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Effect of exercise-based cardiac rehabilitation on cardio metabolic risk profile at patients after Myocardial Infarction

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Abstract

Background: The present review aims to examine the way an exercise-based cardiac rehabilitation program affects the cardio metabolic risk profile at patients after Myocardial Infarction.

Methods: PubMed/Medline and Scopus/Elsevier electronic databases were searched for studies with no publication date limitation. A search strategy was developed based on the intersection of 2 search themes: cardio logical rehabilitation program and cardio metabolic risk profile.

Results: The articles that finally met all the inclusion criteria and were analyzed, after the screening of the title, the summary, and the whole text, were 4. A total of 126 patients after myocardial infarction who received exercise-based cardiac rehabilitation were examined at this review.

Conclusion: The present review has demonstrated that exercise-based cardiac rehabilitation improves physical activity levels and the cardiometabolic profile at patients after myocardial infraction. All the existing literature showed improved results, such as reduction in body weight, increased HDL, improved blood pressure and exercise capacity. The program presented better results compared to classic exercise programs.

Keywords: Cardiac rehabilitation; Cardiometabolic risk profile; ExCR; Myocardium infrastructure.

1. Introduction

Cardiovascular disease (CVD) is a global health problem and prevalence is increasing in the developing world. The clinical definition of Myocardial Infarction (MI) denotes the presence of acute myocardial injury detected by abnormal cardiacbiomarkers in the setting of evidence of acute myocardialischaemia [1].

Exercise-based cardiac rehabilitation (exCR) programs are recognized as a standard of care for patients with CVD, with prevention efforts focused on reducing or preventing secondary coronary events including death and cardiovascular-related morbidity, and improving risk factor profile, functional capacity and quality of life [2-4]. The main objectives of cardiac rehabilitation and secondary CVD prevention are to reduce recurrent events and premature disability in patients with coronary heart disease (CHD) and increase the chances of longer life expectancy [5]. The management of risk factors is a key component of the exCR. The treatment of infarction (conservative or invasive) ensures today more and more the survival of patients. But these treatments do not abolish the disease, which is progressing. The change in lifestyle and the modification of risk factors, along with the appropriate medication offer anti-atherosclerotic protection to prevent or slow down a possible relapse.

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According to recent research data only 50% of all coronary patients were referred and a minority attended a cardiac rehabilitation program [6]. Those attending were more likely to achieve lifestyle targets, had lower depression and anxiety, and better medication adherence. There is evidence that secondary prevention and cardiac rehabilitation have a beneficial and cost-effective impact on all-cause and cardiovascular mortality and the risk of hospital readmissions [7-8].

According to the pre-existing literature, exCR has a variety of benefits for CVD patients and a lot of factors of these programs have been under the microscope the previous years. The research of cardiometabolic risk profile is sparse. The main objective of this paper is to examine the way exCR affects the cardiometabolic risk profile of patients after MI.

2. Material and methods

2.1. Review design

The results are presented as per the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) reporting guideline (supporting checklist/diagram) [9].

2.2. Data Sources and Search Strategy

A search strategy was developed based on the intersection of 2 search themes: cardiac rehabilitation program and cardiometabolic risk profile. The following databases were searched: Medline databases (via PubMed), and Scopus /Elsevier. Additional relevant research was also identified by direct search in scientific journals available online. Prisma methodology was used, and 4 unique studies were included in the review.

2.3. Inclusion Criteria

The review included studies designed to evaluate the cardiometabolic risk profile of an exCR program with no limitation about the publication date. Case reports and case series were excluded.

2.4. Study selection

Eligibility screening of the studies was conducted in a blinded standardized way by two independent reviewers (Ev.T. and E.Z.). Titles and abstracts were screened using and duplicate articles were excluded. After screening titles and abstracts, full paper copies were retrieved. Full text screening was also performed blinded by the same reviewers (Ev.T. and E.Z.). Disagreements between authors during any stage of the screening process were resolved by consulting a third reviewer (Em.T.).

3. Results

The articles that finally met all the inclusion criteria and were analyzed, after the screening of the title, the summary, and the whole text, were 4. (Table 1).

