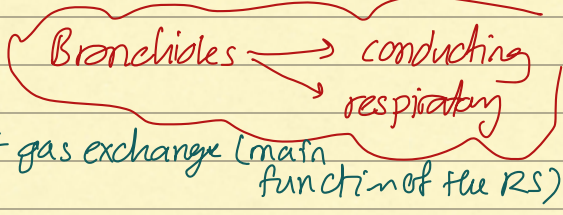


● Histology of the respiratory tract:

* Largest capillaries network is present in the lungs (surrounding the alveoli) → to support gas exchange (main function of the RS)



* Respiratory tract → conducting portion (nose, larynx, pharynx, trachea, bronchi, conducting bronchioles)
 → Respiratory portion (for gas exchange) (respiratory bronchioles, alveolar duct, alveolar sac, alveoli) : ناس التنفس
 ↳ alveoli → جُذُوع (so it's surrounded by many alveoli) Large & small bronchioles
 * alveolar sac is the end of the duct & is also surrounded by alveoli terminal bronchioles

* each lung has millions of alveoli → surrounded by many capillaries
 imp in the RT (is filled with O₂ when the lung is inflated)

* Bronchi → primary → rt & lt main bronchus → Extra pulmonary (outside the lung)

as we move distally towards the lungs → the bronchi diameter decreases

→ secondary (lobar bronchi) → lobes نَوَاحِي (lt lung → 2 lobes / rt lung → 3 lobes)
 so we have
 - 2 left secondary
 - 3 right secondary

→ Tertiary (10 on each lung) → we call them: Bronchopulmonary segments

in cases of tumor in the lung → lobectomy
 (left 2, right 3) ← left 2, right 3
 Now they only perform segmentary (removal of the affected segments)
 bc each segment contains its own alveoli, lymphatics, blood supply & surrounded by CT → easily resected

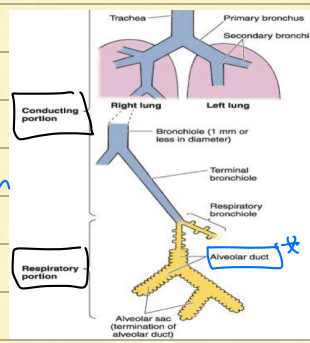
The lining epithelium:-

* Generally • pseudostratified ciliated columnar epi with goblet cells
 ↳ (trachea, bronchi (1^o+2^o+3^o))

* in bronchioles → simple columnar / cuboidal ciliated (conducting) with few goblet cells with no cartilage (absent)

so in cases of asthma, the smooth m. cells in the bronchioles are narrowed & contracted → wheezing during expiration

الجزء الذي لا يحتوي على الكارباجون في القصبة الهوائية وجزء القصبة الهوائية الذي لا يحتوي على الكارباجون



* in respiratory bronchioles → simple squamous epi

* in the alveoli → " " "

* in the capillaries → simple squamous epi (endothelium)

So: they are all thin for gas exchange

الأمعاء: الغشاء المخاطي

- * The lining epi in the: esophagus: stratified squamous non-keratinised
- Stomach: simple columnar epi without goblet cells
- Small intestine: simple columnar with goblet cells

* The layers of the conducting portion walls :-

- mucosa → lining epi / lamina propria / muscularis mucosa
- submucosa → contains glands (seromucous gland) → they open on the surface
- supporting layer (hyaline cartilage & smooth m. cells) → increase in the bronchioles & become spiral
- Adventitia (CT) → C-shape in trachea
- plates in bronchi (decreasing in # as we move distally)

GIT glands
الغدد في الأمعاء

loose CT with few glands

* The 4 layers in the GIT: mucosa / submucosa / muscularis layer / adventitia (serosa)

* The lamina propria in the GIT → filled with glands (in RT, it's in the submucosa)

* The mucosa layers are the same as the RT (lining epi, lamina propria, muscularis mucosa)

* Supportive layer of the respiratory tract:

- Cartilage
- OR
- smooth m. cells

* The glands in the submucosa → trap the foreign bodies

* The cilia → propel foreign bodies by moving outwards (in one direction)

* Lamina propria → loose CT with few glands (unlike the GIT)

* The smooth muscles are increased in the bronchioles (circular & spiral)

Lumen
الفتحة

So: when they contract

Lumen narrowing

* cartilage in the trachea: - (in the supporting layer)
C-shape hyaline cartilage → Why is it not complete?

