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THE CELLULAR STRUCTURES OF THE CORTICAL AND MEDULLA OF THE THYMUS OF RATS IN THE PERIOD OF POSTNATAL ONTOGENESIS ARE NORMAL AND EXPERIMENTALLY EXPOSED TO ENDOGENOUS

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Abstract:
The article presents the data of a study conducted on rats with EN, the cellular structures of the cortical and medulla of the thymus during the period of postnatal ontogenesis in the control group and in an experiment under the influence of EN. The study of the cellular structures of the cortical substance of the thymus of rats revealed that the number of lymphocytes, macrophages and dendritic cells increased at all ages of the experiment and the largest increase was detected by 3 months of age to 32.4%. An increase in the Ghassal bodies in the experiment was detected at 30.0% in relation to the control group at 1 month of the experiment. In the cerebral layer of the rat thymus, an increase in the number of lymphocytes, macrophages and Ghassal corpuscles was revealed by 33.3% at 1 month of age. By age 3 of the experiment, an increase in dendritic cells by 28.6% was detected.

Keywords: rat thymus, postnatal ontogenesis, Energy drinks, medulla, cortex, lymphocytes, macrophages, dendritic cells, Ghassal body.

Introduction

The thymus is the central, or primary, organ of the lymphoid (immune) system. As is known, its main functions are to ensure the maturation and differentiation of thymocytes, the integration of various populations of thymocytes and macrophages for the implementation of immune responses [Ilyasov A.Since 2024]. The thymus medulla contains special morphological structures formed by epithelial cells, thymic corpuscles, which differ from other medullary cells by membrane markers and secreted humoral factors. Thymic corpuscles in humans and some animals are described as multilayered scaly clusters of epithelial cells with keratogyalin deposits in the center. The cells of thymic bodies are light and have an ectodermal origin [Beim 2013].

To date, a huge amount of experimental data has been accumulated concerning the study of various aspects of differentiation, selection and migration of T-lymphocytes [Vacchio 2016]. The cells of the thymic microenvironment involved in these processes are also intensively studied – epithelial cells, stellate cells, dendritic cells, macrophages [Suzuki 2016].

It is known that qualitative and quantitative changes in the Ghassal bodies are of no less importance in assessing the functional activity of the thymus and the pathological processes developing in it [Rakhmonova K.E. 2014]. For the cerebral layer of the thymus, the most characteristic structures are the thymic corpuscles or Gassal corpuscles. They are a concentric cluster of oblong and spindle-shaped cells with large nuclei and acidophilic cytoplasm, they quickly respond to exogenous and endogenous pathological signals, which leads to an imbalance of the entire system of differentiation and proliferation of T lymphocytes and, consequently, the entire immune system. In pathological processes, there is an increase in the number of neutrophils, mast cells, eosinophils, plasma cells in the thymus, as well as the transmigration of lymphocytes through the vascular endothelium [Khasanova D.A 2023]. There are often indications of an inversion of the thymus layers, in which a high cell density is detected in the medulla rather than in the cortex [Ilyasov A.Since 2024], which may be the final stage of thymus atrophy, after which the restoration of the thymus structure begins. The mechanisms of restoration of the thymus structure after stress have not been studied well enough to date. Mast cells, granulocytes, plasmocytes, cells of the APUD system can be identified in the thymus, and basophils in the interlobular connective tissue [Raica M 2007]. The stroma of the definitive thymus is represented by epithelial cells, among which four subtypes are distinguished: subcapsular, internal cortical, medullary epithelium and epithelium of the Ghassal bodies. Normally, the stroma of the organ is filled with thymocytes at different stages of development and differentiation, B lymphocytes are less common. Thymic lymphocytes have the phenotype of mature or activated B cells and account for approximately 1-2% of all thymus cells [Asimova S.In 2021]

Currently, EN such as: Red Bull, Gorilla Energy, Burn, Black Monster and other EN contain inositol. Along with pantothenic acid, it is called the "vitamin of youth". Inositol, which is a hexatomic aromatic alcohol ($C6H6O6$), is partially produced by the human and animal body itself.

Scientists think that inositol has the ability to relieve a person from feelings of tension, worries and fear, as well as reduce blood pressure. Inositol affects the transmission of nerve signals and participates in the regulation of the balance of copper and zinc in the body, which helps to reduce nervousness and irritability [Shterman S. In 2013].

The longest-term tests on the consumption of energy drinks within the established norms, conducted over several weeks, did not reveal any changes in the studied values of biosafety markers in healthy subjects [Roberts, M.D 2008].

