

Comprehensive medical rehabilitation of patients with myocardial infarction in the functional recovery period with the inclusion of bioflavonoids

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Introduction.

Cardiovascular diseases (CVD) are one of the main causes of death in all industrialized countries. Coronary artery disease (CHD) occupies the leading place in the structure of CVD, both in terms of prevalence and mortality. The relevance of coronary artery disease is determined by its role in disability and mortality, financial costs associated with treatment and rehabilitation of patients. Unlike the countries of Western Europe, the USA and Canada, where over the past 30 years there has been reduction in mortality from one of the most severe complications course of IHD myocardial infarction (MI), in Russia this indicator remains at a high level.

The main pathogenetic factors in the development of MI are atherosclerotic coronary sclerosis, hypercoagulation, impaired microcirculation, leading to a sharp discrepancy in volume coronary blood flow to myocardial oxygen demand. Previously we investigated the possibility of improving microcirculation in patients with MI using plant bioflavonoids.

In the process of vital activity, free radicals (oxidants) are formed in every organism - the molecules of which are very active and perform oxidative functions. They destroy cell membranes and tissues of the body, and therefore it is necessary to constantly replenish the body with antioxidants.

A number of researchers have shown that a low level of selenium in blood plasma is a risk factor for the development of MI. A decrease in selenium levels is observed from the first day of MI and remains so on the 10th, 20th day, as well as three, six and twelve months after MI. The relation between the content of selenium and the activity of the processes of lipid peroxidation. With a decrease in the level of selenium in plasma, LPO activity increases, which is more pronounced in ischemic conditions, such as MI, and leads to damage to cardiomyocyte membranes.

Vitamin C is a powerful antioxidant, which plays an important role in the regulation of redox processes, is involved in the synthesis of collagen and procollagen, and folate metabolism. Ascorbic acid also regulates clotting blood, normalizes capillary permeability, necessary for hematopoiesis, has anti-inflammatory and anti-allergic effects. Ubiquinone (coenzyme Q10) is involved in ATP synthesis - the main supplier of energy in the cell and is a cellular energetic, antioxidant. The biological action of coenzyme Q10 is based on its ability to reversible redox transformations. In acute myocardial infarction, one of the possible mechanisms of the positive action of Coenzyme Q10 has been identified - prevention of the development of long Q-T syndrome. The latter is associated with more frequent cardiac death, especially in patients with myocardial infarction. The described properties that can pathogenetically influence the course of MI are possessed by

domestic biologically active supplement (BAA) "Cardio Capillary with coenzyme Q10" (OJSC Plant of Ecological Equipment and Ecological Nutrition "Diod", Moscow), which includes dihydroquercetin - 15 mg, vitamin C - 20 mg, selenium - 20 mcg, coenzyme Q10 - 8 mg. It can be assumed that "Cardio Capillary with coenzyme Q10", which has antioxidant, antihypoxic and capillary protective effects, has an antiischemic and antiangiogenic effect, is able to "prepare" the myocardium for the effects of ischemia and reperfusion and, due to changes in myocardial metabolism, reduce consequences of ischemic and reperfusion complications in

patients with myocardial infarction. In order

to study the effectiveness of the use of a biologically active additive (BAA) "Cardio Capillary with coenzyme Q10" in a comprehensive program of medical rehabilitation of patients with coronary heart disease who had a myocardial infarction, this study was carried out.

