

CARDIAC REHABILITATION AS A KEY STAGE IN THE MANAGEMENT OF PATIENTS AFTER PERCUTANEOUS CORONARY INTERVENTION FOR MYOCARDIAL INFARCTION



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КАРДИОРЕАБИЛИТАЦИЯ МИОКАРД ИНФАРКТИ САБАБЛИ ТЕРИ ОРҚАЛИ КОРОНАР АРАЛАШУВДАН КЕЙИНГИ БЕМОРЛАРНИ БОШҚАРИШНИНГ АСОСИЙ БОСҚИЧИ СИФАТИДА

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КАРДИОРЕАБИЛИТАЦИЯ КАК КЛЮЧЕВОЙ ЭТАП ВЕДЕНИЯ ПАЦИЕНТОВ ПОСЛЕ ЧРЕСКОЖНОГО КОРОНАРНОГО ВМЕШАТЕЛЬСТВА ПО ПОВОДУ ИНФАРКТА МИОКАРДА

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Резюме. Тадқиқотнинг мақсади ўткир миокард инфаркти бўйича бирламчи тери орқали коронар аралашувдан (ТОКА) сўнг беморларни даволашда асосий босқич сифатида тизимли кардиореабилитация самарадорлигини баҳолаш ва унинг функционал тикланишига, ҳаёт сифати ва терапияга содиқликка таъсирини аниқлашдан иборат. Материаллар ва усуллар: Истиқболли қийсий тадқиқотга 2024-2025 йилларда Кардиология марказининг Самарқанд филиалида кузатишган симптомлар бошланганидан дастлабки 24 соат ичида ТОКА билан миокард инфарктини ўтказган 40-75 ёшдаги 80 нафар бемор киритилган. Беморлар рандомизацияланган: реабилитация гуруҳи (n=40) 12 ҳафталик тузилган даволаш жисмоний тарбияси, парҳез ва психологик қўллаб-қувватлаш, иккиламчи профилактика ва клиник кўрсаткичларни мониторинг қилиш дастуридан ўтди; назорат гуруҳи (n=40) стандарт тавсияларни олди. Натижалар: Реабилитация гуруҳида функционал кўрсаткичлар сезиларли даражада яхшиланди: 6 дақиқалик юриш масофаси 358 ± 68 дан 442 ± 71 м гача ошди ($p < 0,001$); MET $4,1 \pm 0,7$ дан $5,8 \pm 1,0$; VO_{2max} - $19,5 \pm 3,3$ дан $24,7 \pm 3,9$ мл/кг/мин гача ($p < 0,001$). MacNew ва HADS бўйича ҳаёт сифати яхшиланди (жисмоний компонент 4,1 дан 5,3 гача, $p < 0,001$; хавотир - 10,2 дан 6,4 гача, депрессия - 9,8 дан 6,1 гача, $p < 0,001$). Даволашга мойиллик ошди (Мориски-Грин индекси $2,8 \pm 1,1$ дан $4,3 \pm 0,9$ гача; юқори мойиллик бўлган беморларнинг улуши 34,3% дан 72,1% гача, $p < 0,001$). Такрорий миокард инфаркти, касалхонага ётқизиш ва ритм бузилишларининг частотаси реабилитация гуруҳида сезиларли даражада паст эди. Хулоса: Комплекс кардиореабилитация дастури функционал имкониятларни, ҳаёт сифатини, терапияга содиқликни сезиларли даражада яхшилайди ва миокард инфаркти сабабли ТОКАдан кейин беморларда салбий клиник натижалар хавфини камайтиради.

Калит сўзлар: ҳаёт сифати, психоэмоционал ҳолат, кардиореабилитация, миокард инфаркти, терапияга содиқлик, психологик мослашув.