Energy drinks are not physiologically necessary for normal human life [Rakhmonova K.E 2024] The prescription composition of energy drinks has not yet had a deep scientific justification. In this regard, it is necessary to conduct further research in this direction on the formulation of the basic principles of the balance of biologically active substances and other components in the composition of drinks of this kind [Shterman S. In 2013].

Designers developing the formulation of energy drinks have recently begun to pay significant attention and often include such a biologically significant component as D-ribose in the composition of drinks. D-ribose is a carbohydrate that is naturally present in the human body and is similar in its chemical structure to glucose. It has been shown that caffeine (not taurine) causes an increase in diuresis and natriuresis [Riesenhuber A 2006]. High consumption of caffeine reduces insulin sensitivity, increases blood pressure [Bichler A 2006].

The morphofunctional state of the central organ largely determines the activity of the secondary (peripheral) structures of immunogenesis and the severity of protective reactions of the whole organism. Currently, knowledge of the structural features of the organs of the immune system and the determination of the beginning of differentiation of immunocompetent cells at different stages of the ante- and postnatal periods of ontogenesis allows us to understand the processes of formation of immunological functions characteristic of these organs.

The purpose of the study: To study the morphometric parameters of the cellular structures of the cortical and medulla of the thymus of rats in the period of postnatal ontogenesis of the control group and in an experiment under the influence of EN. In the period of 1,3,6 months of development, cellular structures in the thymus such as lymphocytes, macrophages, dendritic cells, their quantitative analysis, changes in the structure of Ghassal bodies played an important role in evaluating the quantitative analysis of cells. The conducted studies allow us to better understand the patterns of structure and development of organs of immunogenesis, allowing us to standardize morphological data in the process of physiological ontogenesis.

Materials and methods of research: The object of the study was white rats. 66 rats were studied in this group in the vivarium of the Abu Ali ibn Sina Bukhara Medical Institute. The thymus of rats was taken for research. The isolated organ was fixed in a 10% neutral formalin solution, then the blocks were placed in an automated wiring station KD-TS3D1 Automatic Tissue Processor. The tissue was dehydrated, poured into paraffin and thin sections with a thickness of 4 microns were prepared on a rotary microtome Semi-Automatic Rotary Microtome KD-3358, histological staining of the tissue was performed with hemotaxillin-eosin paint on a KD-RS2 Automatic Slide Stainer. Documenting the obtained thymus sections microscopically on a Nikon eclipse E200 MV research microscope using a LEICA ICC50 E color camera.

The results of the study and their discussion: At 1 month of age, the control group had an average number of lymphocytes in the cortical layer – 47.8±0.7%, macrophages 8.1±0.4%, dendritic cells 5.8±0.5% and Ghassal corpuscles 2.0±0.2%. At this age, the number of cells in the medulla is on average: lymphocytes 30.5±0.7%, macrophages 4.3±0.3%, dendritic cells 5.4±0.5% and Ghassal corpuscles 1.55±0.1%. Figure 3.3.1 shows an image of the cellular structures of the cellular and medulla of the thymus at 1 month of age in the control group.

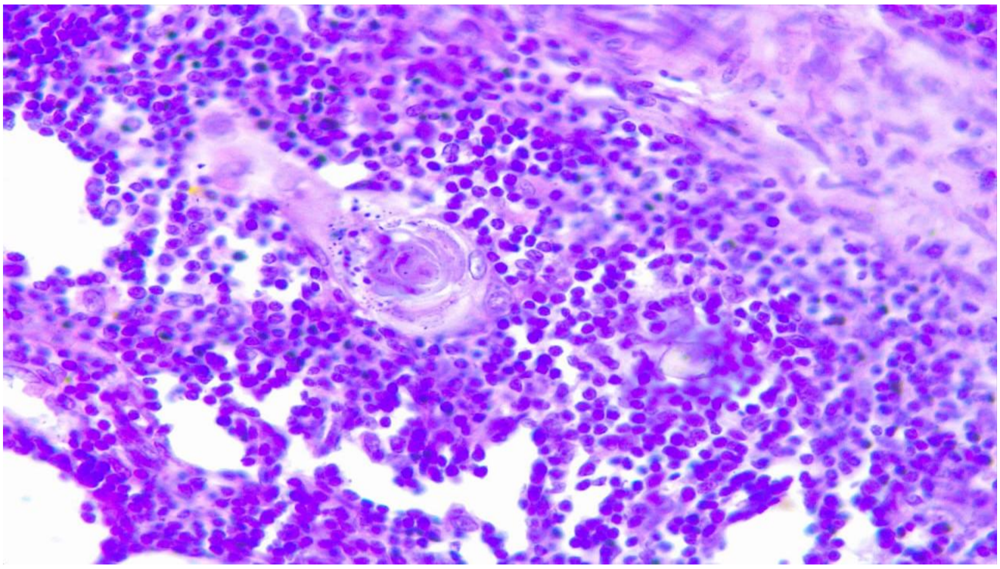

Figure 3.3.1 Cellular structures of the cellular and medulla of the thymus of 1 month of age in the control group

