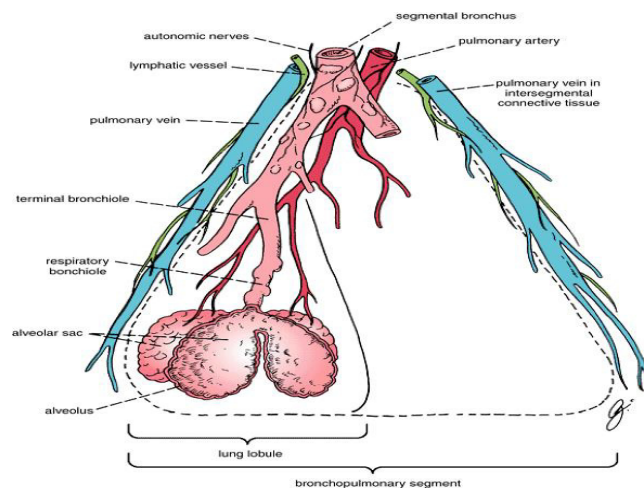
4-each segment contain multiple pulmonary units or lobules.

Lobules = terminal and respiratory bronchioles then alveoli (duct, atria, sac and pulmonary alveoli) + blood vessel +lymphatic

5-each segment surrounded by connective tissue which contain 2 pulmonary veins on both boundaries these two veins are landmark for surgeon,so he looks for

the pulmonary vein in each side of the pyramid and determines the segment that he wants to remove.

The pulmonary artery located in the middle.



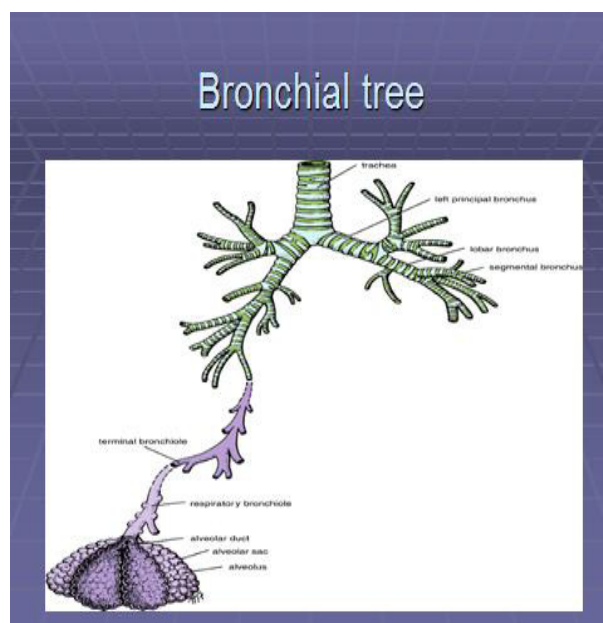
Bronchial tree:

Primary bronchi > secondary bronchi > tertiary bronchi > bronchopulmonary segments > terminal bronchiole > respiratory bronchiole > alveolar duct > alveolar sac > alveoli.

*Remember:

Bronchopulmonary segments

start as bronchi and ends as terminal bronchiole. (correction note: not sure if this is accurate)





• Rt. lung 10 segments :

1-Upper lobe, 3 segments:

Depend on the anatomical position of the lung:

- Anterior segment directed toward anterior border.
- Posterior segment directed toward posterior border.
- Apical segment directed toward apex.

2- Middle lobe, 2 segments:

- Medial directed toward mediastinal surface (Medial side)
- Lateral directed toward costal surface (lateral side)

3-Basal lobe 5 segments:

- Apical (apico basal)>> directed toward upper part of the base.
- Anterior.
- Medial.
- Lateral.
- Posterior.

