

EXPLORING THE MORPHOLOGICAL STRUCTURE OF THE UPPER RESPIRATORY TRACT IN ANIMAL SUBJECTS



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ҲАЙВОНЛАРДА ЮҚОРИ НАФАС ОЛИШ ТИЗИМИНИНГ МОРФОЛОГИК ТУЗИЛИШИНИ ЎРГАНИШ

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ИССЛЕДОВАНИЕ МОРФОЛОГИЧЕСКОЙ СТРУКТУРЫ ВЕРХНИХ ДЫХАТЕЛЬНЫХ ПУТЕЙ У ЖИВОТНЫХ

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Резюме. Ушбу тадқиқот бурун бўшлиғи, ҳалқум, трахея ва бронхларга этибор қаратиб, назорат қуёнларида юқори нафас йўллари деворининг морфоструктуравий хусусиятларини ўрганади. Фарғона Жамоат Саломатлиги Тиббиёт Институти вивариумида турли ёшдаги ўн саккизта эркак шиншилла зотли қуёнлар бир хил шароитда парваришланиб боқилди, ҳамда тўқималар намуналари ахлоқий кўрсатмаларга мувофиқ тўпланган, қайта ишланган ва гистоморфологик таҳлил қилинган. Натижалар ҳар бир нафас олиш органида алоҳида гистологик хусусиятларни, шу жумладан оғиз-ҳалқумда турли хил ҳужайра турларини, уч қатламли ҳалқумнинг мураккаб тузилишини ва трахея шиллиқ қаватидаги ўзига хос хусусиятларни аниқлайди. Этиборли кузатувлардан бири қуёнлардаги яхши ривожланган аксиринг рефлeksi, ҳалқумда Клара ва Лангерганс ҳужайраларининг йўқлиғи ва қуёнларда йўтал рефлексининг йўқлиғи киради. Тадқиқот қуёнларнинг нафас олиш анатомияси ҳақидаги тушунчани яхшилади, келажакдаги тиббий тадқиқотлар ва амалий қўлланмалар учун асосий тушунчаларни беради.

Калит сўзлар: нафас олиш тизими, морфоструктура, бурун бўшлиғи, оғиз-ҳалқум, ҳалқум, трахея, бронхлар, респиратор эпителийси, қуён.

Abstract. This research delves into the morphostructural characteristics of the upper respiratory tract wall in a cohort of control rabbits, with a specific focus on the nasal cavity, nasopharynx, larynx, trachea, and bronchi. Eighteen male rabbits of the chinchilla breed, spanning various ages, underwent examination under standardized conditions at the Fergana Medical Institute of Public Health vivarium. Tissue specimens were procured, processed, and subjected to histomorphological analysis in accordance with ethical protocols. The findings unveil distinctive histological attributes in each respiratory organ, encompassing diverse cell compositions in the nasopharynx, a complex three-layered structure of the larynx, and unique characteristics in the tracheal mucous membrane. Noteworthy observations include the robust sneezing reflex, absence of Clara and Langerhans cells in the larynx, and the lack of a cough reflex in rabbits. This study contributes to a deeper comprehension of rabbit respiratory anatomy, laying the groundwork for future medical investigations and practical applications.

Key words: respiratory system, morphostructure, nasal cavity, nasopharynx, larynx, trachea, bronchi, respiratory epithelium, rabbit.

Introduction. Currently, there is scientific evidence that the respiratory organs, acting as a biological filter, provide the intake of oxygen necessary for energy production in the body. Additionally, the res-

piratory system serves as protection against various pathogenic, endogenous, and exogenous factors.

The airways of the respiratory tract form a system that performs functions of heating, cleansing, and

humidifying inhaled air. Changes in the environmental conditions have led to an increase in the prevalence of respiratory organ diseases, predominantly manifested as chronic conditions in young and working-age individuals.

In contemporary morphology, particular attention is paid to the study of morphostructural components of compensatory and adaptive reactions of bronchial tissues.

Throughout evolution, the influence of the external environment has shaped a high capacity for physiological regeneration in epithelial tissues. This is an important element for fulfilling their barrier function. However, the bronchial epithelium has a slow turnover rate. Many researchers agree that the replenishment of such tissues occurs through the involvement of differentiated cells in the process of intracellular regeneration and regenerative hypertrophy. Nevertheless, there is disagreement regarding the process of cell differentiation under conditions of reparative lung regeneration.

According to modern research, various types of cells participate in the renewal of the epithelial lining of the bronchial mucosa, including basal, undifferentiated, and highly differentiated surface cells. Currently, over 12 cell types are known to exist in the epithelium of the tracheobronchial tree of rabbits. However, the principles of intercellular relationships, differentiation of respiratory epithelium, and the role of mucociliary clearance remain insufficiently understood.

