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MORPHOFUNCTIONAL BASES OF CLINICAL APPEARANCES OF LUNG DISEASE


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ЎПКА КАСАЛЛИКЛАРИ КЛИНИК КЎРИНИШИНИНГ МОРФОФУНКЦИОНАЛ АСОСЛАРИ

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МОРФОФУНКЦИОНАЛЬНЫЕ ОСНОВЫ КЛИНИЧЕСКИХ ПРОЯВЛЕНИЙ ЗАБОЛЕВАНИЙ ЛЕГКИХ

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Резюме. *Нафас олиш йўлларининг шиллиқ қавати доимо ёт жисмлар ва патоген организмларнинг таъсири остида бўлади. Ҳимоя тизимининг мавжудлиги туфайли фақат айрим ҳолларда патоген микроорганизмлар пастки нафас йўлларига кириши мумкин. Нафас олиш органларининг тозалаш қобилияти ва анатомик-физиологик хусусиятлари туфайли 10-20 мкм ўлчамдаги заррачалар бурун-ҳалқум бўшлиғига, 3 микрондан кичик заррачалар эса бронхларга кириб боради. Фарингеал рефлюкс, киприкли эпителий ва қадахсимон ҳужайралар микробларни ушлаш ва чиқариб юбориш учун шилимшиқ ҳосил қилади. Нафас олиш тизимининг интерферон, лизоцим, лактоферрин патоген микроорганизмларга қарши ўзига хос бўлмаган ҳимоя компонентлари ҳисобланади.*

Калит сўзлар: *гистология, ўпка, киприкли эпителий, қадахсимон ҳужайралар, интерферон, лизоцим.*

Abstract. *The mucous membrane of the respiratory tract is constantly under the influence of foreign bodies and pathogenic organisms. Due to the presence of a protective system, only in some cases pathogenic microorganisms can enter the lower respiratory tract. Due to the cleansing ability and anatomical and physiological features of the respiratory system, particles of 10-20 microns in size settle in the nasopharynx, and particles of less than 3 microns in size penetrate the bronchus. Pharyngeal reflux, ciliated epithelium, and goblet cells produce mucus to trap and expel microbes. Interferon, lysozyme, lactoferrin of the respiratory system are nonspecific protective components against pathogenic microorganisms.*

Key words: *histology, lungs, ciliated epithelium, goblet cells, interferon, lysozyme.*

Four main histological layers are distinguished in the respiratory system: the mucous membrane of the respiratory tract, which includes the epithelium and the supporting lamina propria, the submucosa, the cartilage and muscle layer, and the adventitia. The respiratory epithelium is a ciliated, pseudostratified columnar epithelium that lines most of the airways; it is not in the larynx or pharynx. The epithelium is classified as pseudostratified; although it is a single layer of cells along the basement membrane, the nuclei are not in a single plane and look like several layers. The role of this unique type of epithelium is to function as a barrier to pathogens and foreign particles; however, it also acts to prevent infection and tissue damage through the use of a mucociliary elevator. The conducting section of the respiratory system consists of the nasal cavity, trachea, bronchi and bronchioles. The luminal surfaces of this entire part are lined with ciliated pseudostratified columnar epithelium and contain goblet cells. Their role is to secrete mucus, which serves as the first line of defense against incoming pathogens from the environment. Cilia move mucus-bound particles up and down for expulsion from the body. The different types and numbers of cells depend on which area of the airway they are in.