• Lt. lung 10 segments:

1-Upper lobe 5 segments:

- Apical.
- Posterior.
- Anterior.
- **Sup. Lingual.**
- **Inf. Lingual.**

*****The heart pushes the left lung and makes cardiac notch that's not found on the right lung so instead of medial and lateral segments we have sup. Lingual, inf. lingual**

2-Basal lobe: same as right lung

- Apical (apico basal)>> directed toward upper part of the base.
- Anterior.
- Medial.
- Lateral.
- Posterior.

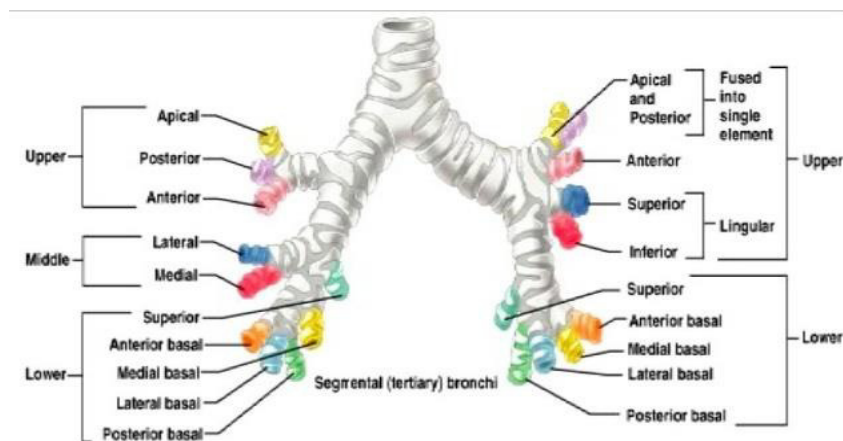
**>>Note:**

- Beforebirth: we have 8 segments in the Lt. Lung. How?

In the upper lobe, “apico posterior” segment (apical + post.).

In the basal lobe, “antero medial” segment (ant. + Medial).

After that the lung will grow and these segments will separate.



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Clinical importance of pulmonary segments:

- Infections>>localized infection but without treatment the infection will spread.
- No barrier >> we don't have obvious barrier to prevent spreading of infection.
- Surgery >>pulmonary vein is a land mark aswe said above.
- Postural drainage >>We can specifically drain the affected segment.
- Bronchoscopy>>To remove the foreign bodies.

Clinical cases:

*1-if the child stays in the standing position (erect) after swallowing the foreign body, we will find this foreign body in the **right main bronchus** if **it's small it will go to Basal lobe; inside its post. Segment.** The reason: **the basal lobe is the most dependent part (straight downward directed).***



2-If the child is in a laying down position. E.g. when he was in the dental clinic, he swallowed his tooth accidentally while the doctor was treating him. The tooth will go through the Rt. main bronchus and continues until reaching the **Basal** lobe. But in this case, we will find it in the **Apico basal segment**.

3) Lungs:

We have two lungs in thoracic cavity

*Lung is a spongy, gray to dark organ filled by elastic fibers, collagen and reticular fibers for inflation and deflation.

*Lung weight is 600-800g. 90% air, 10% tissue.

>>Left lung: oblique fissure and 2 lobes: upper and lower. And is longer and thinner.

>>Right lung: oblique and horizontal fissures, 3 lobes: upper, middle and lower. And is shorter and wider (the liver pushes the diaphragm upwards)

Also each lung has apex and base, the base lies on copula of diaphragm so the lungs have diaphragmatic surface and border, costal surface related to costal cartilage and ribs,mediastinalsurface.

✓ Apex

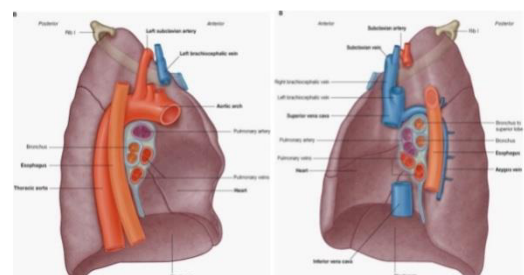
Lies at the root of the neck; 1 inch above the medial 1/3 of the clavicle.

