



LECTURE 2: LOWER RESPIRATORY TRACT & LUNGS

❑ Objectives:

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

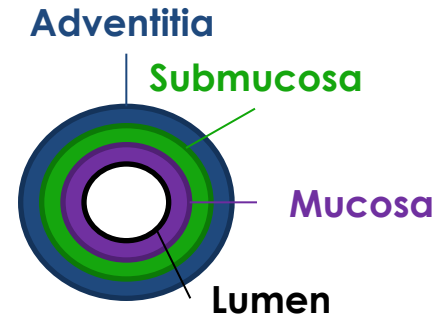
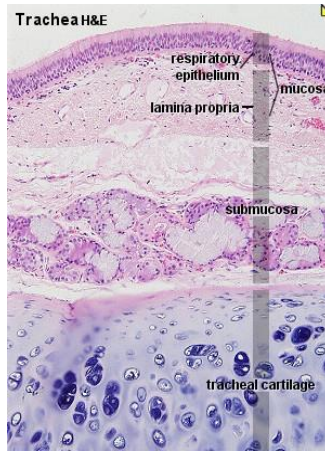
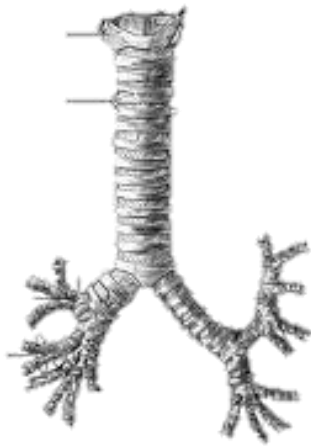
1. The Microscopic Structures of the wall of:

- Trachea
- Primary or Extrapulmonary Bronchi
- Intrapulmonary (secondary & tertiary) Bronchi
- Bronchioles

2. The Microscopic Structures of:

- Inter-alveolar Septum
- Alveolar Phagocytes
- Pleura

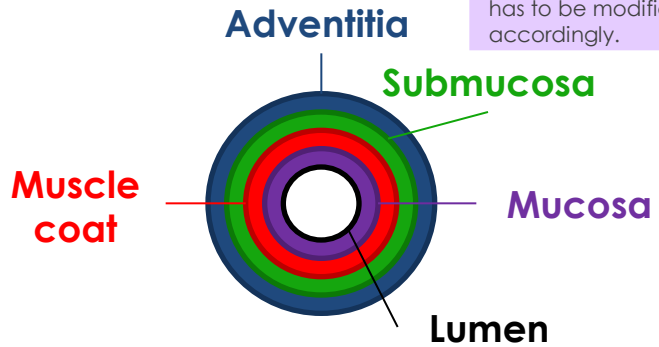
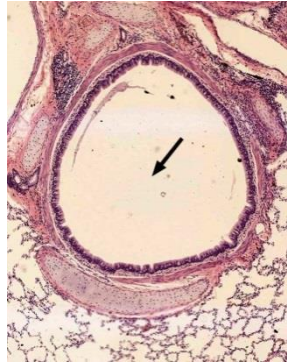
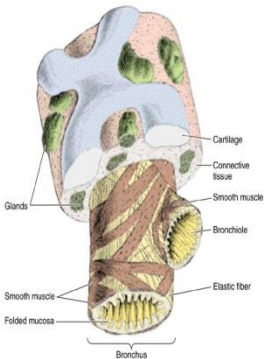
TRACHEA and EXTRAPULMONARY BRONCHUS (1ry BRONCHUS)



Wall Layers	Contents	Section	Notes
<u>MUCOSA</u>	<ul style="list-style-type: none"> Respiratory epithelium Lamina propria Elastic lamina: It is formed of elastic fibers. It separates lamina propria from submucosa. 		The elastic lamina has the liability for coiling and recoiling. This is important when exercising, the trachealis muscle relaxes and the trachea dilates to ease ventilation.
<u>SUBMUCOSA</u>	<ul style="list-style-type: none"> C.T. Numerous mucous & seromucous glands. Lymphoid elements. 		Easy to identify by the numerous characteristic circular glands.
<u>ADVENTITIA</u>	<ul style="list-style-type: none"> Fibro-elastic 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 (incomplete) rings of cartilage. 		

INTRAPULMONARY BRONCHI (2ry & 3ry BRONCHI)

The intrapulmonary bronchi (2ry & 3ry) is different than the extrapulmonary bronchi and the trachea because this part is in the lung, so it has to be modified accordingly.



