DYSTROPHIC AND NECROBIOTIC CHANGES IN THE SPLEEN RESULTING FROM ATMOSPHERIC AIR POLLUTION

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Abstract: Atmospheric air pollution is one of the most pressing environmental and medical problems of the modern era. Fine particulate matter, particularly PM2.5, penetrates deeply into the human body and adversely affects not only the respiratory system but also the central organs of the immune system. This article presents a comprehensive analysis of dystrophic and necrobiotic changes occurring in splenic tissue under the influence of atmospheric air pollution. Based on morphological, histopathological, and immunomorphological data, cellular degeneration, microcirculatory disturbances, damage to lymphoid tissue, and intensification of apoptotic and necrotic processes in the spleen are described. The findings emphasize the importance of understanding the mechanisms by which air pollution affects immune organs and substantiate the need for preventive and hygienic measures to protect public health.

Keywords: atmospheric air, pollution, PM2.5, spleen, dystrophy, necrobiosis, necrosis, immune system, morphological changes.

Main Body

Introduction

In recent decades, rapid industrialization, urbanization, and a significant increase in motor vehicle use have led to a global rise in atmospheric air pollution. According to the World Health Organization, air pollution has a substantial negative impact on human health, increasing the risk of chronic diseases and premature mortality.

Among air pollutants, fine particulate matter (PM2.5) is of particular concern due to its small size (less than 2.5 μm), which allows it to penetrate deep into the respiratory tract and reach the alveoli. From there, PM2.5 particles can enter the systemic circulation and be transported to various organs, including the spleen, a key organ of the immune system.

The spleen plays a crucial role in immune surveillance, blood filtration, and the storage and activation of immune cells. Therefore, studying the morphological changes in splenic tissue caused by atmospheric air pollution is of significant scientific and practical importance.

Pathogenetic Mechanisms of Atmospheric Air Pollution

Following inhalation, PM2.5 particles induce oxidative stress by increasing the production of reactive oxygen species. This leads to lipid peroxidation of cellular

membranes and disruption of intracellular metabolic processes. As a result, splenic tissue becomes vulnerable to hypoxia and metabolic imbalance.

In addition, PM2.5 exposure stimulates the release of inflammatory mediators, including cytokines, interleukins, and tumor necrosis factor. These biologically active substances contribute to microcirculatory disturbances, increased vascular permeability, and the development of interstitial edema.

Chronic exposure to polluted air leads to persistent hypoxic conditions in the spleen, reducing cellular energy supply and creating a pathogenic basis for the development of dystrophic and necrobiotic processes.

Morphological Characteristics of Dystrophic Changes in the Spleen

Dystrophic changes represent the earliest morphological response of splenic tissue to atmospheric air pollution. Morphological studies reveal a reduction in lymphoid follicles, shrinkage of germinal centers, and a decrease in lymphocyte density in the white pulp.

Lymphocytes exhibit cytoplasmic vacuolization, granular dystrophy, nuclear deformation, and chromatin condensation, indicating impaired functional activity of immunocompetent cells.

In the red pulp, congestion, dilation of sinusoids, erythrocyte hemolysis, and increased macrophage activity are commonly observed. In some cases, hemosiderin accumulation indicative of hemosiderosis is detected, reflecting impaired filtration and phagocytic functions of the spleen.

Necrobiotic Changes and Their Stages of Development

Prolonged and high-intensity exposure to atmospheric air pollution causes dystrophic changes to progress into necrobiotic processes. Necrobiosis is characterized by irreversible structural damage and loss of cellular viability.

Morphologically, necrobiotic changes in the spleen include destruction of lymphoid follicles, a marked reduction in lymphocyte populations, and nuclear alterations such as pyknosis, karyorrhexis, and karyolysis. Reticuloendothelial cells demonstrate cytoplasmic disintegration and loss of structural integrity.

In certain cases, focal areas of necrosis develop within the splenic parenchyma, particularly in regions affected by severe microcirculatory impairment. These changes result in a significant decline in both immunological and filtration functions of the spleen.

Immunomorphological Consequences

Dystrophic and necrobiotic changes in the spleen have direct consequences for immune system function. Damage to lymphoid tissue leads to suppression of both humoral and cellular immune responses. Dysfunction of macrophages and dendritic cells impairs antigen presentation and immune regulation.

Consequently, the organism’s resistance to infectious agents, toxic substances, and other environmental stressors is markedly reduced. Under conditions of chronic

air pollution, these morphological alterations may form the structural basis of secondary immunodeficiency states.

Hygienic and Preventive Significance The morphological findings obtained highlight the necessity of improving atmospheric air quality and strengthening sanitary and hygienic control measures. Reducing PM2.5 concentrations in densely populated areas is of particular importance for preventing immune system dysfunction and related diseases.

These data support the development of public health strategies aimed at minimizing exposure to air pollutants and protecting vulnerable populations.

Conclusion

Atmospheric air pollution, particularly exposure to PM2.5 particles, leads to pronounced dystrophic and subsequent necrobiotic changes in splenic tissue. These processes are associated with microcirculatory disturbances, oxidative stress, and degeneration of immunocompetent cells. The resulting morphological alterations in the spleen contribute to a decline in immune system function and exacerbate the adverse health effects of air pollution. The findings of this study provide a scientific basis for the development of preventive measures in environmental medicine and public health.

References:

1. Pope C.A., Dockery D.W. Health effects of fine particulate air pollution. *Journal of the Air & Waste Management Association*, 2006.
2. Brook R.D. et al. Particulate matter air pollution and cardiovascular disease. *Circulation*, 2010.
3. Oberdörster G., Sharp Z., Atudorei V. Translocation of inhaled ultrafine particles. *Inhalation Toxicology*, 2004.
4. Kumar V., Abbas A., Aster J. *Robbins and Cotran Pathologic Basis of Disease*. Elsevier, 2021.
5. Shamsutdinov R.Sh. Environmental factors and the immune system. Tashkent, 2019.
6. Qosimov Kh.O., Kuliev S.B. Atmospheric pollution and morphological changes. Bukhara, 2020.