Morphofunctional State Of Adrenal Blood Vessels In Experimental Rat Thyrotoxicosis

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ABSTRACT

In the bloodstream of the adrenal glands of rats, a number of anatomical and histostructural features of the structure of the terminal part of the hemomicrocirculatory bed in the form of a three-dimensional spatial capillary network are noted, which indicates the organ specificity of this component of the hemocirculation system in the adrenal glands. Changes in the organization of the hemomicrocirculatory bed are directly related to any morphofunctional transformations in the adrenal glands, reflecting the mechanisms of adaptation and compensation.Experimental thyrotoxicosis in rats revealed an increase in the diameter of venules and capillaries to 20.0% in the cortical zone, arterioles to 17.0% in the cerebral zone. The thickness of the microvascular wall decreases by 25.0% of the arteriole of the cerebral zone.

Keywords: rats, adrenal glands, capillaries, arterioles, venules, microcirculation, hemomicrocirculatory bed.

Introduction: The adrenal gland, as an endocrine organ, is highly vascularized, which allows each endocrine cell to be in contact with the endothelial cell [2,7]. The adrenal vascular network consists of fenestrated sinusoids [3], which are highly permeable to liquids and small molecules. This facilitates the entry of nutrients, oxygen and cholesterol into the gland and the secretion of steroid hormones into the bloodstream.

Currently, the main structural formations of the circulatory microcirculatory bed (MCR) include arteriole, precapillary arteriole (precapillary), capillary, postcapillary venule (postcapillary), venule [1].

The arteries of the adrenal glands, penetrating into the capsule dichotomically, are divided into arterioles branching in it or on the surface of the cortical substance. Arterioles branch into precapillaries and capillaries in various layers of the adrenal cortex [6]. Arterioles are small arteries, along the blood flow, immediately preceding the capillaries. Their characteristic feature is the predominance of a smooth muscle layer in the vascular wall, due to which arterioles can actively change the size of their lumen and, thus, resistance. They are involved in the regulation of general peripheral vascular resistance [4]. The adrenal medulla has a blood supply from two different sources, one of which can deliver hormones of the adrenal cortex to the medulla. From the side of the adrenal gland gate, the medulla is additionally

supplied with blood from its own arteries, penetrating deep into the organ, through its gate, accompanying the central vein [5].

The purpose of the study: To study the morphofunctional features of the structure of microvessels of the cortex and the adrenal medulla in experimental thyrotoxicosis.

Research materials and methods: The experiment was performed on 50 white mongrel female rats of young reproductive age weighing 200-250 g, aged 2.5-3.0 months.

The animals were obtained from the vivarium of laboratory animals of the Bukhara Medical Institute. The animals were divided into two groups. An experimental group of animals treated with sodium levothyroxine for 15 days intraperitoneally at the rate of 50mcg per 100 grams of animal weight.

The control group included animals receiving 0.9% NaCl solution in an equivalent volume. The rats were removed from the experiment on the 15th day after the end of the drug administration. The animals were removed from the experiment by decapitation under inhalation anesthesia with chloroform.

The adrenal glands were fixed in a 12% solution of neutral formalin. After washing the fixed samples in running water, they were dehydrated by placing the test material in alcohols of increasing concentration and poured into paraffin according to a generally accepted method.

Histological cross sections of the adrenal glands with a thickness of 7-9 microns were prepared, stained with hematoxylin - eosin and Van Gieson.

Statistical processing of digital data was carried out using FStat and Excel programs.

The results of the study: The capillaries in the adrenal glands make up a single capillary network of cortical and cerebral matter. The capillaries have a general principle of the structure of the vascular wall, the inner layer is the endothelium, the middle one is the basement membrane with pericytes, and the outer adventitial layer is the pericapillary connective tissue.

The endothelium of the capillaries has no pores and is in places delimited from secretory cells only by the basement membrane of the capillary, the arteriole of the subcapsular region or in the surface layers of the glomerular zone, ends with a venous end in the sinusoid of the adrenal medulla.

In the glomerular zone, transverse and oblique capillary anastomoses, surrounding groups of cells, form small loops. The arterial end of the capillary has a narrow lumen lined with thickened endotheliocytes (Fig.1), the venous end has a wide lumen covered with thinned endotheliocytes.