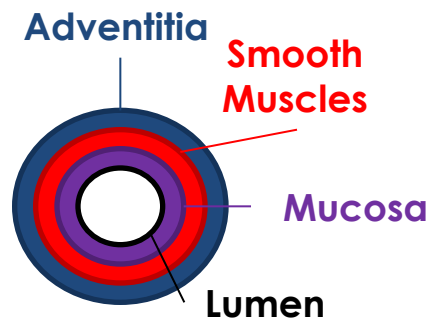
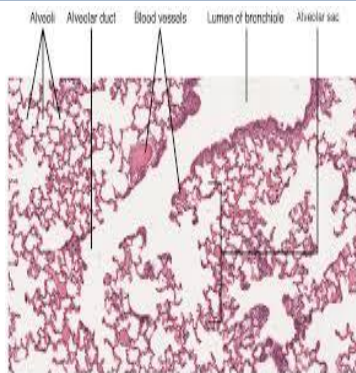
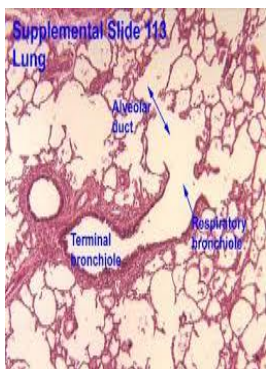
Wall Layers	Contents	Section
<u>MUCOSA</u>	<ul style="list-style-type: none"> Respiratory epithelium. Lamina propria. <p>N.B. No elastic lamina.</p>	
<u>COMPLETE MUSCLE COAT</u>	<ul style="list-style-type: none"> Two distinct layers of smooth muscle fibers spirally arranged in opposite direction. 	
<u>SUBMUCOSA</u>	<p>C.T. contains:</p> <ul style="list-style-type: none"> Seromucous glands. Lymphoid elements. 	
<u>ADVENTITIA</u>	<ul style="list-style-type: none"> Loose C.T. [To ease dilatation] Irregular plates of hyaline cartilage (complete layer). [For dilatation in all directions] Solitary lymphoid nodules. 	<p>Supplemental Slide 113</p>

When you can see the alveoli, you are in the lung, which means it's the intrapulmonary bronchi

After this point, there will no longer be cartilage

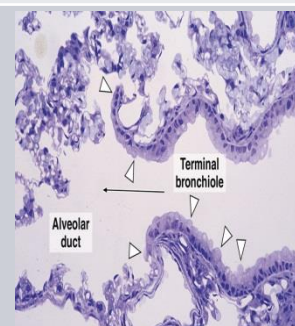
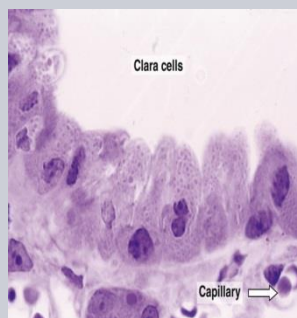
People with asthma usually have problems in the bronchioles because there is no cartilage to support the bronchioles from the constricting muscles.

BRONCHIOLES

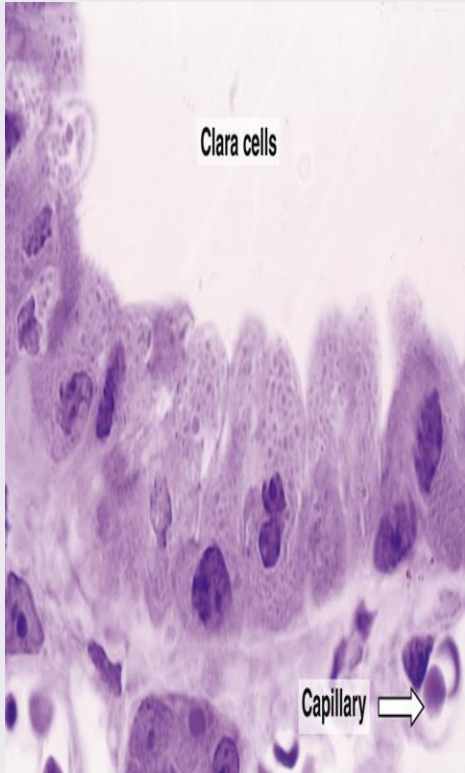
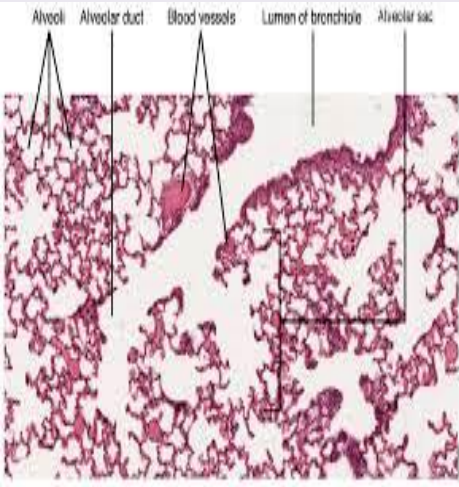
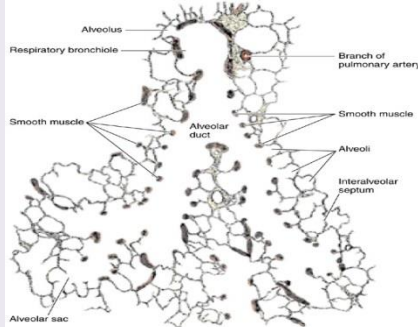