>>Clinically is very important because the apex lies above first rib which has at upper surface subclavian vein so when they put a cannula in the subclavian vein, they must be careful not to injure the apex of the lung. If they injure it, the air will enter the lung from the pleural cavity. So after you insert the cannula, you have to do an x- ray for the patient to make sure that the lung is inflated and not deflated (collapsed).

✓ The Mediastinal Surface.



Mediastinal surfaces of lungs





- Related to the heart (the inner or medial surface).
The mediastinum: (the space between the 2 lungs, divides into: sup., middle and post.) the heart and pericardium are in the middle mediastinum.

- contains the Hilum of the lung.

✓ Hilum:

Through which the bronchi, pulmonary vessels, nerve supply and lymphatics enter and leave the lungs.

>>The Contents:

1-the pulmonary veins: red in color (oxy. blood). They exit the hilum as 2 veins (superior (and anterior) and inferior), and then become 4 veins. So they reach the Lt. Atrium as (4) pulmonary veins. (Correction note: I guess they exit as 2 from each lung and thus they are 4 in total, veins usually don't divide)

2-the pulmonary artery: blue in color (deoxy. blood)

On the right >> the artery lies anterior to the right main bronchus.

On the left >> the artery lies superior to the left main bronchus.

3-bronchi: the Rt. main bronchus divides into eparterial (above the pulmonary artery) and hyparterial (below the pulmonary artery) unlike the Lt. Main bronchus remains one bronchus in the hilum then divide distally not in hilum.

4-nerve supply: sympathetic and parasympathetic fibers from pulmonary plexus.

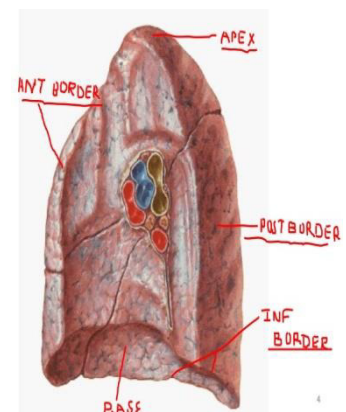
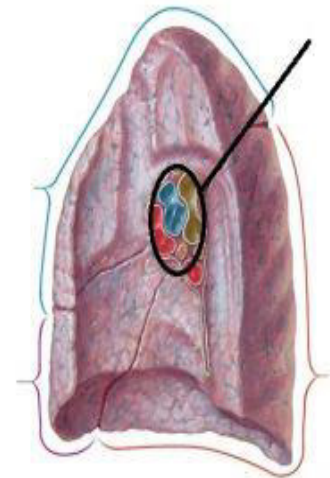
5-lymph nodes & lymphatic vessels:

**these lymph nodes become black in smokers.

6-Bronchial vessels: the main blood supply to the lung tissue

✓ Borders of the lungs

- The inferior border, sharp which lies above the diaphragm.
- The anterior border: sharp and behind the sternum
- The posterior Border: rounded from apex to base



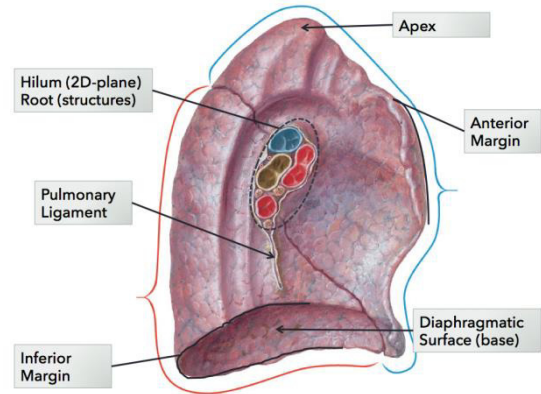


4) The Pleura:

Thin membrane surrounding the lungs composed of:

- 1) Parietal layer: lining the chest wall.
- 2) Visceral layer: adherent to the lung tissue.

