WORLD JOURNAL OF MEDICAL INNOVATIONS

# Physical rehabilitation of patients following acute myocardial infarction after stenting

Makar Oksana[1], Piasetsky Pavlo[2], Bilianskyi Oleg[2], Siabrenko Gennadii[3], Shatynska-Mytsyk Iryna[4], Harbar Myroslava[5]

[1]*Department of Rehabilitation, Faculty of Postgraduate Education, Danylo Halytsky Lviv National Medical University, Lviv, Ukraine.*

[2]*Department of Physical Therapy and Occupational Therapy, Ukrainian Catholic University, Lviv, Ukraine.*

[3]*Kirovohrad regional clinical hospital for war veterans, Ukraine.*

[4] *Family Medicine Department, Faculty of Postgraduate Education, Danylo Halytsky Lviv National Medical University, Lviv, Ukraine*

[5]*Department of Anesthesiology and Intensive Care, Faculty of Postgraduate Education, Danylo Halytsky Lviv National Medical University, Lviv, Ukraine.*

**Article info**

**PHYSICAL THERAPY, CARDIAC REHABILITATION**

**Original Research**

Article history:
Accepted
April 15, 2024

Published online
May 21, 2024

Copyright © 2024 by WJMI
All rights reserved

***Keywords:***
*myocardial infarction,*
*physical therapy,*
*cardiac rehabilitation*

Abstract

Rehabilitation of patients following an acute myocardial infarction remains one of the most urgent tasks of modern cardiology. Cardiac rehabilitation programs are aimed not only at improving the functioning of the cardiovascular system but also at ensuring the mental health of patients, restoring their working capacity, and returning to a full-quality life as soon as possible. Patients receive many benefits of cardiac rehabilitation from physical training. The main type of physical exercise in patients with cardiovascular diseases is aerobic training, which increases maximal oxygen consumption and improves cardiorespiratory endurance. The dosed training method is the basis of the development of the patient's functional adaptation to physical exertion in cardiovascular diseases. The objective was to develop and test the effectiveness of the physical therapy method proposed by the authors for the recovery of patients with acute myocardial infarction after stenting. Material and methods: clinical (standard) examination and interview of the patient, medical history, blood pressure (BP) and heart rate (HR) measurement, pulse oximetry with saturation (SpO2) determination, orthostatic test, 10-meter walk test (10MWT), the Timed Up and Go test (TUG), the 6 Minute Walk Test (6MWT). 16 patients were enrolled in the study which lasted 5 weeks. Sessions according to the developed methodology of physical therapy were conducted with each patient for 12 days. Inclusion criteria: age between 50-80 years old, medical diagnosis: myocardial infarction, after stenting, no contraindications to cardiac rehabilitation. The effectiveness of the developed method of physical therapy for the recovery of patients with acute myocardial infarction after stenting was assessed. Changes in the performance of 10MWT, 6MWT, and TUG tests indicated improved adaptation and tolerance of the respiratory and cardiovascular systems to exercise, as well as normalization of blood pressure, heart rate, and SpO2. Conclusions. Physical exercises, according to the developed program of physical therapy, improve the general physical condition of patients, increase their functional capabilities, improve indicators of cardiovascular and respiratory system and have a positive effect on life quality. The study confirmed the importance of physical therapy in the recovery of patients with acute myocardial infarction after stenting.

**Corresponding author.** Makar Oksana, Department of Rehabilitation, Faculty of Postgraduate Education, Danylo Halytsky Lviv National Medical University, Pekarska str., 69, Lviv, 79019, omakar013@gmail.com

## Introduction

Coronary heart disease (CHD) is the main cause of mortality among the adult population in the world, despite the significant improvement of the prognosis over the last decade [1, 2, 3]. Rehabilitation of patients after an acute myocardial infarction remains one of the most urgent tasks of modern cardiology. Cardiac rehabilitation programs are aimed not only at improving the functioning of the cardiovascular system, but also at ensuring the mental health of patients, restoring their working capacity, and returning to a full-quality life as soon as possible [4]. Patients receive many benefits of cardiac rehabilitation from physical training [5,6,7]. The main type of physical exercise in patients with cardiovascular diseases is aerobic training, which increases maximal oxygen consumption and improves cardiorespiratory endurance. Their essence consists in the long-term performance by the patient of dynamic efforts of a certain intensity by large muscle groups. Most often, a continuous or interval training protocol is used. Training for the early period of rehabilitation can be carried out in various forms: on a bicycle ergometer; walking on a treadmill; on the steppe, rowing machines, or imitating cross-country skiing; walking in controlled conditions with a gradual increase in distance. Walking is a human motor activity that achieves physiological impact with the least amount of energy and mental effort. This is the simplest, most effective, easy-to-dosage and convenient method of training. This type of load is based on the idea of cyclic exercises that are repeated every time. At the same time, large muscle groups are actively functioning. Walking restores adaptation to loads of different intensity, activating the body's vegetative processes [8].

