Features of the Formation of the Heart Wall in Early Postnatal Ontogenesis

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ABSTRACT

In order to identify the features of morphogenesis in postnatal ontogenesis examined histological structure of different departments and shells in the heart of rats 1-22 days after birth. There alternating periods of acceleration and deceleration of the growth rate increase in the thickness of the atrium and the ventricles. The thickness of the endocardial and epicardial increases less significantly. The growth rate of the ventricular myocardium thickness observed in rats 6 and 16 days of age. Structural changes occur due to the growth of the organism. A special feature of the structure and topography of the heart microvessels is their distribution in the course of the cardiomyocytes and the relationship with the fibrous structures of the connective tissue of cardiomyocytes.

Keywords: heart rats, postnatal ontogenesis, cardiomyocytes, fibrous structure of the atrium and the ventricle

Relevance of the topic. Analysis of recent data shows that cardio vascular disease remains the leading cause of death in the developed world [1,2,3,5]. Heart frequently undergoes pathological effects of endogenous and exogenous stimuli, resulting in not only a violation of its function, but also develop various pathological processes in the body. Heart animals and humans and can be adapted to change depending on lifestyles and total body burden [7]. The age structure of the heart is of some importance in the disclosure of certain pathological processes developing in it. Also in the pathogenesis of many diseases of the cardiovascular system it plays a major role component connective infarction, it is the most dynamic component in the heart during morphogenesis and pathogenesis [4,6,8]. Therefore, a deep and comprehensive study of the structure of the heart walls and connective tissue component, is relevant and reasonably identified the choice of the direction of our research. The heart of the rat is a convenient model for experimental studies, as well as to obtain enough material to study.

Materials and methods. Studied 50 heart rats at 1, 6, 11, 16, 22 hours after birth. In each age group studied 10 rats heart. The animals were kept under standard vivarium conditions at t 21-22 ° C and natural photoperiod on a normal diet. Experimental studies were carried out in accordance with the "Rules of work with the use of experimental animals." Slaughter of rats was performed under ether anesthesia. After opening the chest and abdominal cavities of the material was fixed in 12% neutral formalin solution, then isolated heart. After fixation, the heart was withdrawn, and washed for 1-x days in running water. After the body was carried out by increasing the concentration of alcohols. Then the organ divided by the atria and ventricles, and embedded in paraffin. Histological sections 8-10 microns were prepared from paraffin blocks. Apply stain sections with hematoxylin and eosin, van

Gieson techniques, Weigert and impregnation method Foote modification Yurina. Morphometric measurements of the wall thickness of the atrium and ventricle are made via the line by increasing ocular ob.90 microscope ok.7. Mathematical processing of data was performed using Microsoft Excel 2010 application programs in the topic of descriptive statistics, determining the standard deviation, the arithmetic mean M, the average error of the relative values of m. Authenticity of the received data at $P < 0.05$.

The wall of the atrial heart rats is characterized by uneven thickness. Analysis of the table shows that the thickness of the left and right atrium for the entire study period gradually increases. The 6-day age rats in the left and right atrial wall thickness increase compared to infants is 14% and 11%. At 11 days of age, compared to 6 daytime pups left atrial thickness increase of 21% and 14% of the right atrium. In 16-day old rats 18% and 13%. The growth rate of the left and right atria thickness in rats 22 days of age increased by almost the same and amounts to 20% and 19%. Thickness endocardial right and left atrial timing is not the same in all of ontogenesis, larger in the left atrium, a right lower. Endocardium heart atria rats submitted to a single layer of endothelial cells. The nuclei of endothelial cells have a rounded shape (Figure 1)