MATERIALS AND METHODS

The study involved 50 patients with acute myocardial infarction admitted to a rehabilitation center (RC) in a functionally

recovery period for 16 - 28 days after the incident. All examined were men aged 46 to 65 years (mean age 54.7±4.6 years). Of these, myocardial infarction without a Q wave - suffered 19 (38.0%) patients, myocardial infarction with a Q wave - 31 (62.0%) patients. Myocardial infarction of the anterior wall of the left ventricle was diagnosed in 16 (32.0%) patients, posterior - in 34 (68.0%). When studying the anamnesis, it was found that 15 (30.0%) patients suffered a repeated myocardial infarction. According to the NYHA classification, upon admission, 4 (8.0%) patients were assigned to functional class (FC) of angina pectoris, 14 (28.0%) - to FC II, 29 (58.0%) - to FC III, 3 (6.0%) - to IV FC. The most common comorbidities were: hypertension in 27 (54.0%) patients, obesity in 22 (44.0%) patients, peptic ulcer in

8 (16.0%), chronic bronchitis - in 7 (14.0%), type 2 diabetes mellitus - in 7 (14.0%). 23 (46.0%) patients had two or more chronic concomitant diseases. Upon admission, all patients were examined according to a program that included a complex of laboratory and functional diagnostic studies, a study of microcirculation

by laser Doppler flowmetry (LDF), electrocardiography, respiratory function (EPF), computer analysis of low-amplitude morphological variations

QRST complex (Cardiovisor), echocardiography (EchoCG), bicycle ergometry (VEM). The psychological examination of the patients included the SAN, SMOL, and Spielberger-Khanin tests. For a comparative study of the effectiveness of medical rehabilitation of patients with myocardial infarction in the functional recovery period, all examined patients were divided by random sampling.

into the main and control groups. Rehabilitation program 20 patients in the control group (CG) included: sparing regimens (I), gentle training (II) or training (III) depending on the patient's condition; diet number 10 with the restriction of animal fats; climatotherapy in the form of aerotherapy during walks; medical gymnastics; dosed walking; physiotherapeutic procedures: magnetotherapy, laser therapy, massage of the cervicothoracic region spine using a gentle technique. Medical treatment was prescribed according to indications and included the intake of β -blockers, calcium antagonists and nitrates. Rehabilitation program for 30 patients the main group (MG) in addition included taking "Cardio Capillary with coenzyme Q10" at a dose of 500 mg, 1 tablet 3 times during food intake. Rehabilitation of all patients in the RC was carried out for 21 days. By age, FC and comorbidities of the group patients did not differ significantly. overwhelming the majority of patients are workers of highly emotional, mental labor. Statistical processing of the material was carried out with using the program "STATIST" on the PC.

Results of the study Upon admission to

the RC, the most frequent complaints of patients were pain in the region of the heart with irradiation to the left side of the chest. cells or scapula (23 people - 46%) of patients. angina attacks arose when walking on level ground at a normal or accelerated pace, climbing stairs at an average pace of less than two flights of stairs. Some patients experienced angina attacks at rest (6% of patients). The number of episodes of angina at admission was 10.4±1.5; for their relief, patients took sublingually up to 12.5±1.6 tablets of nitroglycerin per week. Shortness of breath when walking on a flat area was noted by 22 (44%) patients, and when climbing stairs to the 2nd floor - 34 (68%). Patients experienced palpitations with little physical exertion.

and sinus tachycardia was diagnosed. In most patients upon admission, signs of moderate hypercholesterolemia, hypercoagulability, hypoxemia, and microcirculation disorders were revealed. When conducting a stress test in all patients, a decrease in tolerance to physical activity was revealed, the average power of the threshold load was 65.6 + 4.6 W. Upon admission to the department, 24 (48.0%) patients were found to have impaired respiratory function (EP): restrictive type - in 7 (29.2%) people, obstructive type - in 17 (70.8%) patients .