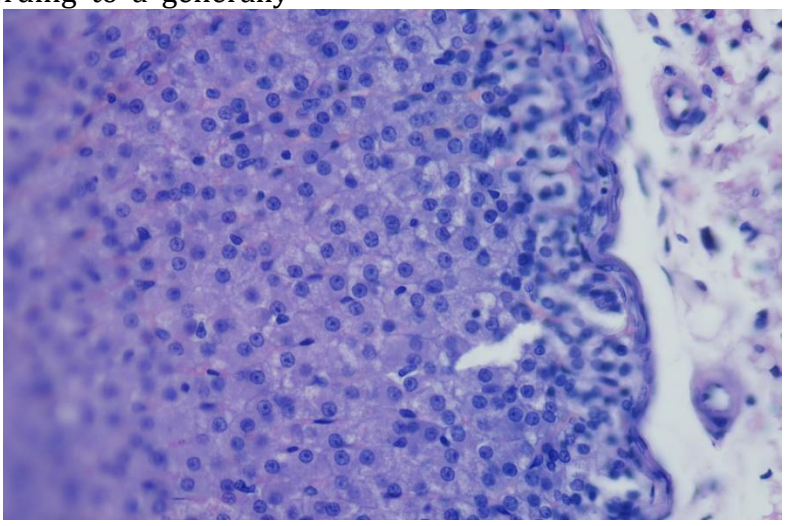

Fig. 1. Microvessels of the adrenal cortical zone of rats of the control group: 1. adrenal capsule 2. glomerular zone. 3. The beam zone. 4. Arteriole. 5. The capillary. Staining with hematoxylin – eosin. About 10 x approx.25.

The main capillaries in the cortical substance are located radially between the gland cells in a

weakly expressed connective tissue framework, practically being its constituent element. Thickening of muscle tissue is visible in the places of discharge of arterioles and capillaries in the vessel wall. The main capillaries in the cortical substance are located radially between the gland cells in a weakly expressed connective tissue framework, practically being its constituent element.

In their structure, the walls of the blood capillaries of the adrenal cortex differ in insignificant thickness. The capillaries of the adrenal cortex have a weakly expressed basement membrane and are covered throughout with endotheliocytes.

In the bundle zone of the adrenal cortex, the main capillaries pass radially and form elongated, oval-shaped loops of a larger size than in the glomerular and reticular zones (Fig. 2).

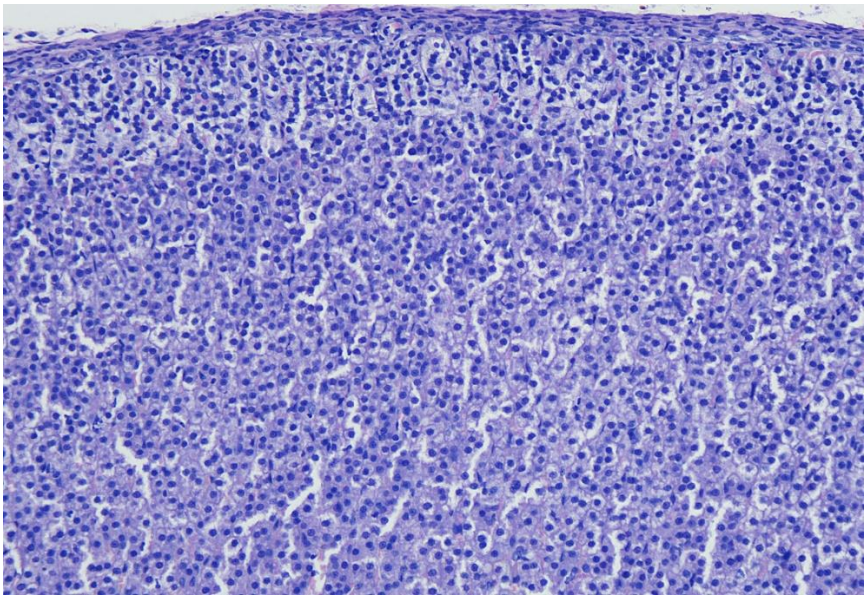

Fig. 2. Microvessels of the glomerular and bundle zones of the adrenal glands of rats of the control group: 1. adrenal capsule 2. glomerular zone. 3. The beam zone. 4. Arteriole. 5. Capillary 6. Nuclei of endocrinocytes. Staining with hematoxylin – eosin. Volume 10 x approx.25

In experimental thyrotoxicosis of rats, the capillary network of the reticular zone of the cortical substance is much more intensively developed. It is a fine-grained network with loops of rounded or oval shape, which are larger than in the control group of animals (Fig.3). One connective tissue cell surrounded by capillaries may contain from one to several cells with acidophilic fine-grained cytoplasm and a significant content of fat droplets in it.