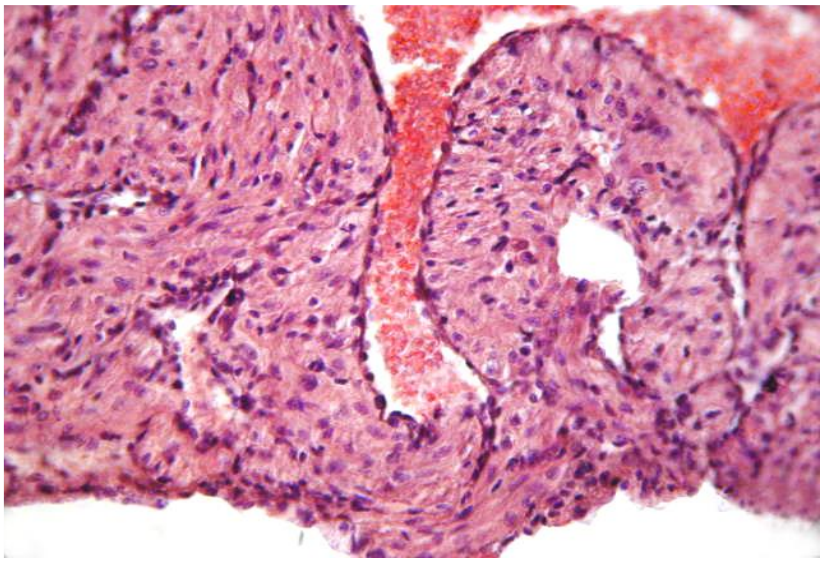

Fig.1. Endothelial cell wall of the left atrium of the heart six day old rats in the control group. Staining: hematoxylin-eosin. Magnification: oc10, ob 20

In atrial endocardium bundles of collagen fibers have different packing density. Bundles of fibers of the connective tissue, lying closer to the atrial lumen arranged loosely, beams lying next to the atrial myocardium more closely adjacent to each other. And they are interwoven with bundles of connective tissue fibers from the inner layer of cardiomyocytes atrial myocardium. The thickness of the bundles of collagen fibers in the endocardium ranges from 5,7 microns to 7,6 microns. The thickness of the endocardium beams of elastic fibers ranges from 3,8 to 7,6 microns. Reticular fibers for atrial endocardial have a different layout density. They are intertwined with the reticular fibers of the connective tissue layers located between the beams of cardiomyocytes inner layer of the atrial myocardium. Rat atrial myocardium is represented by two layers of cardiomyocytes. It consists of a longitudinal surface arranged and directed circularly deep muscle layers. The beams of cardiomyocytes, lying close to the endocardium change direction and are arranged obliquely. The outer layer of beams of cardiomyocytes are arranged longitudinally. In the atrial myocardium boundary between layers of weakly expressed in cardiomyocytes. They are adjacent to each other. Throughout infarction beams of cardiomyocytes in

changing the direction of the layers penetrate each other. Atrial cardiomyocytes surrounded by tufts of fibrous connective tissue structures. In the atrial myocardium depending on the site reveals their different direction. In the inner layer of the myocardial bundles of collagen fibers are deposited in a circular direction between the beams of cardiomyocytes. In the depths of the inner layer of the myocardial fiber structure of the connective tissue change direction and are arranged perpendicular to the atrial endocardium. On the periphery of the outer muscle layer of connective tissue bundles change the direction of the longitudinal to oblique and interwoven with bundles of epicardium. At the boundary of the outer and inner layers of myocardium occurs atrial sites where structures intertwined fibrous connective tissue. The thickness of the bundles of collagen fibers between the tufts of cardiomyocytes ranges from 5,7 to 11,4 microns. The thickness of the bundles of elastic fibers from 3.8 microns to 11.4 microns. Reticular fibers in the myocardium of the atria occur in connective layer between the beams of cardiomyocytes. Reticular fibers located along the cardiomyocytes to form various shapes and sizes hinges. The high density reticular fibers detected between the beams of cardiomyocytes inner layer atrium. The study of the structure of the wall of atrial septal showed that the partition wall is formed of both atria. In atrial epicardium beams of elastic fibers lie loosely compared with bundles of collagen fibers. The thickness of the atrial epicardium bundles of collagen fiber ranges from 5,7 to 7,6 microns, the thickness of the elastic fiber bundles ranges from 3,8 to 7,6 microns. Reticular fibers in the epicardium atrial arranged more densely.

Ventricular endocardium comprises a longitudinally directed bundles of collagen fibers. Identify areas where longitudinal occurring bundles of collagen fibers are intertwined with each other. The fiber bundles of connective tissue located closer to the myocardium of the ventricles are interwoven with bundles of connective tissue fibers located between the beams of cardiomyocytes inner layer of the myocardium. The thickness of the bundles of collagen fibers endocardial ventricular ranges from 5,7mkm to 11,4 microns. Beams ventricular endocardial elastic fibers lie loosely compared with bundles of collagen fibers. In bundles of fibers adjacent to the ventricular myocardium increased packing density. The thickness of the elastic beams ventricular fibers ranges from 5,7 to 9,5 microns. Reticular fibers ventricular endocardium located close to each other (Figure 2).

