

Cardiac Rehabilitation of Patients with Coronary Heart Disease Undergoing Aortocoronary Bypass Surgery

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Abstract In Uzbekistan the incidence of coronary heart disease continues to be stably high fluctuating between 240-400 people per year per 100 000 adult population, but lethality from coronary heart disease has a steady downward trend from 324.1 to 260.4 patients per year per 100 000 adult population, by 2020 lethality decreased by 19.7%. The proposed complex adequate personalized program of cardiac rehabilitation and "School of coronary patients" at the outpatient-polyclinic stage is highly effective, increases self-control of compliance with doctor's prescriptions and health improvement lifestyle. It is an effective secondary prevention of coronary heart disease, as it improves lipid spectrum, reduces total cholesterol, normalizes body mass index of patients, improves quality of life and increases socialization of patients.

Keywords Ischemic heart disease, Morbidity, Mortality, Disability, Cardiac rehabilitation

1. Relevance

The most frequent pathology of cardiovascular system is generally recognized ischemic heart disease, also this disease is the leader in lethality among cardiovascular diseases – 46,8% of patients with cardiovascular diseases [5,13].

Globally, coronary heart disease kills about 3 million people annually, with more than 1/3 of them being young working-age population, and this number is increasing every decade, which gives this problem a socio-economic connotation [18].

The World Health Organization cites data on 690 million people in the world over 65 years of age for 2020 with coronary mortality among this age group of 50 million annually [14]. In Russia, 9,385,000 people died of cardiovascular diseases in 2020, of which 5,087,000 died of coronary heart disease and 581,000 died of myocardial infarction [3].

Economic damage from cardiovascular diseases in Russia in 2020 reached 3.8% of gross domestic product, what is almost the entire annual health care budget, but this is also due to the scarcity of health care funding in Russia (4.6% of the budget), so in Sweden 9.3% of the budget is allocated annually for health care, in Japan – 9.2%, in Germany – 8.9%, in Norway - 8.6%, the USA – 8.5% [3].

Direct medical costs of coronary heart disease in Europe and the USA reach about 40-50% of the total economic damage, 50-60% - indirect economic losses of the state [16,20]. In the structure of direct medical costs for cardiovascular diseases on a global scale, the costs of inpatient care – 60%,

doctors – 13%, drugs at the outpatient stage – 7%, home therapy – 4%, visits and monitoring of patients by nursing staff at home – 16% [23].

In Uzbekistan, the total economic losses due to myocardial infarction amount to more than 30 billion soums annually, with only 18.6% being direct medical costs and 81.4% being indirect economic losses [8].

The colossal economic damage due to cardiovascular diseases with extremely poor funding of health care causes the growth of economic damage, which requires the search for the most cost-effective methods of treatment of these pathologies [19,22].

The increasing occurrence and prevalence of coronary heart disease, the tremendous mortality and economic losses due to the decline in productivity and provision of medical care dictate the need to find effective prevention, treatment and rehabilitation measures for patients with coronary heart disease [21].

In the USA aortocoronary bypass surgery is performed on 180 patients out of 1 million, in European countries on average 360 patients, in Sweden – 777 per 1 million [15], in Russia the annual number of aortocoronary bypass surgeries exceeds 3000 and increases from year to year [7]. [15], in Russia the annual number of aortocoronary bypass operations exceeds 3000 and increases from year to year [7].

In Uzbekistan during the second decade of the new millennium the number of aortocoronary bypass surgeries increased fivefold due to the growing number of operations in an increasing number of institutions – the increase amounted to 26% over 5 years [2,4].

The results of studies by foreign scientists are practically not extrapolated to Uzbekistan due to differences in the principles of financing of medical institutions, methods and

availability of insurance medicine, sources of medicines, etc. It is also a problem to medico-economic analysis of treatment of non-working patients, for example, after 65 years of age, and the frequency of such interventions is increasing annually.

Despite the preservation of the basic principles, the methods of cardiac rehabilitation in the new millennium have changed significantly - dynamic monitoring is optimized by the latest objective methods and scientifically unsubstantiated restrictions are removed, the widespread use of psychophysiological rehabilitation of patients [17,22].

In the Russian Federation, the duration of inpatient cardiac rehabilitation after aortocoronary bypass surgery, in the absence of complications of the operation, is 10-19 days, depending on the medical institution. Further cardiac rehabilitation is possible in the department of a specialized cardiological sanatorium, followed by lifelong secondary prophylaxis, which often turns into only outpatient dispensary monitoring by a district doctor with cardiologist consultations if necessary [1,6,11,12].

The main reasons for insufficient patient participation in cardiac rehabilitation are poor awareness of doctors, social workers, nurses, and patients who have undergone myocardial infarction or aortocoronary bypass surgery about the need for cardiac rehabilitation and its programs, which causes low patient interest, the labor intensity of various cardiac rehabilitation programs in terms of volume and duration, and the significant economic component of cardiac rehabilitation [9,10,25,26].