>>At hilum the two pleura fused together as one membrane surrounding the hilum and ends as pulmonary ligament.



5) The Surface Anatomy of the Lung and Pleura.

>>The surface anatomy of the lungs:

1-The apex:

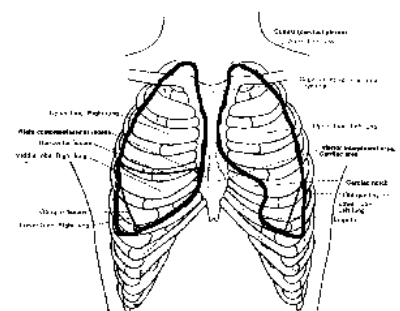
Covered by pleura visceral and parietal, above it suprapleural membrane.

1 inch above the medial 1/3 of the clavicle reach C7

2-The ant. Border of the lungs.

>> Right lung:

Draw a line from the apex to the sternoclavicular joint. Extend this line to the midsagittal line (the midline) on the sternal angle. Extend this line until reaching the xiphisternal joint which is at the level of the 6th costal cartilage.



Remember: the 6th and 7th costal cartilages are connected to each others.



>>Left lung: there is a difference in surface anatomy of the ant. Border between the rt. and the lt. lungs, because we have the cardiac notch in the lt. lung between the 4th and 6th costal cartilages.

According to that we have to draw like a semi-circle or a curve deviated from the midline to the left side between the 4th and the 6th costal cartilages by 1/2 inch.

This is clinically important, how? When a fluid accumulates in the pericardium (cardiac tamponade), we can insert a needle between the 4th and 6th costal cartilage (cardiac notch region) and make aspiration.

3-Posterior surface:

From apex C7 extend backwards to T10 away from dorsal spine 4 cm.

4-the base (the lower border).

Marked by 3 points:

- Draw a midclavicular line crosses with the **6th rib**.
- Draw a midaxillary line crosses with the **8th rib**.
- Posteriorly, draw a line from the apex of the lung (posteriorly) 4c.m away from the dorsal spine and descends downward until reaching the **10th thoracic vertebra**.

>>The surface anatomy of the pleura:

1-the apex:

The same as the lung, because the cervical pleura is adherent to the lung tissue and the lung doesn't expand superiorly.

2-the ant. border: -

The same as the lung, but: the midline reaches the **7th costal cartilage** instead of the 6th.

3-the base (the lower border).

- It increases by 2 spaces (the lung expands downwards). How?
- Draw a midclavicular line crosses with the **8th rib**
- Draw a midaxillary line crosses with the **10th rib**
- Posteriorly, draw a line from the apex of the lung (posteriorly) 4c.m away from the dorsal spine and descends downward until reaching the **12th thoracic vertebra**.

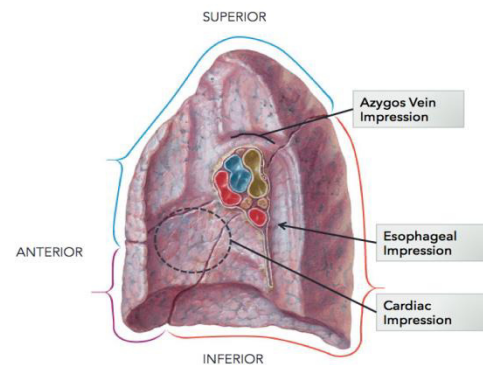


***This is important, why?

Because any fluid accumulate in the lung it descend downward filling the space between the lung and pleura so to aspirate the fluid we put the needle in :

