Human Histology session

1st stage

2020-2021

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Histology of Respiratory system

Introduction

A. The respiratory system provides for gas exchange between the environment and blood.

B. The human respiratory system may be subdivided into two parts:

1- The conducting portion is a continuum of air passageways that conduct air from the environment into respiratory spaces (and back out)

Introduction

2- The respiratory (gas exchange) portion consists of many interconnected air-filled spaces with very thin linings which allow rapid gas exchange.

C. The human respiratory system includes numerous organs.

Introduction

1-nose/nasal cavity

2-Pharynx

3-Larynx

4-Trachea

5-Bronchi

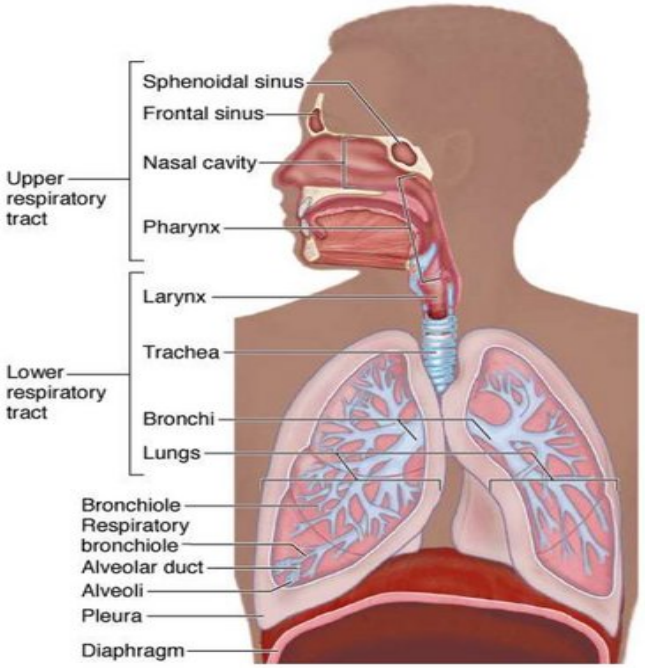
6-Lungs

7-muscles(diaphragm, intercostal muscles)

Introduction

The Respiratory System consist of

1.Conducting portion, which consists of the nasal cavities, nasopharynx, larynx, trachea, bronchi ,bronchioles, and terminal bronchioles



2.Respiratory portion (where gas exchange takes place), consisting of respiratory bronchioles, alveolar ducts, alveolar sacs and alveoli.

Introduction

The conducting portions in addition to their function to provide a passageway for air also they act to condition the incoming air, by warming moistening and cleaning it.

The respiratory portions are serve to rid the carbon dioxide from body and pick up oxygen.

Structural changes in the conducting portions of respiratory tract

Table 12-1 Summary Table of Respiratory System

Division	Region	Skeleton	Glands	Epithelium	Cilia	Goblet Cells	Special Features
Nasal cavity	Vestibule	Hyaline cartilage	Sebaceous and sweat glands	Stratified squamous keratinized	No	No	Vibrissae
	Respiratory	Bone and hyaline cartilage	Seromucous	Pseudostratified ciliated columnar	Yes	Yes	Large venous plexus
	Olfactory	Nasal conchae (bone)	Bowman's glands	Pseudostratified ciliated columnar	Yes	No	Basal cells, sustentacular cells, olfactory cells, nerve fibers
Pharynx	Nasal	Muscle	Seromucous glands	Pseudostratified ciliated columnar	Yes	Yes	Pharyngeal tonsil, eustachian tube
	Oral	Muscle	Seromucous glands	Stratified squamous nonkeratinized	No	No	Palatine tonsils
Larynx		Hyaline and elastic cartilage	Mucous and seromucous glands	Stratified squamous nonkeratinized and pseudostratified ciliated columnar	Yes	Yes	Vocal cords, epiglottis, some taste buds
Trachea and extrapulmonary (primary bronchi)		C-rings of hyaline cartilage	Mucous and seromucous glands	Pseudostratified ciliated columnar	Yes	Yes	Trachealis muscle, elastic lamina
Intrapulmonary conducting	Secondary bronchi	Plates of hyaline cartilage	Seromucous glands	Pseudostratified ciliated columnar	Yes	Yes	Two helical-oriented ribbons of smooth muscle
	Bronchioles	Smooth muscle	None	Simple columnar to simple cuboidal	Yes	Only in larger bronchioles	Club cells
	Terminal bronchiole	Smooth muscle	None	Simple cuboidal	Some	None	<0.5 mm in diameter, club cells
Respiratory	Respiratory bronchiole	Some smooth muscle	None	Simple cuboidal and simple squamous	Some	None	Outpocketings of alveoli
	Alveolar duct	None	None	Simple squamous	None	None	Outpocketings of alveoli, type I pneumocytes, type II pneumocytes, dust cells
	Alveolus	None	None	Simple squamous	None	None	Type I pneumocytes, type II pneumocytes, dust cells