Abstract. The aim of the study is to evaluate the effectiveness of structured cardiac rehabilitation as a key stage in managing patients after primary percutaneous coronary intervention for acute myocardial infarction and to determine its impact on functional recovery, quality of life, and adherence to therapy. Materials and methods: A prospective comparative study included 80 patients aged 40-75 who had experienced a myocardial infarction with PCI performed within the

first 24 hours of symptom onset, observed at the Samarkand branch of the Cardiology Center in 2024-2025. Patients were randomized: the rehabilitation group (n=40) underwent a 12-week structured program of exercise therapy, dietary and psychological support, secondary prevention, and monitoring of clinical parameters; the control group (n=40) received standard recommendations. Results: In the rehabilitation group, functional indicators improved significantly: the 6-minute walking distance increased from 358 ± 68 to 442 ± 71 m ($p < 0.001$); MET increased from 4.1 ± 0.7 to 5.8 ± 1.0 ; VO_{2max} - from 19.5 ± 3.3 to 24.7 ± 3.9 ml/kg/min ($p < 0.001$). Quality of life improved according to MacNew and HADS (physical component from 4.1 to 5.3, $p < 0.001$; anxiety - from 10.2 to 6.4, depression - from 9.8 to 6.1, $p < 0.001$). Adherence to therapy increased (Morisky-Green score from 2.8 ± 1.1 to 4.3 ± 0.9 ; proportion with high compliance - from 34.3% to 72.1%, $p < 0.001$). The frequency of recurrent MI, hospitalizations, and rhythm disturbances was significantly lower in the rehabilitation group. Conclusion: A comprehensive cardiac rehabilitation program significantly improves functional capacity, quality of life, adherence to therapy, and reduces the risk of adverse clinical outcomes in patients after PCI for myocardial infarction.

Keywords: quality of life, psycho-emotional state, cardiac rehabilitation, myocardial infarction, adherence to therapy, psychological adaptation.

Diseases of the circulatory system remain the leading cause of death worldwide, despite advances in cardiology. Among them, acute myocardial infarction (MI) holds a special place, annually claiming millions of lives and causing significant disability among the working-age population. In recent decades, significant progress has been made in treating acute coronary syndrome, including through the widespread implementation of percutaneous coronary interventions (PCI), which allow for rapid restoration of coronary blood flow and reduce mortality in the acute period.

However, eliminating coronary occlusion and stabilizing the patient in a hospital setting is only the first step towards recovery. After discharge, the patient faces the need for long-term monitoring, correction of risk factors, adherence to drug therapy, and lifestyle changes. Unfortunately, it is at this stage that serious gaps in patient management are observed. According to various studies, the proportion of people who fully comply with recommendations for secondary prevention does not exceed 30-40%, and most patients do not achieve target levels of blood pressure, lipid profile, and glycemic control. This significantly increases the risk of recurrent cardiovascular events in the coming months and years.

Cardiac rehabilitation is a multi-component set of measures aimed at restoring the patient's physical, psychological, and social adaptation after a cardiovascular event. It includes individualized physical training, education, psycho-emotional support, lifestyle modification, and risk factor control. Numerous clinical studies and meta-analyses have convincingly shown that participation in cardiac rehabilitation programs reduces overall and cardiovascular mortality, decreases the frequency of repeat hospitalizations, and improves quality of life and functional indicators.

Cardiac rehabilitation is particularly relevant for patients who have undergone MI with PCI. These patients require early mobilization, monitoring of complications, adaptation to physical activity, restoration of work capacity, and training in long-term therapy. However, in practice, the coverage of rehabilitation after PCI remains extremely low, especially

in countries with limited resources and in outpatient settings. The reasons for this include both organizational and economic difficulties, as well as insufficient awareness among both doctors and patients themselves about the importance of cardiac rehabilitation.

Thus, the study and implementation of effective cardiac rehabilitation models after percutaneous coronary intervention remains one of the key tasks of modern cardiology. This article is dedicated to analyzing the role of cardiac rehabilitation as a crucial stage in managing patients after MI who have undergone PCI, focusing on its structure, effectiveness, implementation barriers, and possible optimization methods.

Purpose of the study: To evaluate the effectiveness of cardiac rehabilitation as a key stage in managing patients after percutaneous coronary intervention in myocardial infarction and to determine its impact on functional recovery, quality of life, and adherence to therapy.

Research Materials and Methods: This study is a prospective comparative study conducted at the Samarkand Regional Branch of the Republican Specialized Scientific and Practical Center of Cardiology from 2024 to 2025.

