American Journal of

Medicine and Medical Sciences

American Journal of Medicine and Medical Sciences 2021, 11(5): 434-436
DOI: 10.5923/j.ajmms.20211105.15

Lung Vessel Morphological Structure

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Abstract **Purpose of the study:** to study pulmonary arteries morphological structure. **Materials and methods.** For the experiment, 60 white outbred laboratory rats, weighing 220-280 grams, male aged 4-5 months were used. The structure of the pulmonary arteries layers and their morphometry were studied. **Conclusion:** to compare pulmonary arteries morphological structure, we studied them at 6 levels. Arteries of the 1st and 3rd level belong to the muscular-elastic type, arteries of the 4th-6th level - to the arteries of the muscular type. For a more thorough examination, the arteries were divided into three groups: arteries of small, medium and large caliber. The results of our research show that a spiral smooth muscle layer develops on grade 3 and 4 arteries. This layer appears in cross-section as a separate pillow-like bulge. It is located close to the outer elastic membrane on the side of the adventitia. **Output.** In conclusion, we can say that during the transition of the muscular-elastic arteries to the muscular arteries on the side of the adventitia, an additional muscle layer is formed, which surrounds the vessel wall in the form of a spiral. As a result, the size of the middle layer of the artery increases. This leads to a change in the Kernogh index.

Keywords Pulmonary arteries, Arteries, Postnatal ontogenesis

1. Introduction

One of the urgent tasks of modern morphology and pathomorphology is the law of structural functional formation of blood vessels in the human body at different ages [1,2]. Various pathological processes observed in the lungs can be accompanied by damage to organs of the respiratory system, blood vessels, alveoli, interstitium, pleura. Damage to the pulmonary arteries, changes in the blood vessels of the small circulatory system is a pathology associated with many concomitant diseases.

Impairment of hemodynamics in the small circulatory system, early detection of its causes is of great interest today. It is known that the lungs contain a system that provides the process of gas exchange. In this system, the main role is played by the external arteries of the lungs and intra-organ arteries. The role of structural changes in the arteries in pathologies arising in the small circulatory system has been reported in the literature [3].

In the modern literature, changes in the endothelial layer of the pulmonary arteries in various pathologies are common [1,6]. Pathological processes develop as a result of changes in the collagen, elastic fibers and other fibers of connective tissue of these arteries [7]. In addition, in the blood vessels develop age-related changes.

Received: May 5, 2021; Accepted: May 19, 2021; Published: May 26, 2021
Published online at http://journal.sapub.org/ajmms

2. Purpose of the Research

In view of the above, we set ourselves the goal of study pulmonary arteries morphological structure.

3. Material and Methods

For the experiment, we used 60 white laboratory rats, weighing 220–280 g, adult, 4–5-month-old male. The experiment had been performed in the scientific laboratory of the Department of Anatomy and Clinical Anatomy of Tashkent Medical Academy. In order to study the arteries morphological structure in the small circulatory system, the rats were isolated together with the thoracic cavity organs around the lungs after anesthesia and fixed for 48 hours in 10% formalin solution. It was then washed in running water for 12 h and solidified into paraffin blocks after dehydration in growing alcohol.

Histological preparations of 10-12 microns were prepared and stained by hematoxylin eosin, by Weigert Van Gieson methods. The following dimensions of the arteries were measured when histological preparations were imaged under a microscope on a computer and using the Compass-3D V8 program: the transverse surface of the length of the inner and outer elastic membrane; it is the transverse surface of the middle layer between the elastic membranes; the cross-sectional surface of the adventitia.

Using the data obtained, we calculated the Kernogan index. In the arteries, the Kernogan index indicates the extent to which the organ is supplied with blood [5]. To determine this index, the ratio of the thickness of the middle layer of the vessel and the diameter of the vessel is multiplied by 100.

4. Results and Discussion

The intra-organ arteries of the lung are muscular elastic and muscle-type arteries. In describing the intra-organ arteries, we refer to Esipova I.K., Kaufman O.Ya (1968) and E.K. Weir, Dj.T. We relied on data from Reeves (1995). According to the above authors, the arteries of the small circulatory system are branched according to the branching of the bronchi. The network of each pulmonary artery must correspond to each bronchus.

In order to compare the morphological features, we studied the arteries at 6 levels. Level 1 and 3 arteries are muscle elastic type, level 4-6 arteries are muscle type pulmonary arteries. For a more thorough study, the arteries were further divided into three groups: small, medium, and large arteries. Arterial arteries are arteries of the muscular elastic type. When we observe these arteries under a microscope, the inner layer consists of the endothelium and the thin endothelial layer. In the middle layer are three elastic membranes, between which are smooth myocytes located along a curved longitudinal.

