

DOI 10.64108/imh.2025.2.2.37

UDC 616-036.82

## ROLE AND FEATURES OF PHYSICAL THERAPY IN MYOCARDIAL INFARCTION AT THE STAGES OF REHABILITATION

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**Abstract.** In Ukraine, about 1.2–1.5 million people suffer from coronary heart disease, about 100,000 people suffer from myocardial infarction. Medical and interventional treatments play an important role in the treatment of this chronic disease. Many researchers have found that physical exercise is safe and brings benefits, especially in terms of functional capacity, quality of life and survival.

The rehabilitation program for patients with myocardial infarction is a set of sequential stages of rehabilitation in a cardiac hospital, in the rehabilitation department of a local cardiac sanatorium and in polyclinics at the patient's place of residence. Cardiac rehabilitation is a complex process that involves improvement through endurance training, medical education on proper nutrition and lifestyle changes.

Analyzing the existing literature, in our country there was a system of cardiac rehabilitation, which included 3 stages - inpatient, outpatient and sanatorium.

The following stages of rehabilitation of patients who have suffered a myocardial infarction are distinguished. The inpatient stage, the main purpose of which is to restore the patient's ability to self-service, prevent deterioration of the cardiovascular system, skeletal muscles and other organs and systems due to hypodynamia. This stage includes the psychological preparation of the patient for further expansion of physical activity.

The sanatorium stage of rehabilitation is carried out by the patient on the basis of sanatorium-resort institutions (specialized cardiological sanatoriums). Here, patients perform the recovery phase program. The sanatorium stage, like the inpatient stage, has several levels, starting from the moment of admission to the sanatorium and ending with the end of the period of temporary disability.

The stage of maintenance rehabilitation is carried out under the supervision of a district therapist with periodic consultations of a cardiologist, this stage can be carried out both before and after the sanatorium stage of rehabilitation. In different countries, their own systems of rehabilitation of patients have been created. For some of them, accelerated, for others - slowed down rates of restoration of motor activity of patients are characteristic. However, the first direction prevails.

Thus, different variants of three indicators (degree of myocardial damage, nature of complications and severity of coronary insufficiency) form the class of severity of the patient's condition, which determines the tactics of physical rehabilitation.

**Conclusions.** 1. Existing cardiac rehabilitation programs and physical therapy methods in the recovery of individuals after myocardial infarction require generalization, improvement, approval and inclusion in protocols.

2. The development of rehabilitation programs for patients after acute coronary syndrome should include a phased approach, comprehensiveness, multidisciplinary approach and an individual approach.

3. Cardiac rehabilitation programs at different rehabilitation stages can be proposed when conducting physical therapy in patients with myocardial infarction.

4. The rehabilitation process should be assessed using the method of current and staged control, which ensures adequate expansion of the regimen and intensification of the load of each specific patient.

**Keywords:** physical therapy, cardiac rehabilitation, myocardial infarction, ischemic heart disease, therapeutic exercises, 6-minute walk test, treadmill test, cardioprotective effect, cardiovascular diseases.

**Introduction.** In Ukraine, about 1.2–1.5 million people suffer from coronary heart disease, about 100,000 people suffer from myocardial infarction [1]. Despite progress in diagnosis and treatment, the annual mortality after MI exceeds 40%, pre-hospital mortality is 23–35%, and hospital mortality is 7–15%. Patients who have survived the acute phase of MI have a much higher risk of a repeat cardiac event compared to the rest of the population.

Thus, medical and interventional treatments play an important role in the treatment of this chronic disease. Many researchers have found that physical exercise is safe and [2, 3].