There are no data on medical and economic efficiency of cardiac rehabilitation carried out in Uzbekistan, as well as on the level of economic costs for its implementation, but in the context of world experience its high costliness and huge labor intensity of highly qualified medical personnel are known, which casts doubt on the expediency of prolonged cardiac rehabilitation in our country, taking into account the sharply increasing in this case health care costs and not

known socio-economic effect.

This all substantiates the relevance of the present study, the **purpose** of which was to determine the main indicators of morbidity, disability and mortality from ischemic heart disease in Uzbekistan, to assess the effectiveness of cardiac rehabilitation of patients with ischemic heart disease who underwent aortocoronary bypass surgery.

2. Material and Methods

We studied 354 patients after aortocoronary bypass surgery, aged 40-65 years, (mean age 53.7 ± 5.1 years) hospitalized on days 12-27 for cardiac rehabilitation.

Clinical efficacy of cardiac rehabilitation was evaluated in all studied patients and in a comparative aspect between two groups - Group I included 169 patients who performed >75% of the planned cardiac rehabilitation activities, Group II included 185 less active patients.

Three-stage rehabilitation system (hospital, late hospital and sanatorium stages) was used for 86 patients who were admitted to the outpatient and polyclinic stage of cardiac rehabilitation on average on the 59th day after surgery, from which we formed two groups - the main group of 46 patients after aortocoronary bypass surgery, who underwent outpatient cardiac rehabilitation with inclusion of therapeutic physical training and passing the "School of coronary patients" and the comparison group of 40 patients after aortocoronary bypass surgery who did not undergo the outpatient stage of cardiac rehabilitation.

All patients were treated with standard medical therapy – antithrombotic therapy, hypolipidemic therapy, as well as prevention of heart failure progression, development of heart rhythm disorders and maintenance of optimal blood pressure [24].

We performed general clinical, laboratory, radiologic and functional methods of investigation.

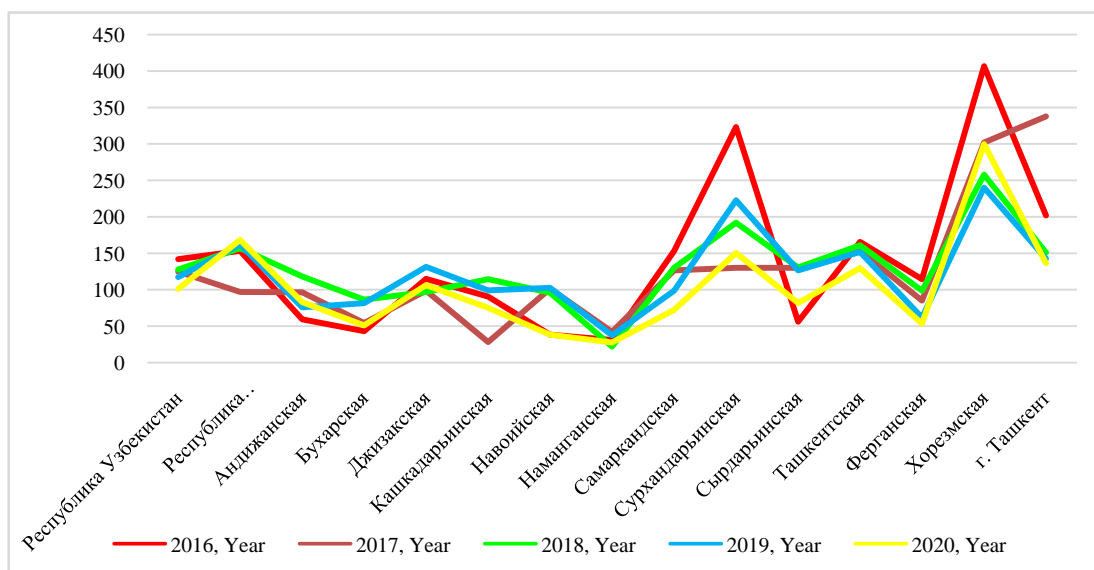


Figure 1. Average annual primary incidence of coronary heart disease per 100,000 inhabitants in the regions of Uzbekistan in 2016-2020 years

3. Results of the Study

Information on the incidence and prevalence of ischemic heart disease and its consequences in the Republic of Uzbekistan is based on the data on demand for medical care, which are reflected in the relevant lines of the state statistical reporting form of the Ministry of Health of the Republic of Uzbekistan.

Morbidity, on the one hand, characterizes the prevalence of diseases in the population, on the other hand - the availability of medical care, including preventive care.

As can be seen from the diagram in all studied zones the dynamics of indicators during five years there was a steady increase in morbidity. Especially high rates were obtained in Surkhandarya and Khorezm regions. In 2016 year these indicators amounted to 173 and 302 per 100,000 inhabitants, then already in 2018 year they increased almost 2 times. In Tashkent city, the opposite picture is noted. Thus, the average annual primary incidence of coronary heart disease per 100,000 inhabitants decreased in relation to the indicators of 2019 by 1.3 times.

The coronary heart disease mortality rate was calculated as the number of deaths from disease codes I00-I99 of the International Classification of Diseases 10th revision for 12 months per 100,000 inhabitants (Figure 2).