Conducting portion

The major function of the conducting division is to provide a route for incoming and outgoing air. While air is entering the respiratory system, the conducting division must prepare the air for the lungs. This preparation includes:

* removing debris and pathogens from the incoming air
* warming the incoming air
* humidifying the incoming air

Each portion of the conducting division is carefully structured to maximize its ability to warm, moisten, and clean the air entering the respiratory division. Several structures within the conducting division perform other functions as well. The epithelium of the nasal passages, for example, is essential to sensing odors, and the bronchial epithelium that lines the lungs can metabolize some airborne carcinogens.

Microanatomy of respiratory system

A-Nose(Nasal cavity)

1-Mucosa

A-Epithelium

Varies according to location

(1) The anterior (outer) region of nasal cavity is lined with stratified squamous epithelium which make a gradual transition from keratinized to non keratinized.

(2) The posterior (inner)region of nasal cavity is lined by 2 types of epithelia:

Microanatomy of respiratory system

(a)Olfactory epithelium(pseudo stratified columnar epithelium)

(b) pseudo stratified ciliated columnar epithelium with goblet cells(frequently called respiratory epithelium) covers most of the luminal surface of the posterior region of nasal cavity. This epithelium contains multiple cell types.

{1}Ciliated columnar cells are tall cells responsible for moving mucous along the surface of epithelium.

{2}Goblet cells are mucous-secreting

Microanatomy of respiratory system

{3}Basal cells are embedded in the basal surface of the epithelium.

{4} Brush cells are with apical microvilli instead of cilia.

{5} Dense core granule cells (small granule cells or argyrophilic cells)

Microanatomy of respiratory system

B-The lamina propria of the nasal cavity is primarily loose FECT with numerous blood vessels.Compound serous tubuloacinar glands near olfactory areas. Hair follicles extended into lamina propria in the nasal cavity.

2-The Muscularis externa region in the nasal cavity is occupied by cartilage of the nose and skeletal elements of the skull.

Nasal passageways functions

Nasal passageways have multiple functions in addition to the obvious function of carrying air from the environment to the deeper parts of the conducting passageways.

A-removal of particulate matter by trapping among hairs or sticking to the mucous or serous glandular secretions.

B-Moistening/humidifying of air by evaporation of water from mucous or serous glandular secretions.

C-warming of air by heat conduction from blood flowing through vessels in the lamina propria.

