"HISTOMORPHOLOGICAL CHANGES IN THE NASAL MUCOSA UNDER THE INFLUENCE OF EXOGENOUS CHEMICAL FACTORS (USING PESTICIDES AS AN EXAMPLE)"

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Relevance of the Research Topic. Under current conditions, the widespread use of pesticides in agriculture, industrial production, and domestic activities has made the problem of the effects of exogenous chemical factors on the human body particularly relevant. Changes in environmental conditions, the increasing scale of chemical substance use, and the growing exposure to factors that adversely affect the respiratory system emphasize the importance of scientific research aimed at studying the mechanisms of the toxic effects of pesticides on the body. In particular, studying the effects of pesticides on the mucous membrane of the respiratory tract is of considerable importance, as the inhalation route is one of the main pathways through which many chemical substances and pesticides enter the body.

The nasal mucosa is an important protective component of the respiratory system that is in direct contact with the external environment and ensures the filtration, humidification, and warming of inhaled air. Due to the presence of pseudostratified ciliated epithelium, mucous glands, and the mucociliary apparatus, the nasal mucosa performs protective, transport, and local immune functions. Prolonged or repeated exposure to exogenous chemical factors, including pesticides, may lead to histological and morphological changes in the mucosa, damage to the epithelial layer, impaired function of the ciliated apparatus, development of inflammatory processes, and reduced mucociliary clearance.

In the Republic of Uzbekistan, particular attention is being paid to environmental protection, ensuring ecological and toxicological safety, and reducing the adverse effects of chemical factors on human health. From this perspective, an

in-depth study of the effects of pesticides and other exogenous chemical factors on organs and systems of the body, particularly on the mucous membrane of the upper respiratory tract, represents an important scientific and practical task.

The present study is aimed at investigating histomorphological changes occurring in the nasal mucosa under the influence of exogenous chemical factors, particularly morphological changes developing in tissue and cellular structures as a result of pesticide exposure. The findings may contribute to expanding scientific understanding of the characteristics and mechanisms of the effects of exogenous chemical factors on the mucosa of the upper respiratory tract and may provide a scientific basis for improving preventive measures aimed at reducing the adverse effects of pesticides.

Aim and Objectives of the Research

The main aim of the study is to investigate the histomorphological and morphometric changes occurring in the nasal mucosa under prolonged exposure to exogenous chemical factors, particularly pyrethroids belonging to the pesticide group.

To achieve this aim, the following objectives were established: to study the normal morphological structure of the nasal mucosa; to determine the structural characteristics of the pseudostratified ciliated epithelium; to examine the condition of the lamina propria; to assess changes occurring in the vascular system under the influence of exogenous chemical factors; to determine the characteristics of disturbances in the mucociliary apparatus; to perform morphometric analysis of the main structures of the nasal mucosa; and to determine the degree of inflammatory and dystrophic changes developing under prolonged pesticide exposure.

Materials and Methods of the Research

The study was conducted using adult laboratory animals. The animals were divided into control and experimental groups. The control group was maintained under standard conditions without exposure to a toxic agent. Animals in the experimental group were subjected to prolonged aerosol exposure to cypermethrin,

a pyrethroid belonging to the pesticide group, for three months. Exposure was carried out in a specially designed sealed experimental chamber, ensuring uniform distribution of the aerosol.

At the end of the experiment, nasal mucosal tissue samples were collected for morphological examination. Histological processing included fixation of the material in formalin solution, tissue processing, paraffin embedding, preparation of sections using a microtome, and hematoxylin and eosin staining. Microscopic examination was performed using light microscopy. In addition, morphometric analysis of the main structural components of the nasal mucosa was conducted.

Monitoring and Analytical Methods

Morphological, morphometric, and statistical methods were used during the study. The thickness of the epithelial layer, the number of goblet cells, the density of inflammatory cellular infiltration, the condition of the ciliated apparatus, the thickness of the lamina propria, and the diameter of blood vessels in the microcirculatory bed were assessed. The obtained data were statistically processed. The arithmetic mean (M), standard error (m), and statistical significance of differences between groups were determined. Differences were considered statistically significant at $p < 0.05$.