Table 1

Results of rehabilitation of patients with myocardial infarction (\bar{y} m) \pm

Indicators	CG (n=20)		MG (n=30)		
	Up to treatment	After treatment	Before treatment	After treatment	
VC	82.6±4.2	95.0±4.4*	81.3±4.3	97.7±4.2*	
FVC	79.2±4.1	91.8±4.2*	79.7±4.2	92.2±4.1*	
FEV1	85.1±4.9	91.8±5.1	84.8±4.7	94.4±4.7*	
FEV1/VC	83.0±4.6	88.5±4.8	84.1±4.1	95.1±3.7*	
MOS25	79.6±5.3	90.2±5.3	80.6±4.7	98.2±4.2*	
MOS50	89.0±5.0	94.4±4.1	84.8±4.5	98.4±4.1*	
MOS75	90.3±5.8	95.5±5.6	91.4±4.2	98.4±4.1	
MVL	68.0±4.2	78.5±4.4*	66.3±4.2	84.9±4.3*	
yyj2, mm Hg	39.6±1.4	38.1±1.5	39.8±1.4	36.2±1.3*	
PO2, mm Hg	69.2±2.6	79.6±2.5*	68.4±2.2	79.4±1.6**	
PM, perfusion units	4.55±0.39	5.10±0.22	4.54±0.36	5.66±0.12*	
Total cholesterol, mmol/l	7.6±0.3	LDL cholesterol, mmol/l	3.7±0.4	3.4±0.6	3.6±0.3
mmol/l Triglycerides, mmol/l	1.2±0.04	1.1±0.03	1.2±0.03	1.4±0.04	
	1.8±0.05	1.7±0.04	1.8±0.04	1.6±0.03	

* - reliability of differences between indicators before and after treatment ($p < 0.05$); ** - reliable ness of differences between the indicators before and after treatment ($p < 0.01$).

Consequently, in patients with MI in the functional recovery period upon admission to the late hospital stage of rehabilitation (RC), manifestations of angina pectoris, hypoxemia, hypercoagulability, signs of heart and respiratory failure, decreased exercise tolerance, and microcirculation disorders prevailed. As a result of rehabilitation, most patients of both groups

noted an improvement in the general condition, a decrease in dyspnea with exercise, reduced angina attacks and the need for nitroglycerin. Table 1 presents results of complex rehabilitation of patients. In the MG of patients with the inclusion of "Cardio Capilar with coenzyme Q10" there was a statistically significant increase in VC, improvement in bronchial patency and increased MVL. The dynamics of the studied parameters in CG patients at the end of the rehabilitation course was less pronounced.

The improvement in the respiratory function contributed to an increase in blood oxygen saturation and a decrease in partial pressure in blood of carbon dioxide, which was confirmed by a statistically significant increase in pO2 in patients of the main group and a decrease pCO2. Improved respiratory function, increased blood oxygenation, capillary-protective action "Cardio Kapilar with coenzyme Q10" led to an improvement in MC, which was confirmed by the analysis of LDF grams, which indicated the existing change in the spectral characteristics due to the weakening of the role of high-frequency and pulse oscillations and increased influence of low frequency oscillations associated with an increase in the activity of the vasomotor mechanism of microcirculation regulation. The data obtained reflect the weakening of passive regulatory mechanisms associated with the state of outflow tracts and indicate a decrease in congestion, especially in patients with OH. Data from biochemical blood tests

indicate metabolic neutrality "Cardio Capilar with coenzyme Q10" - the levels of aspartate aminotransferase (AST), alanine aminotransferase (ALT), bilirubin, urea, creatinine, glucose did not change significantly during treatment. During the course of treatment of patients, a tendency to decrease in indicators was revealed.

total cholesterol (TC), low-density lipoprotein (LDL-C), increased high-density lipoprotein (HDL-C), however the dynamics of indicators was statistically unreliable, apparently due to the short observation period. None of the patients had a worsening of the condition and increased angina attacks and episodes of painless ischemia. All patients indicated good tolerability of the drug, improvement general well-being (reduction or disappearance of shortness of breath, decrease in the intensity of retrosternal pain, increased activity, improved sleep). Table 2 shows changes in hemodynamic parameters of the small and large circulation, tolerance to

physical activity in patients with MI as a result of rehabilitation.

As a result of rehabilitation, there was an improvement in performance hemodynamics, which is confirmed by a decrease in MAP and an increase in myocardial contractility (significant increase in FI). Improvement in hemodynamic parameters, respiratory function, blood oxygenation and microcirculation contributed to an increase in exercise tolerance. In patients with OH, the dynamics of these parameters was more significant than in patients with CG.

