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MORPHOFUNCTIONAL CHANGES IN THYMUS OF WHITE RATS IN ACUTE STRESS

Asadova Nigora Khamroevna
Bukhara State Medical Institute
nasadova1987@gmail.com

Abstract *In the thymus of animals subjected to acute stress, a decrease in lymphoid tissue was found, accompanied by the death of lymphocytes in the cortex and medulla. Acute stress leads to the appearance in the thymus of a large number of degranulating mast cells and actively functioning epithelial tubules.*

Keywords. *Lymphocytes, thymus, stress, histopathological changes.*

Introduction. The blood system plays an important role in the body's response to any stressful effect [2]. In recent decades, the influence of stress on the mechanisms of regulatory processes in humans and animals has been actively studied, its role in the adaptation process with the participation of cytokines and antioxidants has been shown on models of emotional, pain, traumatic and other stresses and also the fact that under the action of stress, all regulatory information goes from the nervous system through the pituitary-adrenal, lymphoid system and hematopoietic organs, and the general adaptation syndrome develops against the background of the restructuring of the activity of the local microenvironment, in which stromal elements and cytokines play an important role [2]. Nevertheless, today there are many unresolved issues in the pathomorphological changes in the organs of immunogenesis under stress, which determines the relevance of research in this direction.

The aim of the study is to experimentally characterize the pathohistological changes in the thymus of white rats under acute stress.

Materials and methods. The experiment involved 30 animals - non-inbred white rats (males and females) of four months of age with a body weight of 150-200 g, kept under standard vivarium conditions (free access to food and water and 12-14-hour daylight hours). Two experimental groups of 10 animals each were formed: I - intact animals in standard vivarium conditions; II - rats subjected to acute cold stress, which was modeled as follows: a single exposure to a temperature of +5 ° C, exposure - 1.5 h. Daily observation of animals included registration of behavior, appearance, physiological functions. On the 7th day, the animals were removed from the experiment under ether anesthesia in compliance with the rules of euthanasia, and the autopsy material was taken for subsequent histological examination (thymus).

Research results. The thymus is covered with a thin capsule of dense unformed connective tissue with a large number of collagen fibers and is divided by trabeculae into indistinctly delimited lobules, consisting of cortical and medulla. In some animals, adipose

tissue is found in the trabeculae. In some preparations, the border between the cortex and the medulla is not clearly revealed. The cortical substance of the thymus is represented by weakly oxyphilic epithelioreticular cells, macrophages and basophilic-stained, tightly adjacent T-lymphocytes; a small number of capillaries surrounded by epithelioreticular cells are found in it.

The thymus medulla looks lighter. Lymphocytes, macrophages and epithelioreticular cells are well visualized in it. At high magnification, thymic bodies formed by reticuloepithelial cells are revealed. In the connective tissue of the thymus septa, single mast cells are detected.

In the group with cold stress, by the 10th day of the experiment, the thymus tissue showed, first of all, vascular disorders (edema of the connective tissue and vascular congestion). As for the changes in the lymphoid tissue, they were expressed to varying degrees in different lobules in the same individuals.

In all animals of the group (100%, $p < 0.05$ with respect to control), inversion of layers was also observed, which is typical for the 3rd phase of accidental thymic involution under stress [1]. In some experimental rats of this group, the disappearance of inversion of layers in individual lobules of the thymus was noted - with the depletion of not only the medulla, but also the cortical layer of the thymus, which was manifested by the depletion of the layers with cells of the lymphoid series and the disappearance of clear boundaries between the layers.In the medulla and cortical layers of the thymus, areas of lymphocyte death were visualized, which manifested itself light-optically as a "picture of the starry sky." In 20% of animals in the lobules, the replacement of lymphoid tissue with adipose tissue was noted.

The blood vessels in the devastated cortex had a structure typical of the vessels of the thymus medulla. It is known that the hemocapillaries of the cortical layer have a relatively thick basement membrane, to which epithelioreticulocytes, macrophages and lymphocytes often adjoin; the basement membrane of the medullary hemocapillaries, on the contrary, is thin [7].

Also, in the cortex and medulla, areas of stromal collagenization and the formation of a large number of thymic bodies were detected.

In the thymus tissue, a large number of mast cells were detected - large cells with basophilic granules. They were found mainly in the interlobular connective tissue, in the connective tissue of the septa inside the lobules in the vicinity of the blood

Mast cells are an integral part of the thymic microenvironment; their main function is to control the composition of tissue fluid, they are regulators of tissue homeostasis and the last link in the general adaptation reaction at the cellular level, in the thymus they are actively involved in the processes of differentiation and migration of thymocytes [7]. In 70% of animals, epithelial tubules lined with cubic epithelial cells were also detected in the cortical layer of the lobules.

It is known that epithelial tissue plays a leading role in the implementation of the functions of the thymus; at the same time, both in the human thymus and in the thymus of

laboratory animals, epithelial tubules, thymic bodies and epithelial accumulations are permanent structures [7]. In 2009, only one term was introduced into the nomenclature, referring to the epithelial structures of the thymus, thymic body; the combination of three types of epithelial formations of the thymus (epithelial cords, epithelial tubules and thymic bodies) under one general term is conditional and inhibits the development of ideas about the structure of the thymus [7].

Most researchers explain the proliferation of epithelial structures in the thymus by the emergence of an urgent need to enhance the secretion of thymic hormones under extreme exposure [3, 4]. The cavity forms of the tubules can be constantly determined with the tension of the functional activity of the thymus, expressed in a change in the emigration and immigration of lymphocytes in the organ - not only in the embryonic, early postnatal and senile periods of genesis, but also under the influence of stress factors on the body. In accordance with modern ideas about the functions of the thymus, all these periods of life characterized by an unbalanced supply of T-precursors from the bone marrow to the thymus and emigration from the thymus to the peripheral lymphoid organs of T-lymphocytes that have passed the intrathymic stage of maturation; at the same time, not only mature T-lymphocytes migrate from the thymus to the lymphoid organs, but also immature forms, which are able to mature in these organs under the influence of thymic factors [6].

Thus, when comparing the data of histological examination of the organs of animals of the experimental and control groups, the following patterns were revealed. In rats subjected to acute stress, changes in the organs of the immune system were found, characteristic of acute stress, a decrease in lymphoid tissue - in the thymus

The study of the thymus as a central organ of the immune system under stress is of particular interest to date.

Later, many researchers have shown that accidental involution of the thymus develops not only when exposed to an infectious agent, but also when various factors affect the body [1].

Under stress conditions, incidental involution of the thymus reflects suppression of its function [5]. Generalization of the information available to date in the literature makes it possible to represent this process as a sequential change of five phases; at the same time, the processes of death and migration of T-lymphocytes in different lobules are uneven, and the absence of strict parallelism of changes in lobules is reflected in the morphological picture of one stage or another, in addition, the nature of the response of the thymus to the stressor depends on the nature of the stressor [1].

At the same time, according to other authors, lymphopenia in lymphoid organs during stress reaction develops not as a result of cell breakdown, but due to a decrease in neoplasm and increased migration of lymphocytes from these organs to the bone marrow with the formation of a "lymphoid peak". It is known that lymphocytopenia accompanies stress practically throughout all its stages, but it is most pronounced in the stage of anxiety and in

the stage of exhaustion (especially), which is characterized by almost complete atrophy of the thymus [8].

Thus, in the central and peripheral organs of immunogenesis of animals subjected to acute cold stress, we observed similar changes, which are manifestations of acute stress, the reduction of lymphoid tissue. In the thymus, the reaction of reticuloepithelial structures and mast cells was also revealed.

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