Research Results

In animals of the control group, the nasal mucosa maintained its normal structural organization. The epithelial layer consisted of pseudostratified ciliated columnar epithelium with a well-preserved ciliary apparatus. Goblet cells were evenly distributed, and no signs of inflammation or tissue destruction were observed. The lamina propria demonstrated the typical structure of loose connective tissue without signs of edema or cellular infiltration. The vascular system showed normal blood filling, and no disturbances of microcirculation were identified.

In animals of the experimental group, pronounced morphofunctional changes were identified in the nasal mucosa. The epithelial layer demonstrated cellular desquamation, dystrophic changes, necrotic processes, loss of cellular polarity, and

thinning of the epithelium. Damage to the ciliated apparatus was manifested by shortening and disorientation of cilia, as well as partial reduction in the number of ciliated cells.

Hyperplasia of goblet cells and increased mucus secretion were observed in the epithelium. In some areas, signs of reduced secretory activity were identified. The lamina propria demonstrated pronounced edema, inflammatory cellular infiltration, an increased number of lymphocytes and macrophages, and initial sclerotic changes. The vascular system showed vascular dilation, hyperemia, blood stasis, and increased vascular permeability. Disturbances of microcirculation were accompanied by deterioration of tissue trophism and intensification of inflammatory and dystrophic processes.

Statistical Results

Morphometric analysis demonstrated statistically significant differences between the control and experimental groups. Animals in the experimental group showed reduced epithelial thickness, an increased number of goblet cells, increased density of inflammatory infiltration, increased thickness of the lamina propria, and dilation of blood vessels in the microcirculatory bed. The identified differences were statistically significant ($p < 0.05$), indicating a pronounced toxic effect of cypermethrin on the nasal mucosa.

Scientific Novelty of the Research

For the first time, the histomorphological and morphometric changes occurring in the nasal mucosa under prolonged exposure to an exogenous chemical factor, specifically cypermethrin, a pyrethroid belonging to the pesticide group, were comprehensively investigated. The specific characteristics of damage to the pseudostratified ciliated epithelium were identified, including desquamation, dystrophic changes, disruption of cellular organization, and damage to the ciliated apparatus. Morphological changes developing in the lamina propria and blood vessels of the microcirculatory bed, as well as their relationship with inflammatory and dystrophic processes, were also assessed.

Conclusion

The conducted study demonstrated that prolonged exposure to an exogenous chemical factor, specifically cypermethrin, a pesticide belonging to the pyrethroid group, causes pronounced histomorphological and morphofunctional changes in the nasal mucosa. The most significant alterations were observed in the pseudostratified ciliated epithelium and were manifested by destructive, dystrophic, and necrotic processes. Damage to the ciliated apparatus was accompanied by impaired mucociliary function and reduced protective properties of the mucosa.

Inflammatory and sclerotic changes developed in the lamina propria, accompanied by edema, cellular infiltration, and disruption of tissue architecture. Vascular changes were manifested by hyperemia, blood stasis, and increased vascular permeability, resulting in impaired microcirculation and deterioration of tissue trophism.

The obtained results demonstrate the adverse toxic effects of exogenous chemical factors, including pesticides, on the nasal mucosa and confirm the importance of studying their effects on the morphofunctional state of the upper respiratory tract.

Practical Significance of the Research

The results of the study are of scientific and practical significance for toxicology, morphology, ecology, and medicine. The findings expand current knowledge of the mechanisms underlying the toxic effects of exogenous chemical factors, particularly pesticides, on the upper respiratory tract and may be used in assessing the toxicological safety of pesticides, developing preventive measures aimed at reducing their adverse effects, experimental morphology and pathology, as well as research into respiratory diseases associated with occupational and environmental factors.

The findings may also serve as a scientific basis for further investigation of the mechanisms of damage to the respiratory mucosa caused by chemical toxicants

and for developing preventive approaches aimed at protecting the respiratory system from the adverse effects of exogenous chemical factors.