

RS Histology



DOCTOR NOTES
LECTURE NO. 2



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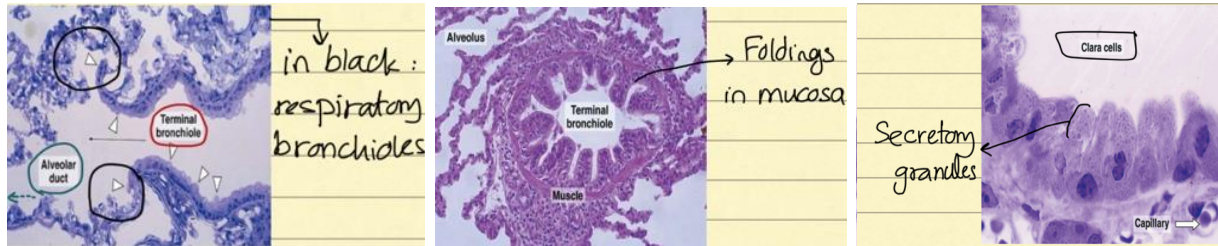
This is an easy lecture with repeated info, say بسم الله and let's start

Histology of bronchioles

Diameter of bronchioles at the beginning = 5mm or less

Then they branch more to give narrower bronchioles.

Their diameter => The large $\approx 1\text{mm}$. The small ones $\approx 0.5\text{ mm}$



Bronchioles => No glands, no cartilage.

=> Goblet cells are very few & replaced by Clara cells.

Clara cells

- Simple cuboidal cells without Cilia.
- Have secretory glands in their apex => Their secretions have 2 effects:
 1. against the bacteria that produce inflammation. And. Exudative pollutants.
 2. Production of some proteins that are important for surfactants formation.
- Exhibit specialized region called neuroepithelial bodies.
- Receive cholinergic nerve endings (Related to demoreceptors That depend on changes in O₂ & CO₂)
- They are seen in terminal and respiratory bronchioles

Lining epithelium in terminal bronchioles:

Simple columnar ciliated + Simple cuboidal ciliated (After being pseudostratified columnar ciliated in the large bronchioles.)

!! The changes happen gradually, **no sudden changes.**

=> As we move distally, Clara cells amount increase.

** No lymphatic nodules. (But there are. Scattered lymphocytes in all respiratory tract.)

** In terminal bronchioles (Conducting part of the respiratory tract), We have prominent foldings in the mucosa, why? Because the lamina propria has ribbons of smooth muscles (spiral and circular, hence the folding) & elastic fibers

Remember!! Smooth muscles increase in bronchioles & they are responsible for asthma disease => Through their contraction (narrowing of the lumen)

=> While the cartilage in **bronchi** prevents the lumen narrowing

** ANS

- Sympathetic => Dilation of bronchioles.
- Parasympathetic (vagus) => Construction of bronchioles.

Clinical application on nervous system:

=> in asthma patients coming to the emergency department Due to an almost complete closure of the airways => we give them, adrenaline (bronchodilation working as sympathetic N.S

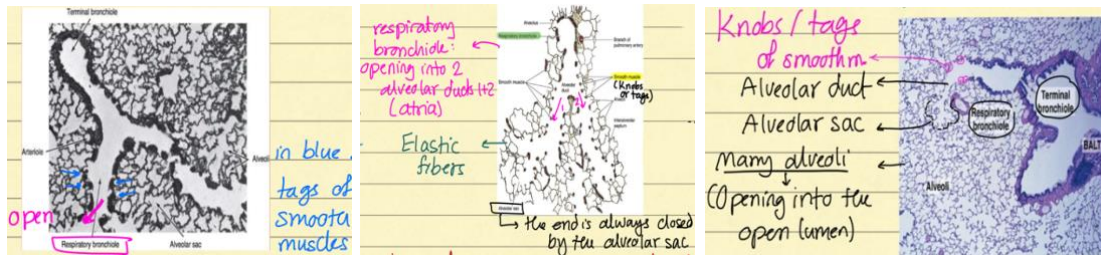
Changes as we go from terminal to respiratory bronchioles:

Terminal:

1. Closed Bronchioles (Rounded/ circular lumen) => Opens into 1/2 Respiratory bronchioles but **still called Closed.**
2. Simple cuboidal ciliated/ Non ciliated (Clara cells)
3. Spiral smooth muscles and circular.
4. Prominent folding of the mucosa.