As can be seen from the diagram for the five-year observation there is a decrease in mortality from ischemic heart disease by 19.7%. The decrease in the overall incidence of coronary heart disease is due to the fact that since 2016, measures have been implemented according to the orders of the Ministry of Health of the Republic of Uzbekistan № 106 of 17.03.2014 "On improving the provision of diagnostic and therapeutic and preventive care for patients with acute coronary syndrome and acute myocardial infarction" and № 422 of 17.11.2014. "On improving the provision of diagnostic and therapeutic and preventive care for patients with arterial hypertension". The orders provided for measures to prevent diseases characterized by high blood pressure, which is one of the causes of coronary heart disease.

It is known that chronic course of ischemic heart disease can lead to the development of myocardial infarction. So according to the statistics of the Ministry of Health of the Republic of Uzbekistan the number of patients with myocardial infarction for 2021 is 59280 cases.

The highest rates are noted in Tashkent, Surkhandarya, Kashkadarya, Andijan, Fergana regions and the city of Tashkent. It should be noted that of all registered cases of myocardial infarction, only 22.9% receive inpatient treatment in specialized institutions.

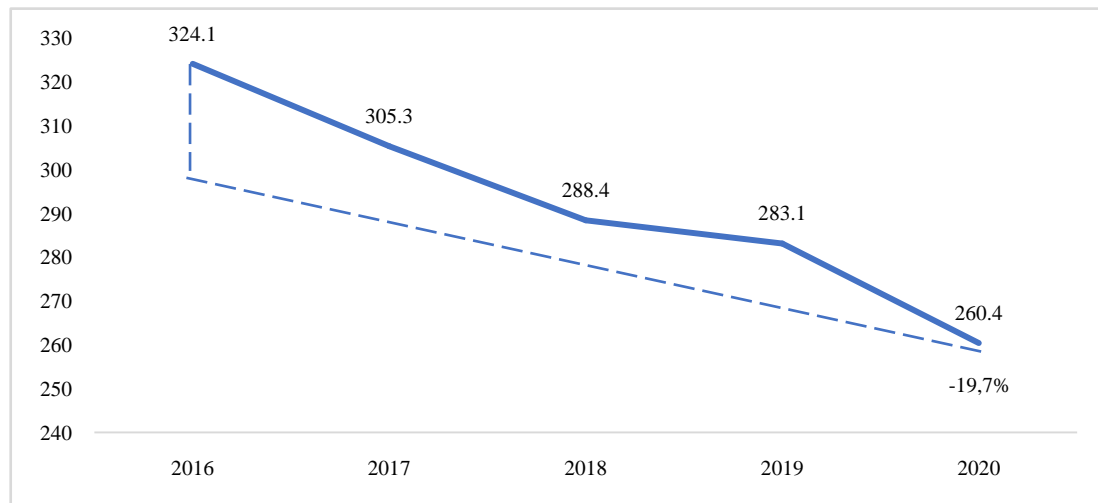


Figure 2. Dynamics of mortality from ischemic heart disease per 100,000 population

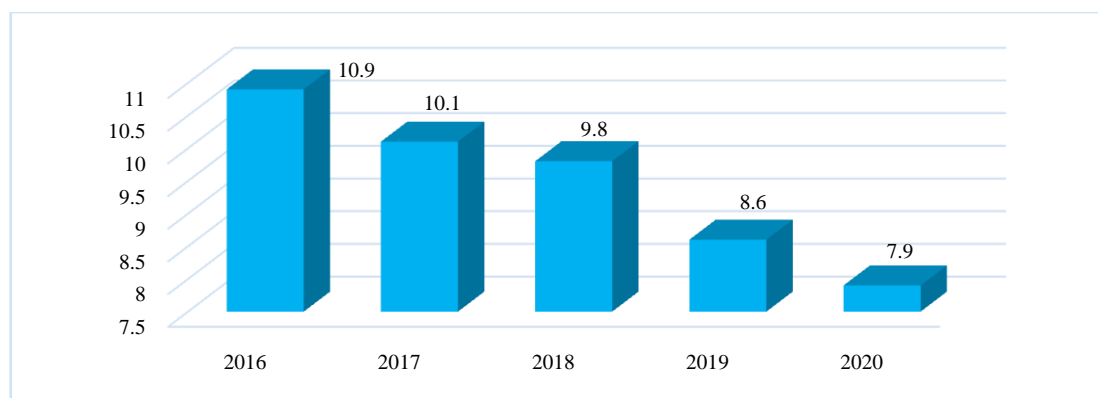


Figure 3. Primary disability among the adult population of Uzbekistan due to ischemic heart disease in 2016-2020 (per 10,000 population)