Collagen fibers can be seen in the middle layer. It was noted that the inner and outer elastic membrane layer with a clear boundary is well developed. As the diameter of the vessel decreased, the elastic membrane of the middle layer became thinner and merged with the outer elastic membrane (Table 1). The outer adventitious layer of the arteries is composed of connective fibers, mainly collagen and elastic fibers.

Pulmonary arteries basis of the muscular type is well-developed smooth-celled muscle in the middle layer. It can be seen that the muscle fibers in the middle layer are composed of a mutually inner and outer elastic membrane. In addition to smooth muscle fibers, thin elastic fibers are found in the middle layer. The inner layer of such arteries consists of multilayered endothelial cells that directly touch the inner elastic membrane. In our study, no subendothelial layer was detected in this type of artery. It can be seen that the outer layer of the muscle-type pulmonary arteries has no clear boundary and is fused with thin fibrous connective tissue fibers located in the outer layer of the bronchi.

The results of our study had shown that in the 3rd and 4th degree arteries, an additional spiral smooth fibrous muscle layer develops (Fig. 1). This layer appears as a separate pads relief in the cross sections. It can be seen that the bulge is located close to the outer elastic membrane by the adventitia. The smooth muscle fibers that form its base have a curved circular direction and are very tightly packed together.

These pads play a special role in the exchange of muscular elastic arteries in the lungs to the type of muscular arteries and play an important role in blood circulation within the small blood vessels.

Figure 1. Appearance of a level 3 muscular elastic type intrapulmonary artery. Dyeing. Hematoxylin-eosin. Ob. 10, ok. 10. The appearance of a cushion-like bulge in the artery wall. (indicated by a pillow embossed arrow)

Table 1. Morphometric parameters of intrapulmonary arteries (M ± т)

Arterial type		Outer elastic membrane length (mm)	Internal membrane length (mm)	Middle layer size (mm)	Outer adventitia layer	Internal diameter (mm2)	Kernogan index
Muscle elastic type	Large caliber	0,57±0,02	0,51±0,03	0,031±0,07	0,033±0,01	0,047±0,03	0,044±0,003
	Medium caliber	0,41±0,05	0,32±0,03	0,027±0,006	0,031±0,006	0,045±0,05	0,057±0,05
	Small caliber	0,32±0,08	0,30±0,06	0,034±0,02	0,030±0,02	0,039±0,08	0,086±0,09
Muscle type	Large caliber	0,26±0,03	0,17±0,09	0,035±0,07	0,019±0,07*	0,032±0,07	0,032±0,006
	Medium caliber	0,20±0,06	0,15±0,06	0,017±0,03	0,015±0,006	0,014±0,09	0,0141±0,06
	Small caliber	0,13±0,03	0,07±0,03	0,014±0,02	0,012±0,01	0,009±0,001	0,136±0,003

Not only did the structure of the vessel wall change during vascular branching, but its morphometric dimensions also changed. The size of the inner and outer diameters of the pulmonary arteries gradually decreased (Table 1). It has been noted that the middle layer of muscle elastic type arteries has a large size. It was observed that the middle layer of the arteries of the middle and small muscle type had small dimensions. An analysis of our studies found that the Kernogan index in the pulmonary arteries differed significantly from one another.

It has been noted that this index is greater in large and small muscular arteries where the middle layer is relatively thick. In large arteries of the muscular elastic type with a large diameter, however, this figure was found to be smaller.

As can be seen from the given table, it can be seen that the cross-sectional area of the middle layer of the arteries gradually decreases from 1 degree to the small muscle-type arteries. Changes specific to these changes can also be seen in adventitia. The largest size of the adventitia was found in the arteries of the large muscular elastic type, and the smallest - in the arteries of the small muscle type.

5. Conclusions

Analysis of the data thus obtained showed that the pulmonary arteries can be recorded as muscular elastic and muscle-type arteries. Since the elastic membrane of the middle layer, which is fully formed in the pulmonary arteries, is the inner and thin outer elastic membrane, it is appropriate to consider them as muscular elastic type arteries.

It has been found that the adventitious formation of an additional muscle layer by the extension of the muscular elastic arteries to the muscular arteries. This muscle layer surrounds the artery wall like separate spiral fibers. As a result, the size of the middle layer of the artery thickens. As a result, the Kernog index would change.

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