Respiratory:

- Open bronchioles (Opens into the alveolar duct), **Not circular lumen**
- Simple squamous epithelium.
- Knobs/ Tags of smooth muscles (In the openings of the alveoli)
- Decreased folding in mucosa => Due to decrease smooth muscles + not circular
- We have gas exchange => In the surrounding alveoli that are presented at the end of the respiratory bronchioles.



When the respiratory bronchioles open into 2 alveolar ducts => We call this **atrium**.

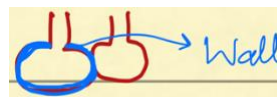
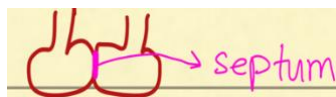
Between the alveoli/ or in the matrix :

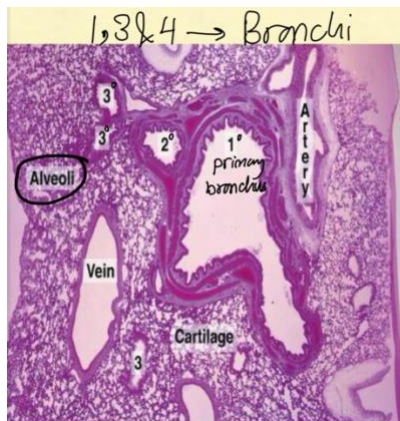
=> there're many elastic fibers (For inflation and deflation of the lung) & Reticular fibers (they support alveolar duct & alveoli to prevent rupture)

** The ends of the alveolar duct: Alveolar sacs (there are alveoli around them)

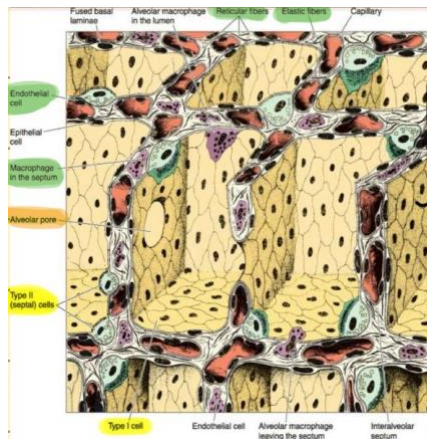
Alveoli:

- **Sac-like** invaginations.
- The diameter is 200 micrometers.
- Spongy, soft in the lung (Because they are filled with air with elastic fibers in between)
- Between two alveoli intra alveolar septum.
- Alveolar wall; The whole wall of the alveolus.





Let's discuss this image:



=> kindly check the highlighted cells in the image!

all these cells are simple squamous epithelium
(Together they formed the alveolar wall) => because the majority of the alveolar cells are type1 (simple squamous cells)

!! you should differentiate between alveolar wall and alveolar septa

Types of alveolar cells:

- Type 1 pneumocytes => Simple squamous cells
- Type 2 pneumocytes (Called septal cells) => secret surfactants

In alveolar wall, 97% Type 1 (main) & 3% Type 2

In septum or corners, 16% Type 2 (main) & 8% Type 1

Other cells/ structures in the wall:

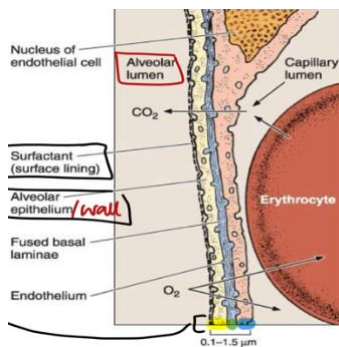
- Endothelial cells of the capillaries => In septum and wall (The lining epithelium of capillaries in the interstitium)
- Interstitium
 - Connective tissue => 1. fibers (reticular+ Elastic) 2. Cells (Fibroblasts+ Macrophages; dust cells + Mast)
 - Capillaries (for gas exchange)

- Alveolar pores connecting adjacent alveoli in the intra alveolar septum.
 - To deliver O₂ between two adjacent alveoli, \uparrow balance between them.
 - Diameter 10-15 μm (micrometer).
 - **Importance:** Equalizing the air pressure between the neighboring alveoli.
 -

Respiratory membrane/ Blood air barrier (in a part of the septum)

- Between the capillary (Endothelial cells)+ Type 1 alveolar cells => It's important for gas exchange (CO₂ From capillary to alveoli/ O₂ From alveoli to capillary)
- It consists of:
 - **The surface lining** (Mainly the surfactant layer)& cytoplasm of alveolar cell type 1
 - **Fused basal membrane** (Basal lamina of endothelial cells+Type 1 alveolar cells)
 - **The cytoplasm of endothelial cells.**
- Importance of the surfactant layer that lines the alveolar wall of type 1 cells => Very important in facilitating inflation of the alveoli (في الولادة)
- Total thickness at this barrier= 0.1-1.5 micrometer (very thin)

**Kindly, check the colors of “it consists of” in the image below:



Interalveolar septum

=> It Contains

- Interstitium => 1. Capillaries (endothelial cells) 2. fibroblast + mast cells
- 3. macrophages
- Type 1 alveolar cells 8%
- Type 2 alveolar cells 16% => hence are called septal cells
- Leukocytes.

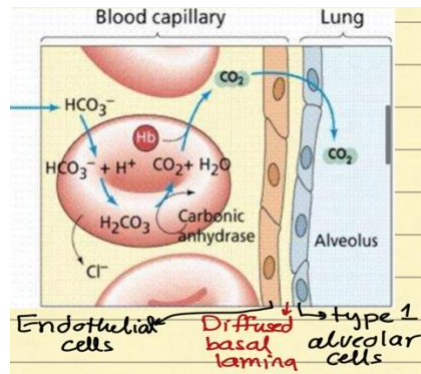
=> Almost special to the septum (type1+2 => special to the septum in these percentages!)

Gas exchange:

- O₂ is transported from type1 alveolar cells to endothelial cells

- CO₂ is from endothelial to type 1 alveolar cells (the opposite), it is related to carbonic anhydrase in erythrocytes

Extra: $(\text{CO}_2 + \text{H}_2\text{O} \xrightarrow{\text{carbonic anhydrase}} \text{H}_2\text{CO}_3 \Rightarrow \text{HCO}_3^- + \text{H}^+)$



*The number of alveoli in the lungs \approx 300 million alveoli

=> Their surface area (for all alveoli) \approx 140 m² (huge! For gas exchange)

Capillary endothelial cells (Endothelial lining of capillaries)

- Extremely thin
- Can be confused with type 1 alveolar cells (Because they are both simple squamous epithelium) => Then how To differentiate between them?
 - ** Many RBCs around => endothelial cells.
 - ** No RBCs => Type 1 alveolar cells.
- Non-fenestrated endothelial cells (Remember types of endothelial cells: fenestrated non fenestrated)
- Characteristic feature;
 - ** Clustering of organelles (e.g. Mitochondria+ Golgi) => Around their nuclei.
 - => while the rest of the cytoplasm is empty => (to contain O₂)
- ** Have pinocytic vesicles inside them