Cardiac rehabilitation (CR) is a complex process that involves improvement through endurance training, medical education on proper nutrition and lifestyle changes. Regular physical exercise is very important in SR [4]. Numerous studies have provided data confirming the cardio-protective effect of regular physical exercise. It has been reported that there is a decrease in heart rate at rest and during submaximal exercise, a decrease in blood pressure during submaximal exercise, an increase in electrical stability of the heart, a decrease in blood lipid levels, an increase in tissue sensitivity to insulin and, finally, a decrease in body weight [5, 6, 7, 8]. The basis of a healthy lifestyle and the main element of primary and secondary prevention of cardiovascular diseases has become physical activity, which causes favorable physiological changes in cardiovascular function, reduces risk factors for cardiovascular diseases, and improves the psychophysical state of patients [9].

In patients after MI, it is important to assess physical performance and functional status using a standard, noninvasive, relatively safe, and inexpensive exercise test, i.e., exercise electrocardiography (treadmill test). Exercise testing is aimed at identifying patients at highest risk of sudden death and recurrent infarction. It is also used to assess the effectiveness of treatment and qualification for therapy and helps to choose the right model of CR (including planning endurance and resistance exercises [10, 11, 12]). Another test for measuring physical motor function and endurance capacity is the six-minute walk test (6MWT). It is a reliable, affordable, safe and easily accessible method [13].

The importance of physical rehabilitation of patients with myocardial infarction cannot be overestimated. The rehabilitation program for patients with myocardial infarction is a complex of successive stages of rehabilitation in a cardiac hospital, in the rehabilitation department of a local cardiac sanatorium and in polyclinics at the patient's place of residence.

The principles of physical rehabilitation are early onset, comprehensiveness, continuity and sequence of all stages of rehabilitation.

The assessment of the rehabilitation process is carried out by the method of current and stage control, which provides adequate expansion of the regimen and intensification of the load of each specific patient. Constant monitoring of the functional state of the patient also allows to assess the coronary reserve and physical performance of

patients, reflects the dynamics of the clinical symptoms of the disease. The first level of control over the process of rehabilitation treatment is the most accessible and at the same time quite informative clinical studies (survey, examination, palpation, percussion, auscultation, etc.), which allow to analyze both the dynamics of individual symptoms, syndromes of the disease, and the course of the disease as a whole. First of all, the patient's well-being is assessed, his appearance and behavior are observed, the pulse rate and AT levels are determined before and after the load [14].

Acceleration of the pulse at the height of the load (domestic - washing, squatting, walking, etc. or training - dosed walking, treadmill, exercise bike) and during the first 3 minutes after it by no more than 10-20 beats per 1 min, breathing - no more than 6-9 per 1 min; increase in systolic AT by 20-40 mm Hg. Art., diastolic - by 10-12 mm Hg. Art. from the initial or decrease in pulse rate by 10 beats per min, decrease in DBP by no more than 10 mm Hg. Art. are indicators of an adequate reaction. The occurrence of an attack of angina, arrhythmia, sharp shortness of breath, pronounced weakness and a feeling of discomfort, pallor of the skin, acrocyanosis, as well as inadequate dynamics of the pulse and BP indicate an adverse reaction to the load. In this case, further exercise should be temporarily stopped.

The second level of control consists of instrumental methods, in particular electrocardiography, blood pressure monitoring and ECG. ECG criteria for stopping exercise are depression or elevation of the ST segment by 1 mm or more, the appearance of frequent and complex rhythm disturbances or significant worsening of the patient's existing arrhythmias.

Of particular importance in the conduct of rehabilitation treatment is the assessment of tolerance to physical exertion, which is carried out using stress tests (dosed walking, bicycle ergometry or treadmill).

A dosed walking test involves walking along the corridor for 3-5 minutes at a pace of 70 steps per minute. If there are no changes on the ECG and the patient's well-being remains satisfactory, then after a 3-5-minute rest, the walking pace is gradually increased by 10 steps per minute to 120 (less often to 130 steps per minute) provided that there are no criteria for stopping the test. When conducting a bicycle ergometric stress test, the load is gradually increased, starting from 25 W. The increase in load is stopped when clinical signs of inadequate response to load or ECG signs of coronary insufficiency appear (ST segment shift, inadequate increase or decrease in heart rate, appearance of arrhythmias or blockades on the ECG). If signs of ischemia do not appear, then the load is increased to the submaximal value of heart rate, but not more than 120 beats per minute for patients with myocardial infarction with early bicycle ergometry.