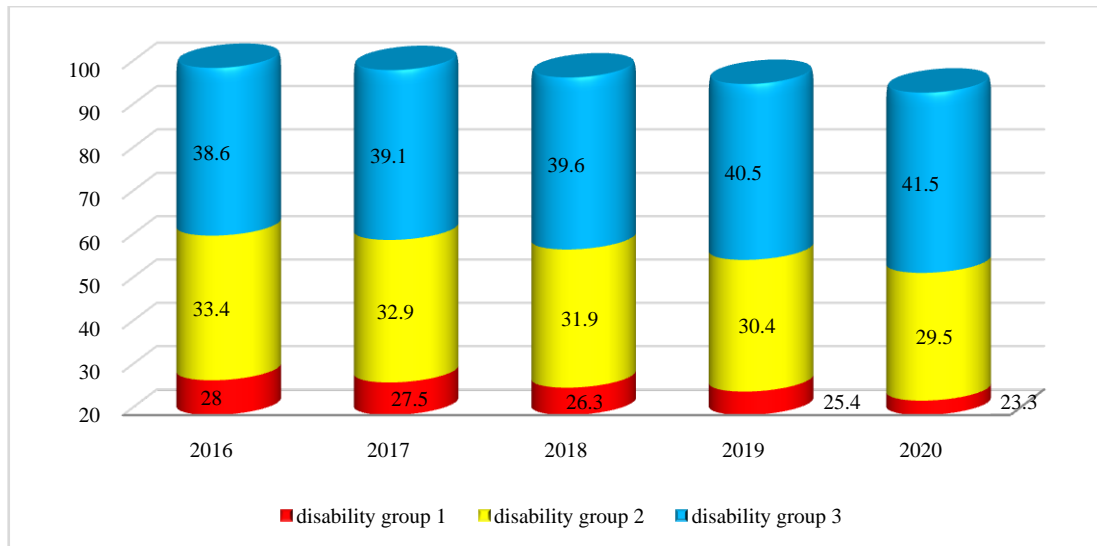


Figure 4. Share of primary disability among the adult population of Uzbekistan due to ischemic heart disease in 2016-2020 by groups (%)

The analysis showed that the primary disability among the adult population of Uzbekistan due to ischemic heart disease for 2016-2020 decreased by 27.5%, from 10.9 to 7.9 per 10,000 population (Figure 3).

The distribution by disability groups showed that the majority of the disabled had the third group (39.5%), the disabled of the second group amounted to 32.8%, and 27.7% were in the first group (Figure 4).

Thus, for the specified period in Uzbekistan there was both an increase and decrease in the incidence of coronary heart disease, as well as multidirectional fluctuations of the indicator in some years.

In patients of functional class I-III, the cycling load was equal to 50% of the threshold power and was often constant; in functional classes I and II, intermittent loading was performed in the final period of therapy with a short rise to 75% of the threshold power starting at 25% and increasing to 50 after 5 minutes. After the exercise bike, patients walked slowly and performed relaxation exercises. Patients who experienced cardialgia, arrhythmia, marked dyspnea, etc. during or after exercise bicycle training were interrupted, and the exercise regimen and intensity were reduced.

The patients practiced respiratory exercises in the respiratory training room in the form of sound exercises and training on a breathing simulator.

Optimized cardiac rehabilitation in 135 (79,9%) patients of group I was reflected by improvement - reduction of dyspnea, intensity of postoperative scar pain and increased tolerance to physical load.

Improvements in the state of cardiorespiratory system were also noted on the results of external respiratory functions, patients had decreased hypoxemia and hypercapnia, indicators of external respiratory functions, blood circulation in the great circle and pulmonary hemodynamics (reduction of average pressure in the pulmonary artery).

Physical performance and threshold power increased from 76.1 ± 4.2 to 107.4 ± 5.1 W ($p < 0.001$).

We noted improvements in myocardial contractility: increase in stroke volume ($p < 0.05$), decrease in end systolic ($p < 0.05$) and diastolic volumes with decrease in peripheral resistance ($p < 0.05$), what is the mode of heart work became more economical due to adaptation to new realities of coronary blood flow.

The effectiveness of cardiac rehabilitation is based on the improvement of myocardial oxygen delivery and optimization of regional coronary blood flow, which reduces the increase in heart rate and decreases the left ventricular end-diastolic volume, what is the dynamics is clearly positive.

The effectiveness of complex cardiac rehabilitation is also confirmed by the results of external respiratory functions: reliable increase of vital capacity of lungs (from $82.6 \pm 4.2\%$ to $95.0 \pm 4.4\%$), forced vital capacity of lungs (from $79.2 \pm 4.1\%$ to $91.8 \pm 4.2\%$) and improvement of bronchial conduction in the form of increase of forced expiratory volume in the first second (from $85.1 \pm 4.9\%$ to $91.8 \pm 5.1\%$), Tiffno index (from $83.0 \pm 4.6\%$ to $88.5 \pm 4.85\%$), maximal expiratory volume velocity₂₅ (from $79.6 \pm 5.3\%$ to $90.2 \pm 5.3\%$), maximal expiratory volume velocity₅₀ (from $89.0 \pm 5.0\%$ to $111.4 \pm 7.1\%$), maximal expiratory volume velocity₇₅ (from $90.3 \pm 5.8\%$ to $95.5 \pm 5.6\%$) and maximal ventilatory rate (from $68.0 \pm 5.2\%$ to $78.5 \pm 4.4\%$).

The function of external respiration within the age norms in group I was stated in 107 (63,3%) patients, the tendency to normalization - in 62 (36,1%), and in group II - in 58 (31,4%) and 115 (62,2%) patients respectively, in 12 (6,5%) patients the results remained the same.

