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CHANGES IN MORPHOMETRIC PARAMETERS OF COLLAGEN FIBER BUNDLES OF THE ADRENAL CAPSULE IN RATS WITH THYROTOXICOSIS OF THE CONTROL AND EXPERIMENTAL GROUPS

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ABSTRACT

The thyroid gland acts directly on the adrenal glands through its hormones. An excess of thyroid hormones leads to a change in the function of the adrenal glands. In rats, when modeling thyrotoxicosis, the adrenal capsule was significantly thickened in all areas compared with the control. This indicator indicated a partial recovery of the capsule during treatment with mercazolil, and a slight improvement in the thickness of the adrenal capsule during treatment with mercazolil and olive oil. In rats with thyrotoxicosis, the bundles of collagen fibers in the adrenal capsule were significantly thickened in all areas compared to the control group, and with traditional and non-traditional treatment they were significantly thinner than in rats with the thyrotoxicosis model. In the group with thyrotoxicosis and in the group where the rats received olive oil with mercazolil, recovery was faster.

Key words: rats, adrenal glands, testis, thyrotoxicosis, mercazolil, selenium, bundles of collagen fibers.

INTRODUCTION

It is known that for the formulation protective and adaptive reactions of the human organism, the endocrine regulatory organs, primarily the adrenal glands, play a major role. Any changes of environmental conditions require increased metabolism, the adrenal glands has certain impact for its structural and functional activity. It has been proven that the morphological state of the adrenal glands

reflects its functional activity and can change depend on age, physiological condition, season, and impact of various diseases, including thyrotoxicosis[1-9].

Nowadays, the main etiological factors in the development of endocrine disorders are associated with disorders of homeostasis, which arise due to impaired interaction between the nervous, immune and endocrine systems, particularly, such integrating systems as the adrenal glands (Morozov V.N., Luzin V.I., 2014).

According to the scientists the different changes of the structural and functional components of the left and right adrenal glands indicate that the contralateral glands have different contribution to the adaptive reaction. This is consistent with the concept of asynchronous adrenal response to stressors [Yusupova A.A., Vashchenko G.A., 2023].

According to the researches of scientists, during 7 days of the condition of thyrotoxicosis in the adrenal glands observed moderate perivascular edema and congestion of blood vessels. In the cortex and medulla of the adrenal glands were not detected any structural changes [3-5].

For today it is enough amount of information has been collected in the scientific literature which indicates a reciprocal relationship between the adrenal glands and mental state (Gorobets L.N., 2018).

It has been proven that thyroid hormones are important metabolic modifiers in the function of the adrenal glands. Its control not only energy, carbohydrate, water, salt, and protein metabolism, but also oxidation-reduction reactions (Zarkovic N., 2020).

The aim of the study. Study of morphofunctional parameters of the adrenal glands of rats during experimental thyrotoxicosis condition and its correction with phytonutrients and selenium.

Research materials and methods. The practice part of the experiment was carried out in the laboratory of Bukhara medical institute in summer. The experiment was carried out on 152 white, purebred rats of reproductive age (3 months - 90 days), weighing 200-250 grams. Animals were divided into six groups. 40 rats were included in the control group and they were divided into 2 groups. 20 rats in the first control group (90 days old) were subcutaneously injected with 1 ml of 0.9% sodium chloride solution through a syringe in the abdomen for 14 days. 20 rats in the second control group (105 days old) were injected with 1 ml of 0.9% sodium chloride solution orally through a metal probe for one month.

The first experimental group consist of 112 rats and its were injected subcutaneously and in the abdominal area with levothyroxine sodium solution at a dose of 5.0 μg per 100 grams of animal weight for 14 days (Sabanov V.I., 2017).

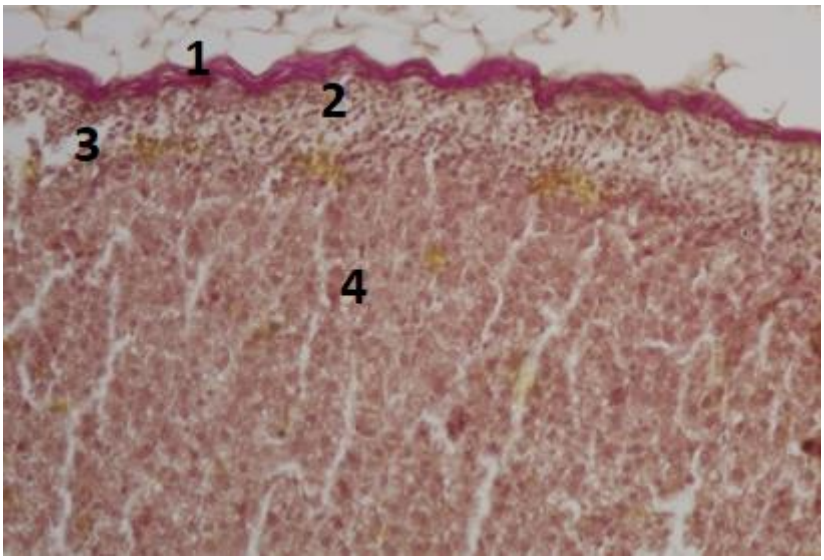
The first experimental group consisted of 112 rats, which were administered subcutaneously, in the abdominal area, 28 rats in the first experimental group and all 20 rats in the first control group (105 days old) were decapitated humanely on the 15th day of the experiment, i.e. under ether anesthesia. The remaining 84 rats poisoned with thyrotoxicosis were saved for further treatment and divided into three equal groups of 28 rats each.

