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MACRO- AND MICROSCOPIC FEATURES OF HYPERTROPHIC CARDIOMYOPATHY

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Abstract: In hypertrophic cardiomyopathy, the walls of the ventricles of the heart continue with symmetric or asymmetric myocardial hypertrophy. Morphologically, in hypertrophic cardiomyopathy, fibrotic foci are detected based on the incorrect arrangement of myocardial muscle fibers, small coronary vessel syndrome, and myocardial hypertrophy.

Keywords: heart, cardiomyocyte, hypertrophy, dystrophy, myofibril.

Introduction: Cardiomyopathy is a primary damage to the myocardium, characterized by inflammation, tumor, specific cardiomegaly not related to ischemia, worsening heart failure and arrhythmia. It is considered an idiopathic (unknown origin) disease of the myocardium, which is based on the development of dystrophic and sclerotic changes in cardiomyocytes. The following types of primary cardiomyopathy are distinguished: dilated, hypertrophic, restrictive and arrhythmogenic [32,62].

Hypertrophic cardiomyopathy is manifested by diffuse hypertrophy of one or all parts of the heart, narrowing of the ventricles. Hypertrophic cardiomyopathy is actually an autosomal dominant disease and occurs more often in men of all ages. In hypertrophic cardiomyopathy, the ventricular wall continues with symmetric or asymmetric hypertrophy of the myocardium. Morphologically, in hypertrophic cardiomyopathy, fibrotic foci are found on the basis of incorrect location of myocardial muscle fibers, "syndrome of small coronary vessels", myocardial hypertrophy. The outcome of hypertrophic cardiomyopathy is often poor, leading to death from heart failure [56,59,104].

The purpose of the research: to clarify the specific macro- and microscopic changes of the heart in hypertrophic cardiomyopathy;

Materials and methods: We reviewed 5,642 reports from the RPAM autopsy department during 2011-2020, and a total of 64 CMPs were identified during this period, accounting for 1.13% of all autopsies and 4.7% of cardiovascular diseases. 15 of the 64 identified cases were found to be hypertrophic cardiomyopathy.

After macroscopic examination of the heart, 1.5x1.5x0.5 cm pieces taken from the walls of both ventricles and both compartments were frozen in a 10% solution of formalin in phosphate buffer for 48 hours, then washed in running water for 3-4 hours and placed in a series of alcohol batteries of increasing concentration (80˚, 90˚, 96˚, 96˚, 100˚) and dehydrated in chloroform, paraffin with added wax was poured, and bricks were prepared. Histological sections 5-6 μm thick were taken from paraffin blocks and stained with hematoxylin-eosin and van Gieson stain to identify connective tissue fibers. Histological preparations were studied in 10, 20, 40 lenses of a light microscope, and pictures were taken from the necessary areas.

Research results: It was found that the macroscopic appearance of the heart in hypertrophic cardiomyopathy consists of the following specific changes. The main hypertrophy-like changes in the appearance of the heart are observed in the left ventricle, where the wall of the left ventricle is thickened by an average of 35-45 mm, all the walls of the left ventricle are thickened to different degrees, the greatest thickening is in the interventricular wall. As a result, it was determined that the condition of obstruction appeared around the blood outlet of the left ventricle of the heart. In 11 of all 15 studied cases, the above-mentioned morphological changes and the development of an asymmetric form of hypertrophic KMP were found. In the rest, it was found that the heart was symmetrical, that is, all areas of the left ventricle were hypertrophied to the same extent. As a characteristic sign of asymmetric hypertrophic KMP, it was observed that the wall of the left ventricle was mainly thickened in the back and the interventricular space, and the difference in wall thickness was 1.2 cm on average. Only in some cases (2 cases) was it found that the right ventricle of the heart was hypertrophied, the orifice of the pulmonary artery narrowed, and hypertension of the pulmonary artery developed in hypertrophic KMP.

In hypertrophic cardiomyopathy, the ventricular and ventricular spaces have changed to different degrees, in most cases, the left ventricle is dilated and expanded, there are specific structural changes in the mitral valve layers, i.e., they are stretched and elongated, and their area is increased. In 25% to 65% of cases, thickening of the endocardium is detected, especially in the upper part of the ventricular septal wall, in areas close to the aortic valve.