Blood circulation in the small circle at the hospital stage of cardiac rehabilitation states slow increase of pressure at dosed load, the average pressure in the pulmonary artery significantly decreased: at rest from 23.8 ± 2.9 to 16.6 ± 2.2 mm.Hg, at the height of loading from 33.2 ± 2.9 to 22.7 ± 2.1 mmHg, at the 5th minute of rest from 27.7 ± 3.1 to 16.9 ± 2.5 mmHg ($p < 0,05$).

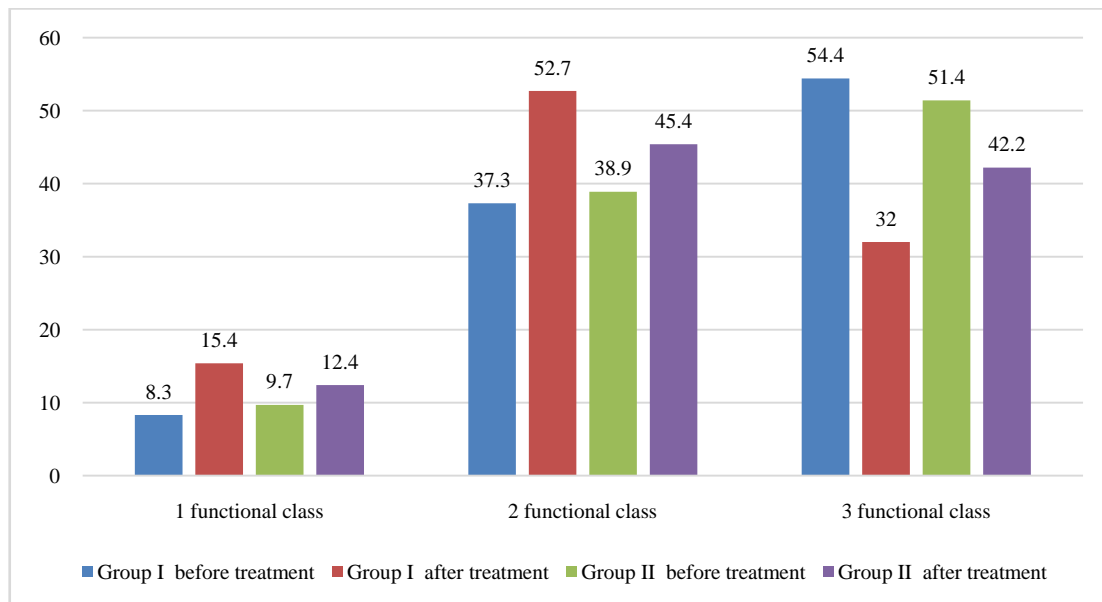
Table 1. Results of rehabilitation of patients at the hospital stage, (M±m)

Indicator	Group 1 (n = 169)		Group 2 (n=185)	
	Before treatment	After treatment	Before treatment	After treatment
Threshold power, W	76,1±4,2	107,4±4,4**	76,1±3,7	97,4±4,3
Mean pulmonary artery pressure, mmHg.	25,9±2,3	18,7±2,4*	24,5±2,3	18,8±2,3*
Heart rate, per min	82,6±3,8	70,1±2,6*	83,7±4,5	73,2±3,6
Total peripheral resistance, units.	1582,9±93,8	1258,8±73,6*	1574,9±83,7	1349,7±67,2*
Left ventricular end-systolic volume, ml.	73,1±3,7	64,4±3,1*	75,3±3,8	66,4±3,2
Left ventricular end-diastolic volume, ml.	144,1±5,9	136,8±4,8	146,2±5,8	139,5±3,8
Expulsion fraction, %	49,1±0,9	52,2±1,4	49,3±1,1	51,3±1,5

Table 2. Changes in external respiratory function as a result of rehabilitation of patients, (M±m)

Indicators	Group I (n = 169)		Group II (n=185)	
	Before treatment	After treatment	Before treatment	After treatment
Lung capacity	82,6±4,2	95,0±4,4*	86,0±4,2	90,5±5,1
Forced vital capacity of the lungs	79,2±4,1	91,8±4,2*	81,4±5,2	83,8±5,4
Forced expiratory volume in 1 s	85,1±4,9	91,8±5,1	87,4±4,3	91,7±4,4
Ratio of forced expiratory volume in 1 s. and vital capacity of lungs	83,0±4,6	88,5±4,8	80,8±4,5	87,5±4,5
Maximum volumetric speed at 25% level	79,6±5,3	90,2±5,3	83,2±5,8	93,0±5,6
Maximum volumetric speed at the level at 50%	89,0±5,0	111,4±7,1 *	89,8±5,3	90,9±5,6
Maximum volumetric speed at 75% level	90,3±5,8	95,5±5,6	96,4±5,2	98,2±5,8
Maximum lung ventilation	68,0±5,2	78,5±4,4*	64,2±4,9	66,1±5,2

Note: *- reliability of differences, p<0.05.

**Figure 5.** Redistribution of patients' functional class, %

We also found correlations between the increase in vital capacity of lungs, Tiffno index and maximal lung ventilation with the increase in tolerance to physical load ($r=0.65$, 0.51 and 0.69 , respectively).