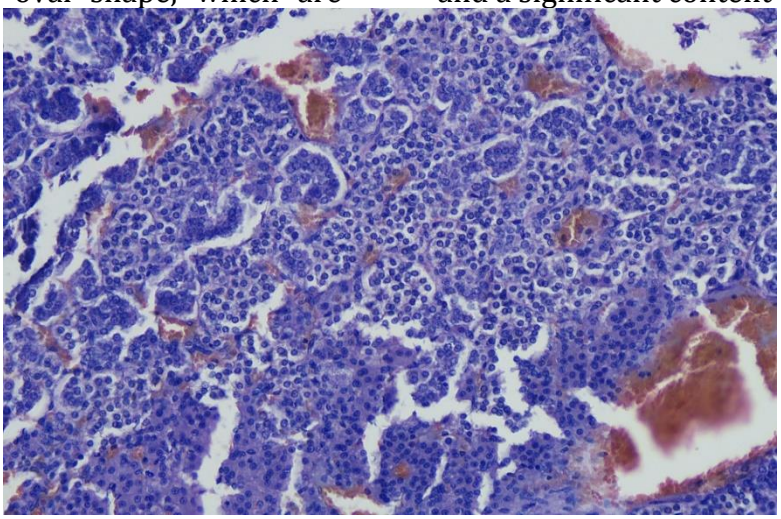

Fig. 3. Microvessels the cortical zone of the adrenal glands of rats of the 1st experimental group: 1. arteriole 2. endocrinocytes. 3. hemorrhage. 4. Red blood cells. 5. capillaries 6. Nuclei of endocrinocytes. Staining with hematoxylin – eosin. About 10 x approx.40.

In the cortical layer of the adrenal glands of rats in the control group, the thickness of the arteriole wall averaged -7.7 ± 0.35 microns, and the inner diameter was -21 ±0.61 microns. The wall thickness of the venule is on average -6.5 ± 0.26 microns, the inner diameter of the venule is -22.7 ± 0.7 microns. The wall thickness of the capillaries averaged 4.10.17 microns, the inner diameter of the capillaries was 9.9±0.52 microns.

In the experimental group, in the cortical layer of the adrenal glands of rats, the thickness of the arteriole wall is on average - 5.9 ± 0.26 microns, and the inner diameter is - 23.9± 0.61 microns. The wall thickness of the venule is on average - 4.9 ± 0.26 microns, the inner diameter of the venule is - 27.2 ± 0.7 microns. The wall thickness of the capillaries averaged - 3.0=0.17 microns, the inner diameter of the capillaries was - 11.5 ± 0.5 microns.

In the reticulated zone of the adrenal cortex of rats, cellular strands are visible, separated by capillaries going in different directions and anastomosing with each other.

Microvessels entering the medulla, the capillaries of the reticular zone of the adrenal glands become wider. The transition of the capillary network of the cortical substance into sinusoids may have a certain biological effect on the chromaffin cells of the medulla and its vessels (Fig.4).

In the experimental group, clusters of cells and sinusoid blood vessels located around them are visible in the parenchyma of the adrenal medulla of rats, the diameter of which is significantly larger than the control group of animals.

In this group, in the medulla, the blood capillaries of the adrenal gland lie somewhat closer to the chromaffin cells, and they have thin walls relative to the control group (Fig.5). In the cerebral layer of the adrenal glands of rats in the control group, the thickness of the arteriole wall is on average - 9.0 ± 0.4 microns, and the inner diameter is - 23.1 ± 0.6 microns. The wall thickness of the venule is on average 6.5 ± 0.33 microns, the inner diameter of the venule is - 24.3 ± 0.6 microns. The wall thickness of the capillaries averaged - 4.5 ±0.33 microns, the inner diameter of the capillaries was - 10.9 ±0.4 microns.

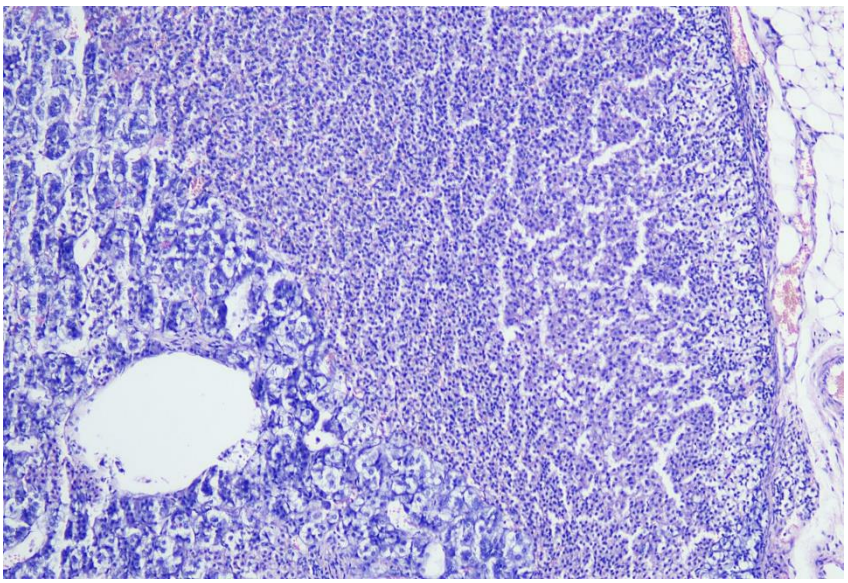

Fig.4. Adrenal microvessels of rats of the control group: 1. Chromaffin cells 2. capillary. 3. The beam zone. 4. Arteriole. 5. Venula. Staining with hematoxylin – eosin. About 10 x approx.25.