## Objective

To develop and test the effectiveness of the physical therapy method proposed by the authors for the recovery of patients with acute myocardial infarction after stenting.

## Materials and methods

To achieve the goal, we used the following clinical and instrumental research methods: clinical (standard) examination and interview of the patient, medical history taking, blood pressure (BP) and heart rate (HR)measurement, pulse oximetry with determination of saturation (SpO2), orthostatic test, 10-meter walk test (10MWT), the Timed Up and Go test (TUG), the 6 Minute Walk Test (6MWT).

Cardiac rehabilitation in the acute period of myocardial infarction, if there are no contraindications, begins 12-48 hours after immobilization, provided the clinical picture is stabilized. Further expansion of mobilization elements depends on the disease duration and possible complications of the acute phase. The occurrence of complications requiring additional therapy makes it necessary to extend individual periods of rehabilitation. Heart rate and blood pressure are measured prior to training, at the peak of exercise, and after training. Exercises should be stopped in case of the following symptoms: anginal pain, shortness of breath, increase in heart rate by more than 20 bpm, decrease in heart rate by more than 10 bpm, dangerous arrhythmias caused by physical exertion, blood pressure drop by more than 10-15 mmHg and/or an increase in systolic blood pressure by more than 40 mmHg and/or diastolic blood pressure by more than 20 mmHg compared to baseline. It is recommended to repeat the exercises twice a day. To preserve the continuity of the rehabilitation process, exercises should be performed on all days of the week [6].

While developing the physical therapy methodology, we considered the basic principles of cardiac rehabilitation and existing methods and tools, as well as scientific research proving the effectiveness of cardiac rehabilitation. Inclusion criteria for this study: age 50-80 years; diagnosis of acute myocardial infarction after stenting, absence of contraindications to cardiac rehabilitation. In this study, we developed a method of physical therapy for the recovery of patients with acute myocardial infarction after stenting and verified its effectiveness. In total, the study lasted 5 weeks. During these 5 weeks, 16 patients participated in the study. Classes according to the developed program of physical therapy were conducted with each patient for 12 days. The individual session with the patient lasted 30 minutes. It included walking on a treadmill, breathing exercises, and exercises to increase the strength of the lower extremity muscles. In addition, the patients had an independent session during which they performed breathing exercises and exercises to increase the strength of the lower extremity muscles. Adjustment of duration, pace and load was made individually, depending on the patient's condition, BP, heart rate, and SpO2 indicators.

## Results and discussion

The developed method of physical therapy for the recovery of patients with acute myocardial infarction after stenting includes two components: examination and intervention.

After getting acquainted with the patient's medical history and interviewing, saturation and hemodynamic parameters were determined, and an orthostatic test was performed. The patient's readiness to conduct physical therapy classes was determined. When the patient is in a supine position, and cannot remain in a sitting position for a long time, breathing exercises and exercises to increase the strength of the lower limb muscles in the supine position are used. In addition, we adapt the patient to a change in body position, encouraging him to sit as long as possible.

Breathing exercises are used to improve ventilation of the lungs with an emphasis on inhalation and movement of the trunk and upper limbs, which would contribute to additional expansion of the chest. Exercises to increase the strength of the lower limb muscles are performed to prepare the patient for walking. Breathing exercises and exercises to increase the strength of the lower limb muscles are performed 2 times daily.