Another important indicator of the adequacy of the load is the "double product", which is determined by multiplying the maximum systolic arterial pressure by the pulse rate.

Rehabilitation of patients with myocardial infarction

(MI) begins from the first days of hospitalization. A feature of the rehabilitation of patients with MI is its multifaceted nature. Based on this, several aspects of rehabilitation can be distinguished. Physical rehabilitation is designed to restore the physical performance of patients who have suffered MI, which is achieved by adequate activation in the early stages of recovery, the appointment of therapeutic gymnastics already 2–3 days after the onset of the disease, provided that the acute pain syndrome is eliminated and there are no complications or their rapid relief.

Physical rehabilitation of patients with MI is designed to solve a number of important tasks:

- creating conditions that reduce the hemodynamic load on the heart;
- correction of the patient's psychoemotional state;
- prevention of thrombosis of small branches of the pulmonary artery;
- normalization of the functions of the autonomic nervous system;
- teaching the patient the correct type of breathing; - increasing the oxygen capacity of the blood;
- normalization of protein and nitrogen metabolism, prevention of muscle hypotrophy;
- improvement of central hemodynamics;
- moderate stimulation of blood circulation.

Absolute contraindications for the appointment of physical exercises are: unstable angina and angina at rest, arterial hypertension with diastolic blood pressure of 110 mm Hg. and above, rhythm disturbances (paroxysmal tachycardia, atrial fibrillation, ventricular extrasystoles, etc.), atrioventricular blocks of more than II–III degree, heart failure of more than II A degree, complicated MI, pericarditis, thrombophlebitis of the lower extremities. When prescribing exercise therapy, it is necessary to remember that from the moment of providing first aid, the process of adaptation of the affected heart muscle to physical exertion begins, since healthy cardiomyocytes have to take on the work that the area affected by necrosis can no longer perform. As a result, the vascular system supplying the heart muscle also undergoes changes (the emergence of new collaterals for better blood supply and oxygen delivery). The respiratory system, which supplies oxygen to all organs and tissues of the body, will also adapt to the new conditions. Therefore, the recovery process is accompanied by the adaptation of systems that ensure the survival of the organism [15].

The physiological aspect of adaptation is associated with the sparing, adequate and effective adaptation of the body to the influence of external environmental factors. In the 14 adaptation process, homeostasis is formed, which requires systematic support. In cardiology, this is a system of physical activity that can maintain the achieved level of activity for a long time.

The main principles of phased systemic rehabilitation of patients who have suffered MI are:

- early onset;
- comprehensive use of all types;
- continuity and continuity between phases;
- introduction of a system of physical activity for each

patient, capable of maintaining a sufficient level of activity for a long time [16].

Views on medical rehabilitation of patients with MI have changed significantly in recent years. If twenty years ago patients were in a mode of prolonged hypodynamia from the first day of the disease, today rapid activation with uncomplicated course or quickly stopped complications is a more acceptable method during the treatment of MI. However, it should be noted that the optimal timing of the expansion of the regimen should be individual for each patient. There are several types of rehabilitation programs, depending on the patient's belonging to one of the four severity classes or to FC. Stages of rehabilitation.

There are 4 stages of rehabilitation of patients who have suffered MI. The inpatient stage, the main purpose of which is to restore the patient's ability to self-care, prevent deterioration of the cardiovascular system, skeletal muscles and other organs and systems due to hypodynamia. This stage includes the patient's psychological preparation for further expansion of physical activity. Modern socio-economic conditions force us to take into account the high cost of the patient's stay in a specialized cardiology department or in an intensive care unit. In such conditions, the goal of the inpatient stage is to restore the patient's physical and psychological condition as soon as possible, and prepare him for the next stage of rehabilitation. The outpatient stage. After discharge from the hospital, the patient is under the supervision of a cardiologist in a polyclinic, where there is an office or rehabilitation department. At this stage, the cardiologist systematically monitors the patient's condition, evaluating ECG data, biochemical blood parameters, and adjusts drug treatment.