Undoubtedly, questions regarding the origin and mechanisms of development of components of bronchial epithelial lining, the characteristics of regenerative capabilities of epithelial cells, structural components of connective tissue, and the nature of relationships in the focus of injury remain open and require further investigation.

Aim of the research: To investigate the morphostructural features of the upper respiratory tract wall in control rabbits.

Materials and Methods: The subjects of our study were male rabbits of various ages, inhabiting homogeneous conditions in the vivarium of the Fergana Medical Institute of Public Health. The subjects were clinically healthy, with an average weight ranging from 2.3 to 2.8 kg, and belonged to the chinchilla breed.

For the study, we used 18 male rabbits. Euthanasia was performed under standard conditions according to the international ethical code for biomedical research involving animals (CIOMS, Geneva, 1985). Samples were taken from the nasal wall, nasopharynx, larynx, trachea, and bronchi. The obtained samples were fixed in neutral formalin. Subsequently, we processed the microslides, staining them with hematoxylin and eosin.

Histomorphological structures of the respiratory tract walls were observed under a light microscope.

Results and Research Analysis: The results of our study show that in rabbits, the cranial respiratory pathways are divided into the nasal cavity and its walls, nasopharynx, larynx, trachea, bronchi, and bronchioles, each of which possesses unique characteristics in histological structure. The mucous membrane of the nasopharynx and nasal cavity walls contains various types of cells, including ciliated, goblet, basal, brush, and endocrine cells (Fig. 1).

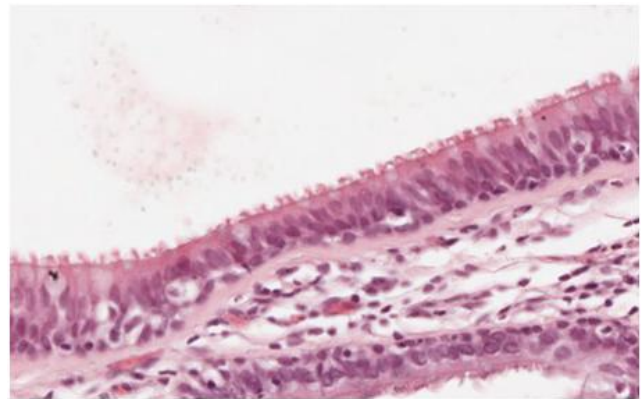


Fig. 1. Respiratory epithelium of the mucous membrane of the airways. The presence of ciliated, endocrine, goblet, brush epithelial cells on the basal membrane is noted

The larynx represents the initial portion of the respiratory tract, opening into the pharynx, with its lower part transitioning into the trachea. Three layers are distinguished in the wall of the larynx.

The mucous membrane covers the inner surface of the larynx wall and is characterized by the presence of multi-layered columnar epithelial cells. Among them, goblet, basal, brush, and ciliated cells are present. In rabbits, Clara and Langerhans cells are absent in the larynx, and there is also an absence of the cough reflex. Beneath the epithelium lies the lamina propria, which is a loose fibrous connective tissue with a network of elastic fibers, containing mixed protein-mucous glands and lymphoid tissue represented by the laryngeal tonsils.

The fibrocartilaginous layer of the larynx serves as a framework due to the presence of hyaline and elastic cartilaginous tissues.

The adventitial layer of the larynx is formed by fibrous connective tissue.

The walls of the rabbit's trachea, like those of humans, consist of three layers (unlike the four layers in humans). The mucous membrane of the rabbit's trachea is lined with a pseudostratified columnar ciliated epithelium containing ciliated cells, endocrine cells, goblet cells, and basal cells (Fig.2).

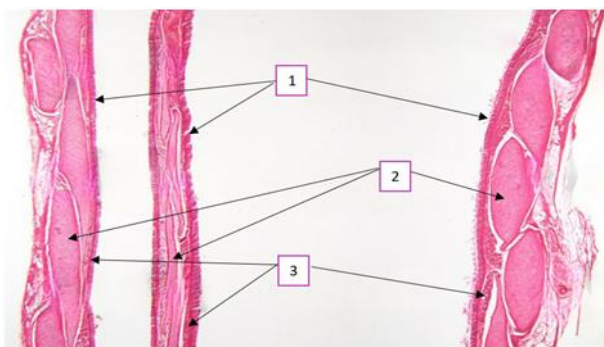


Fig. 2. Longitudinal section of the rabbit trachea (hematoxylin-eosin stain, 32x magnification)
1- Pseudostratified columnar ciliated epithelium; 2- Hyaline cartilage; 3- Submucosal layer

The submucosal layer consists of connective tissue, including elastic and collagen fibers. It is located beneath the epithelium of the tracheal mucosa. The submucosal layer contains blood vessels and lymphatic vessels, providing circulation and fluid drainage. Additionally, epithelial cells of the submucosal layer can secrete mucous substance, which serves for lubrication and protection of the mucous membrane (Pic.3.)