Cardiac rehabilitation favorably affects the coagulogram parameters in all studied patients, the decrease of fibrinogen and soluble fibrin monomer complexes in group I is significantly significant relative to group II.

After the hospital stage of cardiac rehabilitation, the lipid profile improved, the level of total cholesterol significantly decreased from 6.45 ± 0.55 to 4.96 ± 0.35 mmol/L ($p<0.05$), most of all low-density lipoproteins, the other indices showed a tendency to normalization.

The improvement of lipid profile is explained by the increase in the activity of lipid metabolism enzymes due to physical exercise, as well as the quality of life of the studied -

mood, activity and self-confidence increased significantly, fear and anxiety disappeared, pathological fixation of attention on their health in 153 (90.5%) representatives of group I and in 99 (53.5%) in group II ($p < 0.01$).

Our proposed complex cardiac rehabilitation improved the well-being of 165 (97.6%) representatives of group I and 85 (45.9%) in group II - decreased dyspnea, disappeared or sharply reduced the intensity of pain of postoperative scars.

After the hospital phase of cardiac rehabilitation in Group I, the number of functional class 1 increased from 14 (8.3%) to 26 (15.4%), functional class 2 increased from 63 (37.3%) to 89 (52.7%), and functional class 3 decreased from 92 (54.4%) to 54 (32.0%).

In group II, there was a smaller increase in patients from functional class 1 18 (9.7%) to 23 (12.4%), functional class 2 from 72 (38.9%) to 84 (45.4%), and a decrease in patients from functional class 3 from 95 (51.4%) to 78 (42.2%).

The effectiveness of the outpatient stage of cardiac rehabilitation was assessed by comparing the results of clinical-instrumental and biochemical studies of the first year of cardiac rehabilitation.

The main group additionally received therapeutic physical training for half an hour 3-4 times a week, the patients of the comparison group did not receive such physical training.

At the outpatient polyclinic stage of cardiac rehabilitation, the patients were examined at 40-60 (56 ± 4.2) days after aortocoronary bypass surgery. At the first examination, all patients of both groups complained of postoperative scar and muscle pain, which increased during trunk rotations, deep breaths and coughing, which reduced the volume of movements and chest excursion during breathing.

41 (47.7%) patients complained of mild short-term pain in the heart area of aching or stabbing character, not relieved by nitroglycerin, without correlation with physical activity and stress. 49 (57%) patients stated general weakness, sleep disturbances, irritability.

Sinus tachycardia was most often diagnosed in patients of both groups, and supraventricular or ventricular extrasystoles were diagnosed in 2/3 of patients. Arrhythmias were detected in 22 (47.8%) patients of the main group and in 19 (47.5%) in the comparison group, labile hypertension - in 15 (32.6%) patients of the main group and in 5 (32.5%) in the comparison group, hypotension - in 7 (15.2%) and 8 (20.0%), respectively. In 8 (17.4%) patients of the main group and in 8 (20.0%) patients of the comparison group moderate dyspnea on physical load due to latent heart failure, restretractive and obstructive respiratory pathologies was stated.

Cephalgia, dizziness, apparent anxiety, and sleep disorders were found in 26 (56.5%) patients in the main group and 21 (52.5%) in the comparison group.

Before the beginning of outpatient cardiac rehabilitation, all the studied subjects were characterized by low tolerance to physical load, decreased pumping function of the left ventricular myocardium.

The use of early stages of cardiac rehabilitation in the main group of therapeutic physical training for a year led to a reliable decrease in mean arterial pressure, reduction of the

left side of the heart, increase in ejection fraction, increase in the proportion of high-density lipoproteins, decrease in body weight and frequency of angina attacks.

The benefit of outpatient complex cardiac rehabilitation undoubtedly has a positive effect on the clinical condition of patients in the main group - reduction or disappearance of neuropsychiatric syndrome and asthenia, normalization of anxiety and sleep, absence of angina symptoms, increased tolerance to physical load and performance of patients.

Dynamic monitoring of cardiovascular reserve was performed according to the results of exercise tolerance tests by load tests. At the outpatient polyclinic stage of cardiac rehabilitation the patients of the main group demonstrated reliable superiority of threshold power and volume of work performed compared to the comparison group.

Such indicator as double product significantly increased in the main group and showed a tendency to increase in the comparison group, what is myocardial oxygen saturation improved in the main group. In the main group after 2 years a reliable increase of high density lipoproteins and decrease of low density lipoproteins were observed.

The quality of life of patients in the main group showed better positive dynamics from -5.3 ± 0.56 to -2.1 ± 0.62 points ($p < 0.001$), physical and mental well-being increased. In the comparison group, quality of life improved from -5.2 ± 0.63 to -3.7 ± 0.57 ($p \leq 0.05$). Body mass index decreased significantly in the main group by 1.9%, angina attack frequency by 0.9%, and in the comparison group by 0.9% and 0.3%, respectively.