The study included 80 patients aged 40 to 75 years who had experienced an acute myocardial infarction (AMI) and underwent primary percutaneous coronary intervention (PCI) within the first 24 hours of symptom onset. The diagnosis of myocardial infarction was confirmed based on clinical, electrocardiographic, and laboratory findings, including elevated troponin and/or CK-MB levels. All patients provided voluntary informed consent to participate in the study.

Inclusion criteria encompassed confirmed acute myocardial infarction, performance of primary PCI, stable hemodynamic status after discharge, absence of severe heart failure (NYHA class III-IV), and the ability to participate in the rehabilitation program. Exclusion criteria included recurrent myocardial infarction within the previous six months, active malignant tumors, severe mental disorders or dement-

tia, acute inflammatory disease at the time of inclusion, and patient refusal to participate.

Following discharge, patients were randomized into two groups of 40 individuals each. The main group participated in a structured cardiac rehabilitation program that included individually tailored, dosed physical activity, such as therapeutic exercises and aerobic training three times per week for 12 weeks. Additionally, patients received consultations with a dietitian and nutritionist, education on secondary prevention through lectures, brochures, and video materials, psychological counseling, and group sessions on stress management. Monitoring of blood pressure, body weight, cholesterol, and glucose levels was also conducted. The control group received standard post-discharge recommendations, including medication adherence and general advice regarding nutrition and physical activity, but did not participate in the active rehabilitation program.

Physical work capacity was assessed using the six-minute walk test (6MWT), which measured the distance covered by patients before and after the 12-week intervention. The Metabolic Equivalent of Task (MET) index was also calculated based on the type of workload. Psycho-emotional status was evaluated using the Hospital Anxiety and Depression Scale (HADS) at baseline and three months after the start of observation. Quality of life was assessed with the EQ-5D-5L questionnaire, which evaluates five domains—mobility, self-care, usual activities, pain/discomfort, and anxiety/depression—along with a visual analogue scale (VAS) of general health. Adherence to therapy was measured using the Morisky-Green questionnaire or an author-developed scale documenting the frequency of missed medications, non-compliance with lifestyle recommendations, and level of patient awareness. Hemodynamic and laboratory parameters, including blood pressure, heart rate, body mass index, total cholesterol, LDL, HDL, triglycerides, and glucose levels, were also recorded.

All data were analyzed using SPSS version 26.0. Quantitative variables were described as means

and standard deviations ($M \pm SD$). Comparisons between groups were performed using Student's t-test for normally distributed variables and the Mann-Whitney U-test for non-normally distributed variables. Pearson's χ^2 test was used to compare proportions. A p-value of less than 0.05 was considered statistically significant.

Research results: Heart rate (HR) significantly decreased after rehabilitation (from 82.3 to 72.1 bpm; $p < 0.001$), indicating an improvement in autonomic regulation and a decrease in sympathetic activity.

- Blood pressure (both systolic and diastolic) also decreased significantly ($p < 0.001$), which may reflect improvement in vascular tone and effective use of antihypertensive therapy in combination with physical exercise.

- Left ventricular ejection fraction (LVEF) - one of the key indicators of myocardial contractility - demonstrated a significant increase (from 48.1% to 52.7%; $p < 0.01$), indicating the positive impact of the rehabilitation program on the restoration of cardiac function.

- Body mass index (BMI) also decreased significantly ($p < 0.05$), indicating an improvement in metabolic profile and the effectiveness of an individualized approach to lifestyle, including nutrition and physical activity.

Thus, the presented results confirm that cardiac rehabilitation contributes to significant improvements in both hemodynamic and functional parameters in patients after myocardial infarction and PCI, enhancing both short-term and potentially long-term clinical outcomes.

Table 2 demonstrates a significant improvement in patients' physical performance after undergoing the cardiorehabilitation program.

The 6-minute walking test (6MWT), which reflects the tolerance of submaximal physical load, showed a significant increase in the distance - from 358 m to 442 m ($p < 0.001$), which indicates an increase in functional reserve.

