Functional Correlation of The Respiratory System Lec. 18

Histology

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Olfactory Epithelium

- To detect odors, odoriferous substances must first be dissolved. The dissolved odor molecules then bind to odor receptor molecules on olfactory cilia and stimulate the odor-binding receptors on the cilia of the olfactory epithelium to conduct impulses. The unmyelinated afferent axons of olfactory cells leave the olfactory epithelium and form numerous small olfactory nerve bundles in the lamina propria. Impulses from olfactory cells are conducted in the nerves that pass through the ethmoid bone in the skull and synapse in the olfactory bulbs of the brain. Olfactory bulbs are located in the cranial cavity of the skull above the nasal cavity. From here, neurons relay the information to higher centers in the cortex for odor interpretation. Olfactory epithelium is kept moist by a watery secretion produced by serous tubulo-acinar olfactory (Bowman's) glands located directly below the epithelium in the lamina propria. This secretion, delivered via ducts, continually washes the surface of olfactory epithelium. In this manner, odor molecules dissolve in the secreted fluid and are continually washed away by new fluid, allowing the receptor cells to again detect and respond to new odors. The supportive cells provide mechanical support for the olfactory cells, whereas the basal cells function as stem cells. Basal cells give rise to new olfactory cells and supportive cells of the olfactory epithelium.

Conducting Portion of the Respiratory System

- The conducting portions of the respiratory system condition the inhaled air. Mucus is continuously produced by goblet cells in pseudostratified ciliated respiratory epithelium and mucous glands in the lamina propria. These secretions form a mucous layer that covers the luminal surfaces in most conducting tubes. As a result, the moist mucosa in the conducting portion of the respiratory system humidifies the air. The mucus and ciliated epithelium also filter and clean the air of particulate matter, infectious microorganisms, and other airborne matter. In addition, a rich and extensive capillary network beneath the epithelium in the connective tissue warms the inspired air as it passes the conducting portion and before it reaches the respiratory portion in the lungs.

Clara Cells

- Clara cells are most numerous in the terminal bronchioles. These cells become the predominant cell type in the most distal part of the respiratory bronchioles. Clara cells have several important functions. They secrete one of the lipoprotein components of surfactant, which is a tension-reducing agent that is also found in the alveoli. Clara cells may also function as stem cells to replace lost or injured bronchial epithelial cells. These cells may also secrete proteins into the bronchial tree to protect the lung from inhaled toxic substances, oxidative pollutants, or inflammation.

Cells of Lung Alveoli

- The lung alveoli contain numerous cell types. Type I alveolar cells, also called type I pneumocytes, are extremely thin simple squamous cells that line the alveoli in the lung and are the main sites for gaseous exchange. A thin interalveolar septum is located between adjacent alveoli. Located within the interalveolar septum between the delicate reticular and elastic fibers is a network of capillaries. Type I alveolar cells are in very close contact with the endothelial lining of capillaries, forming a very thin blood-air barrier, across which gaseous exchange takes place. The blood-air barrier consists of the surface lining and the cytoplasm of type I pneumocyte, the fused basement membrane of the pneumocyte and the endothelial cell, and the thin cytoplasm of the capillary endothelium.

- Type II alveolar cells, also called type II pneumocytes or septal cells, are fewer in number and cuboidal in shape. They are found singly or in groups adjacent to the squamous type I alveolar cells within the alveoli. Their rounded apices project into the alveoli above the type I alveolar cells. These alveolar cells are secretory and contain dense-staining lamellar bodies in their apical cytoplasm. These cells synthesize and secrete a phospholipid-rich product called pulmonary surfactant. When it is released into the alveolus, surfactant spreads as a thin layer over the surfaces of type I alveolar cells, lowering the alveolar surface tension. The reduced surface tension in the alveoli decreases the force that is needed to inflate alveoli during inspiration.

- Therefore, surfactant stabilizes the alveolar diameters, facilitates their expansion, and prevents their collapse during respiration by minimizing the collapsing forces. During fetal development, the great alveolar cells secrete a sufficient amount of surfactant for respiration during the last 28 to 32 weeks of gestation. In addition to producing surfactant, the great alveolar cells can divide and function as stem cells for type I squamous alveolar cells in the alveoli. It is also believed that surfactant has some bactericidal effects in the alveoli that counteract potentially dangerous inhaled pathogens.

- Alveolar macrophages or dust cells are monocytes that have entered the pulmonary connective tissue and alveoli. The primary function of these macrophages is to clean the alveoli of invading microorganisms and inhaled particulate matter by phagocytosis. These cells are seen either in the individual alveoli or in the thin alveolar septa. Their cytoplasm normally contains phagocytosed particulate particles.