Trachea and Extra pulmonary (primary) Bronchi wall layers

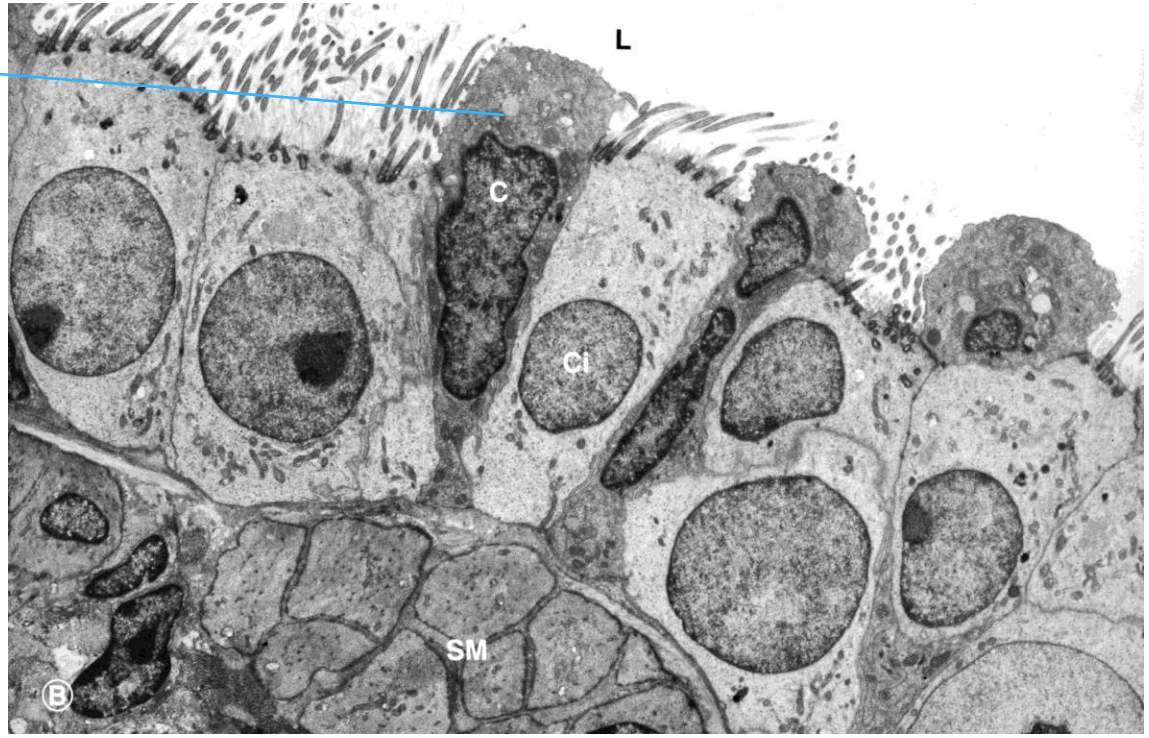
1-Mucosa

A-**Epithelium** lining the trachea and bronchi is very similar to the pseudo stratified ciliated columnar epithelium for the nasal cavity.

* In humans, the epithelium in the trachea and bronchi typically contains ciliated columnar cells, Goblet cells ,Basal cells ,brush cells ,and dense core granule cells similar to those seen in the nasal and pharyngeal cavities and larynx.
* In addition , Clara cells begin to appear in the lower Trachea and become more numerous in the bronchi.
* Clara cells secretions include a phospholipid-rich lipoprotein surfactant which reduces surface tension in air passageways.

Trachea and Extra pulmonary (primary) Bronchi wall layers

* Clara cell



Trachea and Extra pulmonary (primary) Bronchi wall layers

B-Lamina proria of the trachea and bronchi consists of a thin layer of loose FECT which is rich in elastic fibers which frequently contains diffuse or nodular lymphoid tissue.

2-A submucosa is visible in most parts of the human trachea and bronchi as a zone of denser (than the lamina propria) loose to moderately dense FECT which frequently contains tubuloacinar glands.

Trachea and Extra pulmonary (primary) Bronchi wall layers

3-The **Muscularis externa** in the trachea and bronchi contains 3 types of tissue.

A-Tracheal rings(C-shaped) of hyaline cartilage enclosed by a perichondrium of dense regular collagenous CT spaced along the length of the trachea and extra pulmonary bronchi.

In the intra pulmonary bronchi the hyaline cartilages become irregular plates.

Trachea and Extra pulmonary (primary) Bronchi wall layers

B-Smooth muscle tissue forms the **Trachealis muscles** which connect the ends of each tracheal ring in the trachea and extra pulmonary bronchi. smooth muscle occurs as a more or less complete circular layer between the cartilage plates and the lamina propria in the intra pulmonary bronchi.