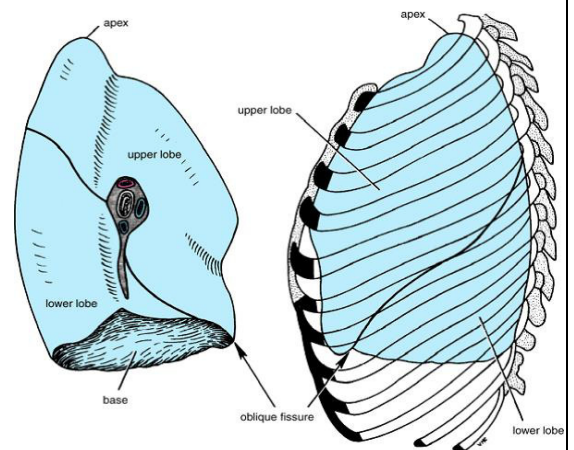
1-the midaxillary line in the **9th intercostal space** because the lung reaches 8th rib and the pleura reaches 10th rib

2-The line in the midclavicular **7th intercostal space** because the lung reaches 6th rib and the pleura reaches 8th rib.



>>surface anatomy of the fissure:

When listening to the lung sounds from each lobe, it is important to place the stethoscope on the right areas, and this is done by knowing the surface anatomy of the fissures; that's why their surface anatomy is essential clinically.

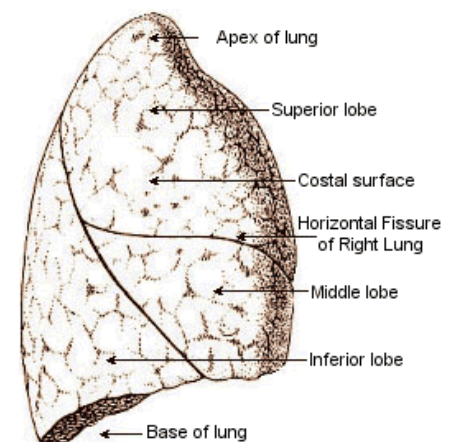


1-The oblique fissure:

Begins away from spine of T3 by 3cm posteriorly but on the right lung from T4 why? Because the right lung is shorter and compress by the liver and diaphragm (correction note: the doctor said that there is no such difference, in both lungs it begins at T3). Then passes along 5th intercostal space laterally to the 6th costal cartilage anteriorly.

2-The horizontal fissure:

The horizontal fissure follows the **fourth intercostal space** from the sternum until it meets the oblique fissure as it crosses rib V.





6) Impressions of the right lung:

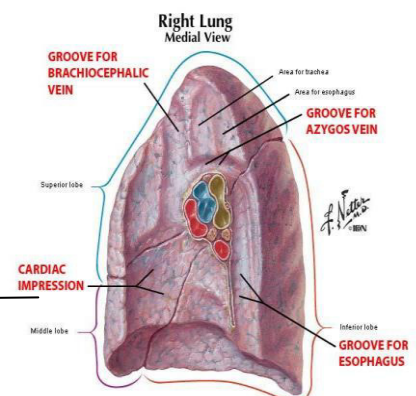
(Related to venous blood vessels)

- 1-Inferior vena cava.
- 2-Superior vena cava.
- 3-Pericardium covering the right atrium
- 4-Right brachiocephalic vein
- 5- Azygos vein – forms an arch above the hilum of the right lung.
- 6-Esophagus – its impression starts from the apex and continues behind the hilum.
***The esophagus is at the midline that's why it makes an impression on both lungs above the hilum, then it deviates to the left, passing anterior to the thoracic aorta, and then it passes through the left copula of the diaphragm one inch to the left of the midline.*
- 7- Trachea - found anterior to the esophagus and it is deviated to the right so it makes an impression only on the right lung.
- 8-The 1st rib on the costal surface and ant. Border.

7) Impressions of the left lung:

(-related to the arterial blood vessels)

- 1-Aortic arch – above the hilum, continues as the descending thoracic aorta.
- 2-Left subclavian artery and left common carotid artery (not the brachiocephalic) left brachiocephalic vein might leave an impression.
- 3-the pericardium of the left ventricle,
- 4-Esophagus.
- 5-Thoracic aorta.
- 6-Left bronchus
- 7-Cephalic vein on the mediastinal surface.
- 8-1st rib on the costal surface.



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