<u>Wall Layers</u>		<u>Preterminal (1ry) Bronchioles</u>	<u>Terminal (2ry) Bronchioles</u>	<u>Respiratory (3ry) Bronchioles</u>
<u>MUCOSA</u>	Epithelium	has longitudinal folds: Simple ciliated columnar epith. with occasional goblet cells.	has longitudinal folds: Simple cuboidal partially ciliated epithelium with clara cells [NO goblet cells, but it is not dry because of the clara cells]	
	Lamina Propria	C.T. rich in elastic fibers.		
<u>SMOOTH MUSCLES</u>		2 helically arranged smooth muscle layers		
<u>ADVENTITIA</u>		C.T.		
<u>NOTES</u>		Are less than 1mm in diameter	Are less than 0.5mm in diameter.	their walls are interrupted by the presence of few pulmonary alveoli.
		No cartilage, No seromucous glands, No lymph nodules.		

SECTION



Clara cells & Alveolar Ducts

	<u>CLARA CELLS</u>	<u>ALVEOLAR DUCTS</u>
<u>Structure</u>	columnar cells (non ciliated).	The wall of alveolar ducts consist of pulmonary alveoli.
<u>Function</u>	1- Degrade toxins in inhaled air. 2- Divide to regenerate the bronchiolar epithelium. 3- Produce surfactant-like material.	Airway
<u>Notes</u>	It is found between the other cells. It secretes other substances with mucous.	Each alveolar duct communicates with 2-3 alveolar sacs
<u>Section</u>	 <p>A histological micrograph showing a layer of columnar Clara cells. The cells are arranged in a single layer. A label 'Clara cells' points to the cells. At the bottom right, a label 'Capillary' with an arrow points to a blood vessel.</p>	 <p>A histological micrograph of lung tissue. Labels at the top indicate 'Alveoli', 'Alveolar duct', 'Blood vessels', 'Lumen of bronchiole', and 'Alveolar sac'. The image shows the branching structure of the airways and the surrounding alveolar sacs.</p>  <p>A schematic diagram of lung anatomy. Labels include: 'Alveolus', 'Respiratory bronchiole', 'Smooth muscle', 'Alveolar duct', 'Branch of pulmonary artery', 'Alveoli', 'Interalveolar septum', and 'Alveolar sac'. The diagram illustrates the relationship between the airway and the alveolar sacs.</p>

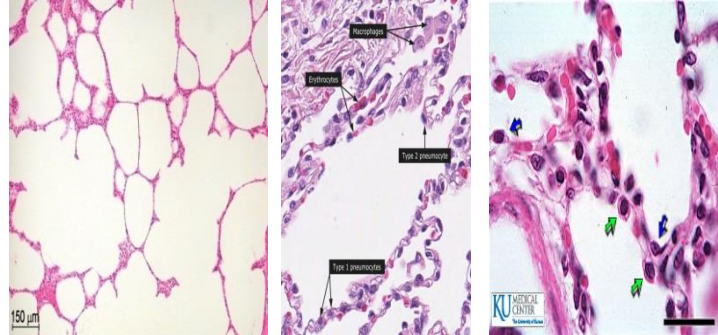
PULMONARY ALVEOLI

Definition:

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

Topics: (Next page)

- Interalveolar septa
- Interstitium of alveolar septa
- Alveolar epithelium
- Alveolar phagocytes



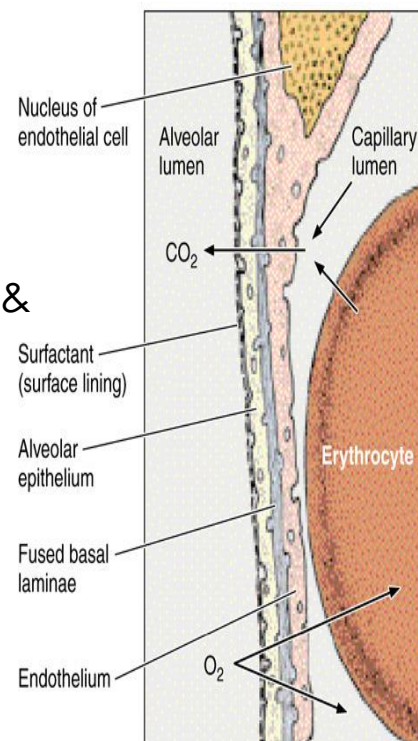
BLOOD-GAS BARRIER (BLOOD-AIR BARRIER)

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.