In December 2015, Ribeiro et al. research evaluated the effect of an exCR program on physical activity levels in patients following myocardial infarction. It was an under-analysis of two randomized controlled clinical trials [10, 11]. Fifty patients, 1 month after myocardial infarction, were randomly divided into the exercise group, which consisted of 25 patients (92% men) with a mean age of 54 ± 9 years, and into the control group, which consisted of 25 patients (80% men) with a mean age of 58 ± 9 years. All patients during their hospitalization received training and advice on a healthy lifestyle, including the benefits of exercise for the exercise team which enhanced during the exercise sessions that followed after regular meetings with the cardiologist. The evaluation of physical activity was conducted using an Actigraph GT1M accelerometer (ActiGraph LLC, Pensacola Florida USA) that was placed on an elastic band at right power for 7 consecutive days (>8 hours / day) to show a realistic picture of the usual daily physical activity of patients. Cardiorespiratory fitness (with stress tests), heart rate, double product, systolic resting pressure, BMI were also evaluated. Patients in both groups initially had similar clinical characteristics (percentage of presence of diabetes, hypertension, hyperlipidemia, etc.) and the majority of them were overweight/obese (80% in the exercise group and 72% in the control group). The exercise team underwent an 8-week aerobic exercise program in the same outpatient clinic of a hospital, taking the usual medication, while the control group was received only medication. The program was prescribed and supervised by a physiotherapist and a cardiologist. The program consisted of 3 sessions per week for 8 weeks and included 10΄ warm-up, 30΄ aerobic exercise on a cycloergometer or rolling treadmill with an intensity of 70-85% of the maximum heart rate measured in the initial stress test, and 10΄ of recovery. Heart rate and fatigue levels (with the Borg scale) were monitored during exercise. At the end of the program, a significant increase in the time spent by the patients of the exercise group in moderate or intense physical activity was observed: from 43.2 minutes/day (with a standard deviation -SD - 36.,3 l / d) to 53.5m / d. (SD 31.9 l/d), while it was reduced in the control group: from 40.8 mph. (SD 26.2 l/d) at 36.8 rpm (SD 26.5m). The number of patients in the exercise group who complied with the instructions of their doctors for at least 30΄ moderate or intense physical activity per day was also increased. While at the beginning of the intervention there was no difference between the patients of the two groups of 52% (13/25), at the end of the intervention compliance in the exercise group reached 76% (19/25). In the control group it decreased to 44% (11/25). Another improvement in cardiorespiratory fitness was observed in the exercise group with an increase in VO2peak of 2.8 ml/kg/min (1.3 to 4.4), but not in the control group (VO2peak by 0.3ml/kg/min (- 0.5 to 1.1).

In March 2009, Ades et al. [12] examined the correlation of exercise protocols in the exCR and weight change as well as cardiac risk factors, in order to design an exercise protocol that would lead to greater changes in these domains. Randomized controlled clinical research was conducted to evaluate the results of a high-calorie exercise program (weekly energy expenditure of 3000-3500 kcal during exercise), compared to a classic exCR program (weekly energy expenditure of 7-800 kcal, during exercise). The study involved 74 overweight coronary patients (after heart attack, percutaneous revascularization, bypass, angina pectoris) 81% men, with a BMI of 32 ± 4 (range 27 - 45) of average age 64 ± 9 years (range 44 - 84 years) in which the presence of cardiometabolic risk factors was common. The patients were randomly divided into the high caloric expenditure exercise group (38 patients) and the classical exCR group (36 patients) and underwent laboratory tests to measure all metabolic syndrome factors and fatigue tests to assess aerobic capacity. The evaluation was repeated 5 months and 12 months later, when the program was completed. The beginning of the program for all patients was ≥ 3 months after their discharge from the hospital. Both groups participated in 16 group counseling sessions with a nutritionist, and a hypocaloric diet was applied in conjunction with a behavioral program for weight loss. The prescription of exercise for the high caloric expenditure group compared to that of the classical exercise group emphasized the longer duration of the exercise (45 – 60΄ compared to 25 - 40΄ per session), the lower intensity (50-60% of VO2peak compared to 65 - 70 %) and the higher frequency (5-7 times a week compared to 3 times a week). The protocol for the classic exCR group included 25΄ walks on a treadmill and 8΄ in two of the three machines: cycloergometer, rowing ergometer or chirogmeter. The results showed that the high caloric expenditure exercise group presented twice as much weight reduction (8.2±4 vs 3.7±5 kg), greater loss of adipose tissue (5.9±4 vs. 2.8±3 kg) and a greater reduction in waist circumference (-7±5 vs. -5±5 cm) compared to the group of a classic exercise program after 5 months. The high-calorie exercise program reduced insulin resistance which was measured using euglycemic hyperinsulinemic clamp, the total cholesterol/HDL ratio as well as the components of metabolic syndrome, compared to the classic exercise program. The loss of adipose tissue improved the metabolic risk and the prevalence of metabolic syndrome was reduced from 59% to 31%. Changes in cardiac risk factors included a decrease in insulin resistance, a decrease in insulin, triglycerides, blood pressure, the plasminogen activator inhibitor (PAI – 1) plasminogen activator inhibitor-1, and the total cholesterol/HDL ratio. The significant reduction in body weight was maintained for a year, while a small recovery observed in individuals could have been avoided if nutrition counseling sessions were more frequent than 1 time per month and exercise sessions were more frequent at the rehabilitation center.