** similar to type 1 alveolar cells

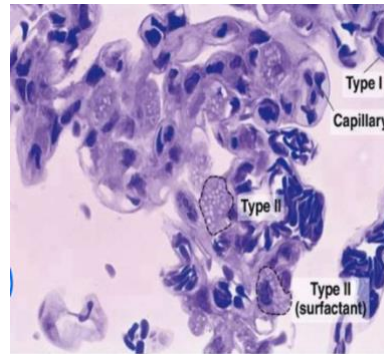
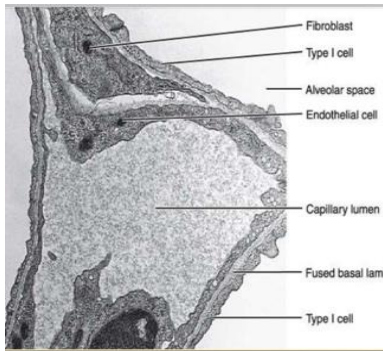
Type 1 alveolar cells

=> 97% of alveolar wall

=> 8% of the septum

- Size \approx 25nm (nanometer)
- *Also, their organelles are clustered around their nuclei (like Golgi complex)
- Part of the blood-air barrier
- *Also have pinocytic vesicles
- Between type1 & type2 alveolar cells we have:
 1. Desmosomes
 2. occluding junctions

*Similar to endothelial cells



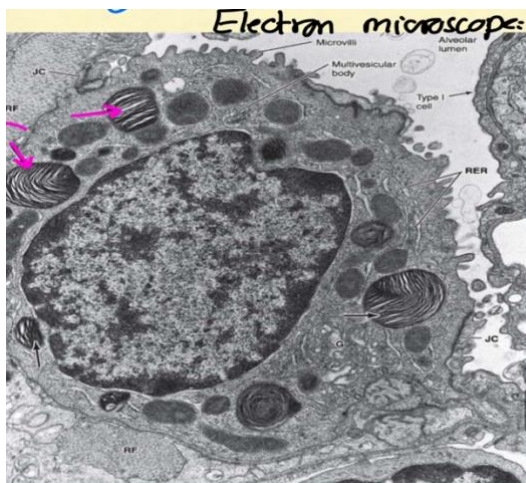
Type 2 alveolar cells

- Cuboidal cells.
- larger than type 1
- desmosomes and occluding junctions with type 1 cells
- secrete surfactants (**Important for decreasing the surface tension in alveoli helps in the inflation**) خصوصاً في الولادة
- Characteristic feature;

Undergoes mitosis and division => So replacement of type **1** + **2** cells

- In electron microscope, type 2 has **lamellar bodies** (have foamy appearance in cytoplasm & contain the pulmonary surfactants that spread on the surface of type1 cells)

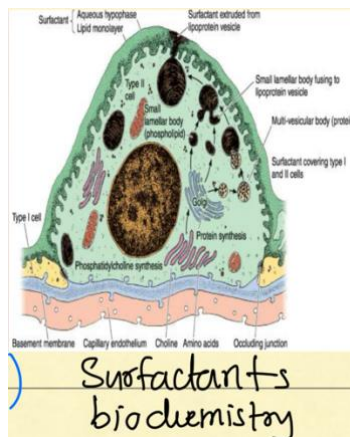
Kindly, Check pink arrows



Pulmonary Surfactants

- Contain proteins A+B+C+D.
- Have bactericidal effects & lysosomal effects (Antibacterial effects)
- Present in Bronchoalveolar fluid (contain structures other than surfactants, like macrophages)

=> That's why once the baby is born, they do suction of this fluid including the surfactant within it



Inhalation of NO₂ => have toxic effect i.e. destruction of cells specially (Type 1 and type 2 alveolar cells)

=> But especially type 2

=> Undergoes continuous turnover with high rate

=> and it's also converted into type 1 cell replacing it

Macrophages (Dust cells)