Instead there are smooth muscles
(trachealis muscles): even helps the bolus
descending through the esophagus

bc there's the esophagus
behind the trachea
which performs peristaltic movement

↓
if it's complete it will impede
& block the way of the descending bolus

* Cartilage in bronchi:

↳ in the form of plates → decrease as we move distally
(hyaline cartilage)

↳ When we reach the 3rd bronchi → they become only

1-3 pieces of cartilage

* Functions of the conducting portion:

↳ Air transmission (major function)

↳ Protection → By cleaning, moistening & warming of air

Thick hairs & skin in the vestibule ⇒ Air filtration

movement of cilia (propelling the dust outside)
in one direction

* The respiratory portion → main function: gases exchange

- the alveoli surround the alveolar sac + duct

↳ type of epi: simple squamous epi (in 97%, the rest are cuboidal
surfactant cells)

↳ When 2 alveoli meet, they form a septum in the middle
+ corners (filled with elastic & reticular fibers)

* the capillaries surround each alveolus
(begin as arterioles & end as venules)

For lung's inflation
and deflation

* Pulmonary trunk → rt & lt pulmonary arteries → Arterioles
(from rt ventricle) (deoxygenated blood) (going to the lungs)

* Blood exiting the arterioles is now oxygenated → venules → pulmonary veins
(taking O₂ from alveoli) (4 in #) → 2 rt & 2 lt
..... Left atrium ←

* Types of alveoli :-

Their walls :-

- 1- Type 1 alveolar cells / pneumocytes (97%) \Rightarrow simple squamous cells
 - 2- Type 2 alveolar cells / pneumocytes (3%) \Rightarrow cuboidal surfactant cells
- \hookrightarrow secrete the surfactants $\xrightarrow{\text{Function}}$ Decrease the surface tension of the alveoli

يغزوا بالهواء 8/9 من الحبل (الكبدية كبيرة)

So: the alveolus becomes filled with air during inspiration

اول ما يدخل في الرئة \leftarrow من الحبل
 brain respiratory center

Surfactants

Respiratory distress syndrome

Sending motor impulses to the diaphragm to descend towards the abdomen

So we put the baby in an incubator

\rightarrow so: intrathoracic pressure < atmospheric

But nowadays, surfactant production can be detected before birth

\hookrightarrow (entry of air to fill the lungs)

اول مرة للبيبي ان يدخل الهواء وصار يتنفس

so: \hookrightarrow thyroxine/cortisone \hookrightarrow surfactants

مساعدة ال surfactants

* Cells of the respiratory epithelium :-

5 types of cells in the lining epi

\hookrightarrow 2 types can be seen by the light microscope

- 1- The goblet cells
 - 2- the pseudostratified columnar cells
- \rightarrow the other types are only seen by the electron microscope

3- Basal cell (in the basement membrane) \rightarrow thick in the RT
 Stem cell (بانيو الخلية)

Function \hookrightarrow mitosis to replace other cells (reservoir cell)

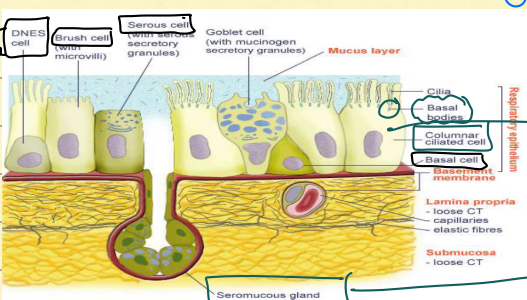
4- Brush cells \rightarrow have microvilli (have sensory receptors) on the surface

5- Granular cells / serous cells

6- Diffuse neuroendocrine cells / Kultichsky cells

\hookrightarrow for secretion of glands

Diffuse neuroendocrine cells



* ciliated columnar (with 300 cilia)
 * the cilia are connected with basal bodies

The glands have ducts to deliver the secretions to the surface

* all the cilia are:
 ↳ surrounded by apical mitochondria → to give energy for cilia movement

* Dynein protein is very imp for movement of cilia (in one direction)

↳ Nicotine kills this dynein (in smokers)
 no efficient ciliary movement → infection (from acute to chronic)
 ↳ immotile cilia syndrome (Kartagener syndrome)
 ↳ leads to chronic RT infections
 ↳ infertility in men
 ↳ Bc sperm have tails & movement

So when we kill the cilia, the flagella of the sperm can't move anymore → immotile sperm

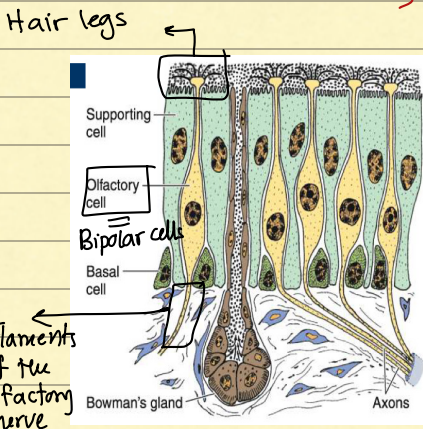
* Mucus goblet cells → produce mucus → trapping of foreign bodies