In the most proximal airways, rings of hyaline cartilage support the larger airways, namely the trachea and bronchi, facilitating the passage of air. Three main cell types are found in this area: ciliated,

non-ciliated secretory cells, and basal cells. Ciliated cells, each lined with 200-300 cilia, make up more than half of all epithelial cells in the conducting airways. As the degree of branching of the airway tree is maintained, the epithelium gradually changes from pseudostratified to simple cuboidal; and non-ciliated cells, Clara cells, become predominant cells. The respiratory region of the lung consists of millions of alveoli lined with extremely thin, simple squamous epithelium, allowing easy diffusion of oxygen and carbon dioxide. In addition, surfactant-secreting cuboidal cells, type II pneumocytes, line the walls of the alveoli. The surfactant, which is mainly composed of dipalmitoylphosphatidylcholine, plays a vital role in lowering the surface tension of water to ensure efficient gas exchange [1]. Type I pneumocytes are flattened cells that provide a very thin diffusion barrier to gases. Tight junctions connecting one cell to another have been found [2]. The main functions of type I pneumocytes are gas exchange and fluid transport. Type II pneumocytes secrete surfactant, which reduces the surface area between the thin alveolar walls and prevents the alveoli from collapsing during exhalation. These cells are connected to the epithelium and other constituent cells by tight junctions. Type II pneumocytes also play a vital role as progenitor cells to replace damaged or damaged type I pneumocytes [3]. Just as the skin protects a person from external pathogens and irritants, the respiratory epithelium protects and effectively clears the airways and lungs from inhaled pathogens and irritants. The division of the respiratory system into conductive and respiratory tracts determines their function and role. The conductive part, consisting of the nose, pharynx, larynx, trachea, bronchi and bronchioles, serves to moisturize, warm, filter the air. The respiratory part is involved in gas exchange. Three main types of cells have been found in the respiratory epithelium, and each plays a vital role in regulating human respiration. If any of these barrier components do not function properly, the body becomes susceptible to infections, pathogens, or causes inflammation and disrupts hemostasis. Humidification requires serous and mucous secretions, and warming depends on an extensive capillary network that runs in the alveoli. The alveoli are also extensively covered with capillaries, which allow the surrounding vascular plexuses to condition and heat the air and provide heat exchange. The branching of the arteries and veins of the pulmonary system follows the same branching pattern as the tree of the respiratory tract. The walls of the pulmonary arteries and veins are more delicate than the vasculature elsewhere in the body because the pulmonary circulation operates at a lower pressure than the systemic circulation. Filtration occurs by the mechanism of trapping the secret of mucus and the beating of cilia. This process allows trapped particles to move to the throat, where the mucus is swallowed or expelled by the body. Goblet cells are columnar epithelial cells that secrete high molecular weight mucin glycoproteins into the airway lumen and supply the epithelium with moisture, retaining incoming particles and pathogens. In healthy airways, ciliated cells are columnar epithelial cells that are modified with hundreds of hair-like projections that beat at a high frequency of about 8 to 20 Hz to mobilize the mucus that is on them [4]. Oxidative Defense and Trauma Response Cells found in the respiratory epithelium constantly fight off inhaled particles and pathogens and regenerate after injury. Basal cells, which are small, almost cuboidal cells attached to the basement membrane by hemidesmosomes, can differentiate into other cell types found in the epithelium. Basal cells serve as the site of attachment of ciliated and goblet cells to the basement membrane. They also respond to injury and are involved in the oxidative defense of the airway epithelium and transepithelial water movement. In hundreds of millions of microscopic alveolar sacs, oxygen is exchanged for carbon dioxide. Inhaled air diffuses through the alveoli into the pulmonary capillaries, and at the same time, carbon dioxide from deoxygenated blood diffuses into the capillaries, then into the alveoli and is expelled through the respiratory tract during exhalation. Light microscopy of respiratory tissue samples stained with hematoxylin and eosin reveals pseudostratified epithelium. The term "pseudostratified" is given to this type of epithelium because it appears to be stratified, but all of its constituent cells are in fact attached to a single underlying basement membrane. The nuclei appear at different levels, causing the appearance of a stratified epithelium. When stained with hematoxylin and eosin under light microscopy, the basement membrane appears as a well-defined pink line [5]. Goblet cells with mucinogen granules are also found scattered among the epithelium, and basal cells are present in the basal part of the epithelium, acting as progenitor cells for other cell typesCells reaching the free or apical surface of the epithelium are ciliated, with thin "hairy" outgrowths. Each cilium is given by a basal body that looks like a dense eosinophilic line [6]. The tracheal epithelium appears as a narrow, pink-stained area immediately at the base of the epithelium due to its unusually thick basement membrane. Outside, the connective tissue layers of the C-shaped cartilage ring keep the lumen of the trachea open. The transition from the trachea to the bronchi is manifested by the appearance of "plates" instead of C-shaped hyaline rings [7]. In addition, there is a layer of smooth muscle between the lamina propria and the submucosa. Bronchioles can be distinguished from bronchi by the absence of cartilage structures and the absence of glands. The transition to the respiratory bronchioles is manifested by the presence of alveoli in their walls and a gradual decrease in the height of the epithelium. Clusters of alveoli, called alveolar sacs, become