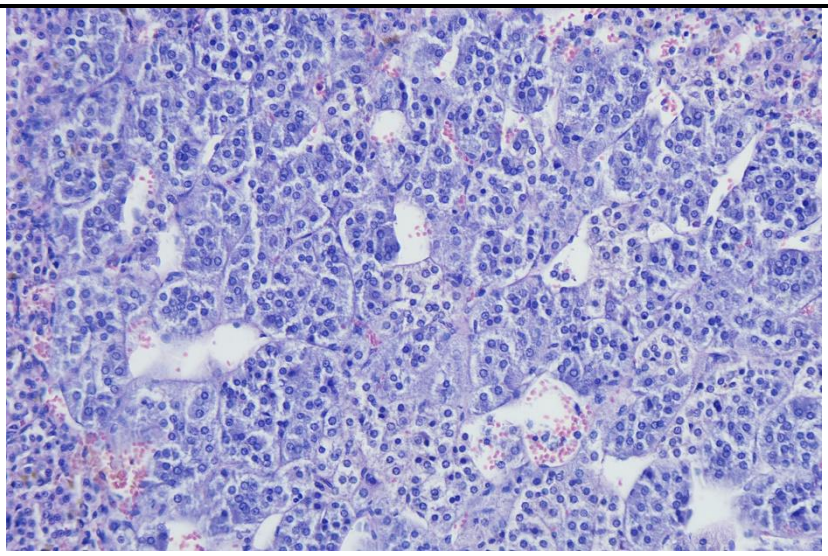

Fig.5. Microvessels of the adrenal medulla of rats of the 1st experimental group: 1. chromaffin cells 2. capillary. 3. The beam zone. 4. Arteriole. 5. Venula. Staining with hematoxylin – eosin. About 10 x approx.25.

In the experimental group, in the cerebral layer of the adrenal glands of rats, the thickness of the arteriole wall is on average 6.75 ± 0.4 microns, and the inner diameter is 27 ± 0.5 microns. In experimental thyrotoxicosis of rats, changes in the structure of venules are observed, their walls are depleted, the contours of the venules become uneven, sinuous.

The wall thickness of the venule is on average 6.0 ± 0.37 microns, the inner diameter of the venule is 27.3 ± 0.8 microns. The wall thickness of the capillaries averaged 2.5 = 0.1 microns, the inner diameter of the capillaries was 12.6 = 0.5 microns.

Table 5

Adrenal microvessels in rats in the control and experimental groups

Vessels / zones		arteriole venule capillary		arteriole venule capillary		arteriole venule capillary	
		inside. diameter	wall thickness	inside. diameter	wall thickness	inside. diameter	wall thickness
cortical	controlь	18-25 21±0,61	6-10 7,7±0,35	19-27 22,7±0,7	5-8 6,5±0,26	7-13 9,9±0,52	3-5 4,1±0,17
	experiment	22-29 23,9±0,6	5-8 5,9±0,26	24-32 27,2±0,7	4-7 4,9±0,26	9-15 11,5±0,5	2-4 3±0,17
brain	control	20-27 23,1±0,6	6-11 9±0,4	22-29 24,3±0,6	5-9 6,5±0,33	9-14 10,9±0,4	3-7 4,5±0,33

	experiment	25-31 27±0,5	5-9 6,75±0,4	25-34 27,3±0,8	4-8 6±0,37	10-16 12,6±0,5	3-5 3,5±0,1

Note. inner diameter - the inner diameter.

Conclusion: Thus, in the study of the microvessels of the adrenal glands of rats, it was shown that, in the control group of rats, the inner diameter and wall thickness of arterioles, venules and capillaries in the cerebral zone are up to 16.9% greater than in the cortical zone. Comparing the microvessels of the adrenal glands of rats with experimental thyrotoxicosis revealed an increase in venule diameter by 19.8% in the cortical zone, arterioles by 16.9% in the cerebral zone and capillary diameter by 16.6% in the cortical zone. The wall thickness decreases by 25.0% of the arteriole of the cerebral zone. The wall thickness of the venule is 24.6% and the capillaries are 26.8% in the cortical zone.

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