

**"MORPHO-FUNCTIONAL CHARACTERISTICS OF REGIONAL LYMPH NODES  
IN THE RESPIRATORY SYSTEM UNDER EXPERIMENTAL CONDITIONS**

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**Abstract:** The experiment was conducted at the "Histology and Biology" Department of the Fergana Medical Institute of Public Health, where 15 clinically healthy adult male rabbits were selected. The rabbits were kept in experimental conditions in the vivarium of the institute for a period of 1 to 6 months. For the research, the pesticide chlorpyrifos, which affects the respiratory system, was applied in aerosol form. The rabbits were kept under experimental conditions for both 1 month and 6 months. The rabbits that underwent euthanasia were analyzed, and bronchial inflammation, alveolar swelling, and fluid accumulation were observed. An increase in the number of lymphocytes and the intensification of inflammatory processes in the lymph nodes, as well as the development of necrosis in the medulla, were identified. The study confirmed the short-term and long-term effects of the chlorpyrifos pesticide on the body, as well as its negative impact on the immune system, further highlighting the ecological risks of pesticides and their effects on health.

**Keywords:** Regional lymph nodes, lymphatic system, respiratory system, immune system, immune response, fibrosis, sclerosis, chlorpyrifos, pesticides, topography, lymph fluid, rabbit, preparation.

**Relevance.** Nowadays, pesticides are widely used in the national economy and play an important role in protecting agricultural products. However, the impact of pesticides on the environment and human health remains a global issue. Pesticides negatively affect surface and groundwater, air, plants, and animals. The way they enter the body through the respiratory system, particularly how they influence the lymphatic system and immune system, is still not fully understood.

Pesticides entering the body through the respiratory system can alter the morpho-functional characteristics of regional lymph nodes. The lymphatic system, especially regional lymph nodes, are crucial structures that regulate the body's immune response and fight infections. As a result of pesticide exposure, structural changes in lymph nodes, a decrease or increase

in the functional activity of lymphocytes, and disruptions in lymph flow may occur. These changes can weaken the immune system and reduce the body's resistance to various diseases. Additionally, pesticides affect various parts of the respiratory system, including the lungs and bronchi, triggering a response from the lymphatic system. The effect of pesticides on the body is a complex and multi-stage process, and fully studying this process is crucial for identifying health risks and developing prevention and treatment methods.

Therefore, studying the impact of pesticides on the respiratory system and the morpho-functional characteristics of regional lymph nodes is important for understanding immune responses and protective mechanisms in the body. This knowledge is essential for developing effective preventive and therapeutic methods to protect the health of individuals working with pesticides. This research is not only scientifically but also practically important, as it can contribute to improving the health of populations living in ecological environments affected by pesticides.

At the same time, evaluating the ecological risks of pesticides and developing new measures to reduce their harmful effects on the body, considering the reactions of the respiratory system and lymph nodes, is a critical direction for the healthcare system.

The effect of the respiratory system and its immune system plays a significant role in the human body. Regional lymph nodes, which are not directly connected to the lungs and alveoli, play an important role during damage to the respiratory system, infections, or exposure to chemicals. These lymph nodes are the first to receive damage signals from the respiratory tract and participate in regulating the immune response. The morphological and functional characteristics of these lymph node cells, as well as their crucial role in protecting the body, eliminating infections, and regulating inflammation, are being studied. The connection between the respiratory system and regional lymph nodes, especially under the influence of ecotoxic factors (such as air pollution, chemicals, or aerosol substances), is subject to change. These facts significantly contribute to understanding the complex interactions between the respiratory system and the immune system. The results of this research provide an opportunity to study the morphological changes in regional lymph nodes and their effect on the immune response as a result of inflammatory, toxic, or infectious processes in the respiratory system.

Studying the morpho-functional characteristics of regional lymph nodes is not only of scientific interest but also plays a significant role in the early diagnosis and treatment of respiratory system-related diseases and infections. Research on changes in lymph nodes, their role in inflammatory processes, and immune responses opens up possibilities for creating new treatment strategies and preventive measures.

Therefore, studying the morpho-functional characteristics of the respiratory system and regional lymph nodes may have significant social importance in the future for long-term research and the development of new technologies.

**Research Objective:** To study the morpho-functional characteristics of the regional lymph nodes of the respiratory system under experimental conditions.

**Materials and Methods:** Experimental work was carried out at the Department of Histology and Biology of the Fergana Public Health Medical Institute. Conditions were created for laboratory rabbits in the vivarium of the institute, and 10 adult rabbits were selected as the material for the study. The rabbits were exposed to the aerosolized chemical indicator chlorpyrifos in order to study the characteristics of the lymphatic system in the respiratory system. The rabbits were kept under experimental conditions until the 6th month and then euthanized. The regional lymph nodes of the rabbits' lungs were studied as the subject of the research.