The sanatorium stage of rehabilitation is carried out by the patient on the basis of sanatorium-resort institutions (specialized cardiological sanatoriums). Here, patients follow the recovery phase program. The sanatorium stage, like the inpatient stage, has several levels, starting from the moment of admission to the sanatorium and ending with the end of the period of temporary disability. The stage of maintenance rehabilitation is carried out under the supervision of a district therapist with periodic consultations and control of a cardiologist; this stage can be carried out both before and after the sanatorium stage of rehabilitation. Different countries have created their own systems of patient rehabilitation. Some of them are characterized by accelerated, while others are characterized by slowed rates of restoration of motor activity of patients. However, the first direction prevails [17].

The terms of activation of patients with MI are influenced by their belonging to the FC, which is determined by assessing, first of all, the degree of reduction in the body's capabilities and the nature of accompanying complications.

Given the great influence of complications on the course of MI and on the acceptability and safety of certain physical rehabilitation measures, complications of MI are conditionally divided into 3 groups.

Complications of the first group:

- a) rare extrasystole (no more than one extrasystole per

minute), frequent extrasystole, but transient, as an episode;

b) atrioventricular block of the first degree, which existed before the development of this MI;

c) atrioventricular block of the first degree only in posterior MI;

d) sinus bradycardia; e) circulatory failure without congestive phenomena in the lungs, liver, lower extremities;

e) epistenocardial pericarditis;

g) blockade of the bundle of His bundle (in the absence of atrioventricular blockade).

The more severe complications of the second group include:

a) reflex shock (hypotension);

b) atrioventricular block above I degree (any) in posterior MI;

c) atrioventricular block of I degree in anterior MI or on the background of bundle branch block;

d) paroxysmal rhythm disturbances, except for ventricular paroxysmal tachycardia;

e) pacemaker migration;

f) frequent extrasystole (more than one extrasystole per minute) or polytopic, or group, or type R on T, long (during the entire period of the disease) or frequently recurring episodes;

g) circulatory failure of stage II-A;

h) Dressler's syndrome;

i) hypertensive crisis (except for the crisis in the most acute period of the disease);

j) stable arterial hypertension (systolic pressure 200 mm Hg, diastolic - 110 mm Hg).

The most severe complications are of the third group. These include:

a) recurrent, prolonged course of MI;

b) state of clinical death;

c) complete atrioventricular block;

d) atrioventricular block above I degree in anterior MI;

e) acute cardiac aneurysm;

f) thromboembolism of various organs;

g) true cardiogenic shock;

h) pulmonary edema;

i) circulatory failure;

k) thromboendocarditis;

l) gastrointestinal bleeding;

m) ventricular paroxysmal tachycardia;

n) a combination of two or more complications of the second group.

The third group of complications includes a combination of two or more complications of the second group. For example, paroxysmal tachycardia is a complication of the second group, but if it develops against the background of circulatory failure, even only stage II-A, the patient's condition becomes more complicated, and its activation should be carried out according to a more careful program, therefore, the combination of these two complications of the second group is regarded as a complication of the third group [18, 19, 20].

The severity of coronary insufficiency has a signifi-

cant impact on the severity of the patient's condition and, accordingly, on the nature of physical rehabilitation measures. Since the conditions for identifying the reserve capabilities of the coronary circulation are limited due to the impossibility of carrying out stress tests in the early period of the disease, one should focus on the frequency of angina attacks as a characteristic of the severity of coronary insufficiency.