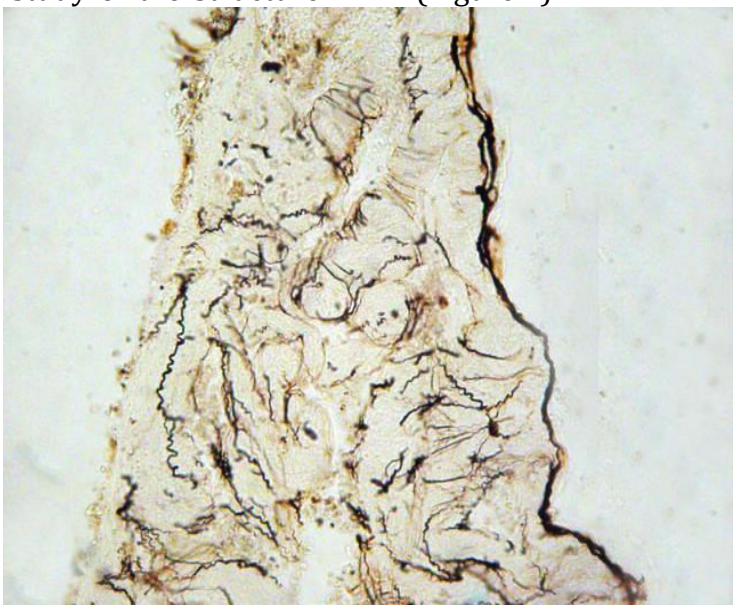

Fig. 2. Reticular fibers lateral endocardial wall of the left ventricle 6 days of age in the control group. Staining: Impregnated with silver nitrate by Foote in Yurina modification. Magnification: oc10, ob20

The ventricular myocardium is represented by 3 layers of cardiomyocytes. Outside, subepicardial layer contains cardiomyocytes, forming longitudinal beams, are found in the middle layer of circularly directed beams, inner subendocardial layer containing slightly obliquely oriented bundles of cardiomyocytes. The outer and inner layers of the longitudinal direction belongs to both ventricles. Superficial fibers cover both ventricles evenly. Internal fiber bundles as it approaches the endocardium become more oblique direction and pass into the papillary muscles. Middle circular layer belongs to only one of the ventricles. Study direction beams ventricular myocardial fibers showed that circularly directed layer has not always not always a clear orientation. Beams of the middle layer of the front wall of the ventricular fibers directed obliquely deflected toward the endocardium. Between the layers of cardiomyocytes ventricular myocardium border weakly expressed. They fit snugly to each other. In the middle layer of beams of cardiomyocytes are arranged circularly. The beams of cardiomyocytes occurring at the inner layer of the myocardium change the direction of the longitudinal to oblique. In the border areas with average myocardial layer in the outer layer of the cardiomyocytes bundles begin to change the direction of the longitudinal to oblique. The left ventricle is not detected a significant difference in the thickness of the layers of cardiomyocytes. The inner layer consists of myocardial parallel beams cardiomyocytes that are parallel with the endocardium. The outer layer of the myocardium and puchkoobraznoe has a loose structure, it cardiomyocytes arranged in different directions. The middle layer of the left ventricular myocardium cardiomyocytes beams are perpendicular with respect to the inner layer. In the center there is a cardiomyocyte oval nucleus at 1-2. Core cardiomyocyte cells located in the center and at the periphery myofibrils. The right ventricular cardiomyocytes into myocardial beams layers similar left ventricular myocardium. But unlike the left ventricular myocardium in the right ventricle of the circular layer thickness cardiomyocytes 2-3 times thicker than the thickness of the layers of longitudinal cardiomyocytes. The nucleus of cardiomyocytes differed elongated shape. In some places in the middle layer of the myocardium revealed arterioles. The outer layer of the myocardium has a large number of venules with a variety of forms. In ventricular myocardium of the heart, depending on the site bundles of collagen fibers having different directions. At the apex of the heart bundles of collagen fibers are directed obliquely, of the bundles of collagen fibers changes the direction of the skew on the longitudinal. The inner layer of myocardial collagen bundles lie longitudinally separating bundles of cardiomyocytes from each other. In the middle layer between the beams of cardiomyocytes myocardial collagen fibers forming beams having a circular direction. The outer layer of the myocardial bundles of collagen fibers are deposited obliquely between the beams of cardiomyocytes. The thickness of the bundles of collagen fibers in the ventricular myocardium varies from 7,6 microns to 13,3 microns.

Reticular fibers in the ventricular myocardium have a different direction depending on the layer. In the inner layer of reticular fibers lie longitudinally in the apex of the heart they are interwoven with the reticular fibers of the outer layer of the heart attack. In the middle layer of myocardium reticular fibers between cardiomyocytes bundles are arranged in a circular direction. The outer layer of the ventricular myocardium reticular fibers lie obliquely, in the apex of the heart increases the density of their location. Reticular and elastic fibers around the beams of cardiomyocytes form a network of various sizes and shapes. Connecting direction of the fiber bundles depends on the direction of cardiomyocytes. They envelop the individual muscle bundles, forming loops of various shapes and sizes. In the myocardium bundles of reticular and elastic fibers it is directed along the beams of cardiomyocytes. Interventricular septum consists of two longitudinal and one circular layer. Longitudinal layers are formed on the left and right of the respective layers of

both ventricles longitudinal and circular middle layer is formed by a circular layer of the left ventricle (Figure 3).