The trachea bifurcates into two main bronchi, which asymmetrically diverge to the right and left from the tracheal bifurcation. The main right bronchus exceeds the length of the main left bronchus by 0.7-1.4 cm, but at the same time, it has a smaller width by 0.6-0.8 cm.

The rabbit's bronchi form a tree-like structure, with approximately 32 bronchi branching from each main bronchus (compared to 25 in humans). The main right bronchus, from the bifurcation to the entrance into the parenchyma, is characterized by the presence of 5-6 cartilaginous rings, while the main left bronchus has 6-7. From the main bronchus at the lung hilum, cranial, middle, and caudal bronchi branch off.

The main left bronchus, after entering the lung hilum, divides into three lobar bronchi: cranial, middle, and caudal. The bronchial wall consists of four layers: mucosal lining, submucosal layer, muscular layer, and adventitial layer. Detailed studies have shown that the diameter of the bronchi varies significantly in size. Thus, as the diameter of the bronchi decreases, their diameter and wall thickness decrease. According to the results of our histological studies, the inner wall of large bronchi is lined with pseudostratified columnar ciliated epithelium, and as the bronchus branches, its height and thickness decrease. The respiratory or pseudostratified columnar ciliated epithelium contains ciliated epithelial cells, goblet cells, brush cells, and endocrine cells. The absence of Clara and Langerhans cells on the bronchial mucosa is noted.

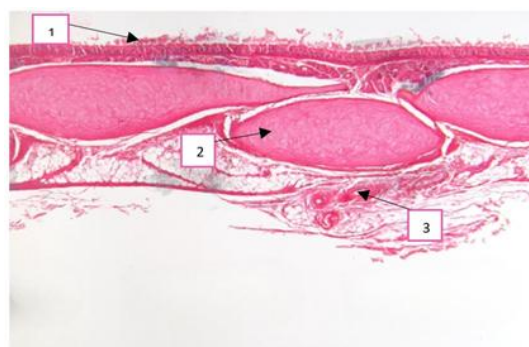


Fig. 3. Transverse section of the trachea. Histological structure of the mucosal and submucosal layers of cartilaginous tissue (hematoxylin and eosin, magnification approximately 64x). 1- Pseudostratified columnar ciliated (respiratory) epithelium; 2- Hyaline cartilage; 3- blood vessels

The fibrocartilaginous layer is characterized by the presence of cartilaginous plates of various sizes and shapes, serving as a framework and conducting moist, purified, and warm air.

Conclusions and Further Research Perspectives. Thus, the investigation of the cranial respiratory pathways in rabbits demonstrates that they are subdivided into several distinct structures, including the nasal cavity, nasopharynx, larynx, trachea, bronchi, and bronchioles, each of which has its own histological characteristics. The mucous membrane of these pathways contains various types of cells, including ciliated, goblet, basal, brush, and endocrine cells. Rabbit larynx is characterized by the absence of Clara and Langerhans cells, as well as the absence of a cough reflex. The walls of rabbit trachea are similar to those of humans and consist of three layers: mucosal, submucosal, and adventitial, each of which performs specific functions such as protection, support, and ensuring blood circulation. Investigation of the structure of the rabbit's trachea and bronchi revealed an asymmetric branching of the trachea into two main bronchi, with differences in their length and width. The bronchi form a tree-like structure with varying numbers of cartilaginous rings in the wall depending on the bronchial level. Structurally, the bronchi consist of four layers, including mucosal lining, submucosal layer, muscular layer, and adventitial layer. Histological data show the presence of pseudostratified columnar ciliated epithelium characterized by the presence of different cell types, but the absence of Clara and Langerhans cells is noted. The fibrocartilaginous layer serves as the framework and support for the bronchi, facilitating the movement of moist, purified, and warm air.

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Резюме. В данном исследовании изучаются морфоструктурные характеристики стенок верхних дыхательных путей у когорты контрольных кроликов, с особым акцентом на носовой полости, гортани, трахее и бронхах. В виварии Ферганского медицинского института общественного здоровья были обследованы восемнадцать самцов кроликов породы шиншилла различного возраста в соответствии с унифицированными условиями. Тканевые образцы были получены, обработаны и подвергнуты гистоморфологическому анализу в соответствии с этическими протоколами. Полученные результаты раскрывают особенности гистологического строения каждого дыхательного органа, включая разнообразные клеточные составы и сложную трехслойную структуру гортани, и уникальные характеристики слизистой оболочки трахеи. Заметные наблюдения включают в себя сильный чихательный рефлекс, отсутствие клеток Клары и Лангерганса в гортани, а также отсутствие кашлевого рефлекса у кроликов. Данное исследование способствует более глубокому пониманию анатомии дыхательной системы кроликов, заложив основу для будущих медицинских исследований и практического применения.

Ключевые слова: дыхательная система, морфоструктура, носовая полость, гортань, трахея, бронхи, дыхательный эпителий, кролик.