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Effects of Cardiac Rehabilitation in Patients after Myocardial Infarction – A Case Report

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Abstract

Purpose: *The objective of the study was to evaluate the effects of cardiac rehabilitation in a patient after myocardial infarction (MI).*

Methods: *The participant in the study was a 58-year-old male with a medical history of myocardial infarction. The participant underwent a 25-day course of cardiac rehabilitation, with pre – and post-intervention outcome measures to assess his physical performance; the evaluation involved a treadmill exercise stress test according to the Bruce protocol. The total time and load of the test, maximal heart rate, systolic and diastolic blood pressure and the reason for discontinuing the study were determined. The rehabilitation protocol included cycling a cycloergometer, active exercises, resistance exercises and relaxation exercises. The level of exercise difficulty was increased weekly, starting from 2 METs (60% of the MET obtained during the stress test).*

Results: *During the exercise stress test performed following the completion of the rehabilitation management, the total stress test time was prolonged by 353 s, while the load of the test was increased by 5.64 METs as compared to the results obtained during the first examination. The maximal heart rate decreased by 12 beats/min, the systolic blood pressure by 15 mm Hg and the diastolic blood pressure by 10 mm Hg. The reason for discontinuing the test was fatigue (the score of 16 using the Borg Rating of Perceived Exertion scale).*

Conclusions: *Cardiac rehabilitation with a higher-intensity training program supplemented by resistance training in patients after myocardial infarction is recommended.*

Key words: *cardiac rehabilitation, myocardial infarction, exercise stress test*

Introduction

Cardiovascular diseases, including myocardial infarction, are recognized as the leading cause of death and disability worldwide [1]. According to the WHO statistics, 17.9 million people die each year because of cardiovascular diseases, 85% of which are caused by myocardial infarction and stroke [2]. In 2019, 2.2 million women and 1.9 million men in Europe died from cardiovascular diseases; 38% of deaths among women and 44% cases of demise among men were due to ischemic heart disease [3].

It is estimated that there are approximately 800,000 American residents who suffer from myocardial infarction every year; of this number, 16.7% result in death [4, 5, 6].

The therapeutic options for reducing mortality and morbidity, and thus improving the quality of life of patients with cardiovascular diseases, include cardiac rehabilitation [7, 8].

It is a secondary prevention management method, which is a comprehensive and multidirectional intervention with documented effectiveness [9]. Strong and consistent evidence of its efficacy in such diseases presenting as stable angina pectoris or myocardial infarction is reported in the literature [10–12].

Comprehensive cardiac rehabilitation significantly reduces the risk of recurrence, positively affecting the function of the coronary vessels and the heart [10]. Despite the benefits of cardiac rehabilitation programs, there are still some barriers that keep many patients from participating in such interventional management [13]. Furthermore, access to these services is not standard in all countries [10].

There are three phases of cardiac rehabilitation. Phase I begins immediately after the vital functions are stabilized and the hospitalized patient undergoes inpatient rehabilitation. It is of crucial importance to begin the physiotherapy program immediately after the life-threatening condition has been resolved [8]. Phase II refers to outpatient therapy consisting of an exercise program with a graded level of difficulty. Stage III involves an unmonitored set of exercises [8, 14]. In addition to physical training, Stage III also concentrates on psychosocial activity, lifestyle modification and patient education

[8, 9, 15]. As a result, cardiac rehabilitation is gaining in importance today and in many countries it is considered the key element of the treatment process in patients with cardiovascular disorders [14, 15].

The objective of the study was to evaluate the effects of cardiac rehabilitation in a patient after myocardial infarction.