The purpose of the research, published in November 2013 by Lee et al. [13], was to test the results of therapeutic cardiac exercise, in terms of coronary risk factors and exercise ability in patients with acute myocardial infarction. The exercise group consisted of 20 male patients aged 49.8 ± 7.5 years of patients who participated in the 2nd phase of a supervised exCR program based on inpatient exercise, lasting 8 weeks, and in the 3rd phase of exCR in a program with therapeutic exercise at home that had a duration of 6 months and was done either by monthly communication or by medical visits at home consisted. The control group consisted of 10 patients aged 48.2 ± 10.2 with no participation in an exercise program. All patients underwent laboratory tests and stress tests during their hospitalization, when the 2nd rehabilitation phase was completed and finally with the completion of the 3rd phase. Each session consisted of 10 minutes of warm-up with gentle stretching exercises and aerobic exercise, the main exercise being done on a treadmill with intensity gradually increasing to 60-79% of their estimated maximum heart rate, continued with 20΄ at a level over which silent ischemia and recovery with 5-minute stretches could be induced. The sessions were supervised and with electrocardiographic monitoring. The patients continued the program at home for 6 months in the form of exercise that was more familiar to them. A total of 17 participants underwent some form of walking exercise and 3 of them some racket sport. The exercise intensity had to be <79% of the maximum heart rate measured in the second fatigue test for each patient for the safety of the participants. No severe heart attacks were observed throughout the program. In the experimental group the exercise capacity increased significantly after the 2nd phase exCR (from 6.8 ± 1.6 METS to 9.8 ± 1.5 METS) and it was maintained until the end of the 3rd phase (10.0 ± 1, 9 METS). The number of smokers decreased significantly in both groups during the second measurement. While in the control group the number increased again over time as shown in the last measurement, in the exercise group the observed decrease was maintained. No statistically significant changes in body mass index or triglyceride values were observed in either group. The prices of

HDL (good cholesterol) increased in the exercise group only in the 3rd measurement (initially: 38 ± 11 mg / dl - in the 2nd phase: 38.8 ± 8.7 mg / dl - in the 3rd phase: 43.7 ± 8, 7 mg / dl), which may mean that this improvement is related to the duration of exercise, while it was reduced in the control group (from 40.6 ± 10.4 mg / dl to 35.9 ± 12.0 mg/dl). The increase in HDL showed not to be related to the decrease in body mass or the decrease in smoking as has been shown in other studies.

Table 1 Studies included in the review

Author (year)	Method	Sample (n)		Intervention		Results
		Size	Age	(Follow up)	Type	
Ribeiro et al. 2015 [10]	Sub-analysis of 2 randomized surveys	Total: 50 T.G: 25 CG: 25	TG: 54 ±9 CG: 58 ±9	8 w	exCR & Exercise 8 weeks. 3syn/week 10' warm-up 30' Cycloergometro or escalator 10΄ recovery 70-85%VO2peak	Improving physical activity levels (improving exercise capacity)
Ades et al. 2009 [12]	Randomized Control study	Total: 74 overweight patients High Caloric Charge Group:38 ExCR sectoral programme group with exercise:36	64 ± 9 63 ± 9	1 y	exCR& 6 months exercise ambulation 45 -60΄ 5 -7 times/week 50-60%VO2peak ≥ 3000-3500 kcal/week 25 – 40΄ 3 times/week 65-70%VO2peak up to 800kcal/week	High caloric expenditure program leads to greater reduction in body weight and more favorable cardiometabolic profile risk in relation to the standard exCR protocol
Lee et al. 2013 [13]	Clinical study	Total: 30 TG: 20 CG: 10	TG: 49.8 ± 7,5 CG: 48,2± 10,2	8 m	II phase:8 weeks. intrahospital 2for/week Phase III: 6 months at home(telephone communication & monthly visit of the therapist)	Increase in HDL cholesterol levels Reduction and retention of people who remained smokers (Increase and maintain exercise capacity)
Kargarfard et al. 2010 [14]	Semi-experimental Randomized study	Total: 72 TG: 35 CG: 37	TG 57,9 ± 4,9 CG 56,3 ± 5,9	2 m	Exercise 2 months/ 3for/week. 10' warm-up 30' walk or jogging on a treadmill (moderate intensity) 10΄ recovery	Improving blood pressure (Improving exercise capacity)