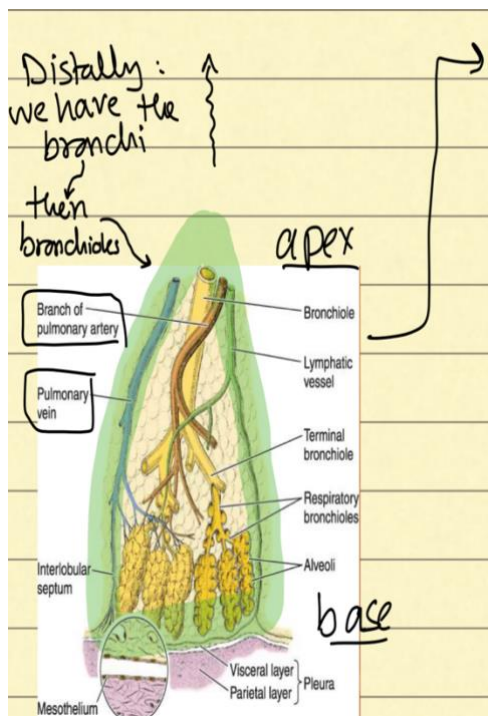
- Seen in lung tissue but can also be seen on the surface in pleura.
- Appear as black dots all over the lung tissue.
- Function; engulfing any foreign bodies or cell debris.
- Come originally from the monocytes (from the WBCs)

=> And reach the lungs through the blood

- => Present in the interalveolar septum to perform their function (engulfing)
- => can sometimes reach the bronchi through the bronchioles.
- => then ascending upward to reach the pharynx.
- => & undergo expectoration with the saliva (extra: expelling substances with this saliva through the mouth)

=> Which type of cells is presented in higher amount in lung tissue type I alveolar cells or macrophages? **Surprisingly Macrophages**

Pulmonary blood vessels



This is the bronchopulmonary segment

- Pyramidal in shape (has apex+base)
- Bronchi=> terminal bronchioles => respiratory bronchioles => alveoli
- Also contains:
 1. Segmental pulmonary artery (non-oxygenated blood) , while the oxygenated arterial blood supply to the lungs: Bronchial arteries (we call them nutrient vessels), (branches of post intercostal arteries=> From descending thoracic Aorta)
 2. The pulmonary veins are on the 2 sides of the segment in the connective tissue (oxygenated blood)
- (Capillaries → venules → veins → left atrium → left ventricle → aorta)

Pulmonary lymphatic vessels

(superficial & deep)

Eventually they go to the hilum of the lung (& we call them in the hilum: mediastinal L.Ns)
=> to thoracic duct (on left side) & right lymphatic duct (right side) => ending at the beginning of brachiocephalic veins (left & right)

Nerve supply

=> Lung tissue and visceral pleura => sympathetic (bronchodilation) + parasympathetic (bronchoconstriction).

** pain+touch+temp. Of them are Through the afferent fibers (extra: but very weak & poorly localized. sensation)

=> the 2 types of pleura (visceral & parietal):

1. Have elastic fibers + reticular fibers (for inflation of the lung)
2. type of epithelium: mesothelial cells (simple squamous epithelium)

=> directly below then collagen + elastic fibers of the lung tissue (also for inflation of the lung)

!! Lung tissue = lung parenchyma

Numbers!!

- Diameter of bronchioles=> 5mm or less. (In narrower ones, from 0.5-1mm)
- Diameter of alveoli => 200 um
- Diameter of alveolar pores => 10-15 um
- Thickness of blood-air barrier => 0.1-0.5 um
- No. Of Alveoli in the lungs=> 300 million
- Total surface area of alveoli => 140 m²
- Thickness of type 1 alveolar cell => 25 nm

| VERSIONS | SLIDE # | BEFORE CORRECTION | AFTER CORRECTION |
|----------|---------|-------------------|------------------|
| V1→V2 | | | |
| V2→V3 | | | |



امسح الرمز و شاركنا بأفكارك لتحسين أدائنا !!