Microscopic examination showed that the myocardium of almost all patients had a strong hypertrophy of cardiomyocytes. In this case, as specific microscopic changes, it is observed that the muscle fibers are arranged randomly, that is, in the direction of different vessels. It is determined that most of the myocardial muscle fibers are located in a circle (Fig. 1), characteristic tufts of different thickness have appeared, and tumor foci have appeared in their cores. Fibrous tissue is densely located between the muscle bundles consisting of cardiomyocytes, and the fibrous bundles are noticeably thick in one place, and relatively thin dark hematoxylinous bundles appear in other areas. Cardiomyocytes are hypertrophied due to the thickening of both myofibrils and sarcoplasm, and their nuclei are relatively small and irregular. In other areas of the myocardium, it is determined that part of the muscle fibers are located longitudinally, and the other part is located transversely. It is observed that the myofibrils of the cardiomyocytes of the longitudinally located muscle fibers are thickened to different degrees, the transverse extension lines are lost, and the nuclei are pushed aside. It is determined that transversely located muscle fibers have different thicknesses, some of them are sharply thickened, their borders are unclear, and they merge with each other. Fibrous tissue and malformed blood vessels are found at the junction of muscle fibers in different directions (Fig. 2). It is determined that the fibers in the fibrous tissue are irregularly arranged, of different thicknesses, and blood vessels similar to random cracks have appeared between them.

In asymmetric forms of hypertrophic KMP, the following changes were detected when microscopic examination of the upper part of the wall of the interventricular space of the heart, that is, the part adjacent to the mitral valve. In this area as well, it is determined that the myocardial muscle fibers are chaotically located, as we can see in the picture, thick muscle bundles are visible in cross-section, their sarcoplasm is swollen, and myofibrils are thinned and sparsely located.

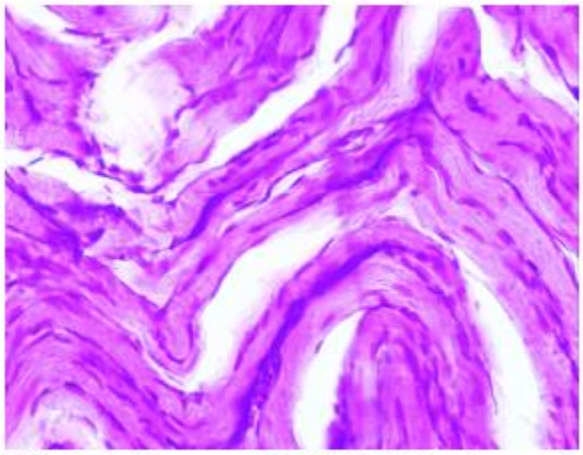

Figure 1. Hypertrophic KMP. It is observed that the muscle fibers are arranged irregularly, and the interstitium between them is swollen. Paint: G-E. Floor: 10x40.

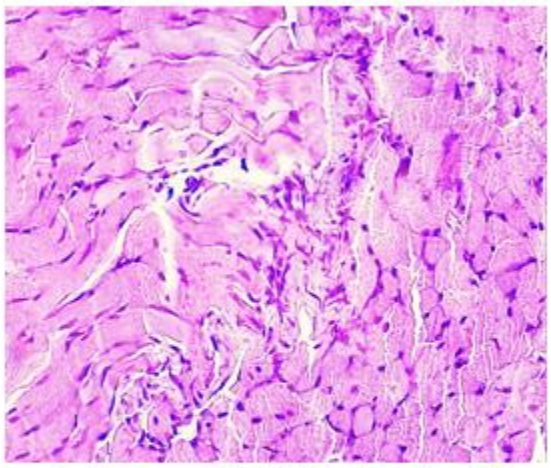

Figure 2. Hypertrophic KMP. Sharply thickened muscle fibers are located both longitudinally and transversely, between which fibrous tissue has appeared. Paint: G-E. Floor: 10x40.

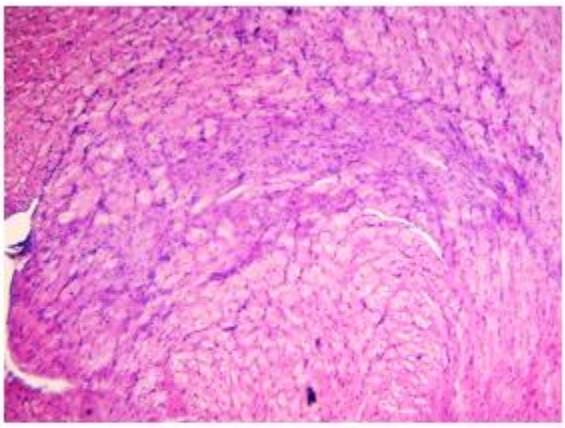

Figure 3. Hypertrophic KMP. The upper part of the interspinous wall, the muscle bundles are chaotically arranged, and relatively thick fibrous tissue has appeared between them. Paint: G-E. Floor: 10x40.