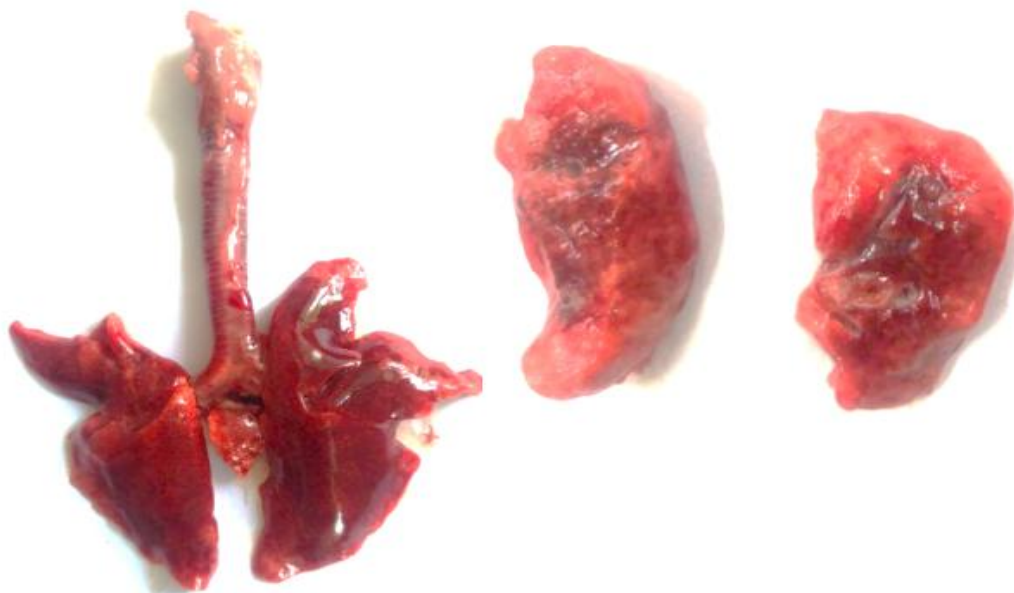
Samples were taken from the lungs of the animals, and histological preparations were prepared. To preserve the vital structure of the tissues, 1 cm<sup>3</sup> samples were immediately fixed and processed for histological examination. The fixative was washed off, and the dehydration process was carried out step by step, starting with 50% alcohol and increasing to 100%. In the next phase, paraffin embedding was performed to facilitate tissue cutting, and thin sections were prepared using a microtome. The sections were then deparaffinized, stained with hematoxylin-eosin, and held in the illuminating medium for 0.5-1 minute to ensure good light transmission. The prepared specimens were examined under a light microscope (MT5300L).

**Results and Discussion:** The experimental materials were used for scientific, educational, and practical purposes at the Department of Histology and Biology of the Fergana Public Health Medical Institute. When the rabbits exposed to aerosolized chlorpyrifos showed a distinct reaction, including trembling, difficulty in breathing, huddling in one corner of the cage, and attempting to escape, it was observed that after a short period, they calmed down. Among the experimental rabbits, four showed signs of diarrhea, loss of appetite, and reduced movement, leading to their death, while the remaining 11 larger rabbits did not show such symptoms.

Upon euthanizing the rabbits, the following observations were made: In the first month, four rabbits euthanized showed no significant signs of the effects of the aerosolized chemical localizer. Histological preparations of the regional lymph nodes of their respiratory systems showed that the indicators were close to the normal values observed in untreated rabbits. The histological examination of the lymph node revealed that the trabeculae were directed towards the center, the stroma was made of reticular tissue, and the T and B lymphocytes were present in the cortex. The medulla showed light-stained structures and darker-stained cortex, with lymphatic follicles, medullary cords, and sinuses, and the presence of T and B lymphocytes close to normal.

In the other seven rabbits, after aerosolized chemical exposure, the following was observed: Purulent abscesses were observed around the eyes. Before the preparation of the samples, mucosal changes were observed in the bronchi and bronchioles of the rabbits. These early signs of inflammation included swelling of the bronchial epithelium, widening of blood vessels, and infiltration. Furthermore, the prolonged exposure to the chemical might lead to hyperplasia of the bronchial epithelial cells, which could cause significant changes in the bronchial passages and even narrow the spaces between the alveoli, leading to difficulty in breathing.

**Alveolar swelling and fluid accumulation:** Swelling and fluid accumulation were observed in the alveoli as a result of the chemical exposure. This disrupted the septa between the alveoli and their structure, hindering the breathing process. Chronic toxic exposure also caused partial fibrosis of the alveoli.



The aerosolized chemical's effect on the respiratory system intensified immunological and inflammatory processes in the regional lymph nodes. The histological changes in the lymph nodes were as follows:

**Changes in the Cortex:** Lymphocyte proliferation (lymphadenopathy). The exposure to pesticides resulted in an increase in the number of lymphocytes in the cortex. The changes in the numbers of B- and T-lymphocytes were observed. B-cells are mainly involved in antibody production, while T-cells carry out cell-mediated immune responses. Pesticides affected their growth and activity, potentially disrupting immune system responses and weakening the body's normal immune functions against infections.