Kargarfard et al. [14] published research in 2010 evaluated the effect of an exercise program on patients after MI on blood pressure while resting and during exercise. The study was a semi-experimental randomized research and 72 patients participated, after myocardial infarction, aged between 40 and 67 years who were randomly selected among others reported in the cardiac rehabilitation unit, of the Isfahan Shahid Chamran cardiovascular research center. After the initial somatometric measurements and the stress test, which included weight, height, exercise capacity, diastolic and systolic blood pressure, both at rest and in a state of fatigue (after exercise), patients were randomly divided into the exercise group, which consisted of 35 people aged 57.71± 4.93 years (69% men) and the control group, 37 people aged 56.32 ± 5.98 (51% men). The control group was asked to maintain a normal lifestyle, while the exercise team participated in a 2-month aerobic exercise program with a frequency of 3 times a week. The program at the beginning included 10΄ warm-up, 30΄ walking or jogging on a treadmill and 10΄ recovery with moderate intensity at 60-70% HRR (6-7 METS). Gradually the training time was increased until at the end of the 2nd week the duration reached 45-60΄ which was maintained for the rest of the two-month period. For the safety of the exercise and its proper implementation, the program was fully supervised and the measurement of blood pressure was done every 10΄. In the end, after all measurements were repeated in both groups, patients in the exercise group showed a statistically significant improvement in resting heart rate (from 79.83 ± 11.63bmp at the beginning after 74.17 ± 10.11bmp thereafter), systolic resting pressure (from 129.60± 10.97 mmHg to 123.54 ± 10.97mmHg) and exercise pressure (from 145.40 ±6.88 mmHg to 133.54±6.82 mmHg), exercise resistance (from 8.23 ± 1.15 METS to 9.42 ± 1.19 METS) and less to diastolic resting pressure (from 81.43mmHg ± 8.44mmHg to 78.8 ± 4.34mmHg) and diastolic fatigue pressure (from 86.43 ± 8.44mmHg to 84.80 ± 4.34 mmHg). No changes were observed in patients in the control group. (resting heart rate from 81.19 ± 7.26 to 81.27 ± 7.75 bmp/resting systolic pressure from 123.57 ± 10.18 to 125.92 ± 9.30 bmp/ systolic fatigue pressure from 147.46± 7.82 to 150.22 ± 7.12 mm Hg/diastolic resting pressure from 81.05 ± 8.29 to 79.73 ± 5.30 mmHg/diastolic fatigue pressure from 83.95 ± 8.47 to 82.59 ± 6.19 mmHg/exercise capacity from 8.37 ± 1.25 METS to 8.49 ± 1.18 METS).

4. Discussion

A total of 126 patients after myocardial infarction who received exCR were examined at this review. All studies showed statistical important difference after exCR [10-14]. As far as the duration is concerned the studies included interventions from 6 weeks to 2 months, with mean duration 7,5 weeks.

Participation in a cardiac rehabilitation program based on 8 weeks of physical exercise, at patients after myocardial infarction, seems to improve physical activity levels [10]. The high-calorie exercise program promotes greater body weight reduction and a more favorable cardiometabolic risk profile, compared to a classic exercise program in cardiac rehabilitation of patients with coronary heart disease [11]. According to Lee et al. after the third phase of exCR with exercise, patients maintained the ability to exercise as well as the reduction in smoking habit that they acquired from the second phase. Patients in the exercise group presented increased HDL cholesterol levels during the third phase [13]. Kargarfard et al. study showed that exCR is very effective in improving both blood pressure and exercise capacity, and should be encouraged more often [14]. Future research is necessary to determine whether the improvement in physical activity is maintained in the long term and at a larger sample.

5. Conclusion

The present review has demonstrated that exCR improves physical activity levels and the cardiometabolic profile at patients after myocardial infraction. All the existing literature showed improved results after the exCR, such as reduction in body weight, increased HDL, improved blood pressure and exercise capacity. The exCR presented better results compared to classic exercise programs.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare no conflict of interest.

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