Original Article

Evaluation of cardiac rehabilitation on functional capacity in depressed and nondepressed patients after angioplasty

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Abstract

Background: About 50% of the annual deaths in the developed countries are as a result of coronary artery disease. Several studies have shown the role of cardiac rehabilitation (CR) in improving cardiovascular indices including functional capacity, reducing depression, and mortality rates in cardiovascular patients. One of the psychological problems observed in cardiovascular patients is depression. Depression is one of the most important barriers to the treatment of heart attack, because it leads to denial of the disease and reduces the patient's motivation to continue treatment. **Objectives:** There are controversy information about the relationship between the effects of CR on these cases after angioplasty. The aim of this study was to evaluate the effect of CR on functional capacity in depressed and nondepressed patients after angioplasty in patients referred to Imam Khomeini, Ahvaz. **Methods:** This descriptive epidemiological study was performed on 54 patients referred for angioplasty. Functional capacity and depression score before and after participation in the 2-month CR program were evaluated in two groups of depressed and nondepressed patients. Data were analyzed by SPSS software, and the significance level was considered as $P < 0.05$. **Results:** The results of this study showed that in both the groups, the functional capacity after CR was significantly increased compared with the previous period ($P < 0.001$). Also in depressed patients, there was a significant decrease in depression scores ($P < 0.001$). **Conclusion:** Our findings showed improvement of functional capacity index following angioplasty, suggesting that patients participating in CR can be recommended by therapists. In addition, the results of this study showed that the participation in the CR program greatly affects the improvement of functional capacity and reduction in depression in patients undergoing angioplasty.

Keywords: Angioplasty, cardiac rehabilitation, depression, functional capacity

Introduction

Coronary artery disease (CAD) is one of the major and leading causes of mortality among Iranians, and consequently about 50% of the annual deaths in the developed countries are a result of this disease. Increasing cardiovascular disease is associated with several factors including changes in dietary habits, physical activity, environmental pollution, and psychological problems throughout the life of individuals.[1,2]

One of the psychological problems observed in cardiovascular patients is depression. Depression is one of the most important barriers to the treatment of heart attack, because it leads to denial of the disease and reduces the patient's motivation to continue treatment. It also has a negative effect on the prognosis of cardiovascular disease and causes several complications such as increased mortality, angina, arrhythmia, readmission, prolonged

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Access this article online

Quick Response Code:

Website: www.jfmpc.com

DOI: 10.4103/jfmpc.jfmpc_306_18

How to cite this article: Haybar H, Shirani T, Pakseresht S. Evaluation of cardiac rehabilitation on functional capacity in depressed and nondepressed patients after angioplasty. J Family Med Prim Care 2018;7:1304-8.

disability, and increased smoking. Depression increases the mortality rate by up to 18 months after heart attack, and therefore in patients with weak immune systems, the problem is more severe and more acute.[1-3]

Cardiac rehabilitation (CR) plays an important role in comprehensive cardiac care programs. In these programs, controlling risk factors, improving nutrition and exercise, and modifying the individual and social psychosocial status of patients are implemented. According to the definition of the World Health Organization, CR is a necessary step that the cardiac patients take to reach the best physical, mental, and social conditions, which will enable them to become as active as possible when they return to their social status.[4,5]

Although participating in CR programs has positive effects, participation rate of eligible patients in these programs is reported to be low, because of lack of awareness of the family of patients and some physicians, the lack of patient referral by physicians,[6] heart failure and low left ventricular ejection fraction (LVEF),[7,8] possibility of complications,[9] doubts about the benefits of rehabilitation programs, such as exercise[10] or neglect,[11] inaccessibility of facilities, and high costs of participation in the program.[12]

Exercise or performance capacity is calculated with the metabolic equivalent of task (MET). METs are equivalent to the activity that consumes 3.5 mL of oxygen/kg body weight/min. The maximum power of a person in terms of METs represents the maximal consumption of oxygen (max VO_2).[13] It has been shown that in normal condition, the increase in max VO_2 following exercise activity is because of increased stroke volume (central factor) and increased oxygen consumption in tissues (environmental agent), but in heart failure, the mechanism of this increase is probably more dependent on the environmental factors. Improvement in blood flow to the organs, increased mitochondrial function of the skeletal muscle system and endothelial cell function, delayed accumulation of lactic acid in the muscles, and improvement of pulmonary ventilation are among the possible factors that may be mentioned.[9,14-16]