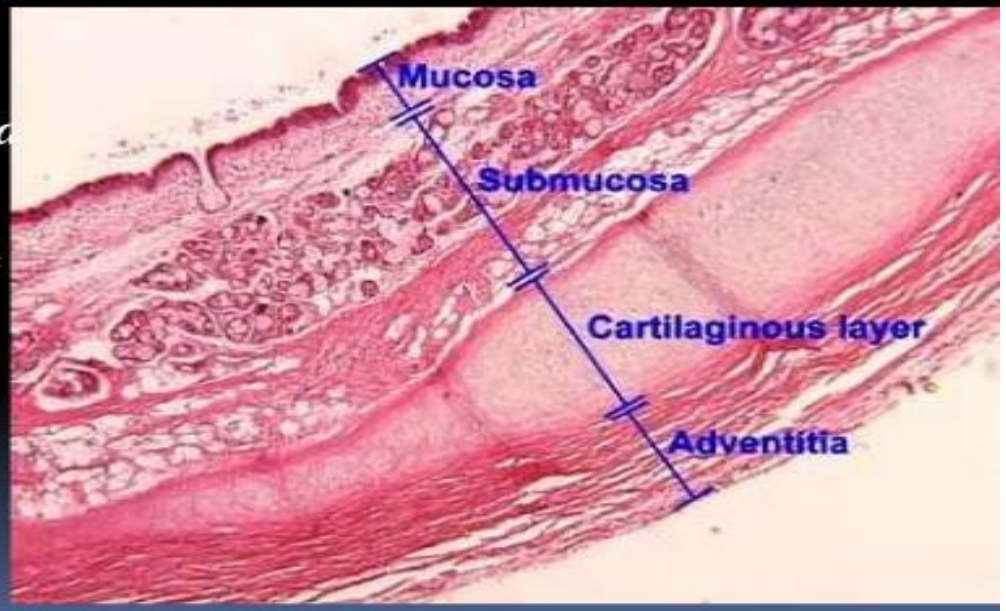
C- Moderately dense FECT occurs between adjacent tracheal rings in the trachea and extra pulmonary bronchi and between adjacent cartilage plates in the intra pulmonary bronchi.

4- **An adventitia** of loose FECT is visible around the trachea and extra pulmonary bronchi and merges with the loose FECT stroma of the lungs.

Trachea and Extra pulmonary (primary) Bronchi wall layers

Trachea

- Mucosa
  - *-Epithelium*
  - *-Lamina propria*
- Sub mucosa
- Cartilage &muscle layer
- Adventitia



Bronchioles

As the bronchi branch and become smaller, the cartilage plates become smaller and farther apart and the mixed glands become fewer.

When the cartilage and glands have disappeared, you have entered the bronchioles. At this point, the muscularis is very close to the epithelium. The epithelium is still pseudo stratified , ciliated columnar , although it becomes progressively less tall. Goblet cells are still quite common in large bronchioles , their numbers also progressively decrease.

Terminal bronchioles

As their name implies , terminal bronchioles represent the last parts of the conducting portions of respiratory tree.

In the terminal bronchioles , the ciliated pseudo stratified epithelium abruptly gives away to simple cuboidal epithelium consisting of CLARA cells.

Functions of Clara cells are:

1-The lipoprotein they secrete prevents luminal adhesion during expiration.

2-Inactivates harmful substances.

Respiratory bronchioles

The respiratory portion of the tree begins in the respiratory bronchioles when these alveoli first arise.

The respiratory portions begins when an air sac appears as an outpocketing of the bronchiole. At this point ,the terminal bronchiole has become a respiratory bronchiole.

Alveoli

Alveoli are the tiny sacs in which the gas exchange takes place.

Septa of alveoli

The septa between alveoli are specialized for the diffusion of gases. The surfaces facing the air are lined by an epithelium made of 2 type of cells (type 1 and type 2 pneumocyte). Most of the surface(about 95%) is lined by type 1 pneumocytes

These cells are extremely squamous. The other type of epithelial cells is the type 2 pneumocytes which are found interspersed among type 1 pneumocyte, singly or in clusters.

