

# Characteristics of Potomorphological Changes in the Myocardial Layer of the Heart in Young People with Chronic Ischemic Heart Disease

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**Abstract** Microscopic examination of the hearts of 28 deceased persons aged 25-45 was conducted in order to study the specificity of photomorphological changes in the myocardial layer of the heart in young people with chronic ischemic heart disease. Morphological changes of ischemic type, hypertrophy of cardiomyocytes and growth of interstitial connective tissue to perivascular areas, quantitatively less focal sclerotic changes were noted in the myocardium. It was found that morphometric indicators differ between young people.

**Keywords** Chronic ischemic heart disease, Myocardium, Youth, Coronary cardiosclerosis

## 1. Introduction

Currently, there are about 126.5 million cases of ischemic heart disease in the world. Coronary heart disease (CHD) remains one of the leading causes of death, accounting for more than 9 million deaths per year worldwide [3,5,6].

The term stable coronary artery disease is often used interchangeably as a synonym for chronic ischemic heart disease and covers a variety of conditions in which there is a recurrent mismatch between myocardial oxygen supply and demand. This is often seen when long-standing atherosclerotic obstruction in the epicardial coronary arteries results in poor flow and distal ischemia. However, this is not the only mechanism. Various pathophysiological processes, such as coronary artery vasospasm, microcirculatory dysfunction, or congenital anomalies, can lead to chronic recurrent ischemia [4,7].

The characteristics of cardiovascular diseases in young people have not been sufficiently studied. Among men with coronary artery disease, those under 39 are considered young; Different age criteria are adopted for women: some authors set the same age limit for men, while others raise it to 45 years. According to various sources, the incidence of ischemic

heart disease in young people is 5-10% of all cases of the disease. Risk factors for young people are generally the same as for ischemic heart disease: arterial hypertension, hypercholesterolemia, excess body weight, physical inactivity, diabetes, etc. Undoubtedly, the way of life (emotional background) plays an important role in the emergence of CHD in young people. According to a study conducted in England, the risk of developing coronary artery disease is 3 times higher in men with depression [2].

## 2. The Purpose of the Study

Study of morphological and morphometric aspects of myocardial changes in chronic ischemic heart disease in young people.

## 3. Materials and Methods

In order to study the morphological characteristics of the myocardial structure in chronic ischemic heart disease in young people, microscopic examination of the hearts of 28 deceased persons aged 25-45 years was performed, of which 21 (75%) were men, 7 (25%) were women. These ages were divided into the following subgroups for the purpose of in-depth study of pathomorphological changes in the myocardium:

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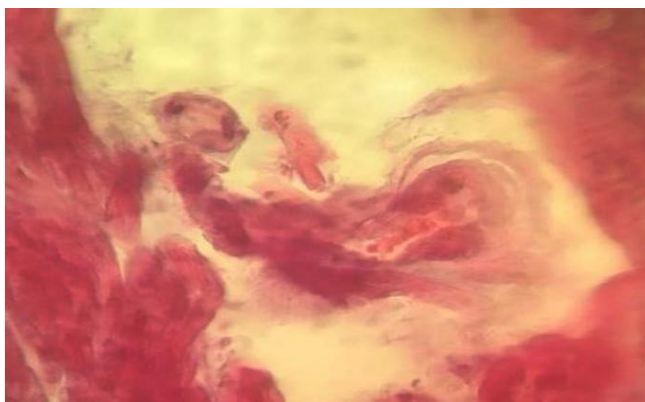
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Group 1: 25-30-year-olds; Group 2: 31-35 years old and Group 3: 36-40 and Group 4: 41-45 years old. Based on the goals and objectives of the study, morphological features of myocardial structures were studied. Material for special histological examination was taken from the anterior wall of the left ventricle and the interventricular septum. The obtained tissue fragments were fixed in 10% neutral formalin, passed through an alcohol battery, and paraffin blocks were prepared. The prepared histological sections were stained with hematoxylin and eosin, according to Van-Gieson. Photomicrographic methods were conducted.

