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MORPHOFUNCTIONAL CHARACTERISTICS OF THYMUS UNDER EXPOSURE TO VARIOUS ENVIRONMENTAL FACTORS

Sabohat Bahodurovna Azimova*

*Bukhara State Medical Institute,
UZBEKISTAN

ABSTRACT

In the presented article, devoted to the features of the structure and function, morph metric parameters of the main structures of the thymus {thymus}, the patterns of development of this organ at the stages of postnatal ontogenesis are revealed. An increase in the number of luminescent granular cells of the cortico-medullary and subcapsular zones is revealed after 1 and 14 days. After 14 days, the cells of both the cortico-medullary and subcapsular zones become larger and more densely filled with granules.

KEYWORDS: *Morphology, Organs Of The Immune System, Thymus, Action Of Environmental Factors*

INTRODUCTION

The immune system of humans and animals is one of the most reactive systems of the body, reacting quickly to the effects of damaging factors at the earliest stages. The immune system is formed by a complex of organs and tissues that create protection against foreign endo- and exogenous influences.

It arose in the early stages of evolution and its activity is based on the recognition of foreign antigens, their destruction and removal, which is absolutely necessary for the survival of the organism. {1}

At present, convincing data have been accumulated indicating that the immune system largely determines the body's resistance to the effects of chemical factors. The central organs of immunogenesis in mammals are the thymus, where the formation and reproduction of T-lymphocytes takes place, as well as the red bone marrow, where B-lymphocytes are formed and multiply. Peripheral lymphoid organs are lymph nodes, spleen, tonsils, intestinal lymphoid follicles. The immune system of humans and animals is one of the most reactive systems of the

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Also immobilization stress induces adrenal hypertrophy, thymic involution and the appearance of destructive lesions in the gastric mucosa of white rats, correlating in terms of potency with the duration of stress exposure. Pathomorphological changes in the adrenal glands were characterized by hypertrophy, predominantly of the fascicular zone of the cortex. Also, under immobilization stress, there was a massive death of T-lymphocytes and their release into the cardiac bed, which was accompanied by involution of the thymus. {10}

During a stress reaction, T-lymphocytes are released into the blood and massive death of lymphocytes in the organ itself, especially in the cortex. Thus, with a 6-hour stress exposure, a 1.3-fold decrease in the thickness of the thymus cortex of white rats compared with that in animals of the intact group, the value of this indicator was 260 μm, with a range of fluctuations from 200 to 290 μm. On the contrary, the area of the medulla in the thymus of rats after stress exposure increased by 1.2 times (Fig. 2) and amounted to 940 μm, the oscillation range varied from 840 to 1020 μm. {11,12}

Lymphoid tissue, being the main site for the development of specific immunological reactions, contains numerous cell populations involved in ensuring the genetic constancy of the internal environment of the body. {2}

The thymus is considered as an immune organ in which acquired and natural immunity is formed with the help of biologically active peptides through the production of thymic hormones and the formation of progenitor cells of T-lymphocytes.

In the structure of the immune system, the thymus provides the maturation and differentiation of T-lymphocytes, including in the peripheral immune organs, stimulates the integration of various populations of T-lymphocytes and macrophages for the implementation of immune responses.

Until the end of the 20th century, the theory of involution of the thymus of humans and animals was considered indisputable. According to the theory of thymus involution in adolescents 14–15 years old and animals aged 8–9 months. upon reaching the period of puberty, the organ under study undergoes complete involution in the body and loses its functional purpose. The founders of this development and age-related changes in the organ before the onset of biological death. In a 4-week-old embryo, the reticuloepithelial complex and its cellular elements are formed. The thymus reaches its maximum functional development in newborns. However, there are substantiations for the morphofunctional significance of this gland in northern animals throughout all periods of the individual Thymus is a combination of epithelial and mesenchymal reticules and, together with the capillary network, form a reticulo-epithelial complex.

Epitheliorеticulocytes differentiate and various cellular immunities appear in the body and form thymus-dependent zones (in the spleen, lymph nodes, etc.). The epithelial islets of the thymus of

young adult animals secrete into the blood a secret that contains hormones of the thymosin family. These hormones regulate humoral immunity in the body of animals and humans. {3}

The development of T-lymphocytes is the result of the interaction of progenitor cells and immature thymocytes with components of the thymicstroma, which contains several types of cells that create a supporting framework and form a microenvironment for developing thymocytes. {4}

Autopsy studies of the thymus of people of different age groups made it possible to verify the expression of serotonin in human thymus cells at all stages of ontogenesis. A significant increase in the number of cells containing serotonin in humans has been established.

living age and the preservation of this hormone in people of old age and long-livers at the same level as at the initial stages of ontogenesis. The intensity of serotonin synthesis does not change during ontogenesis. The data obtained convincingly indicate the preservation of the endocrine function of the gland during aging {5}.