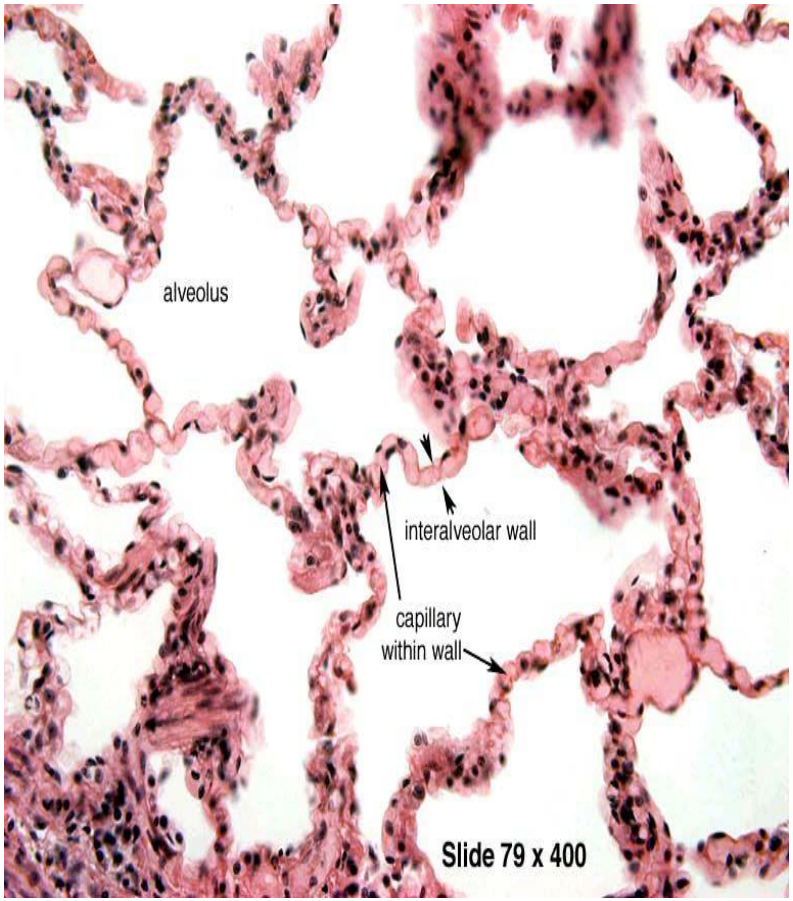
Septa of Alveoli

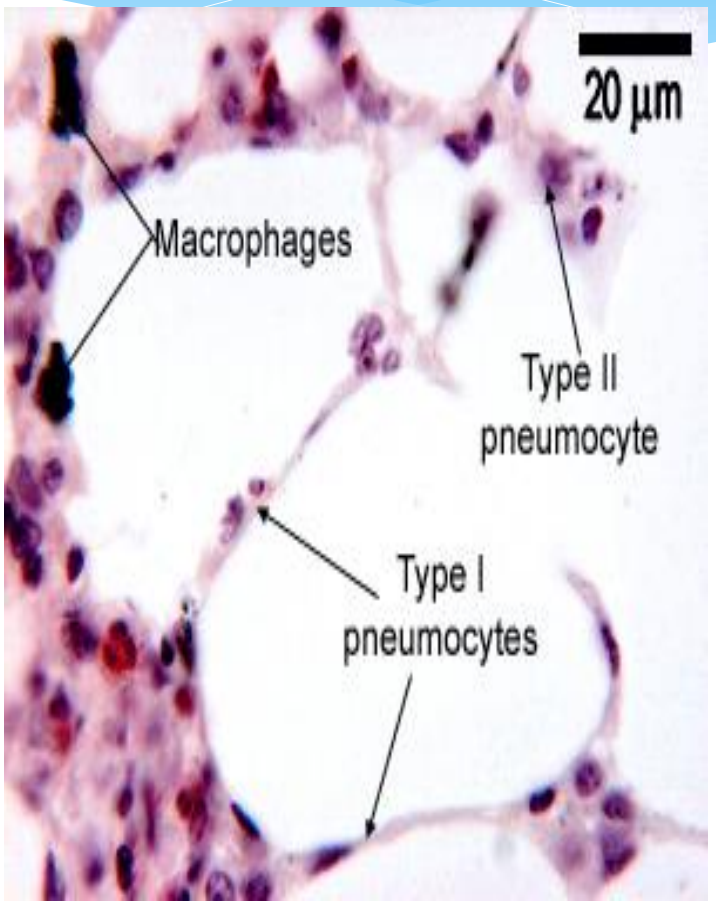
Within the septal wall are found capillaries (the alveoli contain the richest capillary network of the body) elastic and collagen fibers, fibroblast and macrophages .

The septal walls have thick portions and thin portions .