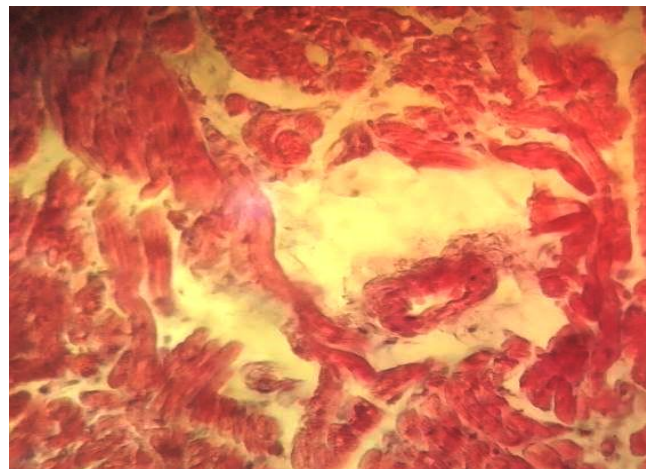
## 4. Results and Discussion

25-30-year-olds died from chronic ischemic heart disease, 6 of them were women. The average weight of the heart of the deceased was  $343.3 \pm 5.1$ , its dimensions were  $10.5 \times 8.7 \times 5.1$  cm, the thickness of the left ventricle was  $1.11 \pm 0.12$ , and the right ventricle was  $0.33 \pm 0.02$  cm. Myocardial consistency elasticity. In the micropreparations prepared from the myocardium layer of the heart of this age group, the growth of intermediate connective tissue in the perivascular areas between the muscle fibers is determined. Due to the thickening of the wall of small intramyocardial artery blood vessels, their spaces are narrowed. Hypertrophy of cardiomyocytes around foci of coronary cardiosclerosis is observed (Fig. 1).



**Figure 1.** 25-30-year-old patients with foci of coronary cardiosclerosis in intramyocardial blood vessels. Stained in hematoxylin-eosin. Ob.40, ok.10

7 people aged 31-35 died from chronic ischemic heart disease, 2 of them were women. The average weight of the heart of the deceased was  $343.3 \pm 3.7$ , its dimensions were  $11.1 \times 8.6 \times 5.3$  cm, the thickness of the left ventricle was  $1.05 \pm 0.12$ , and the right ventricle was  $0.34 \pm 0.01$  cm. At this age, muscle fibers are removed from the myocardium of the heart, swelling of the adipose tissue, and hypertrophy of the surrounding cardiomyocytes are noted. In the field of vision, the growth of intermediate connective tissue in perivascular areas, i.e. foci of coronarocardiosclerosis, is determined. The wall of small intramyocardial artery blood vessels is thickened, the intima layer is not defined, and their spaces are narrowed by more than 45-50% (Fig. 2).



**Figure 2.** Coronarocardiosclerosis caused by sclerotic changes in intramyocardial blood vessels in patients aged 31-35 years. Stained in hematoxylin-eosin. Ob.40, ok.10

8 people aged 36-40 died from chronic ischemic heart disease, 2 of them are women. The average weight of the hearts of the deceased is  $345.3 \pm 3.8$ , the dimensions are  $11.4 \times 8.7 \times 5.4$  cm, the thickness of the left ventricle is  $1.2 \pm 0.11$ , the right is  $0.35 \pm 0.02$  cm. At this age, muscle fibers are removed from the myocardium of the heart, swelling of the adipose tissue, and hypertrophy of the surrounding cardiomyocytes are noted. In the field of vision, the growth of intermediate connective tissue in perivascular areas, i.e. foci of coronarocardiosclerosis, is determined. The wall of small intramyocardial artery blood vessels is thickened, the intima layer is not defined, and their cavities are narrowed by more than 65%.

7 people aged 41-45 died from chronic ischemic heart disease, 1 woman and 7 men. The average weight of the hearts of deceased persons is  $346.4 \pm 1.9$ , the dimensions are  $11.5 \times 8.9 \times 5.1$  cm, the thickness of the left ventricle is  $1.15 \pm 0.1$ , the right is  $0.34 \pm 0.03$  cm. Myocardial layer of the myocardium of this age group is characterized by muscle fibers, strong hypertrophy of myocardiocytes and swelling of interstitial tissue. Perivascular areas are marked by growth of interstitial connective tissue - foci of coronarocardiosclerosis. The wall of small intramyocardial artery blood vessels is sharply thickened and their spaces are narrowed by more than 65-70%.

Anatomically, a stenosis of 50% or more of the left main artery or a stenosis of 70% or more in any of the other coronary arteries is considered severe [1]. In our research, it was found that 41-45-year-olds have more than 65-70% narrowing of intramyocardial arteries. In this regard, foci of coronarocardiosclerosis appear in significant areas.

25-30-year-olds who died of chronic ischemic heart disease have characteristic morphometric indicators of morphological changes in myocardial structures, hypertrophy of cardiomyocytes, thickening of blood vessel walls, and rapid growth of perivascular areas and intermuscular connective tissue (Table 1).

