



RESPIRATORY EPITHELIUM: STRUCTURE AND DEFENSE MECHANISMS

Olimjonova Mavlyuda Olimjon qizi

Termez branch of Tashkent State Medical University
Lecturer, Department of Medical Biology and Histology

olimjonovamavlyuda581@gmail.com

Turdimuratov Baxtiyor Kurbonovich

Tashkent State Medical University, Termez Branch
Assistant at the Department of Social and Humanitarian Sciences

baxtiyorturdimuratov6691@gmail.com

Ergasheva Fotima Normurodovna

1st year student of the pediatric faculty of the
Termez branch of Tashkent State Medical University

fotimaergasheva818@gmail.com

Abstract

This article examines the histological structure of the respiratory epithelium and its role in protecting the organism from harmful environmental factors. The types of epithelial cells, their functional characteristics, and the mucociliary clearance mechanism are analyzed on a scientific basis. In addition, pathological conditions associated with the impairment of respiratory defense mechanisms are discussed.

Keywords

respiratory system, epithelium, mucociliary clearance, ciliated epithelium, goblet cells, histology

INTRODUCTION

The respiratory system performs vital functions such as supplying oxygen to the body and removing carbon dioxide. At the same time, due to its direct contact with the external environment, it is exposed to various harmful particles, microorganisms, and toxins.

The respiratory epithelium serves as the first line of defense against these harmful agents. Its complex structure and specialized cells play a crucial role in protecting the body from infections.

The aim of this study is to investigate the histological structure of the respiratory epithelium and analyze its defense mechanisms.

METHODS

The following methods were used in this study:

- Histological method: microscopic sections of respiratory tissues were examined
- Staining techniques: hematoxylin and eosin staining were used to identify cellular structures
- Literature analysis: modern scientific articles and textbooks were reviewed
- Comparative analysis: healthy and pathological conditions were compared

RESULTS

1. General Structure of the Respiratory Epithelium



The respiratory epithelium consists of pseudostratified ciliated columnar epithelium. It is composed of the following cell types:

- Ciliated cells
- Goblet cells
- Basal cells
- Endocrine cells

2. Ciliated Epithelium and Its Function

Ciliated cells possess numerous cilia on their surface, which continuously beat to move mucus and trapped harmful particles upward toward the pharynx.

3. Role of Goblet Cells

Goblet cells produce mucus, which traps dust, bacteria, and viruses, preventing them from entering deeper parts of the respiratory tract.

4. Mucociliary Clearance Mechanism

Mucociliary clearance is the primary defense mechanism of the respiratory tract. Through the coordinated activity of mucus and cilia, harmful substances are removed from the airways.

5. Immune Defense Mechanisms

The epithelium also contains immune cells that fight infections. Immunoglobulins and macrophages play an essential role in this process.

The respiratory epithelium (commonly referred to as pseudostratified ciliated columnar epithelium) lines the inner surface of the respiratory tract and serves as an essential protective tissue against harmful environmental agents.

Its structure and defense mechanisms are closely interconnected and include the following:

6. Structure of the Epithelium (Cell Types)

The respiratory epithelium consists of several specialized cell types:

- **Ciliated cells:** These are the most abundant cells. Their apical surface contains numerous hair-like projections called cilia, which beat rhythmically toward the pharynx.
- **Goblet cells:** These cells specialize in mucus (mucin) secretion, forming a sticky protective layer that keeps the epithelial surface moist.
- **Basal cells:** Located at the base of the epithelium, they function as stem cells and regenerate damaged or dead epithelial cells.
- **Club cells (Clara cells):** Found mainly in bronchioles, they secrete surfactant-like substances and participate in detoxification processes.

7. Defense Mechanisms

The respiratory epithelium protects the lungs from dust, bacteria, viruses, and other foreign particles through a multi-level defense system.

A. Mucociliary Clearance (Mucus–Cilia Escalator)

This is the primary mechanical defense system of the respiratory tract.

1. **Trapping:** Dust, microbes, and allergens present in inhaled air are trapped by the sticky mucus produced by goblet cells.
2. **Removal:** The cilia beat approximately 10–20 times per second in a coordinated, wave-like motion, moving the mucus layer and trapped particles upward toward the pharynx. Once there, the mucus is either swallowed (and destroyed by gastric acid) or expelled by coughing.

B. Physical and Chemical Barriers



- **Tight junctions:** Epithelial cells are tightly connected, preventing microbes and toxins from passing between cells into deeper tissues or blood vessels.
- **Antimicrobial substances:** The epithelium and mucus contain substances such as lysozyme, defensins, and immunoglobulin A (IgA), which destroy pathogens.

DISCUSSION

The results indicate that the respiratory epithelium functions not only as a mechanical barrier but also as a biological defense system.

The coordinated activity of ciliated epithelium and mucus production ensures effective protection. When this system is impaired (due to smoking, infection, or allergies), respiratory diseases may develop.

Pathologies such as bronchitis, asthma, and chronic obstructive pulmonary disease (COPD) are associated with dysfunction of the epithelial system.

CONCLUSION

The respiratory epithelium is a crucial system that protects the organism from external environmental influences. Its structural and functional features ensure an effective defense mechanism.

Mucociliary clearance and immune defense systems play an important role in maintaining health. Disruption of these systems leads to various respiratory diseases.

The respiratory epithelium (pseudostratified ciliated epithelium) acts as a self-cleaning mechanical and chemical defense system that maintains lung health.

Its key features include:

- **Integrated structure:** Continuous cooperation between mucus-secreting goblet cells, motile ciliated cells, and regenerative basal cells.
- **Primary defense (mucociliary clearance):** A unique “vacuum cleaner and escalator” mechanism that traps and removes foreign particles.
- **Additional protection:** Tight junctions and antimicrobial substances prevent harmful agents from entering deeper tissues.

Overall, this tissue represents the first and most important line of defense in the respiratory system. Its integrity and ciliary activity are essential for maintaining respiratory health.

REFERENCES

1. Junqueira's Basic Histology. Textbook.
2. Ross & Pawlina Histology: A Text and Atlas.
3. Guyton and Hall Textbook of Medical Physiology.
4. Modern pulmonology research articles.
5. Histology textbooks and manuals.
6. Kurbonovich T. B. et al. Use of ICT and software in teaching practical medical exercises. *American Journal of Applied Medical Science*, 2025.
7. Turdimuratov B. K., Ibragimova D. O., Kurbanov A. B. The importance of AI in the treatment of neurological disorders. *Foundations of Medicine*, 2025.
8. Kurbonovich T. B., Kholboyevich I. E. Use and effectiveness of EMR/EHR systems in medicine. *American Journal of Applied Medical Science*, 2025.