Table 3. Effectiveness of the «Coronary Care School»

Therapeutic measures	At the beginning of treatment		At the end of treatment	
	N	%	N	%
Take recommended medications on a regular basis	37	80,4	45	97,8
Regularly take the recommended medication at the recommended dose	15	32,6	35	76,1
Quit smoking	20	43,5	28	60,9
Strictly adhere to dietary recommendations	18	39,1	27	58,7
Regularly engage in physical activity	10	21,7	30	65,2

The effectiveness of the "Coronary Care School" is determined by the patient's accurate execution of the treatment complex.

Before training in the "School of Coronary Patients" 80.4% of patients regularly received prescribed medications, 32.6% complied with the required dosage, after training - 97.8% and 76.1%, respectively. Before "Coronary Care School", 39.1% of patients followed diet, 21.7% exercised, and after training, 58.7% and 65.2% of patients respectively. Non-smokers before the training were 43.5%, after it became 60.9%.

In the main group, only 2 patients underwent inpatient treatment of ischemic heart disease exacerbation, and in the comparison group, 7 (17.5%) patients received acute myocardial infarction, of which 4 (10.0%) died (Table 4).

Having analyzed the results of prospective observation of patients after aortocoronary bypass surgery we came to the conclusion that hospital, sanatorium and outpatient-polyclinic stages of complex adequate personalized cardiac rehabilitation program improve physical performance up to I-II functional class clinically and on bicycle ergometry, normalize the psychological status of patients in the first six months after aortocoronary bypass surgery.

Table 4. Clinical efficacy of the «Coronary Care School»

Complications of the outpatient polyclinic stage	Main group (n=46)		Comparison group (n=40)	
	N	%	N	%
Number of hospitalizations	2	4,3	7	17,5
Development of myocardial infarction	-	-	7	17,5
Dead	-	-	4	10,0

1 year after aortocoronary bypass surgery, the period of active monitoring of patients' condition by district cardiologists is practically over, and patients themselves start to neglect physical rehabilitation and autogenic training, immersing themselves in everyday problems. The overall quality of life decreases, but not to the original level.

4. Conclusions

1. In Uzbekistan, the incidence of coronary heart disease continues to be stably high, ranging from 240-400 per 100,000 adults per year.
2. Due to the competent health care reforms carried out in Uzbekistan, the mortality rate from ischemic heart disease has a steady downward trend from 324.1 to 260.4 patients per 100,000 adults per year; by 2020, the mortality rate has decreased by 19.7%.
3. In 2021, the number of patients with acute myocardial infarction was 59,280, but only 22.9% of them received inpatient treatment in specialized institutions, which cannot but alarm the cardiology service of the Republic of Uzbekistan.
4. Primary disability among the adult population of Uzbekistan due to ischemic heart disease is decreasing every year, for 2016-2020 decreased by 27.5%, from 10.9 to 7.9 per 10,000 adults, also from year to year there is a clear trend to reduce the number of disabilities of groups 1 and 2 due to an increase in disability group 3.
5. The proposed methodology of the hospital stage of cardiac rehabilitation improved exercise tolerance, hemodynamics and myocardial contractility, which immediately after aortocoronary bypass surgery were inferior to those in patients with conservative therapy of ischemic heart disease, indicating the greater severity of the condition after aortocoronary bypass surgery.
6. The proposed complex adequate personalized cardiac rehabilitation program and "School of coronary

patients" at the outpatient-polyclinic stage is highly effective, increases self-control of compliance with doctor's prescriptions and health improvement lifestyle. It is an effective secondary prevention of coronary heart disease, as it improves lipid spectrum, reduces total cholesterol, low-density lipoproteins and body mass index of patients, improves quality of life and increases socialization of patients.

REFERENCES

- [1] Aronov D.M. Rehabilitation and secondary prevention in patients with coronary heart disease // *Lechachy Doctor*. - 2017. - №3. - p.2-7. (in Russian).
- [2] Babadjanov S.A., Mansurov A.A., Murtazaev S.S., Makhkamov N.K., Khalikulov H.G., Anvarov J.O. Prognostic assessment of risk factors for the development of complications in patients with coronary heart disease after aortocoronary bypass surgery "Cardiology of Uzbekistan", 2020, №1(55), pp.23-27. (in Russian).
- [3] Health care in Russia. 2021. Statistical collection / P.A. Smelov, S.Y. Nikitina. - Moscow, Rosstat. - 2021. - 171 p. (in Russian).
- [4] Zufarov M.M., Bakhritdinov F.Sh., Makhkamov N.K., Babadjanov S.A., Algorithm of tactics of management of patients with coronary heart disease with lesions of the carotid arteries // *Methodical recommendations*. GU "RSNPMCH named after Acad. V. Vakhidov". Tashkent, 2019. 25 p. (in Russian).
- [5] Cardiac rehabilitation and secondary prevention / edited by D. M. Aronov. - Moscow: GEOTAR-Media, 2021. 464p., (in Russian).
- [6] Kartashov V.T., Danilov Y.F. Medical and prophylactic issues. Labor capacity of patients after reconstructive surgeries on coronary vessels // *Voен.-Med. zhurn.* - 2014. - T. 325, № 1. - p. 52-54, (in Russian).
- [7] Klimko V.V. Optimization of stage medical rehabilitation of patients with coronary heart disease who underwent coronary artery bypass grafting: Dissertation ... DSc medical sciences. - M, 2019. - 284 p. (in Russian).
- [8] The concept of development of health care system of the Republic of Uzbekistan for 2019-2025 (Annex 1 to the Decree of the President of RUz dated 07.12.2018 № UP-5590) (in Russian).
- [9] Rusakevich A.P. Complex medical rehabilitation of patients with coronary heart disease after percutaneous coronary interventions with the use of cyclic aerobic exercise at the late hospital stage: Autorref. disc. ...candidate of medical sciences. M., 2019. - 24 p., (in Russian).
- [10] Filimonov A.I. Assessment of the features of primary disability in patients with CHD after aortocoronary bypass surgery to form an optimal model of rehabilitation // *Medico-social expertise and rehabilitation*. - 2019. - № 1. - p. 22-24.; (in Russian).
- [11] Shevchenko IA, Vershinin AS, Barashkov VG, Saparunskaya

