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THE SPECIFIC STRUCTURE OF THE AORTIC WALL IN RATS

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✓ ***Resume***

In this work, specific morphological and morphometric parameters of the aortic wall of white rats were studied, depending on the age of the animals. As a material, the aorta of 6, 12 and 24-month-old rats was taken in its entirety, that is, the thoracic, thoracic and abdominal parts separately. When analyzing the morphometric parameters of the rat aorta by age, it was confirmed that all its parameters: the outer and inner diameter increased by 2 times by 24 months, the area of the cavity-by 9 times, the Foggenworth index, on the contrary, decreased. It was observed that the layers of the aortic wall increased by 35.1% by 24 months each and the total wall thickness.

In young rats, the endothelial layer of the aortic wall is uneven, of varying thickness, the basal membrane is wavy, the intimate is relatively thick, with a large number of cells, in the adjacent part of the median layer, elastic fibers are thin and randomly arranged, in the outer layer of the median shell, elastic fibers are thick and wavy. It was found that 24-month-old rats had specific morphological changes in almost all layers of the aortic wall. The endothelium is thickened, its cells are dense, the elastic fibers of the median are thick and dense, the borders are blurry, adjacent to each other, the cells of the urinary muscle are densely located between them.

Key words: rat, aorta, endothelium, intima, mediastinum, adventitia, morphology, morphometry.

ҚУЁНЛАР АОРТА ДЕВОРИ ТУЗИЛИШИНИНГ ЎЗИГА ХОСЛИГИ

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✓ ***Резюме***

Ушбу ишда қуёнлар аорта деворининг ўзига хос морфологик ва морфометрик кўрсатгичлари ҳайвонлар ёшига қараб ўрганилди. Материал сифатида 6, 12 ва 24 ойлик қуёнлар аортаси тўлиқ ҳолда, яъни равоғи, кўкрак ва қорин қисми алоҳида-алоҳида олинди. Қуёнларнинг ёши бўйича аортаси морфометрик кўрсатгичлари таҳлил қилинганда, барча кўрсатгичлари: ташқи ва ички диаметри 24 ойликга келиб 2 баробарга, бўшлигининг майдони 9 баробарга ошагнлиги, Воггенворт индекси аксинча камайиб борганлиги тасдиқланди. Аорта девори қатламлари ҳар бирининг ва умумий девор қалинлиги 24 ойликга келиб 35,1% ошиб борганлиги кузатилди.

Ёш куёнлар аорта девори эндотелий қавати нотекис, ҳар хил қалинликда, базал мембранаси тўлқинсимон, интимаси нисбатан қалин, ҳужайралари кўп, медия қаватининг унга туташ қисмида эластик толалар юпқа ва бетартиб жойлашган, медиянинг ташқи қаватида эластик толалар йўғон ва тўлқинсимон жойлашган. 24 ойлик қуёнлар аортаси деворида деярлик барча қаватларида ўзига хос морфологик ўзгаришлар мавжудлиги аниқланди. Эндотелий қалинлашган, ҳужайралари зич, медиянинг эластик толалари қалин ва зич, чегаралари ноаниқ, бир-бирига туташиб кетган, уларнинг орасидаги силлиқ мушак ҳужайралар сиқилиб жойлашган.

Калит сўзлар: каламуш, аорта, эндотелий, интима, медия, адвентиция, морфология, морфометрия.

СПЕЦИФИКА СТРОЕНИЯ СТЕНКИ АОРТЫ КРОЛЫК

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✓ ***Резюме***

В этой работе были изучены специфические морфологические и морфометрические показатели стенки аорты кролик в зависимости от возраста животных. В качестве материала была взята аорта 6, 12 и 24-месячных кролик в полном объеме, то есть грудная,

грудная и брюшная часть отдельно. При анализе морфометрических показателей аорты кролик по возрасту было подтверждено, что все ее показатели: наружный и внутренний диаметр к 24 месяцам увеличились в 2 раза, площадь полости-в 9 раз, индекс Фоггенворта, наоборот, уменьшился. Было замечено, что слои стенки аорты увеличиваются на 35,1% к 24 месяцам каждый и общая толщина стенки.