Organization and course of the study

The program of cardiac rehabilitation extended over 25 days and was based on recommendations of the Section of Cardiac Rehabilitation and Exercise Physiology, Polish Cardiac Society [16]. Prior to commencing the therapy, during the first session, the patient's medical history was taken and a physical examination was carried out. Subsequently, the tolerance of physical exercise was assessed using the exercise test on a treadmill in keeping with the Bruce protocol, evaluating the following parameters: time [s] and load during physical exercise [MET], maximum heart rate, systolic and diastolic blood pressure, as well as fatigue level as measured by the Borg scale. Prior to commencing each session, blood pressure and heart rate were measured; the parameters were periodically controlled during the exercises. Each 1.5-hour long rehabilitation session was divided into four parts, representing aerobic training, i.e. cycling a cycloergometer, active exercises, resistance exercises and relaxation exercises. The level of training difficulty was gradually increased and matched the individual abilities of the patient as determined by the results achieved in the exercise stress test. Every week exercises characterized by a higher level of advancement were introduced and thus the cycling time was prolonged and the MET load was increased starting from 60% of the MET achieved initially during the exercise stress test. The patient repeated each exercise 10–15 times. A physiotherapist was present with the patient during the preliminary examination and the entire rehabilitation session. Having completed the rehabilitation cycle, the patient's tolerance of physical exercise was again tested using a treadmill. The rehabilitation program additionally included a session with a dietician aiming at developing proper nutritional habits and maintaining appropriate body mass, as well as another session offering psychosocial support.

Case report

The patient recruited to the study was a 58-year-old professional driver. Due to myocardial infarction, he underwent coronary angiography, after which he was referred to cardiac rehabilitation. Two months after hospitalization, the patient began a course of physiotherapy, following his granting written informed consent to participate in the study.

During the first assessment, the subject was interviewed to obtain information about his lifestyle. He was reported to smoke 6 cigarettes a day, follow a heavy diet, and not regularly perform any physical activity. The exercise stress test was performed according to the Bruce protocol (Table 2). Subsequently, the subject proceeded to a cycle of cardiac rehabilitation procedures following the designed protocol. The participant underwent a 25-day course of cardiac rehabilitation, in a series of 5-day meetings, with the level of exercise difficulty starting from 2 METs. After the final intervention, the treadmill stress test was repeated. The results obtained pre – and post-cardiac rehabilitation were compared with respect to the total time and load of the test, maximal heart rate, systolic and diastolic blood pressure, as well as the reason for discontinuing the study (Table 2).

A considerable improvement was observed in the parameters illustrating the physical exercise time and load. The post-cardiac rehabilitation stress test was discontinued due to physiological factors. Following the completion of the rehabilitation program, the authors noted lower values of maximal heart rate, systolic and diastolic pressure. The results indicated improved exercise tolerance in the patient.

Discussion

The available studies on patients after myocardial infarction who were subjected to cardiac rehabilitation as complementation of the therapeutic process prove the effectiveness of the therapeutic intervention [10, 17]. The investigators observed decreased mortality rates and a decreased risk of repeated infarction, while the clinical effect was described as "considerable"

as compared to other forms of treatment not employing physical therapy [10]. Improved quality of life was also noted [18]. Finally, employing cardiac rehabilitation decreased long-term costs associated with the process of convalescence [19–21]. Sjölin et al. demonstrated that patients after myocardial infarction who were subjected to cardiac rehabilitation achieved a marked improvement of their cardio-vascular factors as compared to patients not included in physical therapy programs [22].

The development of medical science has positively affected the survival of patients after myocardial infarction; nevertheless, complications associated with the disease continue to constitute a considerable burden to the patient and the state [13]. The possibilities offered by cardiac rehabilitation have not been sufficiently exploited, while the patients' interest in this type of therapy is low [23, 24]. Therefore, the activities are constantly modified [23]. In spite of significant health-associated and economic benefits, the percentage of countries offering such a rehabilitation program is as low as 40% [10]. The recommendations employed in these countries differ significantly [10]. The divergencies predominantly address exercise intensity, duration and frequency of training sessions [10]. Many countries continue to recommend training sessions with a moderate degree of intensity, without any weight-bearing components [10].