Table 3 presents the results of rehabilitation according to the indicators of the computerized heart screening system "Cardiovisor", indicating that in patients, as a result of rehabilitation, the processes of derepolarization in the myocardium stabilized. This was confirmed by the positive dynamics of the integral

indicator "myocardium". A statistically significant decrease in the "Rhythm" indicator indicated an improvement in the autonomic regulation of the heart rhythm.

table 2

Changes in hemodynamic parameters and TFN in patients with MI as a result of rehabilitation ($M \pm m$)

Indicators, units measurements	CG (n=20)		MG (n=30)	
	Before treatment	After treatment	Before treatment	After Treatments
AvPLA, mm Hg SI,	23.1±2.5	18.8±2.0	23.5±2.4	16.3±2.1*
I/sq.m2 Fl, % RPS,	2.70±0.13	2.60±0.16	2.70±0.12	2.68±0.14
us.un. TFN, W	50.5±0.8	52.0±1.1	50.2±1.1	53.7±0.8*
	1128.1±39.6	1123.3±40.2	1178.4±36.7	1114.3±32.2
	65.5±4.8	83.3±4.4*	65.8±4.2	96.4±4.1**

* - reliability of differences between indicators before and after treatment ($p < 0.05$);
* - reliability of differences between the indicators before and after treatment ($p < 0.01$).

Table 3

Evaluation of the rehabilitation effect with Cardiovisor ($M \pm m$)

Indicator	CG (n=20)		MG (n=30)	
	Before treatment	After treatment	Before treatment	After Treatments
"Myocardium"	37.2±3.1	26.9±4.1	36.8±3.4	22.4±3.2*
"Rhythm"	62.7±4.2	48.3±4.6*	62.4±4.4	41.4±4.2*

* - reliability of differences between the indicators before and after treatment ($p < 0.05$);

The inclusion of the Cardiovisor computer heart screening system in monitoring the course of rehabilitation treatment of post-infarction patients made it possible to evaluate the effectiveness of drug therapy, the state of the autonomic nervous system, cardiac arrhythmia and conduction disturbances, the presence and duration of ST segment depression, episodes of painless ischemia during treatment, which made it possible to timely correct the treatment and the program of physical rehabilitation of patients acute myocardial infarction. On the portrait of the heart, there was an increase in myocardial zones, colored in green (Fig. 1, 2).



Figure 1

Verification of myocardial infarction using Cardiovisor. The

implementation of rehabilitation programs contributed to the improvement psychoemotional state of all patients. In the majority of patients with OH, the RT index significantly decreased from 46.6±4.4 to 34.5±3.2 ($p < 0.01$), in the CG from 46.4±5.1 to 39.5±4.4 ($p > 0.05$). There were no significant changes in LT in any of the groups. Among the patients of the main group, the number of patients without violations of psychological adaptation and with mild

violations of psychological adaptation, which indicates the effectiveness of the rehabilitation program. In the control group, the positive dynamics was insignificant. According to the SAN test in MG showed a more significant improvement in a number of indicators in compared with the CG: well-being improved - by 18.8% ($p < 0.05$), in the CG - by 11.6% ($p > 0.05$); activity increased in MG by 24.2% ($p < 0.05$), in CG - by 12.8% ($p > 0.05$); mood improved in the MG by 30.8% ($p < 0.05$), in the CG - by 15.0% ($p > 0.05$), respectively. A decrease in the manifestations of respiratory and heart failure, an increase in exercise tolerance ensured a redistribution of patients according to angina pectoris FC (Fig. 3).

Distribution of patients of the main group by functional classes, after rehabilitation, indicates an increase in patients in the 2nd FC, and a decrease in the 3rd and 4th FC. Most patients in the control group remained the same functional class. Thus, as a

result of medical rehabilitation of patients with MI with the use of "Cardio Capilar with coenzyme Q10", the majority of patients showed an improvement in the parameters of respiratory function, central and peripheral hemodynamics, circulatory oxygenation

vi, improvement of microcirculation, which led to an increase in tolerance to physical activity, an improvement in the psycho-emotional state of patients and, ultimately, to an increase in the rehabilitation effect.