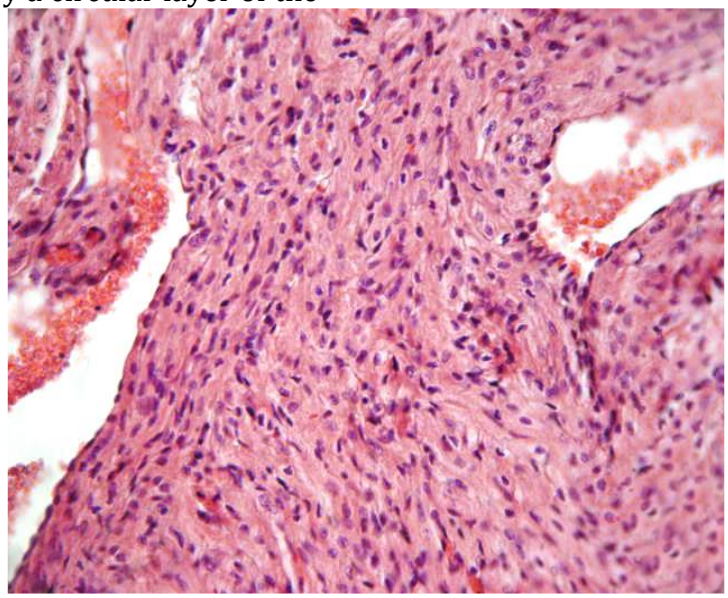

Fig. 3. Interventricular septum rat heart 6 day old rats in the control group. Staining: hematoxylin-eosin. Magnification: oc10, ob20

In ventricular myocardium occur arterioles, capillaries, venules and sinusoids. Arterioles characterized in that between the thin inner sheath clearly pronounced middle shell and an outer shell mild. Inner sheath arteriolar endothelial cell nuclei represented rounded shape, they are at a slight distance from each other. Clearly marked tunica consists of circularly directed bundles of muscle fibers. They form two layers. The outer shell is formed by loose fibrous tissue, there are different adventitial cells. The thickness of the inner diameter ranges from 9,5 to 15,2 microns, and an average of 11,7 ± 0,6 microns.

Venules infarction in most cases represented by sinusoids of different diameter and different form. The wall of the venules is presented by the endothelial cells, which are located at a great distance from each other. The muscular layer venules underdeveloped. Venules thickness ranges from 15,7 to 20,5 microns. Myocardial sinusoids have an elongated, oval, or irregular shapes. Sinusoids found in podepikardialnom layer. sinusoids wall consists of a single layer of endothelial cells. In most cases elongated endothelial cells. capillary wall is represented by endothelial cells. The nuclei of endothelial cells are round and oval shape. They are at a slight distance from each other. The thickness of the inner diameter of the capillary has a thickness of from 5,7 to 11,4 microns, in an average-9,3 ± 0,6.

The ventricular epicardium bundles of collagen and elastin fibers lie longitudinally, and have a greater packing density than the bundles of collagen and elastic fibers endocardial. The ventricular epi1cardium collagen fiber bundles thickness ranging from 5,7 microns to 11,4 microns, beams of elastic fibers have a thickness of from 5,7 microns to 9,5 microns. The ventricular epicardium reticular fibers are arranged longitudinally. Analysis of the table shows that the thickness of the bottom of the ventricle is always prevails over the top. The thickness of the right ventricular wall is always less than the right side. Increasing the wall thickness only occurs over 6 and 16 hours after birth, their growth rate is in the left ventricle 27% and 22%, and in the right ventricle 19% and 15%. On day 11 the thickness increase is reduced to 14% of the left ventricle and the right 11%. On day 22 after birth, increase of left and right ventricular thickness is 21% and 16% respectively.

Conclusions.

1. The results of the study suggest that the time of birth in white rats heart is not fully differentiated, their development continues after birth.
2. The myocardial blood vessels are directed along the beams cardiomyocytes. The vessels are surrounded paravasal bundles of connective tissue. The difference in diameter intraorgan vascular walls of the left and right ventricles almost none.
3. The superficial fibers cover the left and right ventricle uniformly. Internal bundles of myocardial fibers as it approaches the endocardium become more oblique direction and pass into the trabeculae and papillary muscles. The middle layer consists of a circularly directed beams of cardiomyocytes, which belongs to only one of the ventricles.

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