Histology Lecture (2)

Histology of the Lower Respiratory Tract & the Lung

By: Lulu Al Obaid

Arwa Al Meshaan

Rana Al Ohaly

Reviewed by :

Yasir Sharifi

Mohammed Adel

Objectives:

By the end of this lecture the student should be able to describe the microscopic structures of:

1- The microscopic structures of the wall of:

- **Trachea.**
- **Primary or extrapulmonary bronchi.**
- **Intrapulmonary (secondary and tertiary) bronchi.**
- **Bronchioles.**

2- The microscopic structures of :

- **Interalveolar septum.**
- **Alveolar phagocytes.**
- **Pleura.**

From previous lecture:

MUCOSA (MUCOUS MEMBRANE):

(A) Epithelium:

Pseudo-stratified ciliated columnar epithelium with goblet cells (Respiratory epithelium).

(B) **Lamina propria (Sub-epithelial C.T.)** contains:

1- Large arterial plexuses & venous sinuses (Highly vascularized C.T.)

2- Many seromucous glands (acini).

3- Abundant lymphoid elements: Including occasional lymphoid nodules, plasma cells & mast cells.

Structure	Wall formed of		diameter	notes
Bronchus => bronchi Bronchiole => bronchioles Trachea	**1-Musoca**	**-Epithelium:** Respiratory epithelium **-Lamina propria** **-Elastic lamina** (special feature)**:** It is formed of elastic fibers. It separates lamina propria from submucosa.	More than 1 mm	
	2-Submucosa	C.T. containing: - **Numerous mucous & seromucous glands** (we can call them trachealis glands. Their function is to maintain the surface wet) - **Lymphoid elements** (form nodules)		
	3-Adventitia (fibrocartilage layer)	- **Fibroelastic C.T.** **- C-shaped rings (12-16) of hyaline cartilage.** Trachealis muscle (bundle of smooth muscle fibers) connects the 2 ends of each C-shaped cartilage.		
EXTRAPULMONARYBRONCHUS (1ry BRONCHUS)	Generally have the same histological appearance as the trachea.			
INTRAPULMONARY BRONCHUS	(1) **Mucosa:**	a- Epithelium: Respiratory epithelium b- Lamina propria N.B. No elastic lamina.	More than 1mm.	

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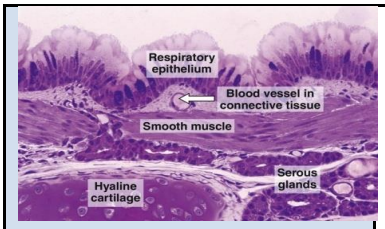
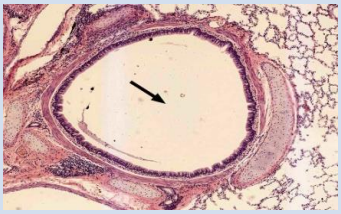
<tr>
<td rowspan="3"> 


Alveoli are clear (tells us It's inside the lung)
Presence of cartilage (tells us it's bronchus)</td>
<td><u>(2) Muscle coat (complete):</u>
(because the lung do continuous expansion and recoiling in all directions)</td>
<td>- Two distinct layers of smooth muscle fibers spirally arranged in opposite direction.</td>
<td rowspan="3"></td>
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</tr>
<tr>
<td>(3) Submucosa:</td>
<td>C.T. contains:
a- Seromucous glands.
b- Lymphoid elements.</td>
</tr>
<tr>
<td>(4) Adventitia:</td>
<td>a- <u>Loose C.T.</u>
b- Irregular plates of hyaline cartilage <u>(complete layer)</u>.
c- Solitary lymphoid nodules.</td>
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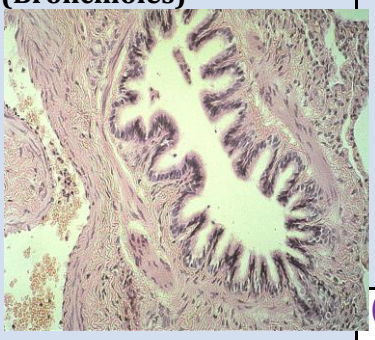
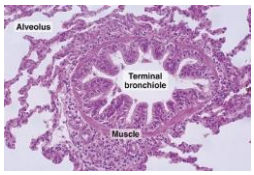
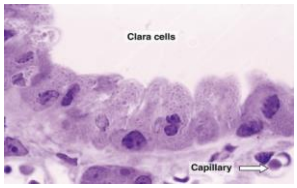
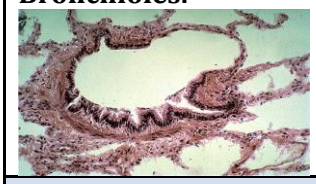
<tr>
<td rowspan="3">Preterminal (1ry) Bronchioles (Bronchioles)
  </td>
<td>(1) Mucosa:</td>
<td>has longitudinal folds: (irregular to increase the surface area and allowing the dilatation to occur)
A- Epithelium:
Simple ciliated columnar epithelium
with occasional goblet cells.(they start to decrease in number thus producing less mucus)
B- Lamina propria:
C.T. rich in elastic fibers.</td>
<td rowspan="3">less than 1mm</td>
<td rowspan="3">We can know if it's bronchiols or not in general lung view but we can't determine whether it's preterminal or terminal bronchiol until we see a focus view then according to the type of the epithelium we know.