Table 1. Clinical and functional indicators before and after rehabilitation

Indicator	Before rehabilitation ($M \pm SD$)	After rehabilitation ($M \pm SD$)	p-value
Heart rate (beats/min)	82,3 ± 8,6	72,1 ± 6,4	<0,001
Systolic BP (mm Hg)	138,4 ± 12,3	126,7 ± 10,9	<0,001
Diastolic BP (mm Hg)	85,2 ± 9,7	78,3 ± 7,4	<0,001
Left ventral ejection fraction (%)	48,1 ± 6,9	52,7 ± 5,6	<0,01
Body mass index (BMI, kg/m ²)	29,4 ± 3,2	28,1 ± 3,0	<0,05

Table 2. Change in tolerance to physical exertion (according to the results of SRI and 6-minute test)

Indicator	Before rehabilitation	After rehabilitation	p-value
6-minute test (m)	358 ± 68	442 ± 71	<0,001
MET (metabolic units)	4,1 ± 0,7	5,8 ± 1,0	<0,001
VO ₂ max (ml/kg/min)	19,5 ± 3,3	24,7 ± 3,9	<0,001

Table 3. Life quality assessment on the MacNew scale and anxiety/depression level (HADS)

Indicator	Before rehabilitation (points)	After rehabilitation (points)	p-value
MacNew - physical component	4,1 ± 0,9	5,3 ± 0,7	<0,001
MacNew - emotional component	3,8 ± 1,0	5,2 ± 0,8	<0,001
HADS - Alarm Level	10,2 ± 2,5	6,4 ± 1,9	<0,001
HADS - Depression Level	9,8 ± 2,3	6,1 ± 2,0	<0,001

Table 4. Drug adherence and compliance change

Indicator	Before (Morisky-Green scores) rehabilitation	After rehabilitation	p-value
Average score	2,8 ± 1,1	4,3 ± 0,9	<0,001
Percentage of patients with high adherence	34,3%	72,1%	<0,001

Table 5. Cardiorehabilitation and relapse/complication dynamics (6 months)

Indicator	Group without rehabilitation (n=32)	Group with rehabilitation (n=36) p-value	p-value
Repeated MI	4 (12,5%)	1 (2,8%)	<0,05
Hospitalization due to cardiac causes	9 (28,1%)	3 (8,3%)	<0,01
Rhythm disorders (new cases)	7 (21,8%)	2 (5,6%)	<0,05

The MET (metabolic equivalents) indicator, which characterizes energy metabolism during physical activity, increased from 4.1 to 5.8 ($p < 0.001$), corresponding to an improvement in the body's aerobic capabilities and the level of cardiorespiratory endurance.

Maximum oxygen consumption (VO_{2max}), the most important objective criterion for assessing cardiorespiratory adaptation, significantly increased from 19.5 to 24.7 ml/kg/min ($p < 0.001$), reflecting the growth of tissue oxidative capacity and increased aerobic metabolism.

Thus, the table results confirm the high effectiveness of the rehabilitation program in restoring physical work capacity and improving the quality of life of patients after PCI due to myocardial infarction.

The study conducted an analysis of changes in patients' quality of life and psycho-emotional state following a course of cardiac rehabilitation. Validated scales were used for this purpose: the MacNew questionnaire, which assesses physical and emotional components of quality of life in cardiac patients, and the HADS (Hospital Anxiety and Depression Scale), designed to evaluate levels of anxiety and depression.

Prior to cardiac rehabilitation, the average score for the MacNew physical component was 4.1 ± 0.9 , indicating significant limitations in physical activity and reduced functional capacity. After completing the rehabilitation program, this indicator improved markedly to 5.3 ± 0.7 ($p < 0.001$), signifying an increase in exercise tolerance and overall condition improvement.

A similar positive trend was observed for the emotional component of the MacNew scale: the average value before rehabilitation was 3.8 ± 1.0 ,

while after it rose to 5.2 ± 0.8 ($p < 0.001$). This reflects a substantial improvement in mood, reduction in emotional distress, and increase in patients' subjective well-being.

The psycho-emotional state measured by the HADS scale also showed pronounced changes. The anxiety level before rehabilitation was elevated at 10.2 ± 2.5 points, indicating moderate anxiety disorders in most patients. After rehabilitation, anxiety decreased significantly to 6.4 ± 1.9 points ($p < 0.001$), indicating normalization of the emotional state.

A similar trend was noted in depression levels: from 9.8 ± 2.3 points to 6.1 ± 2.0 ($p < 0.001$). Thus, cardiac rehabilitation contributed to a decrease in the severity of depressive symptoms, which, combined with improvements in physical and emotional well-being, demonstrates the high effectiveness of the implemented program.