visible in the form of small tubercles of smooth muscle, elastic fibers and collagen. Electron microscopy can be used to visualize individual cell types and epithelial ultrastructural features found in respiratory tissue samplesAt the level of the trachea and its mucosa, electron microscopy identifies various cell types: basal cells, goblet cells, and ciliated cells, as well as their associated organelles and cytoplasmic components. The ciliated epithelium with microvilli is clearly visible under EO, the cross section of the cilia allows visualization of the typical arrangement of 9+2 microtubules in the cytoplasm [4].

At the level of the alveoli, an extremely thin air-hematic barrier is visible, consisting of type I pneumocytes, capillary endothelium, and fused basal laminae [6]. In addition, type II pneumocytes differ from the thinner and more delicate type I pneumocytes. Type II cells contain lamellar bodies, rough endoplasmic reticulum, Golgi and reticular fibers, and microvilli. A number of diseases affect the respiratory system, which may be due to some degree of barrier dysfunction, a genetic mutation, or an inflammatory process. The following discussion describes several major diseases that affect breathing. Although not exhaustive, the importance of the proper functioning of the respiratory system and what happens when any component fails can be appreciated based on a few selected diseases discussed below. Asthma is an inflammatory disease that leads to remodeling of the airway walls and induces a hyperresponsiveness response to external triggers with mucus overproduction [7]. Asthma is a common chronic disease that affects both adults and children. The incidence is increasing and is a major concern due to the impact on health, economic burden and environmental quality. [one]. Asthma is caused by inflammation and swelling of the airways, which leads to bronchospasm, which blocks the flow of air into the lungs. It can be caused by environmental factors such as dust, pollen, debris, and pathogens. The response to such triggers is bronchoconstriction, a process in which smooth muscles tighten and constrict the caliber of the bronchi and bronchioles, resulting in wheezing and shortness of breath. Bronchoconstriction results from a series of complex interactions between mucosal epithelium, mast cells, smooth muscle, and the parasympathetic nervous system [4]. Cystic fibrosis is a disease that once had a life expectancy of a few months but now has an average life expectancy of about 40 years [1,2]. To maintain the quality of life of patients, early diagnosis and optimized mutation-specific treatment are required. Cystic fibrosis is an autosomal recessive pathology caused by a mutation in the gene for the cystic fibrosis transmembrane conductance regulator, CFTR, most commonly in the gene [1, 3]. The CFTR protein functions as an ion channel that regulates fluid through chloride secretion and inhibition of sodium absorption by exocrine glands. Transport of chlorides and bicarbonates plays a role in regulating the thickness of the epithelial lining fluid, maintaining pH, and detecting the presence of invading pathogens or irritants. If not controlled, increased sodium reabsorption causes water to follow and results in thick mucus secretions in almost all organ systemsAlthough thousands of mutations in the CFTR gene have been described, each mutation has a different effect on the gene and can lead to different phenotypic manifestations in patients, some of which lead to milder disease, others to a much worse prognosis. Cystic fibrosis can affect several organ systems, from the lungs to the digestive tract, pancreas, liver, or reproductive organs [1,4]. In most patients, cystic fibrosis leads to chronic progressive lung disease and eventually death. Recurrent and infectious exacerbations lead to structural changes and damage to the respiratory systemThese complications, in turn, dictate the goals of treating the condition; to improve mucociliary clearance and reduce the incidence of bacterial infections in order to improve the quality of life [1, 2]. Ciliary dyskinesia of the respiratory system is largely dependent on the ability of the cilia to move mucus and inhaled materials up into the proximal airways and out of the lower airways. Primary ciliary dyskinesia often presents with locational abnormalities, chronic sinus or lung disease, and abnormal sperm motility. The ciliary movement plays a role in many organs of the body. When disturbed, this manifests itself in several organ systems. In the respiratory system, mucociliary clearance is impaired, leading to recurrent infections of the sinuses, ears, and lungs. In the reproductive tract, both sperm motility from the flagella and fimbriae of the fallopian tubes are affected, often leading to infertility. Situs invertus results from a defect in the cilia during embryogenesis, as normal functioning cilia are required for visceral organ rotation [4].