У молодых кролик эндотелиальный слой стенки аорты неравномерный, различной толщины, базальная мембрана волнистая, интимная относительно толстая, с большим количеством клеток, в прилегающей к ней части срединного слоя эластические волокна тонкие и хаотично расположенные, в наружном слое срединной оболочки эластические волокна расположены толстыми и волнистыми. Было обнаружено, что у 24-месячных кролик были специфические морфологические изменения почти во всех слоях стенки аорты. Эндотелий утолщен, клетки его плотные, эластические волокна срединные толстые и плотные, границы расплывчаты, прилегают друг к другу, между ними плотно располагаются клетки мочевыделительной мышцы.

Ключевые слова: кролик, аорта, эндотелий, интима, средостение, адвентиция, морфология, морфометрия.

Relevance

The urgency of the problem. Recently, changes in the anatomical, topographic and histological structures of the aorta under the influence of various exogenous and endogenous factors, cardiovascular disease, increasing the number of scientific studies on human age (1,2,3). The researchers note that under the influence of the above factors, the organometric parameters, biomechanical properties of the aorta change (Avtandilov GG Meditsinskaya morphometry.- M.- 1990.- 378 p.). In this process, the wall of the aorta thickens, the lining changes, the diameter expands, the ratio of the layers of the aortic wall to each other changes to different degrees (4,5,6). Not only under the influence of internal and external factors, but also as a person ages, changes occur in the layers of the aortic wall due to the process of physiosclerosis. Under the influence of exogenous factors in addition to invasive changes, specific changes initially begin in the intima of the aortic wall. It often develops pathomorphological changes in metabolism, including the absorption of cholesterol and lipids (7,8,9,10). Because each of the layers of the aortic wall has a unique tissue structure, more dystrophic and destructive in the intima, mucoid and fibrinoid swelling of the basement membrane, swelling and fibroelastosis in elastic fibers, hyperplasia, hypertrophy, sometimes metaplasia and dysplasia processes in smooth muscle cells may develop. In view of the above discussion, modeling and testing of pathomorphological changes specific to diseases that develop in the aorta, the most important organ of the human body, including the cardiovascular system, in experimental animals will help to understand these pathomorphological changes. Therefore, the study of the anatomical, histological specific structure of the animal aorta in relation to age is the basis of scientific research.

The aim of this study was to study the specific morphological and morphometric characteristics of different parts of the aorta in the experiment depending on the age of the animals.

Material and methods

The aorta of 6-, 12-, and 24-month-old rabbits was completely removed, as were the pelvis, chest, and abdomen. The length, diameter, and wall thickness of all parts of the aorta were measured. Fragments were cut from each for histological examination. The aortic segments were immersed in a neutralized solution of 10% formalin for 48 h, then washed in running water for 3 h, dehydrated in increasing concentrations of alcohol, and paraffin was poured and the implants were prepared. Histological incisions of 5-6 microns thickness from paraffin bricks were prepared on a special microtome. From the histological incisions, the paraffin material was dissolved in xylene and stained with hematoxylin and eosin dyes. Histological preparations were studied on 10, 20, 40 lenses of Leyka type microscope and the necessary areas were photographed. Morphometric calculations were performed on micrographs taken on 40 microscope lenses, each with 6 images. In histological preparations, the outer and inner diameter of the aorta were measured, the intra-aortic cavity and aortic wall area were measured in mm2, and the aortic wall, intima, medial, and adventitia thickness were measured in μm. To assess the functional status of the aorta, the Wogenworth index was calculated, i.e., the ratio of the area of the aortic wall to the area of the aortic cavity. Morphometric data were statistically processed in the IBM SPSS Statistics program.

Result and discussion

The outer diameter of the aorta was 2.4, ± 0.04 mm at 6 months and slightly less than doubled at 24 months. In parallel with these figures, it was found that the internal diameter of the aorta also doubled by 24 months. The cross-sectional area of the aorta was 2.54 mm2 in 6-month-old rabbits, doubled at 12 months, and 9-fold (11.33 mm2) at 24 months. the Wogenworth index decreased in recent periods due to a significant expansion of the aortic cavity wall (Table 1).

