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# MORPHOLOGICAL AND FUNCTIONAL STATE OF EXTRAORGANIC BLOODSTREAM OF PINEAL GLAND OF RATS UNDER THE CHRONIC STRESS AND ILLUMINATION

***Abstract.*** *The results of the study of the morphological and functional state of extraorganic bloodstream of pineal gland of rats under the chronic stress and illumination are presented in the work. It has been found out that there is complete absence of blood corpuscles in the lumens of venous and arterial vessels. Thus, the blood circulation abnormality and exsanguination of the vessels are accompanied by the hypoxia, edema of the surrounding tissues and atrophy of the parenchymatous elements of pineal gland.*
***Keywords:*** *pineal gland, chronic stress, bloodstream.*

**Introduction.** The problem of study of the structure, functioning and pathology of pineal gland is still relevant, as the pineal gland is one of the most significant parts of the neuroendocrine system, and takes part in a wide range of the regulatory effects on numerous vital activities [1-4]. As the hypothalamus and pituitary gland, pineal gland is the central regulatory element, which controls activity of the endocrine glands. The deep connection of the pineal gland with the reactive and adaptive processes, which are the result of stressors, is explained by the extremely wide range of regulatory effects, in which the pineal gland is involved, and by its hypersensibility to changes in external and internal environment.

It is well known, that the stress, which can be characterized as the non-specific component of the organism response to an irritant, is implemented involving the neuroendocrine system. The neurosecretory complex of hypothalamus and pituitary gland is the higher neuroendocrine transmitters of the organism, it coordinates endocrine control of metabolism with the work of the autonomic nervous system and integrated emotional and behavioral reactions. And while the role of the complex is studied in detail, the significance of the pineal gland in these processes is not studied enough. Many aspects of this problem, especially those connected with the bloodstream reaction on the different stresses, are still not solved [5-8].

**Objective**: to find out the features of the morphological and functional state of extraorganic bloodstream of pineal gland of rats under the chronic stress and 30-days illumination.

**Materials and methods**. Study was performed with 24 pubertal male Wistar rats with the body weight of 220-240 g. The animals were kept in vivarium under the day and night illumination. The intensity of illumination was 1000-1500 lux and was carried out with two lamps, which were located on both sides of the cage within 30 days. Starting from the 21st day of the experiment the rats were placed in a tank

with some water for 1 hour for the forced swimming. The disposable trainings were conducted during 10 days.

At the end of the experiment the animals were subjected to euthanasia in strict accordance with the requirements of the "European Convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes" (Strasbourg, 1986) and "General Ethical Principles of Animals Experiments", ratified on the First National Congress of bioethics (Kyiv, 2001).

After removing the pineal gland with the adjoining blood vessels, the obtained complex was immersed into the fixing solution of 10% neutral formalin. Using standard methods the samples were placed in paraffin blocks. The slices with thickness of 4 mm were produced from the blocks and stained with hematoxylin and eosin. Obtained samples were studied with the microscope «PrimoStarZeiss» at different magnifications with the following photography of micropreparations with DSLR «Canon».

**Results and discussion.** As a result of study of the tissue specimens it was found out, that when the diameter of the extraorganic venous vessels becomes bigger, the distribution of blood corpuscles in them changes considerably. It was revealed, that in rather large venous vessels there is a predominance of plasma component of blood, and a small amount of blood corpuscles mainly takes the central position. Red cell mass may contain the separately located spherocytes. But mostly there are the clods of red blood cells in the lumen. Some venous walls are thickened. The dissection of the vascular wall is observed frequently. In this case there is a formation of two layers of cell structures, which in some cases is accompanied by the spasm of the vascular wall.

In some places there is a destruction of the integrity of the vascular wall, which accompanied by the formation of extravasates, i.e. the appearance of red blood cells outside the bloodstream (Fig. 1).