1. **Lymphocytes 2. Macrophages 3 Dendritic cells 4 Ghassal corpuscles. Hematoxylin-eosin staining. Approx.10 x 40 vol.**

At the age of 1 month, the number of cells of the cortical layer in rats is on average: lymphocytes 61.5±0.8%, macrophages 10.3±0.6%, dendritic cells 7.7±0.4% and Ghassal corpuscles 2.6±0.3%. The number of cells of the medulla is equal on average:

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lymphocytes 40.2±0.7%, macrophages 5.7±0.4%, dendritic cells 6.9± 0.5% and the number of Ghassal corpuscles 2.0±0.2%. Figure 3.3.2 shows the cellular elements of the cortical and medulla of the thymus of 1-month-old rats. The table shows the cellular structures of the cortical and medulla of the thymus of rats in the period of postnatal ontogenesis in the control and experimental groups under the influence of ENDOGENOUS.

Cellular structures of the cortical and medulla of the thymus of rats in the period of postnatal ontogenesis in the control and experimental groups under the influence of ENDOGENOUS.

Table

		the cortical layer				**the brain layer**			
		lymphocytes	macrophages	dendritic cells	the taurus of Ghassal	Lymphocytes	macrophages	dendritic cells	the taurus of Ghassal
contact	**1 month**	45,0-52,0 47,8±0,7	6,0-10,0 8,1±0,4	3,0-8,0 5,8±0,5	1,0-3,0 2,0±0,2	27,0-34,0 30,5±0,7	3,0-6,0 4,3±0,3	3,0-8,0 5,4±0,5	1,0-2,0 1,55±0,1
ex		57,0-65,0 61,5±0,8	7,0-13,0 10,3±0,6	6,0-10,0 7,7±0,4	1,0-4,0 2,6±0,3	37,0-44,0 40,2±0,7	4,0-8,0 5,7±0,4	4,0-9,0 6,9±0,5	1,0-3,0 2,0±0,2
conta	**3 months**	38,0-44,0 41,3±0,55	7,0-11,0 9,0±0,37	5,0-9,0 7,0±0,37	1,0-4,0 2,5±0,3	18,0-25,0 21,3±0,64	5,0-8,0 6,0±0,3	5,0-9,0 6,3±0,37	1,0-2,0 1,83±0,1
ex		51,0-58,0 54,7±0,64	10,0-14,0 11,9±0,37	7,0-11,0 9,2±0,37	2,0-5,0 3,2±0,3	25,0-32,0 28,0±0,64	6,0-9,0 7,8±0,37	6,0-10,0 8,1±0,37	1,0-3,0 2,25±0,2
conta	**6 months**	27,0-33,0 30,1±0,6	4,0-9,0 6,0±0,5	3,0-8,0 5,0±0,5	1,0-2,0 1,5±0,1	10,0-15,0 12,5±0,5	2,0-5,0 3,2±0,3	3,0-7,0 4,4±0,4	1,0-2,0 1,27±0,1
ex		34,0-40,0 36,3±0,6	5,0-10,0 7,4±0,5	4,0-8,0 6,1±0,4	1,0-4,0 1,8±0,3	12,0-18,0 14,5±0,6	2,0-5,0 3,7±0,3	3,0-8,0 5,0±0,5	1,0-3,0 1,6±0,2

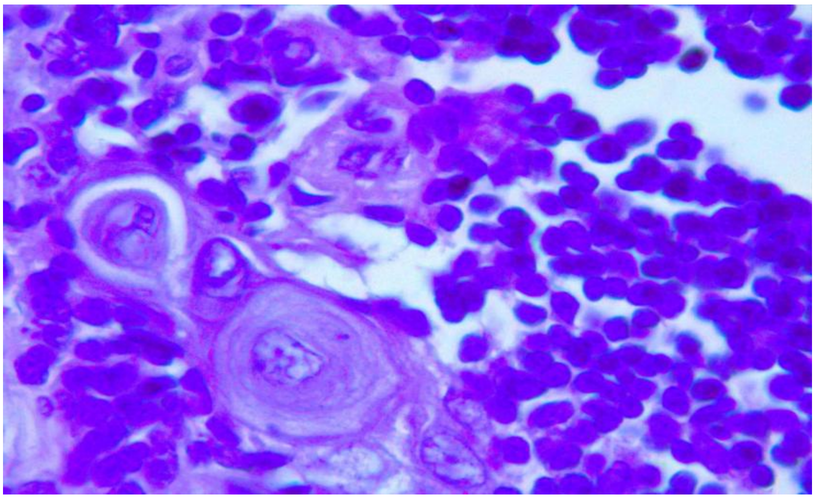

Figure 3.3.2 Cellular structures of the cellular and medulla of the thymus of the 1-month-old experimental group.