Interalveolar Septa

It is the region between 2 adjacent alveoli.

Alveolar phagocytes (Alveolar Macrophages) (Dust Cells)

Alveolar Epithelium:

lines both sides of interalveolar septum

Interstitial.

Sites:

1- In the lumen of pulmonary alveoli.

2- 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.

Type I Pneumocytes

Type II Pneumocytes

(1) Continuous Pulmonary Capillaries.

(2) Interstitial C.T.:

a- C.T. Fibers: elastic fibers & type III collagen (reticular fibers).

b- C.T. Cells:
*Fibroblasts,
*Macrophages,
*Mast cells,
*Lymphocytes.

- line **95% of the alveolar surface.**

- **Count:** less numerous than type II pneumocytes

[flat and thin for gas exchange, which makes it less numerous but covers most of the surface]

- **L/M:** simple squamous epithelium

- **Function:** Exchange of gases.

- Line **5% of the alveolar surface.**

- **Count:** more numerous than type I pneumocytes.

- **L/M:** Are cuboidal or rounded cells, With Foamy cytoplasm: the cytoplasm contains membrane-bound Lamellar Bodies that contain pulmonary surfactant

Nucleus: central & rounded.

- **Function:**

1- Synthesis & secretion of pulmonary surfactant.

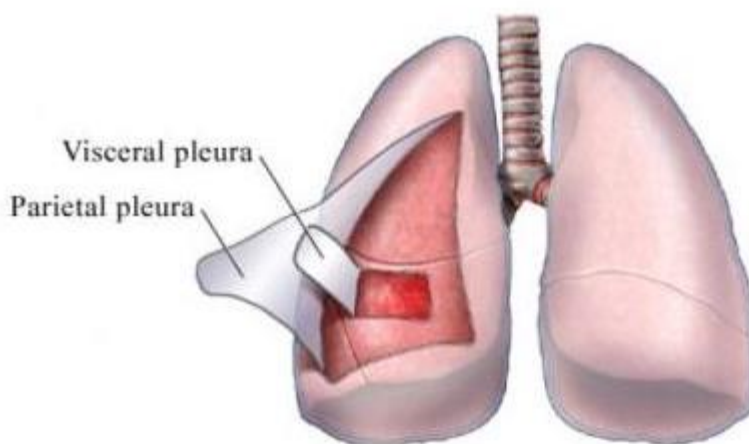
2- Renewal of alveolar epithelial cells: Type II cells can divide to regenerate **both type I & type II pneumocytes.**



Pleura

**Is formed of two layers:
Parietal and visceral.**

It is formed of **simple squamous mesothelium**. The two layers are separated by **serous fluid**. The visceral layer has sub-epithelium loose C.T that extends into the lung tissue



MCQs

1) Mucosa of Intrapulmonary Bronchus has NO:

- a) Lamina Propria b) Respiratory Epithelium c) Elastic Lamina

2) Adventitia of trachea has:

- a) Fibroelastic C.T b) Loose C.T c) Reticular C.T

3) The epithelium of terminal bronchioles is:

- a) Simple Cuboidal partially ciliated epithelium b) Simple ciliated Columnar epithelium
c) Pseudo stratified ciliated Columnar epithelium

4) Which one of these cells produce surfactant like material:

- a) Goblet cell b) Clara cell c) Type I Pneumocyte

5) The function of type I pnemocytes is:

- a) Exchange of gases b) Produce surfactant c) Toxin in inhaled air

6) The lining of the preterminal bronchioles is:

- a) Pseudostratified ciliated columnar b) Simple ciliated columnar c) Stratified Squamous

7) The function of Clara cell:

- a) Muscle contraction b) Gas exchange c) Degrade toxins

8) The wall of alveolar duct consists of:

- a) Pulmonary alveoli b) Terminal bronchi c) Clara cell

9) Type II pneumocyte line 95% of the alveolar surface :

- a) True b) False

10) Adventitia of intrapulmonary bronchus consist of C-shape ring of hyaline cartilage :

- a) True b) False

6) b

5) a
10) b

4) b
9) b

3) a
8) a

2) a
7) c

Answers: 1) c

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Good Luck! 😊