There is also another more common type of distribution of blood, when the extraorganic


*Fig. 1. Photomicrography of the bloodless extraorganic blood vessels of the pineal gland of the rat under the chronic stress and 30-days illumination. Magnification: eyelens×10, objective ×10. Coloration: hematoxylin and eosin. 1 - lumen of the small venule; 2 - isolated red blood cells outside the vessel; 3 - anemied small arterioles; 4 - perivascular space.*

venous vessels look like completely bloodless (Fig. 1). These changes were found out in the samples of the large venous vessels. The feature is that their walls are mostly thinned, and in some places there are small defects between the neighboring endotheliocytes. Thereby, the edema of the surrounding tissue of various degrees is developed.

It was established, that in the arterial system of the extraorganic blood vessels of the pineal gland there are also reactive changes in response to the stressors. The feature of the arterial vessels of all dimensions is the complete absence of the blood corpuscles in their lumens. It was revealed, that transverse sections of the small arterioles are roundish-shaped, and their lumens are narrowed. This state is the result of the thickening of the vessels wall. The hypertrophy of endothelial cells, which is shown as the increasing volume of nuclei, is the main reason of the thickening of the vessel wall. The cells become ovoid or round-shaped and appear in the lumen of the vessel, causing its narrowing.

In the arterial vessels of the larger dimensions the feature is the spasm of their vessel wall. The result of this spasm is a modified form of the lumen. The lumen became the ellipse-shaped with sinuous surface instead of the round-shaped, which is typical for these

vessels. Restructuring of the coat of the arteriole wall leads to the contraction of the myocytes. Thus, endothelial cells lose their typical shape and order of location. The nuclei of these cells are usually hypertrophied. Their chaotic location relatively to the surface of the endothelial lining is the feature. The elastic membrane of the vessel wall acquires well marked but disordered sinuosity. The muscular layer of the vessel wall is thickened and structureless in some places with the signs of homogenization (Fig. 2).

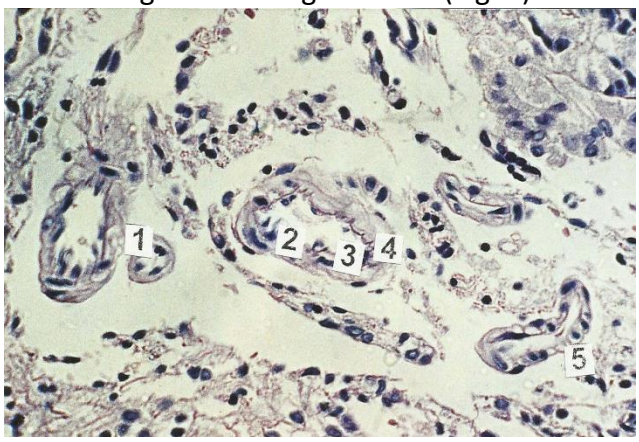


*Fig. 2. Photomicrography of the bloodless extraorganic blood vessels of the pineal gland of the rat under the chronic stress and 30-days illumination. Magnification: eyelens×10, objective ×10. Coloration: hematoxylin and eosin. 1 – hypertrophy and destruction of the arteriole wall; 2 – spasm of the arteriole wall; 3 – sinuosity of the elastic membrane of the arteriole wall; 4 – homogenization and thickening of the muscular coat of the arteriole; 5 - perivascular space.*

It was revealed, that the blood vessels, which are adjacent to the capsule of the pineal gland, look like the hollow tubes of different caliber without the blood cells. A small amount of red blood cells, which occupy a peripheral position in the lumen of the blood vessel, can be found in some samples.

Thus, the blood circulation abnormality and exsanguination of the vessels are accompanied by the hypoxia, edema of the surrounding tissues and atrophy of the parenchymatous elements of pineal gland.

**Conclusions:** Morphological state of extraorganic bloodstream of pineal gland indicates that the chronic stress accompanied with the abnormal photoperiod, caused by the day and night illumination of animals during 30 days, leads to the inhibition of its functional activity due to the emerging hypoxia.

**Prospects of further research.** According to the results of the experiments it is planned to perform the further study of the intraorganic bloodstream of pineal gland under the chronic stress and 30-days illumination.

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