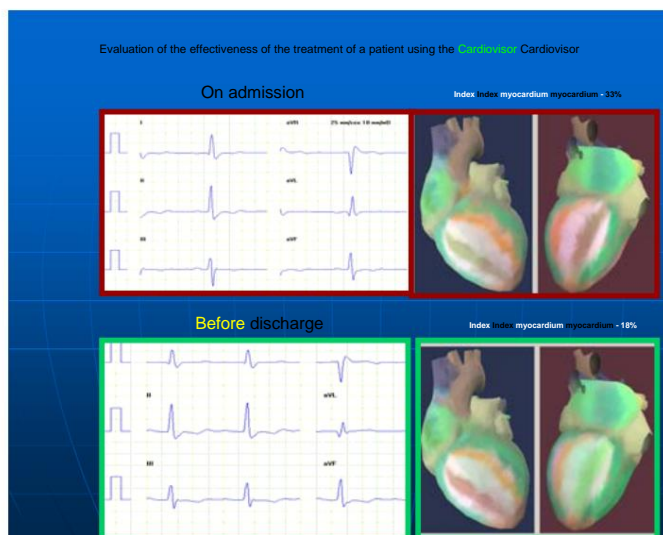


Figure 2
Evaluation of the rehabilitation treatment of myocardial infarction using "Cardiovisor".

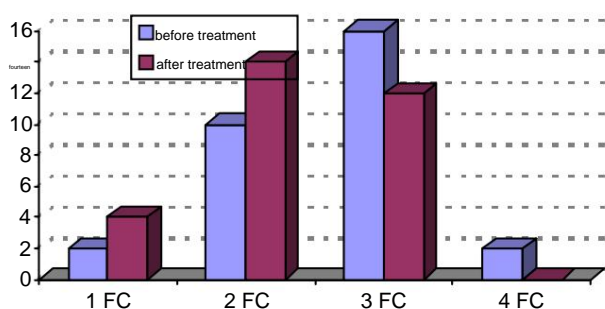


Figure 3

Redistribution of patients in the main group according to FC during rehabilitation

Discussion

The main pathogenetic factors in the development of a heart attack myocardium are: atherosclerotic coronary sclerosis; hypercoagulation due to activation of coagulation processes with simultaneous inhibition of the fibrinolytic system and violation of the rheological properties of blood associated with an increase in the ability of platelets to aggregate; coronary spasm like a manifestation of a functional disorder of the coronary blood supply, leading to a sharp discrepancy between the volume of coronary blood flow and the oxygen demand of the myocardium. The combined effect of these factors leads to critical occlusion coronary artery, causing a violation of microcirculation and ischemic myocardial damage with the development of AMI. Development microcirculatory disorders in MI is mainly due to changes in the rheological properties of blood, due to impaired deformability of erythrocytes, increased aggregation of them and platelets, increase in hemostatic and decrease in fibrinolytic blood potential, latent disseminated blood coagulation, as well as changes in the dynamics microvessels, which lead to an increase in the volume of the microcirculatory bed, centralization of blood flow and inefficiency of the MC. In turn, disturbances in the rheological properties of blood associated with aggregation of erythrocytes, accompanied by a decrease in quantities of the latter, even more disturb the supply of tissues with oxygen. The main cause of tissue hypoxia is the development of a mechanical microcirculatory block. Formed "vicious circle": pronounced violations of pulmonary ventilation in patients cause hypoxia and metabolic disorders in tissues. This leads to the appearance of a number of vasoactive substances that contribute to the development of microvascular disorders and intravascular aggregation, which, in turn, maintains and aggravates tissue metabolism disorders.