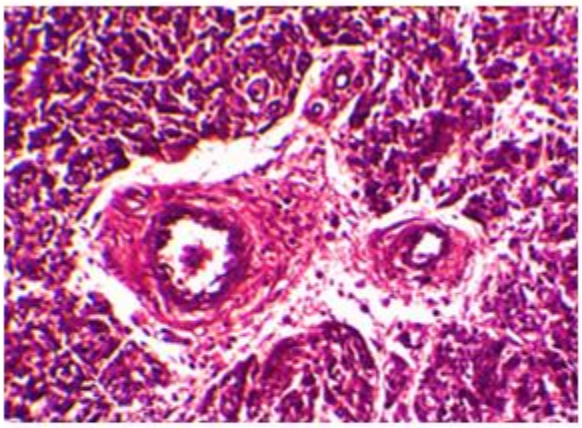

Figure 4. Hypertrophic KMP. Sclerosis and thickening of the wall of the coronary arteries located in the myocardial intramural. Paint: G-E. Floor: 10x20.

It is observed that other bundles of myocardium are located longitudinally and form the outer part of the wall of the interventricular space, and myofibrils of cardiomyocytes are relatively dense and darkly stained, but their histotopography is disturbed due to thickening. Between the muscle bundles located in the two indicated directions, it is determined that each muscle fiber is separated from each other, dense fibrous tissue has appeared between them (Fig. 3). Fibrous tissue differs from muscle fibers in terms of its coloring and composition, it is determined that its fibers are densely and irregularly arranged, and its cells are relatively numerous and disorderly.

In hypertrophic KMP, it is determined that there are specific morphological changes in the intramural coronary arteries of the heart myocardium. In this case, it is observed that the walls of almost all intramural coronary arteries are sclerotized and thickened. The larger the diameter of the artery, the more connective tissue grows around it and is found to be sclerosed (Figure 4). It is determined that the intima of these

arteries is uneven, the cells in it are hypertrophied and hyperchromic, and the basal membrane is also thickened. Smooth muscle cells are found to undergo both hyperplasia and hypertrophy, and some muscle cells are surrounded by fibrous tissue. Due to the abundance of fibrous structures in the surrounding connective tissue, it is determined that it is densely wrapped around the vessel in the form of a ring, as a result, the artery cavity is compressed and narrowed. It is determined that the walls of relatively small arteries and arterioles are thickened due to the growth of the connective tissue, which has spread and penetrated into the surrounding muscle tissue.

As another characteristic change of hypertrophic KMP, thickening of the endocardium of the left ventricle, growth of connective tissue, and sclerosing were found in most cases. It is observed that the endocardium of the endocardium is atrophied and desquamated in some places, migrated, and in other areas it is proliferated, increased and thickened. The basement membrane beneath the endothelium is found to have almost disappeared, disintegrated, and merged with the surrounding newly formed connective tissue. It is observed that the endocardium is thickened in the section (Fig. 5), and even grows towards the myocardium adjacent to it. It is determined that the connective tissue fibers and cells in the endocardium have undergone dystrophy and dysregeneration and have changed morphologically. Fibrous structures are determined to be shriveled and fragmented due to strong swelling in some places, relatively pale in color, in other places they are dense, homogenized, and destroyed like fibroelastosis and hyalinosis. It is found that the cellular composition of the endocardial tissue is thinned, their nuclei are deformed and hyperchromic. Myocardial muscle fibers adjacent to the endocardium are fragmented, separated into parts, and most of them are destroyed. The destruction of muscle fibers is manifested by the loss of the nucleus, the loss of cross-promoting lines in myofibrils, their homogenization and myolysis.