*how to know it's bronchiol?
1- no cartilage.
2-small diameter
3-<u>simple</u> epithelium.</td>
</tr>
<tr>
<td>(2) Smooth muscle:</td>
<td>2 helically arranged smooth muscle layers.</td>
</tr>
<tr>
<td>(3) Adventitia:</td>
<td>C.T.
N.B. <u>No cartilage</u>, <u>No seromucous glands</u>, <u>No lymph nodules</u> <u>(the lymphatic elements scattered)</u></td>
</tr>
<tr>
<td rowspan="2">Terminal (2ry) Bronchioles.
 

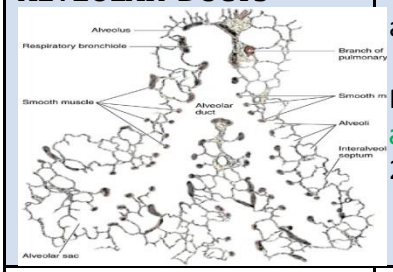
Clara cells
 
</td>
<td colspan="2">Similar structure to preterminal bronchioles, but:
Epithelium:
Simple cuboidal partially ciliated epithelium.
With Clara cells (With NO goblet cells).</td>
<td rowspan="2">less than 0.5mm</td>
<td rowspan="2"></td>
</tr>
<tr>
<td colspan="2">Clara cells:
Structure:
Columnar cells (Non ciliated). Has dome shape.
Function:
1- Degrade toxins in inhaled air.
2- Divide to regenerate the bronchiolar epithelium
3- Produce surfactant-like material.</td>
</tr>
</table>

Respiratory (3ry) Bronchioles.



Are similar in structure to terminal bronchioles **But:** their walls are interrupted by the presence of few pulmonary alveoli.
(Respiratory Bronchioles = alveoli +No specific epithelium)

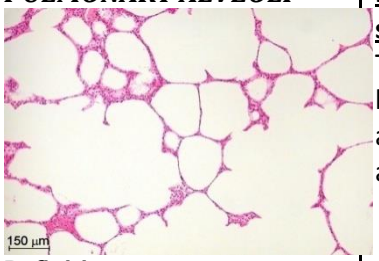
ALVEOLAR DUCTS



The wall of alveolar ducts consist almost of pulmonary alveoli. (No wall for alveolar duct and the atrium)

N.B. Alveolar duct → ends by: atrium (group 2, 3 or 4 alveolar Sacs opened to each other) → communicates with: 2-3 alveolar sacs

PULMONARY ALVEOLI

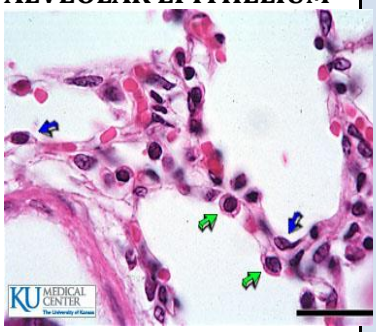


Definition:
They are small out-pouching of respiratory bronchioles, alveolar ducts & alveolar sacs.