The absence of angina attacks or the development of an anginal attack of exertion no more than once a day without ECG changes indicates the degree of coronary insufficiency, which does not significantly affect the pace of physical rehabilitation. The occurrence of angina attacks of exertion up to 2-5 times a day indicates coronary insufficiency, which requires a more careful approach to activating the patient, but at the same time does not exclude its gradual increase.

With more frequent angina of exertion (more than 6 times a day) and angina at rest, the patient's condition should be classified as a more severe class, the physical rehabilitation program for such a patient should be cautious.

Thus, different options for three indicators (degree of myocardial damage, nature of complications and severity of coronary insufficiency) form the severity class of the patient's condition, which determines the tactics of physical rehabilitation.

Analyzing the existing literature, in our country there was a system of cardiac rehabilitation, which included 3 stages - inpatient, outpatient and sanatorium.

The main tasks of the previous model were as follows.

Inpatient stage.

The tasks of the inpatient rehabilitation stage:

- to achieve such a level of physical activity that the patient could serve himself;

--climb one floor up the stairs;

- to walk up to 2-3 km in 2-3 approaches during the day.

The main tasks of the sanatorium stage were:

- further increase in the physical performance of patients;

- elimination or reduction of psychopathological syndromes;

- preparation of patients for professional activity;

- secondary prevention of progression of ischemic heart disease;

- psychological readaptation of the patient;

- to prepare the patient for independent life and production activity [21, 22, 23].

This stage provided for a significant increase in the intensity of physical exertion during physical rehabilitation, primarily due to physical rehabilitation.

Outpatient. After completion of treatment in a cardiological sanatorium or rehabilitation department of a hospital

The main tasks of this stage:

- restoration of cardiovascular system function;

- increase of tolerance to physical exertion;

- secondary prevention of coronary heart disease;

- restoration of working capacity, return to professional activity;
- preservation of restored working capacity;
- partial or complete refusal of supportive drug therapy;
- improvement of the patient's quality of life.

In modern conditions, such a model needs to be improved with the development of protocols and programs for providing assistance to patients after acute coronary syndrome - at the acute, post-acute and long-term stages of rehabilitation [24, 25, 26].

The provision of rehabilitation care for patients with cardiovascular pathology is provided for in medical guarantee programs. In particular, the direction of cardiorespiratory rehabilitation includes the following conditions:

1. Condition after acute myocardial infarction
2. Conditions after coronary revascularization operations
3. Conditions after heart valve operations
4. Conditions after invasive interventions to restore sinus rhythm (catheter radiofrequency destruction (ablation), defibrillation and cardioversion, implantation or replacement of an artificial pacemaker, implantation of a cardioverter-defibrillator)
5. Conditions after heart and lung transplantation

Rehabilitation is implemented by a multidisciplinary team, in particular, rehabilitation specialists begin to provide assistance at the acute stage (in patients with acute coronary syndrome) and continue at the following stages

**Conclusions.** 1. Existing cardiac rehabilitation programs and physical therapy methods in the recovery of

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individuals after myocardial infarction require generalization, improvement, approval and inclusion in protocols.

2. The development of rehabilitation programs for patients after acute coronary syndrome should include a phased approach, comprehensiveness, multidisciplinary approach and an individual approach.

3. Cardiac rehabilitation programs at different rehabilitation stages can be proposed when conducting physical therapy in patients with myocardial infarction.

4. The rehabilitation process should be assessed using the method of current and staged control, which ensures adequate expansion of the regimen and intensification of the load of each specific patient.

**Prospects for further research.** Our research is aimed at finding new and improving existing rehabilitation programs after myocardial infarction.

**Conflict of interest.** The authors declare that they have no conflict of interest in relation to this study, including financial, personal, authorship, or any other conflict that could affect the research and its results presented in this article.

**Financing.** The study was conducted without financial support.

**Author contributions:** M.V. Zelinska a) conception and design; c) provision of materials for the study; d) collection and synthesis of data; Yu. S. Kuravska, M.V. Mylenka e) analysis and interpretation of results; I.K. Churpiy f) writing of the manuscript; b) administrative support; g) editing of the manuscript;

All authors have read and agreed with the published version of the manuscript.