Limited studies have shown beneficial effects of CR, including improvement of aerobic activity and decrease in mortality in patients after therapeutic interventions such as percutaneous coronary intervention (PCI),[17] and or coronary artery bypass grafting (CABG).[18] In addition, the beneficial effects of CR on the reduction in depression have been studied in various studies.[17,18] Despite the general similarity between CR programs, it seems that differences in the content of rehabilitation programs and the quality of service delivery in different centers, such as the type, intensity and frequency of exercise sessions, the length of the rehabilitation period, as well as the training and interventions of lifestyle modification can lead to different outcomes.[19]

Objectives

Although several studies have reported the effects of CR on the reduction in morbidity and mortality, as well as other physiological and laboratory parameters in depressed patients, there is lower knowledge about the relationship between the effects of CR on these cases after angioplasty. The aim of this study was to investigate the effect of CR on functional capacity in depressed and nondepressed patients after angioplasty.

Methods

Type of study

Descriptive epidemiological study was used to perform the comprehensive CR program on patients referred to the cardiology clinic of Imam Khomeini Hospital (Jundishapur, Ahvaz, Iran) for the purpose of angioplasty before and after participating in the program.

Inclusion and exclusion criteria

The patients were divided into depressed and nondepressed groups. The patients who had bradycardia (heart rate less than 55 bpm during vigilance), significant changes in atrial conduction, professional sport activity, permanent pacemakers, significant electrolytic disturbances at admission, thyroid disease, or abnormal liver function were excluded from the study.

Sampling method

The sample size was determined to be 54 (27 in depressed and 27 in nondepressed groups) based on previous studies using MedCalc with 90% potency and 5% error. Depression was evaluated using Beck Depression Inventory (BDI) and a 21-part BDI-II questionnaire performed by clinical psychologist. The scores of 10 or more were considered as depression, and the scores of 0–9 as normal, 10–16 as mild depression, 17–20 as moderate depression, 30–21 as severe depression, and more than 30 were considered as very severe.[18] BDI is the most common screening tool used to determine the extent of depression in humans. This test is a self-assessment questionnaire, mainly used to assess the severity of depression in psychiatric patients and to identify depression in others. The questionnaire consists of 21 sections and its answers are scored from 1 to 3.[20]

The patients were given an opportunity to refer to the Cardiac Rehabilitation Center of Imam Khomeini Hospital for 8–12 weeks after angioplasty. They underwent a symptom-limited exercise test before entering the program to identify and evaluate important symptoms, ischemia, or arrhythmias that might require other interventions before CR. Patients participated in 24 sessions, 3 days a week, including 1 h of training and 1 h of exercise, for 2 months in the cardiac rehab. The issues raised in the classroom included a structured approach to stress and depression, and the identification and control of cardiovascular risk factors such as blood pressure, diabetes, blood lipid disorder, reduced exercise, and smoking with improper nutrition, and weight gain. After training, the patients participated in dynamic exercise programs using treadmills and fixed bikes along with walking and warm-up. The exercise program performed in each session included 5 min of warm-up at the beginning, followed

by 20–45 min of aerobic exercise training and 10 min of cooling at the end of the program. Control of exercise intensity was at the level of 70%–80% of max heart rate (mHR) and was performed using the Borg's scale of exercise intensity.[26] During the course, the patients were prevented from changing drugs as far as possible, and the medication regimen was corrected by a cardiologist only if necessary. For each patient, two exercise tests were performed with treadmill before and after the CR period, and the performance was recorded according to the maximum capacity of slope tolerance and treadmill speed in terms of METs.

Outcomes

Prior to the participation of eligible patients in the comprehensive CR program, clinical examinations and routine laboratory tests including blood glucose, triglyceride, high-density lipoprotein (HDL) and low-density lipoprotein (LDL), as well as chest X-ray and routine echocardiography were performed. A written consent form was obtained from the patients, and then a questionnaire including age, sex, weight, height, history of diabetes mellitus, high blood pressure, smoking, and drug use was completed by the researcher through interviewing the patient and using the information from the patient.