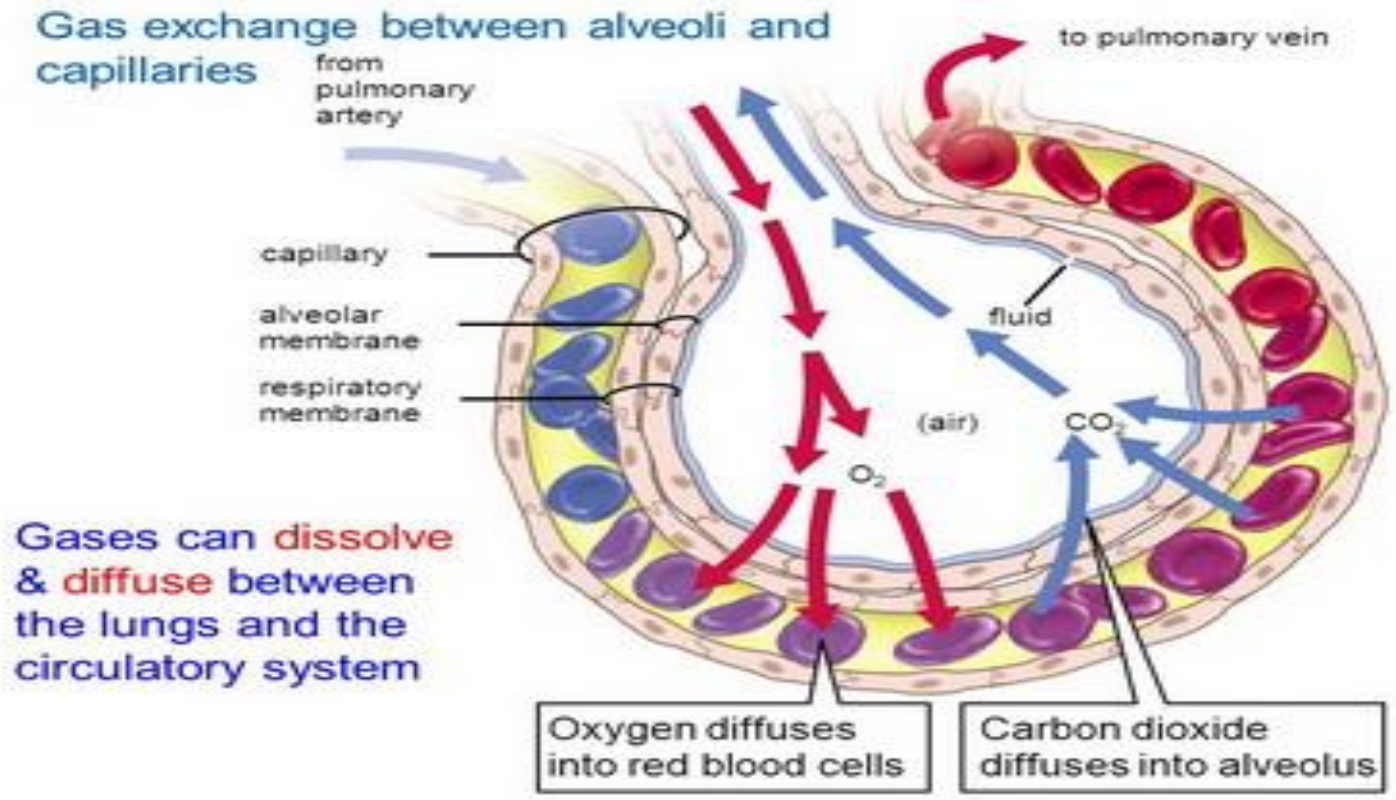
The gas exchange of gases occurs in the thin portions of septa.

Alveoli


alveolus
interalveolar wall
capillary
within wall
Slide 79 x 400


20 µm
Macrophages
Type II
pneumocyte
Type I
pneumocytes

Alveoli


Gas exchange between alveoli and capillaries
from pulmonary artery
to pulmonary vein
capillary
alveolar membrane
respiratory membrane
fluid
(air)
CO_2
O_2
Gases can dissolve & diffuse between the lungs and the circulatory system
Oxygen diffuses into red blood cells
Carbon dioxide diffuses into alveolus

END

* Thanks a lot for attention

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