



Original Article

Effect of cardiac rehabilitation programme following elective percutaneous coronary angiography on depressive symptoms: A cohort study



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ABSTRACT

Background: Depression is a common condition in cardiac patients. We investigated the effect of cardiac rehabilitation on depressive symptoms as detected by Beck depression inventory II score (BDI) in patients who underwent percutaneous coronary intervention (PCI).

Methods: In this cohort, 95 patients met our criteria. Patients were then studied in two groups based on their participation in the rehabilitation program to rehabilitation (exposure) and the control (non-exposure) groups. The control group consisted of those who only participated in the introductory session and decided not to continue the program. Finally, demographic and clinical parameters as well as the BDI scores were compared between the study groups.

Results: Data of 35 patients who completed rehabilitation program was compared with 60 patients who did not. There was no significant difference between the study groups regarding the demographic and clinical variables, except for a higher frequency of family history for CAD in the control group ($p < 0.001$). The frequency of the patients with no or mild depression was significantly higher in the rehabilitation group than the controls ($p = 0.02$). There was also a significant increase in the BDI score of the control group and a significant decrease in the rehabilitation group ($p < 0.001$). After adjustment for confounders (family history and severity of CAD), not attending the rehabilitation program was a strong risk factor for depression (OR = 10.8, 95% CI: 1.3, 88.5; $P = 0.027$).

Conclusion: Overall, this study showed that not attending cardiac rehabilitation program following elective PCI was a risk factor for depression.

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1. Introduction

Coronary artery disease (CAD) is one of the leading causes for mortality and morbidity worldwide.¹ Like any other chronic disease, CAD is associated with depression.^{2,3} Studies have shown a bilateral association between CAD and depression as well as the prevalence of depressive symptoms among patients with acute myocardial infarction (AMI).^{3,4} About 15–20% of the patients with AMI experience various degrees of depression.⁵ On the other hand,

depression can increase the risk of mortality following AMI up to 50% and its treatment can significantly improve the survival of the patients.^{6,7} Moreover, evidence show that invasive treatment modalities for CAD patients such as coronary artery bypass graft surgery and percutaneous coronary intervention (PCI) are also associated with depression.^{8–11}

Cardiac rehabilitation is a protocol that reduces mortality and morbidity of AMI patients by 20–30%.^{12,13} This improvement depends on various aspects of cardiac rehabilitation such as physiologic and psychological benefits of exercise, nutritional consultation, and control of cardiovascular risk factors.^{14–16} Despite the benefits of cardiac rehabilitation, not more than 25% of cardiac patients who undergo invasive treatments participate in such programs.¹⁷

In the present study, we aimed to investigate the effect of cardiac rehabilitation on the severity of depressive symptoms in a cohort of patients who underwent elective PCI at our hospital.

Abbreviations: AMI, acute myocardial infarction; BDI, Beck depression inventory; BMI, body mass index; CAD, coronary artery disease; EF, ejection fraction; OR, odds ratio; PCI, percutaneous coronary intervention; SVD, single vessel disease; VD, vessel disease.

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2. Methods

In this prospective cohort, we studied patients who underwent elective PCI due to ischemic heart disease at Imam Khomeini Hospital, affiliated to Tehran University of Medical Sciences, Tehran, Iran. Patients were enrolled consecutively based on the following criteria: 1) age > 18 years; 2) no history of previous cardiac rehabilitation; 3) physical ability for performing the exercises; 4) no history of psychiatric disorders, particularly major depressive disorder or taking antidepressants. The protocol of this study was approved by the institutional research board and committee of ethics. All patients gave a written informed consent for taking part in this study. This study conforms to the declaration of Helsinki.

At baseline, demographic and medical history of the patients, including cardiovascular risk factors and medication was collected. The data of coronary angiography and PCI were collected from the patients' records. The extent of coronary atherosclerosis was assessed with clinical vessel score and CAD was defined as the presence of $\geq 70\%$ stenosis in the coronary arteries; single-vessel disease (SVD): stenosis of one of left anterior descending artery or left circumflex artery or right coronary artery or main branches of each; double-vessel disease (2VD): stenosis in two coronary arteries other than left main artery; triple-vessel disease (3VD): stenosis in three coronary arteries.¹⁸ For this study, we included the number of stents from the angiography reports.

The hospital-based rehabilitation program consisted of 24 outpatient sessions, each lasting 45–60 min, three times per week for two months. Every session included three steps: warm-up, aerobic exercise (30 min) and cool-down. Also, those who completed the rehabilitation program received specialized psychological and nutritional consultation as our routine.

For this study, patients were categorized into two groups based on their participation in the cardiac rehabilitation programs. The rehabilitation (exposure) group included those who voluntarily completed the rehabilitation program and the control (non-exposure) group consisted of the patients who only participated in

the introductory session of the rehabilitation and decided not to attend the program afterwards. Those who took part less than two third of the rehabilitation sessions were excluded.

Our primary end-point was the development and degree of depressive symptoms among the study participants. Evaluation of depression was made by the standardized Persian version of Beck Depression inventory second edition.¹⁹ BDI questionnaire was completed for every patient at baseline and then 6–8 months after intervention for those who did not take part in the rehabilitation program and 1 month after the end of the program for those who took part. We categorized patients into 4 groups based on the standardized Persian BDI score: Normal: BDI = 0–9; mild depression: BDI between 10 and 19; moderate depression: BDI between 20 and 29; severe depression: between 30 and 40; and very severe depression: BDI ≥ 41 . Then, the study variables as well as the BDI scores and the depression categories were compared between the study groups at baseline and follow-up.