Randomization and blinding

This was a double-blind study in which participants and outcome assessors were blinded but not the investigators because of the nature of the interventions.

Ethics consideration

Informed written consent was obtained from all participants, and the Ethical Committee of Ahvaz Jundishapur University of Medical Sciences approved this study in 2017 (IR.AJUMS.REC.1396.323).

Statistical methods

To describe qualitative data, absolute frequency was used, and for quantitative data, central tendency indices such as mean and standard deviation were used. Chi-square test and *t*-test were used to compare qualitative and quantitative variables, respectively. In addition, paired *t*-test was used to analyze obtained data before and after the CR program. The significance level for all statistical tests was 0.05. Statistical analysis was performed using SPSS version 23 software.

Results

Demographic characteristics (age, gender), clinical and laboratory risk factors, functional capacity, and depression scores of patients before participating in the CR period are shown in Table 1. Statistical comparisons of age, sex, background of diabetes mellitus, hypertension, hyperlipidemia, smoking, and laboratory factors including triglyceride, HDL, LDL, BMI, and LVEF showed that there was not a significant difference between the two groups of depressed and nondepressed patients ($P > 0.05$). However, there was a significant difference between the two groups in terms of functional capacity (METs) and mean depression scores ($P < 0.001$).

In depressed patients as seen in Table 2, there was a significant difference between mean METs before and after participation in the CR program. Also, depression in this group after the completion of rehab improved significantly ($P < 0.001$). In nondepressed patients, there was a significant difference between mean METs before and after participation in the CR program ($P < 0.001$). However, unlike the depressed group, the depression score in the nondepressed patients did not change significantly at the end of rehab ($P = 0.20$) [Table 3]. Statistical analysis of the METs' data showed that there was no significant difference between THE two groups of depressed and nondepressed patients [$P = 0.09$, Table 4], but depression scores showed significant changes ($P = 0.01$).

Table 1: Baseline characteristics for 54 patients participating in cardiac rehabilitation (*n*=27)

Variable	Depressed	Nondepressed	*P*
Age (year), mean±SD	63±6	65±8	0.09
Sex (men/women) (%)	74/26	70/30	0.10
Smoking (%)	29	25	0.08
Hypertension (%)	55	51	0.20
Diabetes mellitus (%)	29	22	0.09
Hyper lipidemia (%)	26	22	0.08
TG (mg/dL), mean±SD	216±91	185±54	0.07
HDL (mg/dL), mean±SD	39±8	34±10	0.10
LDL (mg/dL), mean±SD	116±34	125±28	0.09
BMI (kg/m2), mean±SD	27.4±4.0	26.1±3.8	0.20
LVEF (%), mean±SD	44.8±4.9	45.6±5.3	0.10
METs, mean±SD	6.2±1.3	7.1±0.8	<0.001*
BDI score, mean±SD	12.7±2.3	4.1±2.5	<0.001*

SD: Standard deviation; TG: Triglyceride; HDL: High-density lipoprotein; LDL: Low-density lipoprotein; BMI: Body mass index; LVEF: Left ventricular ejection fraction; MET: Metabolic equivalent of task; BDI: Beck Depression Inventory. *Statistical significance at *P*<0.001

Table 2: Functional capacity and depression score changes before and after CR in depressed participants (*n*=27)

	Before CR	After CR	Change (%)	*P*
METs, mean±SD	6.2±1.3	8.6±1.6	+45	0.001*
BDI, mean±SD	12.7±2.3	7.9±2.1	−40	0.001*

CR: Cardiac rehabilitation; MET: Metabolic equivalent of task; SD: Standard deviation; BDI: Beck Depression Inventory. *Statistical significance at *P*<0.001

Table 3: Functional capacity and depression score changes before and after CR in nondepressed participants (*n*=27)

	Before CR	After CR	Change (%)	*P*
METs, mean±SD	7.1±0.8	9.3±1.2	+34	0.001*
BDI, mean±SD	4.1±2.5	3.7±1.8	−12	0.20