Morphometric parameters of the aorta (M ± m) **Table 1**

Indicators	6 months old	12 months old	24 months old
Outer diameter, mm	2,4,±0,04	3,3±0,06*	4,4±0,05**
Internal diameter, mm	1,8±0,03	2,6±0,05*	3,6±0,07**
Wall area, mm^2	0.36	0,49	0,64
Space area, mm^2	2,54	5,74*	11,33**
Vogenvort index	0,14	0,085*	0,056**

*Application: * - statistical indicator difference (T-criterion, r≤0.05 relative to 6-month indicators); ** - Difference of statistical indicators (Manna-Whitney criterion, compared to 6-month indicators).*

Analysis of the obtained morphometric parameters showed that the total thickness of the aortic wall at periods of 12 and 24 months (81.13 ± 4.45 and 92.28 ± 3.19 μm) was equal to the thickness of the aortic wall at 6 months (68.33 ± 4.21 μm). observed to increase relatively reliably. It was found that the aortic wall layers also differed from each other according to the age of the rabbits. Intima thickness was 6.87 ± 0.27 μm at 6 months, 7.92 ± 0.33 μm at 12 months, and 8.24 ± 0.36 μm at 24 months. The median thickness was also found to be slightly less than doubled by 24 months, compared with 49.57 ± 4.08 μm at 6 months (Table 1).

No significant thickening was observed in the adventitia layer.

Thickness indices of aortic wall layers, μm Table 2

Indicators	6 months old	12 months old	24 months old
Intima	6,87±0,27	7,92±0,33*	8,24±0,36**
Media	49,57±4,08	57,2±4,16*	69,69±2,4**
adventure	12,88±1,61	15,01±1,48	14,75±1,53
The total thickness of the aortic wall	68,33±4,21	81,13±4,45*	92,28±3,19**

*Application: * - statistical indicator difference (T-criterion, r≤0.05 relative to 6-month indicators); ** - difference in statistical indicators (Manna-Whitney criterion, compared to 6-month indicators).*

The results of the study showed that the control group rabbit aorta wall consisted of intima, media, and adventitia layers as usual. The aortic wall consists of endothelial cells covering the surface of the inner intima layer, the basal membrane, and a thin connective tissue intima stroma. Endothelial cells have a flattened structure, only the area where the nucleus is located is observed to be swollen. The nucleus of endothelial cells is elongated, the surface is smooth, stained dark with hematoxylin, and some nuclei are found to protrude from the inner surface of the aorta (Fig. 1). In some places, several nuclei are detected in the endothelial cell, and their shape is mainly flat, polygonal structure, located in the basal membrane below. The basal membrane has a relatively thin, fine, and sparse fibrous structure. The endothelial cells and the intima layer beneath the basement membrane are composed of well-developed, finely formed non-vascular connective tissue and a layer containing collagen and elastic fibers. The tissue interstitial material of this layer consists of alkaline mucopolysaccharides and phospholipids, which ensure the permeability of the aortic wall. In some areas of the intima, slightly basophilic stained foci with slightly vacuolated, containing hematoxylin inclusions are detected, which means that in terms of staining, these foci indicate the accumulation of alkaline mucopolysaccharides (Fig. 2).

The middle layer of the aortic wall of the control group rabbits consists mainly of elastic fibers, in which the layers of elastic fibers are counted from 15 to 20. Each of the elastic fibrous layers is connected to the adjacent ones by elastic

tufts and generally forms a whole eastern fibrous carcass (Fig. 3) .Elastic fibers have a wavy structure due to the presence of smooth muscle cells between them, the thickness and color are almost the same everywhere. Among the elastic fibers, smooth muscle cells of various sizes and shapes are identified. Their cytoplasm is stained light purple, some of which have vacuolation. The nuclei of smooth muscle cells are mostly elongated and oval in shape, forming irregular fine-grained clusters of chromatin. Some smooth muscle cells have a thin and slender shape as a result of compression between elastic fibers, and the nuclei are also elongated. When we examined the outer adventitious layer of the aortic wall, it was found that the outermost tuft of elastic fibers there was slightly torn, fragmented, and connected to the surrounding connective tissue fibers (Fig. 4). The connective tissue has a thin, unformed structure. The argyrophilic fibers in it are sparse and chaotic, the intermediate material is in a swollen state, the cells are sparse and consist of young connective tissue cells.