The clinical significance of respiratory diseases in the context of histology and function is a complex and broad topic. There are many conditions and diseases associated with the respiratory system. The microanatomy and functioning of the respiratory system is the key to the mechanism of each of the diseases listed below. Bronchial diseases: asthma, bronchiectasis, bronchitis, bronchopneumonia, tracheobronchomalacia, bronchogenic cyst, cilia motility disorders, Kartagener's syndrome, larynx diseases, laryngitis, laryngomalacia, vocal cord paralysis, neoplasms, pulmonary diseases, etc. diseases.

Conclusions. Thus, the main function of the respiratory system is pulmonary ventilation, which is the movement of air between the atmosphere and the lungs due to inhalation and exhalation, driven by the respiratory muscles. The respiratory system works as a single unit, extracting oxygen from the air we inhale and removing carbon dioxide from the body

when we exhale. The upper respiratory tract mainly performs an air-conducting function, while the lower respiratory tract performs both conductive and respiratory functions. In addition to its primary function of carrying air to the lower airways, the upper airways also perform a number of other functions. The nasal cavity and paranasal sinuses change the properties of the air, humidifying and warming it to prepare it for the breathing process. The air is also filtered from dust, pathogens and other particles by the nasal hair follicles and ciliated epithelium. The section of the lower respiratory tract, starting from the respiratory bronchioles, is the place where gas exchange begins. This process is also known as external respiration, in which oxygen from inhaled air diffuses out of the alveoli into neighboring capillaries, and carbon dioxide diffuses out of the capillaries into the alveoli for exhalation. The oxygenated blood then supplies all the tissues of the body and undergoes internal respiration. This is the process by which oxygen from the systemic circulation is replaced by carbon dioxide from the tissues. In general, the difference between external and internal respiration is that the former is gas exchange with the external environment and occurs in the alveoli, while the latter is gas exchange within the body and occurs in the tissues.

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МОРФОФУНКЦИОНАЛЬНЫЕ ОСНОВЫ КЛИНИЧЕСКИХ ПРОЯВЛЕНИЙ ЗАБОЛЕВАНИЙ ЛЕГКИХ

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Резюме. *Слизистая оболочка дыхательных путей постоянно находится под воздействием инородных тел и патогенных организмов. Благодаря наличию защитной системы только в некоторых случаях патогенные микроорганизмы могут попасть в нижние отделы дыхательных путей. Благодаря очищающей способности и анатомо-физиологическим особенностям органов дыхания частицы размером 10-20 мкм оседают в носоглотке, а частицы размером менее 3 мкм проникают в бронхи. Фарингеальный рефлюкс, реснитчатый эпителий и бокаловидные клетки вырабатывают слизь для захвата и изгнания микробов. Интерферон, лизоцим, лактоферрин дыхательной системы являются неспецифическими защитными компонентами в отношении патогенных микроорганизмов.*

Ключевые слова: *гистология, легкие, мерцательный эпителий, бокаловидные клетки, интерферон, лизоцим.*