**Table 1.** Morphometric indicators of the area of connective tissue growth in the myocardial layer of young people who died of chronic ischemic heart disease (%%)

Age	The area occupied by muscle tissue	Area occupied by fibrous tissue	General area
25-30	81,4±0,59	17,4±0,43	98,8±1,02
31-35	72,0±0,43***	25,4±0,63**	97,4±1,06
36-40	69,4±0,59***	26,5±0,29***	95,9±0,88
41-44	65,3±0,30***^^^°°	31,1±0,32***^^^°°°	96,4±0,62

Note: \* - significant differences compared to the data of group 1 (\* - P<0.05, \*\*\* - P<0.001); ^ - significant differences compared to the data of group 2 (^ - P<0.05, ^^ - P<0.01, ^^ - P<0.001); ° - significant differences compared to the data of group 3 (° - P<0.05, °° - P<0.01, °°° - P<0.001)

As can be seen from the table, there is a significant difference in the morphometric parameters of those who died from chronic ischemic heart disease by age. In particular, the area occupied by muscle tissue was on average 72.0±0.48, and the area occupied by fibrous tissue was 25.4±0.43 on average. In middle-aged people, these indicators are equal to 61.4±0.33/35.5±0.39, respectively. It was determined that the area occupied by muscle tissue was 53.9±0.63, and the area occupied by fibrous tissue was 34.1±0.53.

The morphometric indicators of intramyocardial blood vessels in young people who died of chronic ischemic heart disease according to age criteria are presented in the table below (Table 2).

**Table 2.** Morphometric indicators of intramyocardial blood vessels in young people who died of chronic ischemic heart disease

Age	The area occupied by the vascular wall	The area occupied by the vascular space	General area
25-30	7,7±0,30	2,2±0,12	9,9±0,42
31-35	8,1±0,21***	2,8±0,22**	10,9±0,43
36-40	8,2±0,17***	2,9±0,15***	11,1±0,32
41-44	8,3±0,13***^^^°°	2,9±0,13***^^^°°°	11,2±0,26

Note: \* - significant differences compared to the data of group 1 (\* - P<0.05, \*\*\* - P<0.001); ^ - significant differences compared to the data of group 2 (^ - P<0.05, ^^ - P<0.01, ^^ - P<0.001); ° - significant differences compared to the data of group 3 (° - P<0.05, °° - P<0.01, °°° - P<0.001)

As can be seen from the table, the area occupied by the wall of intramyocardial blood vessels in 25-30-year-olds who died of chronic ischemic heart disease is equal to 74.0%, and the area occupied by the vascular cavity is 26.0%, in 31-35-year-olds in patients, these indicators are equal to 74.0/26.0%, respectively. In 36-40-year-old patients, the percentage of the vascular wall is 78%, while the percentage of the vascular cavity is 28%. 41-44-year-old patients have a ratio of 67% to 33% of the area occupied by the wall of blood vessels and the cavity of the femoral head.

Thus, in the age group of 25-30-year-olds, only 26% of the vascular cavity remains open due to the development of sclerotic processes in the wall of intramyocardial blood vessels. This figure is 20% among 31-35-year-olds. In 36-40-year-olds, due to slow sclerotic processes in intramyocardial vascular walls, the narrowing of the vascular

space (33%) occurs slowly. In 41-44-year-olds, this indicator is 50%.

**Table 3.** Morphometric indicators of cardiomyocytes (μm) in the myocardial layer of young people who died of chronic ischemic heart disease

№	Age	Cardiomyocytes
1	25-30	24,5±0,01
2	31-35	26,5±0,15***
3	36-40	27,6±0,05***^^^°°
4	41-44	28,1±0,05***^^^°°°

Note: \* - significant differences compared to the data of group 1 (\* - P<0.05, \*\*\* - P<0.001); ^ - significant differences compared to the data of group 2 (^ - P<0.05, ^^ - P<0.01, ^^ - P<0.001); ° - significant differences compared to the data of group 3 (° - P<0.05, °° - P<0.01, °°° - P<0.001)

As can be seen from the data of Table 3, the morphometric parameters of cardiomyocytes of 25-30-year-old patients who died of chronic ischemic heart disease are 2.14±0.05 μm, and these parameters are 1.81±0.19 μm in 31-35-year-old patients. At the age of 36-40, it is equal to 1.75±0.05 μm, respectively. At the age of 41-44, this indicator is 1.63±0.07 μm.

## 5. Conclusions

Thus, morphological changes in the myocardial layer of the heart of young patients with chronic ischemic heart disease are manifested mainly in the form of coronary atherosclerosis. The narrowing of the wall of intracardiac arteries develops more strongly. The myocardium shows morphological changes of the ischemic type, hypertrophy of cardiomyocytes and growth of intermediate connective tissue to perivascular areas, and quantitatively less focal sclerotic changes. Hypertrophy of cardiomyocytes in young people who died of chronic ischemic heart disease, 36-40 in 25-30-year-olds; Compared to 31-35-year-olds, the enlargement of cardiomyocytes is slower in 41-44-year-olds compared to younger patients.

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