If the patient can already sit for a long time, the above exercises are performed in a sitting position, in addition, the patient tries to adapt to a standing position. With the help of an orthostatic test (standing), further actions are determined. Thus, other tests are used according to the dynamics of the patient: "Get up and go" test, 10-meter walk test, 6-minute walk test. Since all study participants were adapted to the vertical position, on the 1st day of rehabilitation, after the orthostatic test (standing), the "Get up and go" tests and the 10-meter walk test were used. On the 2nd day a 6-minute walking test was performed. With this in mind, the study used breathing exercises and exercises to increase the strength of the lower limb muscles in a standing position, as well as dosed walking. To increase the load, the distance was increased, then the pace of walking was increased. Breathing exercises were performed as 1 approach from 5 to 8 times. Exercises to increase the strength of the lower extremity muscles as 1 approach from 5 to 10/15 times. Between these exercises, the patients rested for 1 to 2 minutes. The number of repetitions was increased gradually, considering the patient's condition and contraindications. We used a treadmill and walking stairs with a gradual increase in the load on the cardiovascular system. Walking on the treadmill started at a speed of 2 km/h, lasting from 5-8 minutes with a gradual increase to 10 minutes on the following days of rehabilitation. After the patients were able to walk for 1 set of 10 minutes without rest, the speed was increased to 2.5-3.0 km/h. In the following days, after 10 minutes on the treadmill at a speed of 2.5-3.0 km/h, the speed was increased to 3.5-4.0 km/h. The maximum speed in this study was 5 km/h for 10 minutes. In most patients, walking speed increased from 2 km/h to 4.0-5.0 km/h during 12 days of rehabilitation. Between walking on the treadmill and walking up the stairs, there was a rest break of up to 5 minutes. Walking up the stairs took place as follows: going down to the 1st floor and going up to the 2nd. At the beginning of the rehabilitation, walking up the stairs was started with 1-2 sets of 1-2 minutes each, and the rehabilitation was completed with 2 sets of 3-4 minutes each. Between sets, the patients rested from 2 to 5 minutes.

Hemodynamic parameters were measured before, during, and after the exercises. The IBM SPSS (Statistical Package for the Social Sciences) program was used to perform statistical data analysis. The Wilcoxon test was used to evaluate the differences in the results before and after physical therapy. The following tests were used for initial and final testing: "Get up and go" test, 10-meter walk test, 6-minute walk test.

The initial testing with the help of the "Get up and go" test and the 10-meter walk test was carried out on the first day of rehabilitation, and the final - on the 11th day of rehabilitation. Instead, a 6-minute walking test was performed on the 2nd and 12th day of rehabilitation. The results of initial and final testing were compared to evaluate the effectiveness of the physical therapy technique. A comparison of BP, heart rate, SpO2, stand-up-and-go test, 10-meter walk test, and 6-minute walk test was performed between all patients at the beginning and e the end of the study. The average of the results of all patients was calculated and the changes in the percentage ratio between the initial and final examination, as well as between the indicators before and after the test, were determined.

Changes in the indicators of the "Get up and go" test indicate an improvement in the adaptation and tolerance of the respiratory and cardiovascular systems to physical exertion, as well as the normalization of all indicators (Table 1).

Table 1. Comparison of the indicators of the "Get up and go" test

| Examination | BP (average) (%-change between before and after) | BP changes between the beginning and the end of examination (%) | Heart rate (average) (%-change between before and after) | $SpO_2$ (average) | Changes between before and after (%) | |
|---|---|---|---|---|---|---|
| | | | | | HR | $SpO_2$ |
| **Initial** | Before: 136/85<br>After: 134/86<br>(SBP↓1,5%\|<br>DBP↑1,2%) | SBP↓4,4%\|<br>DBP↓1,2% | Before: 77<br>After: 86<br>(↑11,7%) | Before: 96%<br>After: 96% | ↑3,8% | ↑1% |
| **Final** | Before: 130/84<br>After: 131/83<br>(SBP↑0,8%\|<br>DBP↓1,2%) | SBP↓2,2%\|<br>DBP↓3,5% | Before: 80<br>After: 86<br>(↑7,5%) | Before: 97%<br>After: 97% | 0% | ↑1% |

BP – blood pressure; SBP – systolic blood pressure; DBP – diastolic blood pressure; HR – heart rate.

By averaging the results, it was found that patients completed the Get Up and Go test 1.9 seconds faster than at baseline.

Changes in the parameters of the 10-meter walking test indicate improvement in adaptation and tolerance of the respiratory and cardiovascular systems to physical exertion, as well as normalization of blood pressure and SpO2 (Table 2).