Examination of the aorta of 6- and 12-month-old rabbits revealed that the endothelial surface is uneven, the basal membrane has a wavy structure, the unformed connective tissue intima is of different thickness, in some places there are many cells, few fibers, in other places there are many fibers. determined to do. Another distinctive structure in the aortic wall of animals of this age is that the elastic fibers in the medial layer close to the intimate aortic wall are relatively thin and chaotic, with smooth muscle cells arranged randomly, and the nuclei in various shapes, most reminiscent of young cells. (Figure 5). In the middle areas of the medial layer, the elastic fibers have a relatively thick and wavy structure, between which the smooth muscle cells are found to have both a cytoplasm and a hyperchromic and blast structure of the nucleus.

In the aortic wall of 24-month-old rabbits, specific morphological changes were found in almost all layers relative to young rabbits. The endothelial layer is slightly thickened, the cells are densely packed, and their nuclei are found to be relatively hyperchromic. It is observed that the unformed connective tissue intima is thinner and denser than in previous periods, directly attached to the elastic fibers. The elastic fibers are also relatively thick and dense, the boundaries are indeterminate, intertwined (Fig. 6). It is found that the urinary muscle cells between them are compressed between the fibers, resulting in an elongated shape, especially when the nucleus is elongated and the chromatin is relatively concentrated.

Conclusions

When analyzing the aortic morphometric indicators of the age of the control group rabbits, it was confirmed that all indicators: outer and inner diameter increased by 2 times by 24 months, the area of the cavity increased by 9 times, Voggenworth index decreased by contrast. It was observed that the thickness of each of the layers of the aortic wall and the total wall increased by 35.1% by 24 months.

The endothelial layer of the aortic wall of young rabbits is uneven, of varying thickness, the basal membrane is wavy, the intima is relatively thick, many cells, the elastic fibers are thin and chaotic in the adjacent part of the medial layer, the elastic fibers are thick and wavy in the outer layer of the media.

In the aortic wall of 24-month-old rabbits, specific morphological changes were found in almost all layers relative to young rabbits. The endothelial layer is slightly thickened, the cells are dense, the elastic fibers of the media are also relatively thick and dense, the boundaries are indistinct, intertwined, the urethral muscle cells are compressed between them, resulting in an elongated shape, especially the nucleus elongated and chromatin relatively concentrated.