Hypoxia, blood hypercoagulability, and MC disorders significantly affect the state of myocardial contractility. patients with MI. Violation of the contractility of the left and of the right ventricle of the heart, increased peripheral resistance

resistance eventually leads to reduced performance hearts like a pump.

"Cardio Capilar with coenzyme Q10" improves intracardiac hemodynamics, systemic and pulmonary circulation, improves respiratory function and blood gases. The drug, having a positive effect on the indicators of peripheral microhemodynamics, promotes the transition of pathological types of microcirculation to normal and, thus, optimizes tissue microcurrent. "Cardio Capilar with coenzyme Q10" contributes to the redistribution of blood flow in small arteries, improving the perfusion of ischemic areas in tissues, including the myocardium. He

also eliminates spasm of the arteries, including the coronary. At severe atherosclerotic lesions of the coronary arteries, even minimal changes in the normal tone of the smooth muscles in areas of constriction may exacerbate ischemia, or contribute to its reduction. reduction in ischemia be also a consequence of the relaxation of the normal tone of the smooth muscles of the stenotic areas of the coronary arteries. In addition, taking "Cardio Capilar with Coenzyme Q10" prevents and relieves spasm in both normal and affected atherosclerotic process of the coronary arteries and thus contributes to the elimination of microangiopathy. The results of the study showed the high clinical efficacy of "Capilar-cardio" in a comprehensive program of medical rehabilitation of patients with coronary artery disease after AMI. Antioxidant effect of "Cardio Capilar with coenzyme Q10" helps to reduce the formation of active forms in tissues and blood

oxygen and peroxide radicals, which, under conditions of insufficient endogenous antioxidant system, have a direct damaging effect on cardiomyocytes, contribute to arrhythmogenic activity of the myocardium, activate procoagulant the blood system and accelerate the degradation of endothelial nitric oxide (NO), which provides vasodilation, reduce the antianginal efficacy of nitrates and the vasodilating ability of antihypertensive drugs. Application of "Cardio Capilar with coenzyme Q10" contributes to the improvement of microcirculation due to the normalization of the rheological properties of blood; increasing fibrinolytic activity; a decrease in the level of fibrinogen and platelet aggregation; improves central hemodynamics, myocardial contractility.

According to our data, in the course of complex treatment of patients with coronary artery disease after acute myocardial infarction using Cardio Capilar with coenzyme Q10 " there was an improvement in the performance of respiratory function, central and peripheral hemodynamics, blood oxygenation, improvement microcirculation, which led to an increase in tolerance to physical activity, an improvement in the psycho-emotional state and an increase in the rehabilitation effect. The results of the conducted studies show that several mechanisms underlie the positive effect of the components included in the "Cardio Capillary with Coenzyme Q10" : restoration of the oxygen transport function of the blood, normalization of the processes

LPO, rheological properties of blood and improvement of microcirculation.

Thus, the use of dietary supplement "Cardio Capilar with coenzyme Q10" in complex programs for the rehabilitation of patients with myocardial infarction helps to reduce the number of anginal attacks, improve the performance of the cardiorespiratory system, microcirculation, improve the psychophysiological state of patients, increase TFN, which allows us to recommend it as an additional therapy in the rehabilitation treatment of this category of patients. Conclusions:

- At the late hospital stage of rehabilitation in patients with MI in functional recovery period, hypercoagulation, hypoxic syndromes, microcirculatory disorders, which leads to disorders of central and peripheral hemodynamics, respiratory function, psychological state of patients and decrease in

TFN. • Inclusion in the comprehensive program of medical rehabilitation of patients with myocardial infarction Dietary supplement "Cardio Capilar with coenzyme Q10 " helps reduce the number of anginal seizures, improvement of indicators of the cardiorespiratory system, microcirculation, psychophysiological state of patients, which ensures an increase in the rehabilitation effect. • The use of the computer system "Cardiovisor" allows to analyze in dynamics the state of the myocardium of patients with MI in functional recovery period, control the course recovery process and evaluate the effectiveness of rehabilitation tations.