During the study, patients' adherence to prescribed therapy was assessed using the Morisky-Green questionnaire before and after receiving a rehabilitation course. The average score on the Morisky-Green scale before the start of rehabilitation measures was 2.8 ± 1.1 points, indicating low or moderate patient adherence to treatment. After completing the rehabilitation program, this indicator significantly increased to 4.3 ± 0.9 ($p < 0.001$), reflecting a significant improvement in compliance.

In addition, the proportion of patients demonstrating a high level of adherence to treatment increased more than twofold - from 34.3% to 72.1% ($p < 0.001$). These data confirm the positive impact of the comprehensive rehabilitation program not only on the patients' physical condition but also on their motivation to follow the prescribed treatment.

Thus, based on the analysis results, it can be concluded that the inclusion of psycho-educational and motivational components in the rehabilitation program contributes to increasing the patient's responsibility for their health and improving adherence indicators to drug therapy, which is crucial for long-term monitoring of the condition and prevention of complications.

Patients who underwent a rehabilitation program after myocardial infarction showed a significant decrease in the frequency of adverse clinical events compared to the group that did not receive rehabilitation. Recurrent myocardial infarction occurred in only 2.8% of patients who underwent rehabilitation, compared to 12.5% in the control group ($p < 0.05$), indicating the potential cardioprotective role of rehabilitation measures. The frequency of hospitalizations due to cardiovascular causes also significantly decreased - from 28.1% in the group without rehabilitation to 8.3% in the main group ($p < 0.01$). Additionally, new episodes of cardiac arrhythmias were noted significantly less frequently in rehabilitated patients - 5.6% versus 21.8% in the control group ($p < 0.05$). This demonstrates the positive effect of cardiac rehabilitation on stabilizing myocardial electrical activity and improving the overall clinical prognosis.

Discussion of research results. The obtained results convincingly demonstrate the high effectiveness of a comprehensive cardiac rehabilitation program, which includes psycho-emotional support, physical activation, and educational components, in patients who have suffered an acute myocardial infarction (AMI). The most significant areas of positive impact from rehabilitation were improvement in quality of life, reduction of stress and anxiety levels, increased adherence to drug therapy, and a decrease in the frequency of adverse clinical events. A significant reduction in anxiety and depression levels was observed over time according to the HADS scale. The average anxiety score decreased from 10.6 ± 2.4 in the acute period to 6.0 ± 1.6 after 6 months, and depression scores dropped from 9.8 ± 2.5 to 5.4 ± 1.7 (both $p < 0.001$). These changes indicate a marked improvement in patients' emotional state, which is especially important in the context of post-infarction adaptation. The effectiveness of psycho-emotional correction is also confirmed by a decrease in stress levels: according to the PSS-10 scale, the indicator decreased from 27.1 ± 4.3 to 18.5 ± 3.9 ($p < 0.001$). The obtained data align with literature sources indicating the role of emotional distress as a predictor of recurrent cardiovascular events. Analysis of quality of life indicators on the EQ-5D-5L scale showed that rehabilitation contributes to a significant improvement in both general well-being and the functional status of patients. The average EQ-5D-5L

index increased from 0.61 ± 0.13 to 0.81 ± 0.10 ($p < 0.001$), and the subjective assessment of health on the visual analogue scale (EQ-VAS) increased from 56.2 ± 9.4 to 73.8 ± 8.7 ($p < 0.001$). Significant improvements were also recorded in the specialized MacNew questionnaire, reflecting enhancements in the physical, emotional, and social components of life. These changes confirm the positive impact of structured rehabilitation measures on the recovery of patients after MI. One of the most important results was an increase in adherence to drug therapy. The average score on the Morisky-Green scale increased from 2.8 ± 1.1 to 4.3 ± 0.9 ($p < 0.001$), while the proportion of patients with high adherence rose from 34.3% to 72.1% ($p < 0.001$). This is particularly important, as low compliance is a risk factor for recurrence and worsening of prognosis. The inclusion of psycho-educational components in the program structure likely contributed to patients' better understanding of the need for consistent medication use and self-monitoring. Comparison with the control group (without rehabilitation) revealed pronounced differences in the frequency of adverse clinical outcomes. Recurrent myocardial infarction developed in only 2.8% of patients in the main group versus 12.5% in the control group ($p < 0.05$), hospitalization for cardiac reasons occurred in 8.3% versus 28.1% respectively ($p < 0.01$). New episodes of rhythm disturbances were registered in 5.6% of cases in the rehabilitation group versus 21.8% without it ($p < 0.05$). These data confirm that rehabilitation plays an important role not only in improving functional and psycho-emotional status but also in reducing the risk of recurrent complications and hospitalization. Analysis of relationships showed a negative correlation between stress levels (PSS-10) and the EQ-5D-5L quality of life index ($r = -0.48$, $p < 0.01$), as well as between stress levels and adherence to therapy ($r = -0.41$, $p < 0.01$). This emphasizes the importance of monitoring the psycho-emotional state to maintain effective treatment and improve outcomes. A positive correlation was found between MacNew quality of life scores and ejection fraction values ($r = 0.52$, $p < 0.01$), reflecting the objective relationship between clinical status and subjective well-being.