1. Lymphocytes 2. Macrophages 3 Dendritic cells 4 Ghassal corpuscles. Hematoxylin-eosin staining. Approx.10 x about 60.

At three months of age, in the control group, the number of cells of the cortical layer is 41.3±0.55% lymphocytes, 9.0±0.37% macrophages, 7.0±0.37% dendritic cells, 2.5±0.3% Ghassal corpuscles. At this age, the cells of the cerebral layer number: lymphocytes 21.3±0.64%, macrophages 6.0±0.3%, dendritic cells 6.3±0.37%, Ghassal corpuscles 1.83±0.1%. Figure 3.3.3 shows an image of the cellular structures of the thymus in the control group of a 3-month-old rat.

At three months of age, in the experimental group of rats, cortical layer cells with EN poisoning: lymphocytes 54.7+0.64%, macrophages 11.9+0.37%, dendroid cells 9.2+0.37% and Ghassal corpuscles 3.2+0.3% increased. At this age, the cells of the cerebral layer are lymphocytes 28.0±0.64%, macrophages 7.8±0.37%, dendritic cells 8.1±0.37%, and Gassal corpuscles 2.25±0.2%. Figure 3.3.4 shows the cellular structures in the experimental group of 3 months old rat thymus.

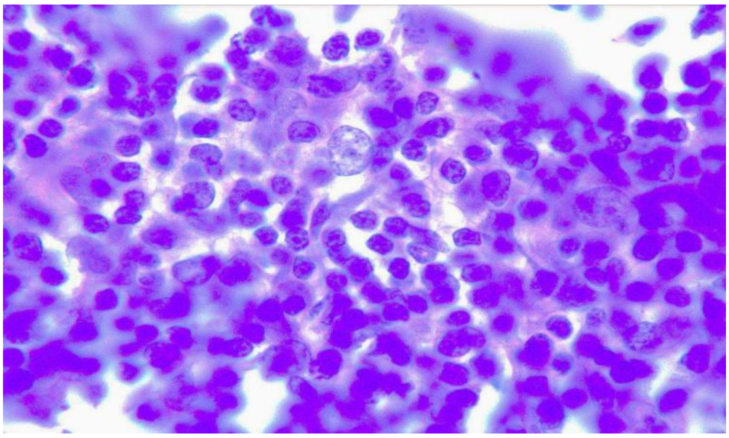

Figure 3.3.3 Cellular structures of the cellular and medulla of the thymus at 3 months of age in the control group.

1. Lymphocytes 2. Macrophages 3 Dendritic cells Hematoxylin-eosin staining. Approx.10 x 40 vol.

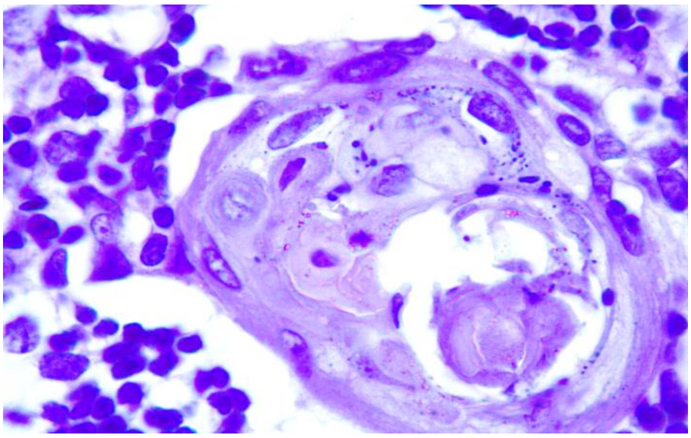

Figure 3.3.4 Cellular structures of the cellular and medulla of the thymus of the 3-month-old experimental group.