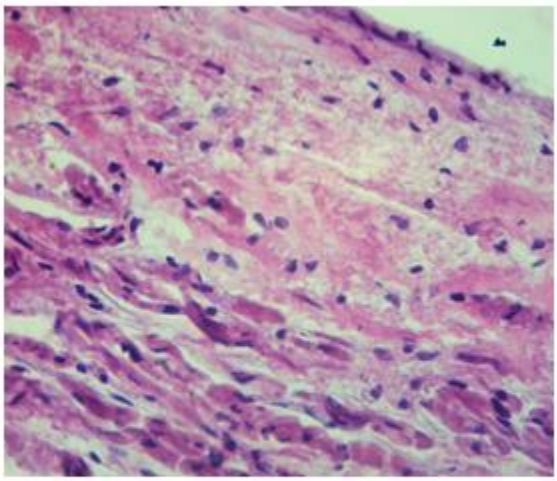

Figure 5. Hypertrophic KMP. Thickening of the endocardium, elastofibrosis and hyalinosis of connective tissue fibers. Paint: G-E. Floor: 10x40.

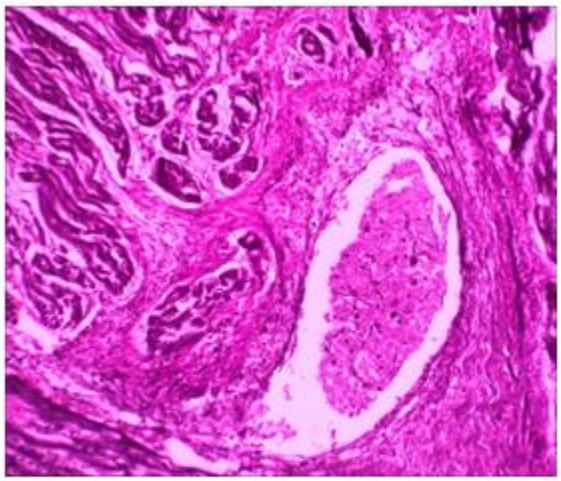

Figure 6. Hypertrophic KMP. Fibromatosis and sclerosis of the endocardium, invasion into the myocardium. Paint: G-E. Floor: 10x20.

Fibromatosis and sclerosis are found in the myocardium of the heart in individual cases. It is observed that the rough fibrous connective tissue completely covers the endocardial layer and has grown into the myocardium (Fig. 6). Fibrous tissue contains a significant number of fibrous structures with a coarse structure, and the intercellular substance has a fine-grained coarse eosinophilic structure. Fibrous structures are chaotically arranged, and in some areas dark colored fibrous concretions with a dense and coarse texture are found. It is observed that connective tissue cells are significantly less than fibrous structures, they are randomly located, the cytoplasm of most of them is vacuolated and expanded. As a result of fibromatosis of the interstitial tissue of the myocardium, it is determined that the muscle bundles are torn, fragmented and

separate islands appear, and the cardiomyocytes in these islands are destroyed and located in a disorderly manner.

It should be noted that in most cases of hypertrophic KMP, the functional state of the mitral and aortic valves is impaired. The morphological basis of these functional disorders is definitely the pathomorphological changes developed in the myocardium and, in addition, the development of sclerosis and fibromatosis in both the myocardium and the endocardium. The reason is that due to the development of fibromatosis in the endocardium, the sclerosis process spreads to the layers of the valves, causing it to be structurally damaged. In this case, the microscopic examinations showed that the myocardial tissue adjacent to the layers of the heart valves is hypertrophied and thickened, and the connective tissue that is part of the valves adjacent to it is fibrosed and thickened. It is determined that the fibrous structures in the fibrous tissue have multiplied and are scattered in this place, on the one hand, they have spread to the myocardium, and on the other hand, they have deformed the surface of the plate. It is determined that the connective tissue cells in the fibrous tissue of the cap layer are relatively few, and those that are present are vacuolated, hydropic dystrophy, and are randomly located.

Conclusion: In most cases of hypertrophic KMP, an asymmetric shape is developed, the wall of the left ventricle is mostly thickened in different degrees, the left ventricle is dilated in most cases, specific structural changes in the layers of the mitral valve, i.e., they are stretched and elongated, and their area is increased. In 25% to 65% of cases, thickening of the endocardium is detected, especially in the upper part of the ventricular septal wall, in areas close to the aortic valve. Microscopically, this hypertrophic KMP is a typical condition, that is, the muscle fibers are located in a chaotic and chaotic manner, the connective tissue grows between the muscle bundles, the fibrous tissue develops, the fibrous tissue often occupies the subendocardial area and the endocardium thickens, the fibrous tissue spreads to the valvular layers, as a result, it leads to a functional violation of the valve. proved.

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