CR: Cardiac rehabilitation; MET: Metabolic equivalent of task; SD: Standard deviation; BDI: Beck Depression Inventory. *Statistical significance at *P*<0.001

Table 4: Comparison of functional capacity and depression score changes between depressed and nondepressed patients (*n*=27)

Change (%)	Depressed	Nondepressed	*P*
METs	+45	+34	0.09*
BDI	−40	−12	0.001*

MET: Metabolic equivalent of task; BDI: Beck Depression Inventory. *Statistical significance at $P<0.001$

Discussion

The results of this study showed that the rate of depression in depressed patients was significantly reduced after participating in the CR which indicates the useful of participation in the courses. In this case, studies have also shown the role of rehab in improving the symptoms of depression and subsequently reducing the mortality rate of patients with myocardial infarction (MI)[21] and CABG.[18]

Meurs *et al.* (2015) reviewed the causes of reduced mortality resulting from performing CR in depressed and nondepressed patients afflicted to MI. Of the 52% of patients participating in the rehab, 26% of patients had BDI ≥10 (depressed), and 18% of them died during the follow-up period. This study showed that cardiac rehab is significantly associated with decreasing mortality in depressed patients, but this relationship was not observed in nondepressed patients.[21]

Sharif *et al.* (2012) performed a randomized controlled clinical trial study on 80 patients under CABG in hospitals under Shiraz University of Medical Sciences, to investigate the effect of CR on anxiety and depression in control and case groups. Hospital discharge time was immediately after eight-session CR, in a 4-week course and 2 months after the completion of rehab. The control group spent only the regular follow-up period and did not attend cardiac rehab. There was a significant difference in depression scores between the two groups in all three time periods. However, there was no significant difference in the score of anxiety between the groups. The results of this study also showed that cardiac rehab was effective in decreasing depression 2 months after surgery in patients with CABG.[18]

Depression is involved not only in the generation and development of cardiovascular disease but also in how to follow and control the complications of these diseases.[22] Although previous studies have shown the role of CR in reducing symptoms and prevalence of depression and mortality, the mechanisms of communication between depression and MI have not been identified so far.[21,23-25]

In this study, the mean METs increased significantly in both the groups after CR. These results are consistent with the findings of most previous studies, particularly studies conducted on patients undergoing angioplasty and open heart surgery, and it showed that participating in exercises during the rehabilitation period can improve the athletic capacity in patients with heart failure.[17,26,27] Beckie *et al.* (2013) observed that women with acute MI background, unstable angina, and CABG or PCI, who participated in two types of CR program, had a significantly improved functional capacity.[26] Goel *et al.* (2011) reviewed the records of 2395 patients under angioplasty and reported that the association between coronary heart disease and the reduction in mortality rates for both males and females, young and old, as well as for patients who underwent selective or nonselective angioplasty were similar. Based on the results, it was observed that participation in the cardiac rehab was associated with significant reduction in mortality rate after PCI.[17]

Overall, the results of this study showed that participating in the comprehensive cardiac rehab program had beneficial results for patients undergoing angioplasty. Increasing functional capacity and reducing depression as a result of participating in a rehab program can greatly improve the recovery and survival rate of patients. Various studies have also shown the beneficial effects of CR, including improvement of aerobic activity and reduction in mortality rates in post-angioplasty patients.

Conclusion

Improvement of functional capacity index following angioplasty suggests that the referral of these patients for participation in CR can be recommended by therapists. Significant improvements in symptoms and severity of depression further reveal the need for the introduction of these patients to participate in the program of CR.

Authors' contributions

Heybar H, Shirani T, and Pakseresht S contributed equally to the design and performance of the study. All authors performed the literature review, drafted the article, and are the guarantors. All authors reviewed and approved the final article.

Ethics approval and consent to participate

The study was conducted according to the principles of the Declaration of Helsinki and approved by the Douala Ahvaz Jundishapur University of Medical Sciences on Human Health Ethic Committee (registry no. IR.AJUMS.REC.1396.323). Participation to the study was voluntary, and written informed consent was obtained from each participant.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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