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УДК 616-036.82

## РОЛЬ ТА ОСОБЛИВОСТІ ФІЗИЧНОЇ ТЕРАПІЇ ПРИ ІНФАРКТІ МІОКАРДА НА ЕТАПАХ РЕАБІЛІТАЦІЇ

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**Резюме.** В Україні близько 1,2–1,5 мільйона людей страждають на ішемічну хворобу серця, близько 100 000 осіб переносять інфаркт міокарда. Медичні та інтервенційні методи лікування відіграють важливу роль у лікуванні цього хронічного захворювання. Багато дослідників виявили, що фізичні вправи безпечні та приносять переваги, особливо щодо функціональної здатності, якості життя та виживання.

Програма реабілітації хворих на інфаркт міокарда – це комплекс послідовних етапів реабілітації в кардіологічному стаціонарі, у відділенні реабілітації місцевого кардіологічного санаторію та в поліклініках за місцем проживання хворого. Серцева реабілітація – це складний процес, який передбачає вдосконалення за допомогою тренувань на витривалість, медичної освіти щодо правильного харчування та зміни способу життя.

Аналізуючи існуючу літературу, у нашій державі існувала система кардіологічної реабілітації, яка включала 3 етапи – стаціонарний, поліклінічний та санаторний.

Розрізняють наступні етапи реабілітації хворих, що перенесли інфаркт міокарда. Стаціонарний етап, головне призначення якого – відновлення здатності хворого до самообслуговування, запобігання погіршенню стану серцево-судинної системи, скелетної мускулатури й інших органів і систем внаслідок гіподинамії. Цей етап включає психологічну підготовку хворого до подальшого розширення фізичного навантаження.

Санаторний етап реабілітації хворий проходить на базі санаторно курортних закладів (спеціалізовані кардіологічні санаторії). Тут хворі виконують програму фази одужання. Санаторний етап, як і стаціонарний, має кілька рівнів, починаючи з моменту надходження до санаторію і закінчуючи завершенням терміну тимчасової непрацездатності.

Етап підтримувальної реабілітації здійснюється під наглядом дільничного терапевта з періодичними консультаціями кардіолога, цей етап може здійснюватися як до, так і після санаторного етапу реабілітації. У різних країнах створені власні системи реабілітації хворих. Для одних із них характерні прискорені, для інших – уповільнені темпи відновлення рухової активності хворих. Проте перший напрямок переважає.

Таким чином, різні варіанти трьох показників (ступінь ураження міокарда, характер ускладнень і вираженість коронарної недостатності) формують клас тяжкості стану хворого, що визначає тактику фізичної реабілітації.

**Висновки.** 1. Наявні програми кардіологічної реабілітації та методи фізичної терапії у відновленні осіб після перенесеного інфаркту міокарда, потребують узагальнення, удосконалення та затвердження і внесення в протоколи.

2. Розробка програм реабілітації пацієнтів після гострого коронарного синдрому має включати поетапність, комплексність, мультидисциплінарність та індивідуальний підхід.

3. Програми кардіологічної реабілітації на різних реабілітаційних етапах може бути запропонована при проведенні фізичної терапії у пацієнтів з інфарктом міокарда.

4. Оцінку реабілітаційного процесу проводити методом поточного та етапного контролю, що забезпечує адекватне розширення режиму та інтенсифікацію навантаження кожного конкретного пацієнта.

**Ключові слова:** фізичне навантаження, серцева реабілітація, інфаркт міокарда, ішемічна хвороба серця, терапевтичні вправи, тест з 6-хвилинною ходьбою, тредміл-тест, кардіопротекторний ефект, серцево-судинні захворювання.

Стаття надійшла в редакцію 11.06.2025 р.

Стання прийнята до видання 29.08.2025 р.