A comprehensive assessment of the immunoarchitectonics of the thymus revealed some important trends regarding the development of stress-induced immunomodulation in the growing organism of experimental animals. under the action of various types of stressors (physical and psychoemotional). According to quantitative immunohistochemistry data

According to the analysis, among the mechanisms of thymus involution under chronic stress in a growing organism, excessive apoptosis of double positive T-lymphocytes of the cortical substance and inhibition of the proliferation of cortical thymocytes are of great importance {8}.

It has been shown that under chronic stress there is a decrease in the number of T-lymphocyte precursors in the red bone marrow and a decrease in the level of their chemoattractants in the thymus, which contributes to organ hypoplasia {9}.

MATERIAL AND METHODS

The regenerative potential of the thymus of adults (54 people) who underwent chemotherapy for 12 months for lymphoma was investigated. The dynamics of thymic activity was analyzed by assessing structural changes in the thymus using sequential computed tomography, correlating them with the results of studying the thymus by simultaneous analysis of T-cell receptor excision circles (sjTREC) and CD31 (+) recently emigrated from the thymus (recent thymic emigrants - RTE) in peripheral blood. In addition, the regeneration processes in the thymus were assessed based on the recovery of peripheral CD4 (+) T cells after chemotherapy. An enlargement of the studied organ after chemotherapy compared with the baseline level, called recurrent thymic hyperplasia, was detected in 20 patients aged 18–53 years (average 33 years).

Using general linear models of mathematical analysis, it was found that patients with hyperplasia had a faster recovery of TREC and CD31 (+) RTE levels after chemotherapy than patients of the same age, sex, diagnosis, stage of disease, and thymic function at baseline. but without hyperplasia.

These data suggest that the adult thymus retains its ability to regenerate after chemotherapy, especially in young adults. The presence of hyperplasia may promote the renewal of thymopoiesis and replenishment of the peripheral CD4 (+) T-cell pool after chemotherapy in

adults {6}. The role of cytokines produced in the thymus is mainly to maintain the main processes in the thymus, that is, T-lymphopoiesis. Cytokines also coordinate cell-cell relationships.

In an experiment on white outbred male rats who were injected intramuscularly with cyclophosphamide, imunofan and their combinations, it was found that the course administration of imunofan leads to changes in the morphology of the thymus and the functioning of its bioamine-containing structures. Imunofan significantly increases the width of the cortical, diameter and area of the medulla of the thymus with a corresponding increase in the mass of the organ 7 and 14 days after the end of the course of injections. An increase in the number of luminescent granular cells of the cortico-medullary and subcapsular zones is revealed after 1 and 14 days. After 14 days, the cells of both the cortico-medullary and subcapsular zones become larger and more densely filled with granules. It has been shown that the use of Imunofan against the background of the administration of cyclophosphamide promotes an increase in the mass of the thymus, the size of the cortex and medulla of the lobules, and the acceleration of the restoration of the cytoarchitectonics of the thymus. Recovery processes occur within 1 day after the combined course. After 7 days, the weight of the thymus and the size of the cortex and medulla in rats with isolated administration of cyclophosphamide and in the group with combined administration of cyclophosphamide and imunophan differ little, but there is a tendency towards normalization of the thymus structure. After the combined administration of imunofan and cyclophosphamide, the thymus structure and bioamine supply of cells differ significantly from those with the isolated administration of both drugs. It was found that an increase in the size of the cortical and medullary substance of the lobules with the introduction of imunofan occurs due to the activation of proliferation and differentiation of thymocytes, which can be mediated by the inclusion of the production of factors that control the growth and development of lymphocytes. Imunofan reduces the destruction of lymphocytes, because it has the ability to protect their DNA from damage caused by cyclophosphamide. {7}

Increased migration of thymocytes from the thymus to the blood and peripheral immune organs is believed to be the cause of accidental involution.

CONCLUSION

Morphological studies of the thymus {thymus gland} make it possible to assess age-related changes in the functioning of the immune system in response to the action of factors of various nature. Modern immunohistochemical research methods create opportunities for elucidating stromal relationships in the thymus. Further study of the morphofunctional organization of the organ will make it possible to identify and analyze the patterns of its structural and functional changes under the action of factors of various origins on the body.

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