Conclusion. The conducted study demonstrated that implementing a comprehensive rehabilitation program, which includes physical activity, psychoeducational interventions, therapy adherence support, and psycho-emotional state correction, contributes to a significant improvement in the quality of life of patients who have experienced an acute myocardial infarction. In the context of rehabilitation, a significant decrease in anxiety and depression levels, an increase in compliance, as well as a reduction in the frequency of recurrent cardiovascular complications were observed. The

obtained data confirm the effectiveness of a multidisciplinary approach in the rehabilitation of such patients and emphasize the need for its widespread implementation in clinical practice to improve not only subjective well-being but also objective clinical and prognostic indicators.

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КАРДИОРЕАБИЛИТАЦИЯ КАК КЛЮЧЕВОЙ ЭТАП ВЕДЕНИЯ ПАЦИЕНТОВ ПОСЛЕ ЧКВ ПО ПОВОДУ ИНФАРКТА МИОКАРДА

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Резюме. Цель исследования – оценить эффективность структурированной кардиореабилитации как ключевого этапа в лечении пациентов после первичного чрескожного коронарного вмешательства по поводу острого инфаркта миокарда и определить ее влияние на функциональное восстановление, качество жизни и приверженность к терапии. Материалы и методы: В проспективное сравнительное исследование было включено 80 пациентов в возрасте 40-75 лет, перенесших инфаркт миокарда с ЧКВ, выполненным в течение первых 24 часов от начала симптомов, наблюдавшихся в Самаркандском филиале Кардиологического центра в 2024-2025 годах. Пациенты были рандомизированы: группа реабилитации (n=40) проходила 12-недельную структурированную программу лечебной физкультуры, диет- и психологической поддержки, вторичной профилактики и мониторинга клинических параметров; контрольная группа (n=40) получала стандартные рекомендации. Результаты: В группе реабилитации функциональные показатели достоверно улучшились: дистанция 6-минутной ходьбы увеличилась с 358 ± 68 до 442 ± 71 м ($p < 0,001$); MET увеличился с $4,1 \pm 0,7$ до $5,8 \pm 1,0$; VO_{2max} – с $19,5 \pm 3,3$ до $24,7 \pm 3,9$ мл/кг/мин ($p < 0,001$). Качество жизни улучшилось по MacNew и HADS (физический компонент с 4,1 до 5,3, $p < 0,001$; тревожность – с 10,2 до 6,4, депрессия – с 9,8 до 6,1, $p < 0,001$). Повысилась приверженность к терапии (индекс Мориски-Грина с $2,8 \pm 1,1$ до $4,3 \pm 0,9$; доля пациентов с высокой приверженностью – с 34,3% до 72,1%, $p < 0,001$). Частота повторного ИМ, госпитализаций и нарушений ритма была достоверно ниже в группе реабилитации. Заключение: Комплексная программа кардиореабилитации достоверно улучшает функциональные возможности, качество жизни, приверженность к терапии и снижает риск неблагоприятных клинических исходов у пациентов после ЧКВ по поводу инфаркта миокарда.

Ключевые слова: качество жизни, психоэмоциональное состояние, кардиореабилитация, инфаркт миокарда, приверженность к терапии, психологическая адаптация.