1. Lymphocytes 2. Macrophages 3. Ghassal Corpuscles. Hematoxylin-eosin staining. Approx.10 x about 100**.**

By the age of 6 months, the cellular composition in the thymus changes. In the cortical layer at 6 months of age, the control group had lymphocytes of 30.1±0.6%, macrophages of 6.0±0.6%, dendritic cells of 5.0±0.5, Gassal corpuscles of 1.5±0.1%, at this age, the number of lymphocytes in the medulla was 12.5±0.5%, macrophages of 3.2±0.3%, dendritic cells of 4.4±0.4%, Gassal corpuscles 1.27±0.1%. Figure 3.3.5 shows an image of the cellular structures of the thymus in the control group of a 6-month-old rat.

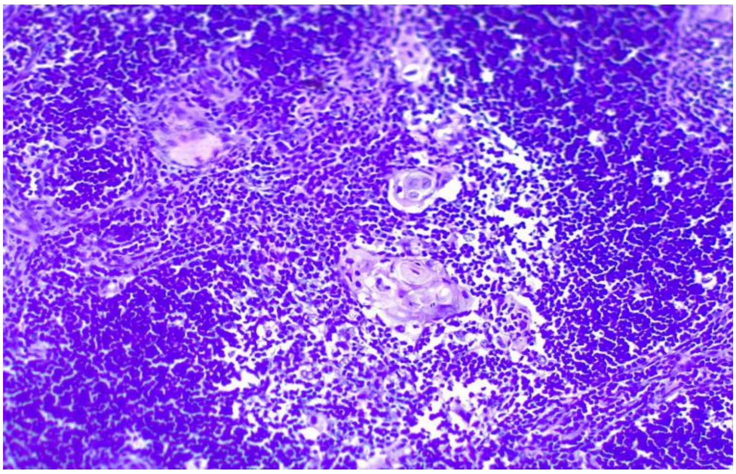

Figure 3.3.5 Cellular structures of the thymus in the control group of a 6-month-old rat. 1. Lymphocytes 2. Macrophages 3. Ghassal Corpuscles. 4 Dendritic cells are stained with hematoxylin-eosin. Approx.10 x 40 vol.

At the age of 6 months in the experimental group, cells of the cortical layer lymphocytes 36.3± 0.6%, macrophages 7.4±0.5%, dendritic cells 6.1±0.4%, Ghassal corpuscles 1.8±0.3%. At the age of 6 months in the experimental group, lymphocytes 14.5±0.6%, macrophages 3.7±0.3%, dendritic cells 5.0±0.5%, Ghassal corpuscles 1.6±0.2%. %. Figure 3.3.6 shows the cellular structures of the thymus in the experimental group of a 6-month-old rat.

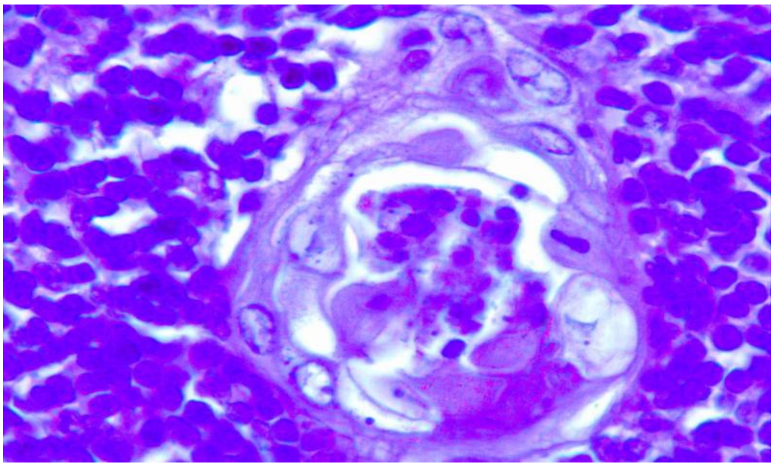

Figure 3.3.6 Cellular structures of the cortical substance of the rat thymus in the period of postnatal ontogenesis in an experiment under the influence of ENDOGENOUS.

1. lymphocytes. 2. Macrophage. 3. The thymic body of Ghassal. Hematoxylin-eosin staining. Approx.10 x about 40

Conclusions:

Thus, the study of the cellular structures of the cortical substance of the thymus of rats revealed that the number of lymphocytes, macrophages and dendritic cells increased at all ages of the experiment and the largest increase was detected by 3 months of age to 32.4%. An increase in the Ghassal bodies in the experiment was detected at 30.0% in relation to the control group at 1 month of the experiment. In the cerebral layer of the rat thymus, an increase in the number of lymphocytes, macrophages and Ghassal corpuscles was revealed by 33.3% at 1 month of age. By the age of 3, the experiment revealed an increase in dendritic cells by 28.6%.

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