The most current reports emphasize the important role of aerobic training of increased intensity and resistance exercises in programs of cardiac physical therapy [10, 14]. Studies performed to date have been mostly based on a group of patients participating in moderate intensity cardiac rehabilitation programs [14, 25]. The present investigation addresses newly introduced exercises that follow the most recent recommendations. The exercise time has been prolonged and the load increased, starting from moderate exercise and ending with the recommended intensely difficult training. In addition, resistance exercises have been employed from the very start; such exercises are recommended in primary and secondary prevention [13]. The results confirm the validity of offering such a rehabilitation program. The change in the level of the tested parameters indicates the increased capacity of the patients and their adaptation to physical effort.

Conclusions

Cardiac rehabilitation employed in patients after myocardial infarction should be a therapeutic standard. It is the key element of convalescence that allows for decreasing therapy-associated costs. The training should include resistance exercises and activity characterized by an intense degree of difficulty.

References

1. Thygesen K, Alpert JS, White HD. Universal definitione of myocardialin farction. Journal of the American College of Cardiology 2007; 50(22): 2173–2195.

2. Cardiovascular diseases [Internet]. Available from: https://www.who.int/health-topics/cardiovascular-diseases#tab=tab_1 [cited 17 November 2021].

3. Timmis A, Townsend N, Gale CP, Torbica A, Lettino M et al. European Society of Cardiology. European Society of Cardiology: Cardiovascular Disease Statistics 2019. Eur Heart J 2020 Jan 1; 41(1): 12–85.

4. Felix H, Narcisse MR, Rowland B, Long CR, Bursac Z, McElfish PA. Level of Recommended Heart Attack Knowledge among Native Hawaiian and Pacific Islander Adults in the United States. Hawaii J Med Public Health 2019; 78(2): 61–65.

5. Fryar CD, Chen TC, Li X. Prevalence of uncontrolled risk factors for cardiovascular disease: United States, 1999–2010. NCHS Data Brief 2012 Aug; (103): 1–8.

6. Hyattsville, MD: National Center for Health Statistics; 2012 [cited 9 May 2019].

7. Nolan M, Nolan J. Cardiac rehabilitation following myocardial infarction. British Journal of Therapy and Rehabilitation 1999; (60): 142–148.

8. Piotrowicz R, Wolszakiewicz J. Cardiac rehabilitation following myocardial infarction. Cardiol J 2008; 15(5): 481–487.

9. Deskur Śmielecka E, Jóźwiak A, Dylewicz P. Rehabilitacja kardiologiczna u osób w podeszłym wieku. Kardiologia Polska 2008; 66(6): 684.

10. Price KJ, Gordon BA, Bird SR, Benson AC. A review of guidelines for cardiac rehabilitation exercise programmes: Is there an international consensus? Eur J Prev Cardiol 2016 Nov; 23(16): 1715–1733.

11. Oldridge N. Exercise-based cardiac rehabilitation inpatients with coronary heart disease: Meta-analysis outcomes revisited. Future Cardiol 2012; 8: 729–751.

12. Anderson L, Oldridge N, Thompson DR, Zwisler AD, Rees K, Martin N, Taylor RS. Exercise-Based Cardiac Rehabilitation for Coronary Heart Disease: Cochrane Systematic Review and Meta-Analysis. J Am Coll Cardiol 2016 Jan 5; 67(1): 1–12.

13. de Gregorio C. Physical Training and Cardiac Rehabilitation in Heart Failure Patients. Adv Exp Med Biol 2018; 1067: 161–181.

14. McMahon SR, Ades PA, Thompson PD. The role of cardiac rehabilitation in patients with heart disease. Trends Cardiovasc Med 2017 Aug; 27(6): 420–425.

15. Wenger NK. Current status of cardiac rehabilitation. Journal of the American College of Cardiology 2008; 51(17): 1619–1631.