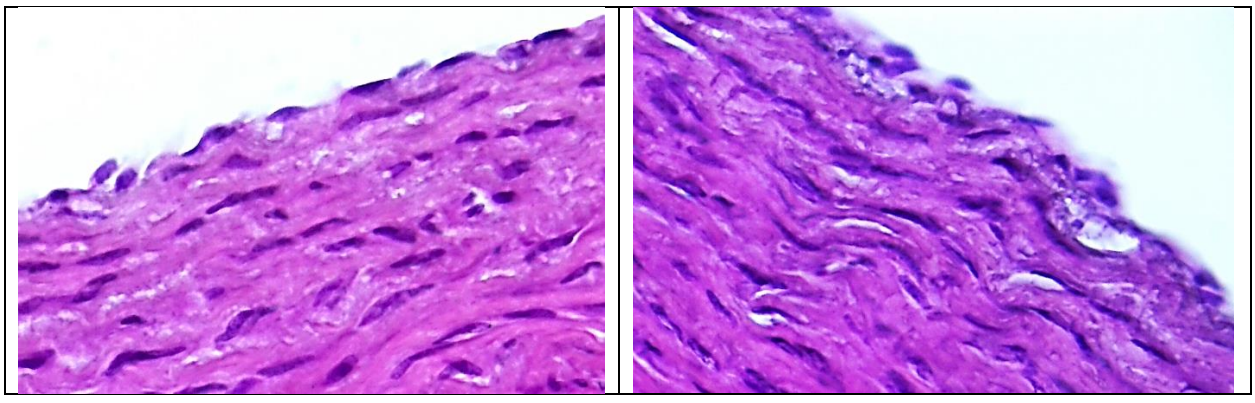

Figure 1. The aortic wall is composed of single-layered flattened endothelial cells, the nuclei of which are also elongated cells. Paint: G-E. X: ok.10 x ob. 40.	Figure 2. There are aortic wall intima, small and large vacuolated foci. Paint: G-E. X: ok.10 x ob.40.
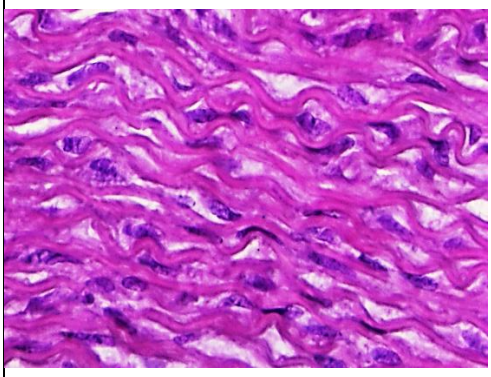	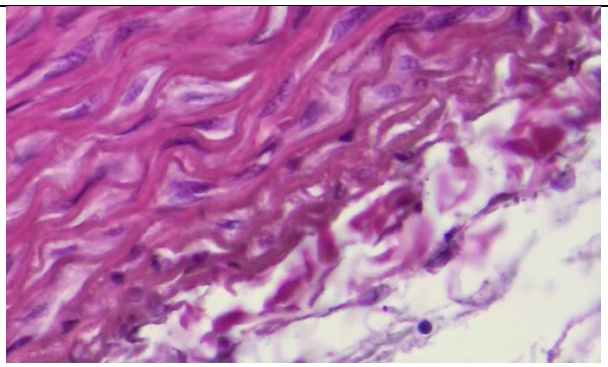
Figure 3. The elastic fibers of the aortic wall have a wavy structure. Paint: G-E. X: ok.10xob.40.	Figure 4. The aortic wall is an adventitious layer composed of unformed connective tissue. Paint: G-E. X: ok.10 x ob.40.
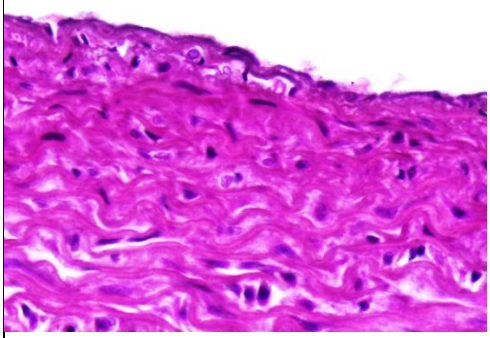	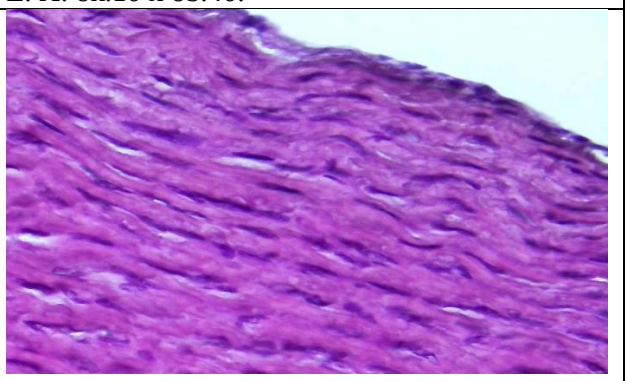
Figure 5. The aortic wall is a 6-month-old rat. The intima is thick, the elastic fibers beneath it are thin and chaotic. Paint: G-E. X: ok.10 x ob.40.	Figure 6. 24-month-old rat aortic wall. The intima is thickened and compacted, the elastic fibers are thickened and densely packed, the smooth muscle cells in between are elongated. Paint: G-E. X: ok.10 x ob.40.

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