- TA, Shevchenko VI Rehabilitation of patients with cardiovascular diseases // *World of Medicine*. - 2020. - № 11-12. - p.12-14. (in Russian).
- [12] Shestakov, V.N. Medical aspect of rehabilitation of patients with ischemic heart disease at the sanatorium stage // *Cardiosomatics*. - 2018.-№1. - p. 5-8. (in Russian).
- [13] Ades Ph.A., Pashkow F., Nestor J.J. Cost-effectiveness of cardiac rehabilitation after myocardial infarction // *Cardiopulm. Rehabil.* - 2017. - Vol. 17. - P. 222-231.
- [14] Anttila T, Herajärvi J, Laaksonen H, Mustonen C, Honkanen HP, Y Dimova E, Piuhola J, Koivunen P, Juvonen T, Anttila V. Remote ischemic preconditioning and hypoxia-induced biomarkers in acute myocardial infarction: study on a porcine model. // *Scand Cardiovasc J*. - 2023. - №57(1). - p.225-230.
- [15] Atar D, Rosseland LA, Jammer I, Aakre KM, Wiseth R, Molund M, Gualandro DM, Omland T. Implementing screening for myocardial injury in non-cardiac surgery: perspectives of an ad-hoc interdisciplinary expert group. // *Scand Cardiovasc J*. - 2023 - №57(1). - p.31-39.
- [16] Erhardt L., Ball S., Andersson F. et al. Cost effectiveness in the treatment of heart failure with ramipril. A Swedish sub study of the AIRE study // *Pharmacoeconomics*. - 2017. - Vol. 12. - P. 256-266.
- [17] Gao S, Huang S, Lin X, Xu L, Yu M. Prognostic implications of stress hyperglycemia ratio in patients with myocardial infarction with nonobstructive coronary arteries. // *Ann Med*. 2023 - №55(1). - p.990-999.
- [18] Jiang Q, Zhang N, Zhang H, Xiao Y, Zhang X, Gao J, Liu Y. Impact of off-hour admission on the MACEs of patients with acute myocardial infarction. *Clin Exp Hypertens*. 2023 - №45(1). - p.218-227.
- [19] Li X, Xu C, Chen H, Yi F, Liao J, Han J, Li C, Han W, Han RPS, Chen H. A capillary-based microfluidic chip with the merits of low cost and easy fabrication for the rapid detection of acute myocardial infarction. // *Talanta*. 2023 - №265. - p.124-129.
- [20] Mark D.B. et al Economics overacting heart failure // *Am. J. Cardiol.* - 2017. - Vol. 80, 8B. - P. 33-38.
- [21] Pedersen OB, Larsen SB, Kristensen SD, Hvas AM, Grove EL. Immature platelets and cardiovascular events in patients with stable coronary artery disease. // *Platelets*. 2023 - №34(1). - p.221-230.
- [22] Ritin S.F., Davidson P., Griffiths R. et al. Improving Cardiac Rehabilitation Services - Challenges for Cardiac Rehabilitation Coordinators // *Eur. J. Cardiovasc. Nurs.* - 2021. - Vol. 10, №1. - P. 37-43.
- [23] Steinwachs D.M. et al. The future of cardiology: utilization and costs of care // *J. Am. Am. Coll. Cardiol.* - 2016. - Vol. 35, № 4. - P. 1092-1099.
- [24] Stroo JF, van Steenberghe GJ, van Straten AH, Houterman S, Soliman-Hamad MA. Long-term Outcome of Reexploration for Bleeding After Coronary Artery Bypass Grafting. // *J Cardiothoracic Vasc Anesth*. 2023 - №37(9). - p.1624-1630.
- [25] Todd M.B., Adrian F.H., Bittner V. et al. Predictors of cardiac rehabilitation referral in coronary artery disease patients // *J. Am. Am. Coll. Cardiol.* - 2019.-Vol. 54.-P. 515-521
- [26] Toor I, Bakhai A., Keogh B. et al. Age or 75 years is associated surgery: results from the United States Medicare program // *Ann. Thorac. Surg.* - 2018. - Vol. 85. -P. 1980-1986.