Interalveolar septa:
The region between 2 adjacent alveoli

Components:
1) Alveolar Epithelium:
Lines both sides of interalveolar septum.
2) Interstitium made of:
- *Continuous Pulmonary Capillaries.*
- *Interstitial C.T* consisting*:*
  a) C.T. Fibers: elastic fibers & type III collagen (reticular fibers).
  b) C.T.Cells: Fibroblasts, Macrophages, Mast cells, Lymphocytes.

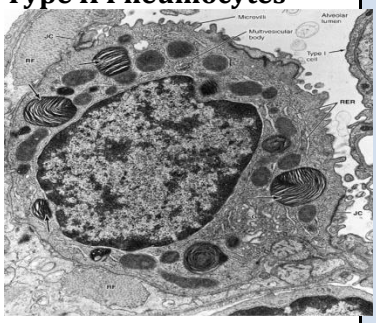
ALVEOLAR EPITHELIUM



Alveolar epithelium (remember it's part of alveolar septa)

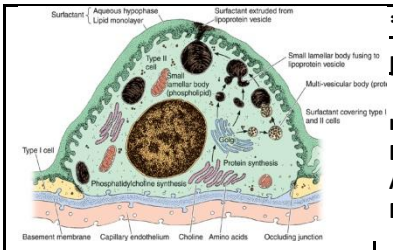
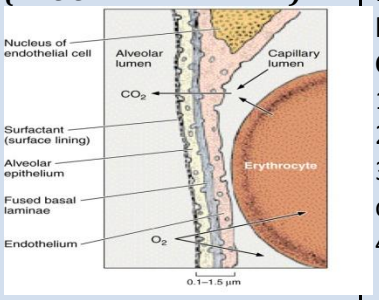
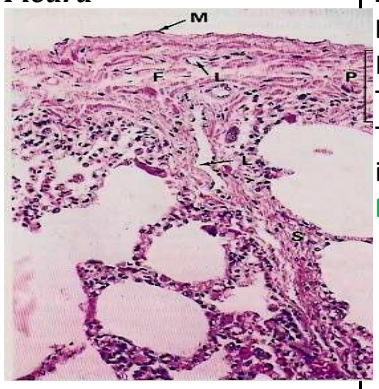
Contains:
1. **Type I Pneumocytes**
   - line **95%** of the alveolar surface.
   - **Count:** less numerous than type II pneumocytes.
   - **L/M:** simple squamous epith.
   - **Function:** Exchange of gases
2. **Type II Pneumocytes**
   - Line **5%** of the alveolar surfaces.
   - Are **more** numerous than type I pneumocytes.
   - Are **cuboidal or rounded cells,** With **Foamy** (like a bubble or vesicle contain surfactant) **cytoplasm.**
   - Nucleus: central & rounded.
   - The cytoplasm contains membrane-bound **Lamellar bodies** (contain pulmonary surfactant).
   - **Function:**
     - Synthesis & secretion of **pulmonary surfactant.**
     - **Renewal** of alveolar epithelial cells: Type II cells can divide to regenerate both type I & type II pneumocytes.

Type II Pneumocytes



If there is infection or inflammation Collagen type I will be there

Interalveolar septa has many macrophages + Type 1 Pneumocytes 95% alveolar surface and Type 2 Pneumocytes 5% (but it is more in number and small in size)

	**<u>* Alveolar phagocytes</u>** **Lung macrophages = Dust Cells = Alveolar Macrophages**	***Sites:*** • In the lumen of pulmonary alveoli. • In the interstitium of interalveolar septa. • **Function:** Phagocytose particulate matter (e.g. dust) & bacteria in the lumen of pulmonary alveoli and in the interstitium of interalveolar septa.		
BLOOD-GAS BARRIER (BLOOD-AIR BARRIER) 	**Definition:** It is the region of the interalveolar septum that is traversed by O2 & CO2 **Components:** 1- Thin layer of surfactant. 2- Type I pneumocyte. 3- Fused basal laminae of type I pneumocytes & endothelial cells of the pulmonary capillary. 4- Endothelial cells of the pulmonary capillary.			Gas exchange between Alveoli lumen and blood
Pleura 	***Is formed of two layers:*** **Parietal and visceral.** It is formed of **<u>simple squamous</u>** mesothelium. The two layers are separated by **serous fluid**. The <u>visceral</u> layer has **sub-epithelium loose C.T** that extends into the lung tissue. **Function:** prevent friction**.**			

- In all tubular structure we take transverse or perpendicular section and because trachea is a tubular structure we take transverse section.