* Nasal cavity → vestibule: ^{air} fine type of epi is skin
 * contains thick & short hair (for air filtration)

↳ The respiratory area
 ↳ covering all the lateral wall (pseudostratified ciliated columnar epi with goblet cells)
 ↳ Submucosa: ^{glands} Glands

* its disadvantage:
 ↳ venous plexus of veins → for warming of air (to protect the brain cells from cold air)
 ↳ in cases of infections/rhinitis → engorgement of blood → block of the nose
 ↳ could be treated by giving: Decongestants

↳ Olfactory region (above the superior conchae)



↳ has Bipolar cells (small → impulses) → & then are sent to the smell
 = olfactory cells
 Through the olfactory center in the brain
 nerve (cranial nerve # 1)

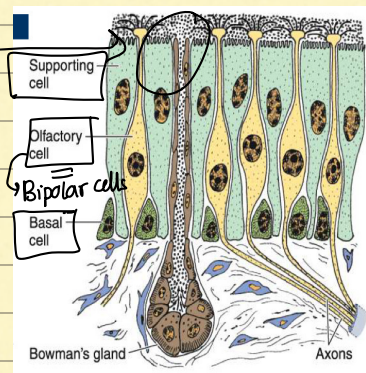
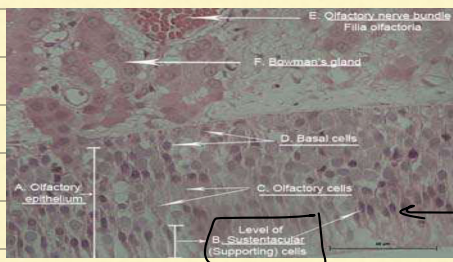
↳ * 1 pole has hair legs

* the other pole → filaments of olfactory nerve

* Walls of olfactory region :-

- * Bipolar cells → are surrounded by supporting cells
- * on the base → basal cells (stem cells; just like the ones in the respiratory epi)
- * in the submucosa → glands (Bowman's glands → seromucus/mucus secreting)
- * Microvilli on the cells surfaces → For surface dissolving
- * Supporting cells = sustentacular cells

BC fluid ducts reach the surface



* Paranasal sinuses (12) : Cavities inside the skull base

- 1- Frontal (2) / 2- Maxillary (2) / 2- sphenoid (2) / 4- ethmoidal (6)

* Their lining epi is very thin

* Goblet cells & glands are very few (Bc the sinuses have different function = Resonance of voice)

* The underlying periosteum is adherent with the lining epithelium

* Trachea → ends at (T4) → in inspiration: it descends & could reach (6) ribs → C-shaped hyaline cartilage with trachealis muscle (posteriorly)

* Tertiary bronchi → each one gives 5-7 terminal bronchioles
 ↳ smaller diameter

!! Remember: conducting bronchioles = terminal bronchioles

* Clara cells → Cuboidal cells without cilia → imp function
 ↳ it's said that they substitute the goblet cells in surfactants formation
 ↳ as goblet cells become absent

* Bronchi → have pieces of cartilage / plates of cartilage

- ↳ primary: extrapulmonary
- ↳ 2° & 3°: intrapulmonary

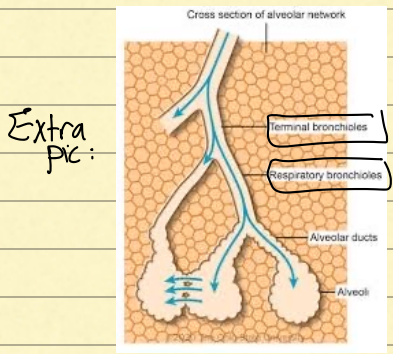
↳ # of hyaline cartilage is less than the 2°

* Conducting bronchioles → many smooth m. cells

- No cartilage
- No glands
- simple cuboidal (columnar with cilia) → Then: without cilia
- Goblet cell → Clara cell (simple cuboidal without cilia)

* Respiratory bronchioles → simple squamous

- No cartilage
- Clara cells without cilia
- Surrounded then by alveoli (simple squamous epi)



In the lung:

- * Elastic fibers + reticular fibers → between the alveoli in the lung responsible for inflation & deflation of the lung
- No smooth m. cells in the lung (only knobs of smooth muscles)