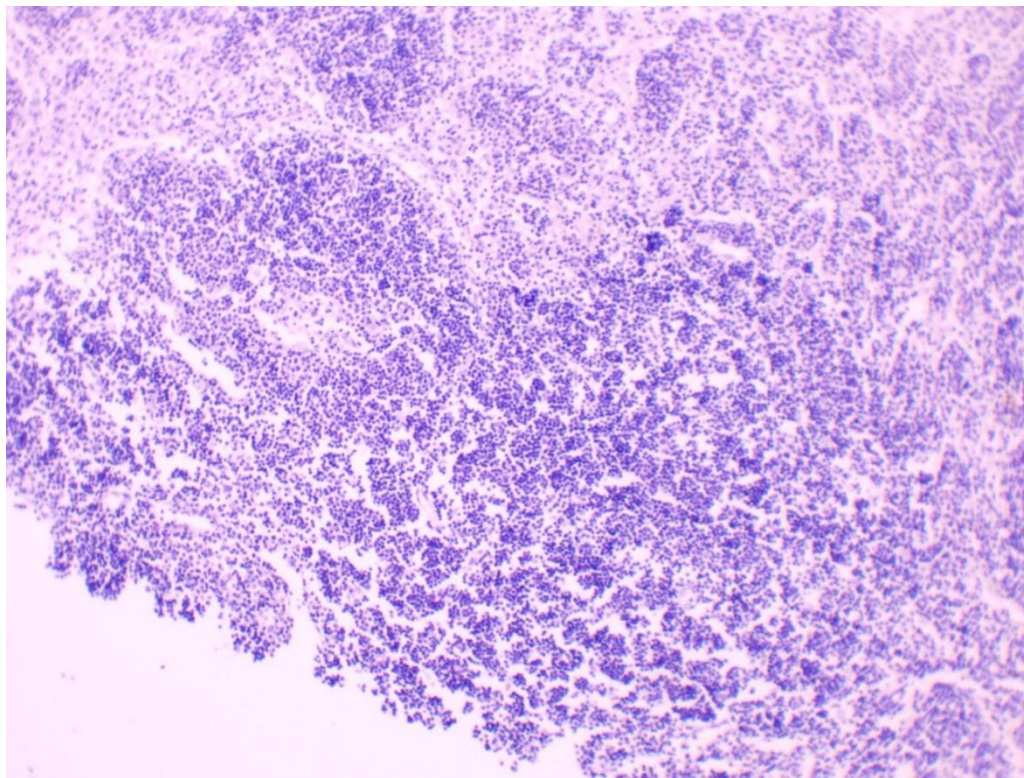
**Changes in the Medulla:** Macrophages and dendritic cells increased in the medulla, as these cells attempted to phagocytize and neutralize the pesticides. The proliferation of these cells caused an excessive immune response, leading to intensified inflammatory processes in the lymph nodes. In the medulla, the inflammation and cellular infiltration became more pronounced. The increase in macrophages, neutrophils, and lymphocytes in the medulla further aggravated the inflammatory processes, impacting the functional state of the lymph nodes.

**Necrosis and Damage in the Medulla:** The exposure to pesticides led to necrosis and damage in the medullary area of the lymph nodes. These changes disrupted the normal functioning of the lymph nodes and weakened the body's protective mechanisms. Prolonged exposure to aerosolized chemicals in the respiratory system resulted in an accumulation of lymphocytes and other immune cells in the regional lymph nodes. This led to an increase in the size of the lymph nodes, densification of their tissue, and sometimes the appearance of inflammatory signs. The immune response began as a result of the entry of chemical substances into the respiratory system. The proliferation of T- and B-lymphocytes in the lymph nodes played a crucial role in managing inflammation and eliminating damaged cells. Macrophages and neutrophils also accumulated in the lymph nodes, increasing their activity as they responded

to the accumulation of harmful substances and attempted to combat infection and manage the inflammatory response.

Prolonged exposure to chemicals resulted in fibrosis or sclerosis of the lymph nodes, leading to

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normal function and weakening their capacity to respond effectively to immune challenges. Chronic inflammation in the lymph nodes deepened changes, including alterations in lymphatic follicles and tissue growth.

**Conclusions:** The study investigated the effects of the chlorpyrifos pesticide on rabbits. The aerosolized chemical led to bronchial inflammation, alveolar swelling, and fluid accumulation in the respiratory system. These conditions hindered breathing, and prolonged toxic exposure might cause hyperplasia of the bronchial epithelium and significant changes in the bronchial passages. The lymph nodes showed an increase in lymphocyte count, intensified inflammation, and necrosis in the medullary region. Additionally, the long-term exposure to chemicals disrupted the normal functioning of the lymph nodes and weakened the immune system's effectiveness. The results of the study highlighted the harmful effects of chlorpyrifos on the organism and its detrimental consequences for the immune system. Based on the findings, it was concluded that chemicals like chlorpyrifos have a significantly negative impact on the body, and the changes observed, especially in the respiratory system and lymph nodes, indicate that long-term exposure to such chemicals is dangerous to the organism.

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