The second experimental group included 28 rats from the first experimental group with thyrotoxicosis. After modeling thyrotoxicosis, they were orally administered 1 ml of mercazolil solution at a dose of 2.5 mg/100 grams through a metal probe for one month (Maksyutov R.R., Baimatov V.N., 2013).

The third experimental group consisted of 28 rats with thyrotoxicosis, which were administered 1 ml of olive oil orally through a metal probe simultaneously with mercazolil for 1 month (Apryatin N.A., 2016).

The fourth experimental group consisted of 28 rats with thyrotoxicosis, which were orally administered selenium at a dose of 15 μg/100 grams along with mercazolil for one month (Sindireva A.V., Maidanyuk G.A., 2018). The decapitation procedure was performed on the 31st day of the experiment (in 136-day-old rats) for rats in experimental groups 2,3,4 and the second control group.

The results of the study. In the white-bred rat, the adrenal gland is surrounded by a connective tissue sheath on the outside, in which two layers are distinguished: the outer (dense) and the inner (cavernous). In the deeper layers of the sheath, a ring of capillaries is often observed, which surround groups of adrenocorticocytes and turn into connective fibers.



Picture 1. Collagen fiber tufts of the adrenal gland capsule of rats in the control group:
1. adrenal gland capsule. 2. bundle of collagen fibers in the adrenal gland capsule. 3. glomerular zone. 4. fascicular zone. Stained according to Van Gizon. 10x 40.

In the rats of the first control group, the average thickness of the capsule layer covering was 18.5±0.55 μm, the average thickness of the capsule collagen fiber tufts was 11.7±0.52 μm. Under the influence of sodium levothyroxine (the first experimental group), the average thickness of the layer of the capsule cover was 26.5±0.7 μm, and the thickness of the bundles of collagen fibers was 16.0±0.46 μm.

In the rats of the second experimental group, the average thickness of the layer of the capsule cover was 25.5±0.74 μm, and the thickness of the bundles of collagen fibers of the capsule was 14.0±0.43 μm.

Under the influence of mercazolil and olive oil (the third experimental group), the average thickness of the layer of the capsule coating was 23.0±0.74 μm, and the average thickness of collagen fiber bundles was 13.2±0.46 μm. Because of mercazolil and selenium effect (fourth experimental group), the average thickness of the layer of the capsule coating was 21.7±0.55 μm, and the average thickness of the collagen fiber tufts was 12.8±0.39 μm.

In the first experimental group, a loose and scattered condition was observed in the tufts of collagen fibers in the capsule lining (picture 2). Table 2 shows the parameters of capsular lining and capsular collagen fiber tufts of rats in control and experimental groups.

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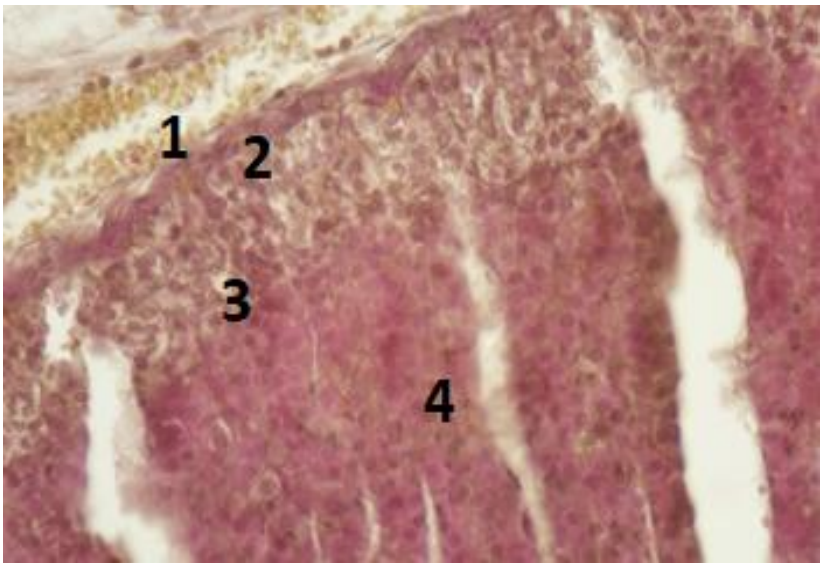

Picture 2. Collagen fiber bundles in the adrenal gland of rats in first experimental group: 1. Adrenal gland capsule. 2. Collagen fiber bundles in the adrenal gland. 3. Glomerular region of the adrenal gland. 4. Tumor region. Van Gizon staining method. 10x40.