Table 2. Comparison of the indicators of the 10-meter walking test before and after physical therapy

| Examination | BP (average) (%-change between before and after) | BP changes between the beginning and the end of examination (%) | Heart rate (average) (%-change between before and after) | $SpO_2$ (average) | Changes between before and after (%) | |
|---|---|---|---|---|---|---|
| | | | | | HR | $SpO_2$ |
| **Initial** | Before: 136/84<br>After: 134/86<br>(SBP↓1,5%\|<br>DBP↑2,4%) | SBP↓4,4%\|<br>DBP 0% | Before: 80<br>After: 86<br>(↑7,5%) | Before: 96%<br>After: 96% | ↑2,5% | ↑1% |
| **Final** | Before: 130/84<br>After: 132/83<br>(SBP↑1,5%\|<br>DBP↓1,2%) | SBP↓1,5%\|<br>DBP↓3,5% | Before: 82<br>After: 89<br>(↑8,5%) | Before: 97%<br>After: 97% | ↑3,5% | ↑1% |

BP – blood pressure; SBP – systolic blood pressure; DBP – diastolic blood pressure; HR – heart rate.

After calculating the average of the results, it was found that the patients passed the 10-meter walking test 0.19 m/s faster than at the initial examination.

Changes in the parameters of the 6-minute walk test indicate improvement in adaptation and tolerance of the respiratory and cardiovascular systems to physical exertion, as well as normalization of heart rate and SpO2 (Table 3).

Table 3. Comparison of indicators of the 6-minute walking test before and after physical therapy

| Examination | BP (average) (%-change between before and after) | BP changes between the beginning and the end of examination (%) | Heart rate (average) (%-change between before and after) | $SpO_2$ (average) | Changes between before and after (%) | |
|---|---|---|---|---|---|---|
| | | | | | HR | $SpO_2$ |
| **Initial** | Before: 128/80<br>After: 131/85<br>(SBP↑2,3%\|<br>DBP↑6,3%) | SBP↑1,6%\|<br>DBP↑ 1,3% | Before: 82<br>After: 95<br>(↑15,9%) | Before: 96%<br>After: 96% | ↓2,4%<br>↓1,1% | ↑2%<br>↑2% |
| **Final** | Before: 130/81<br>After: 131/82<br>(SBP↑0,8%\|<br>DBP↑1,2%) | SBP 0%\|<br>DBP↓3,5% | Before: 80<br>After: 94<br>(↑17,5%) | Before: 98%<br>After: 98% | | |

BP – blood pressure; SBP – systolic blood pressure; DBP – diastolic blood pressure; HR – heart rate.

After calculating the average of the results, it was found that the patients passed the 6-minute walk test by 64 m more than at the initial examination.

## Conclusions

Physical exercises, as a means of physical therapy in the recovery of patients with acute myocardial infarction after stenting, improve the general physical condition of patients, increase their functional capabilities, improve indicators of cardiovascular and respiratory system activity, and positively affect the quality of life. This study confirmed the effectiveness of the proposed method of physical therapy in the recovery of patients with acute myocardial infarction after stenting.

## References

1. Reed GW, Rossi JE, Cannon CP. Acute myocardial infarction. Lancet. 2017;389(10065):197-210.
2. Lekhan VM, Kriachkova LV. The system of measures to improve the health of the population of Ukraine based on the analysis of the global burden of diseases and its risk factors. Medicni perspektivi. 2019;24(3):113-122.
3. Cardiovascular diseases – WHO [interner sourse: https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)]
4. Tessler J, Bordoni B. Cardiac Rehabilitation. StatPearls Publishing, Treasure Island (FL). 2022; [https://pubmed.ncbi.nlm.nih.gov/30725881/]
5. Wisloff U, Stoylen A, Loennechen JP, Bruvold M, Rognmo O, Haram PM, et al. Superior cardiovascular effect of aerobic interval training versus moderate continuous training in heart failure patients: a randomized study. Circulation. 2007;115(24):3086–94.
6. Edwards DG, Schofield RS, Lennon SL, Pierce GL, Nichols WW, Braith RW. Effect of exercise training on endothelial function in men with coronary artery disease. Am J Cardiol. 2004;93(5):617–20.
7. Gielen S, Hambrecht R. Effects of exercise training on vascular function and myocardial perfusion. Cardiol Clin. 2001;19(3):357–68.
8. Lawler PR, Filion KB, Eisenberg MJ. Efficacy of exercise-based cardiac rehabilitation post-myocardial infarction: a systematic review and meta-analysis of randomized controlled trials. Am Heart J. 2011;162(4):571-584.e2.