16. Piotrowicz R, Jegier A, Szalewska D, Wolszakiewicz J, Piotrowicz E, Smolis-Bąk E, Dylewicz Pet al. Rekomendacje w zakresie realizacji kompleksowej rehabilitacji kardiologicznej. Stanowisko Ekspertów Sekcji Rehabilitacji Kardiologicznej i Fizjologii Wysiłku Polskiego Towarzystwa Kardiologicznego. Gdańsk: Asteria Med Gdańsk; 2017.

17. Tian Y, Deng P, Li B, Wang J, Li J, Huang Y, Zheng Y. Treatmentmodels of cardiacrehabilitation in patients with coronaryheartdisease and relatedfactorsaffectingpatientcompliance. Rev Cardiovasc Med 2019; 20(1): 27–33.

18. Galve E, Cordero A, Bertomeu-Martínez V, Fácila L, Mazón P, Alegría E, Fernández de Bobadilla J, García-Porrero E, Martínez-Sellés M, González-Juanatey JR. Update in cardiology: vascular risk and cardiac rehabilitation. Rev Esp Cardiol (Engl Ed). 2015 Feb; 68(2): 136–143.

19. Shields GE, Wells A, Doherty P et al. Cost-effectiveness of cardiac rehabilitation: a systematic review. Heart 2018; 104: 1403–1410.

20. Urbinati S, Tonet E. Cardiacrehabilitationafter STEMI. Minerva Cardioangiol 2018 Aug; 66(4): 464–470. https://doi.org/10.23736/S0026–4725.18.04674–1.

21. Laukkanen JA. Cardiac rehabilitation in the modern interventional cardiology era. Eur J Prev Cardiol 2020 Nov; 27(16): 1713–1715.

22. Sjölin I, Bäck M, Nilsson L, Schiopu A, Leosdottir M. Association between attending exercise-based cardiac rehabilitation and cardiovascular risk factors at one-year post myocardial infarction. PLoS One 2020 May 11; 15(5): e0232772.

23. Thomas RJ, Beatty AL, Beckie TM, Brewer LC, Brown TM, Forman DE, Franklin BA, Keteyian SJ, Kitzman DW, Regensteiner JG, Sanderson BK, Whooley MA. Home-Based Cardiac Rehabilitation: A Scientific Statement From the American Association of Cardiovascular and Pulmonary Rehabilitation, the American Heart Association, and the American College of Cardiology. J Am Coll Cardiol 2019 Jul 9; 74(1): 133–153.

24. Urbinati S, Tonet E. Cardiac rehabilitation after STEMI. Minerva Cardioangiol 2018 Aug; 66(4): 464–470. https://doi.org/10.23736/S0026–4725.18.04674–1.

25. Heran BS, Chen JM, Ebrahim S, Moxham T, Oldridge N, Rees K et al. Exercise-basedcardiacrehabilitation for coronaryheartdisease. Cochran Database Syst Rev 2011; 6(7): CD001800.

Table 1. Distribution of exercise time (in minutes) in particular weeks of cardiac rehabilitation

Weeks		I	II	III	IV	V
Exercises	Cycling a cycloergometer	15 min	20 min	25 min	30 min	30 min
	Active exercises	30 min	30 min	25 min	20 min	20 min
	Resistance exercises	10 min	15 min	20 min	25 min	30 min
	Relaxation exercises	35 min	25 min	20 min	15 min	10 min

Source: own elaboration.

Table 2. Pre-and post-cardiac rehabilitation results of treadmill stress test according to the Bruce protocol

Factors	Pre-rehabilitation	Post-rehabilitation
Physical exercise load	3,44 MET	10,21 MET
Physical exercise time	187 s	722 s
Maximal heart rate	138 beats/min	126 breaths/min
Systolic blood pressure	150 mm Hg	135 mm Hg
Diastolic blood pressure	85 mm Hg	70 mm Hg
Reason for discontinuing the test	Chest pain	Fatigue (score 16, Borg scale)

Source: own elaboration.