Table 2

Numerical values (in μm) of the adrenal gland capsule and collagen fiber bundles of rats in the control and experimental groups.

Groups	The thickness of adrenal gland capsule	Collagen fiber bundles	
		In capsule	In the brain part
Control 1	16-22 18,5±0,55	10-16 11,7±0,52	3-5 3,8±0,17
Experimental 1	22-39 26,5±0,7*	13-19 16,0±0,46*	4-6 5,1±0,15*
Control 2	16-22 18,5±0,55	10-17 12,2±0,61	3-6 4.0±0,26
Experimental 2	20-28 25,5±0,74*	12-17 14,0±0,43*	3-5 4,4±0,17
Experimental 3	19-27 23,0±0,74*	11-17 13,2±0,46	3-6 4,2±0,23
Experimental 4	18-24 21,7±0,55*	11-16 12,8±0,39	3-6 4,0±0,23

Note* - the level of reliability of the experimental groups compared to the control group is indicated ($r<0.05$).

Thus, in rats with experimental thyrotoxicosis, the thickness of the adrenal capsule increases by 43.0%. The thickness of the collagen fiber bundles in the adrenal capsule increases by 36.7% compared to animals in the control group. The thickness of the adrenal capsule decreases by 9.8% with non-traditional treatment (mercazolil and olive oil), and with correction with mercazolil and selenium, the thickness decreases by 14.9% compared to traditional treatment with mercazolil.

In the third experimental group (mercazolil and olive oil), the thickness of the collagen fiber bundle in the adrenal capsule decreased by 5.7%. In the fourth experimental group (mercazolil and selenium), the thickness of the collagen fiber bundle in the medullary layers of the adrenal gland decreased by 9.1%.

REFERENCES

1. Apryatin S.A., Mzhelskaya K.V., Trusov N.V., Balakina A.S., Kulakova S.N., Soto H.S., and others. Comparative characteristics of in vivo models of hyperlipidemia in Wistar rats and C57Bl/6 mice // Nutrition issues. 2016. Vol. 85, No. 6. pp. 24-33.

2. Botasheva V. S., Shaposhnikov B. S. Pathomorphological aspects of adrenal gland damage in thyrotoxicosis. Bulletin of the Young Scientist, No. 1, 2017, pp. 12-14.

3. Gorobets L. N. Mental disorders in endocrine diseases / L. N. Gorobets, G. P. Ivanova, A.V. Litvinov, V. S. Bulanov // Mental disorders in general medicine. – 2018. – No. 1. – pp. 31-36.

4. Maksyutov R.R., Baymatov V.N. The study of the thyroid status of rats in the correction of disorders induced by experimental hypothyroidism. Pathological physiology of RVH SHH No. 3/2013. 36-39 p.

5. Morozov V.N., Luzin V.I. Organometric parameters of the adrenal glands of rats during the period of readaptation after 60-day administration of tartrazine and the use of mexidol // Bulletin of Problems of Biology and Medicine – Vol.3, 2014. – Iss.3, V.1(110) – pp. 238-241.

6. Sabanov V. I. Activity of lipid peroxidation, antioxidant protection and the state of the myocardium in experimental hyper- and hypothyroidism / V. I. Sabanov, I. G. Dzhioev, A. T. Lolaeva // International Journal of Applied and Fundamental Research. - 2017. – No. 6. – pp. 241-244.

7. Sindireva A.V., Maidanyuk G.A., Golubkina N.A. The effect of selenium on the content of trace elements in the liver of Wistar rats // Bulletin of Nizhnevartovsk State University.2018. No. 3. pp. 103-109.

8. Yusupova A. A., Vashchenko G. A. et al. Dynamic and morphological changes of the adrenal glands in rats with non-fatal general hypothermia. ICNP "New Science" Scientific Consolidation 2023. pp.15-19.

9. Zarkovic N. Roles and Functions of ROS and RNS in Cellular Physiology and Pathology / N. Zarkovic //Cells. – 2020. – Vol. 9, No. 3. – P. 767-771. doi: 10.3390/cells9030767.