2.1. Statistical analysis

Continuous variables were described with mean and standard deviation (SD) or with median and 25th and 75th for skewed data; and were compared between the rehabilitation and control groups using student's *t* or Mann-Whitney *U* test where appropriate. Categorical variables were expressed as frequency and percentage and were compared rehabilitation and control groups using chi-square test or Fisher's exact test where appropriate. Repeated measure analysis of variance was applied to compare the changes of BDI score between the study groups. A multiple logistic regression model was applied to evaluate the association of not attending the rehabilitation programme and increase in the BDI score, adjusted for detected potential confounders. The adjusted effect was reported through odds ratio (OR) with 95% CI. P-values less than 0.05 were considered as statistically significant. The statistical analysis was performed using SPSS software (Statistical Package for the Social Sciences, version 15.0, SSPS Inc, Chicago, IL, USA).

Table 1
Comparison of the baseline characteristics between the study groups.

Characteristic ^a	Rehabilitation group (n = 35)	Control (N = 60)	Total (n = 95)	P-value [†]
Age, year	58.8 ± 11.6	60.0 ± 10.1	59.5 ± 10.6	0.585
Male gender, n (%)	23 (65.7)	43 (71.7)	66 (69.5)	0.543
BMI, kg/m ²	28.1 ± 4.3	28.0 ± 4.0	28.0 ± 4.1	0.844
Hypertension, n (%)	16 (45.7)	35 (58.3)	51 (53.7)	0.234
Diabetes mellitus, n (%)	11 (31.4)	16 (26.7)	27 (28.4)	0.62
Dyslipidemia, n (%)	16 (45.7)	22 (36.7)	38 (40.0)	0.385
Smoking, n (%)	12 (34.3)	23 (38.3)	35 (36.8)	0.693
Opium, n (%)	2 (5.7)	7 (11.7)	9 (9.5)	0.478
Family history of CAD, n (%)	0 (0)	7 (11.7)	7 (7.4)	0.044
History of Major depressive disorder, n (%)	3 (8.6)	6 (10.0)	9 (9.5)	0.819
Other organic disease	4 (11.4)	6 (10.0)	10 (10.5)	0.827
Presentation, n (%)				0.545
Acute coronary syndrome, n (%)	18 (51.4)	27 (45.0)	45 (47.4)	
Stable ischemic heart disease, n (%)	17 (48.7)	33 (55.0)	50 (52.6)	
CAD, n (%)				0.145
SVD	12 (34.3)	26 (43.3)	38 (40.0)	
2VD	14 (40.0)	23 (38.3)	37 (38.9)	
3VD	9 (25.7)	7 (11.7)	16 (16.8)	
MVD	0 (0)	4 (6.7)	4 (4.2)	
Number of stents, n (%)				0.213
One	21 (60.0)	45 (75.0)	66 (69.5)	
Two	13 (37.1)	14 (23.3)	27 (28.4)	
≥ 3	1 (2.9)	1 (1.7)	2 (2.1)	

BMI: Body mass index; CAD: Coronary artery disease; EF: ejection fraction; MVD: multi-vessel disease; SVD: Single vessel disease; VD: vessel disease.

^a Data are shown as mean ± standard deviation or frequency (percentage) where appropriate.

[†] P-value < 0.05 was considered as statistically significant.

3. Results

In this study, we enrolled 95 patients (mean age = 59.9 ± 10.6 years; male gender = 66 (69.5%). 35 patients (36.8%) of patients took part in the rehabilitation programme. There was no significant difference between the study groups regarding baseline characteristics, except for family history of CAD that was significantly higher in the control group (P = 0.04) (Table 1).

There was no significant difference between the groups regarding the BDI scores and the depression categories. However, the BDI score was significantly higher in the control group after the follow-up period (P < 0.001). Additionally, the number of patients without depression or with mild depression was significantly higher in the rehabilitation group in comparison with the controls (P = 0.02). Comparison of the BDI scores and categories of patients based on the degree of depressive symptoms between the study groups are summarized in Table 2.

The repeated measure analysis showed that the rehabilitation group had a decrease in the BDI score while there was an increase in the control group. There was also a significant difference between the groups regarding the changes of BDI (P < 0.001) (Fig. 1). The unadjusted regression model showed that not attending the rehabilitation programme was a risk factor for developing depression in our patients (OR = 13.4, 95% CI: 1.7–106.1; P = 0.014). After adjustment for confounding variables (including family history and severity of CAD), this association was still significant (OR = 10.8, 95% CI: 1.3–88.5; P = 0.027).

4. Discussion

Not attending the rehabilitation programme was a strong risk factor for the development or exacerbation of depressive symptoms, as detected by BDI score. Therefore, completing the rehabilitation programme can improve the psychological condition of the patients.

Cardiac rehabilitation programme has become an inseparable part of the standard treatment for cardiovascular patients. Moreover, it has shifted from exercise training to secondary prevention programmes including education of cardiovascular risk factors and psychological support.¹² Based on the current cardiovascular guidelines,^{20,21} addition of cardiac rehabilitation to medical treatment as well as surgery or PCI is beneficial and can improve the patients' quality of life. It can also reduce the duration of hospitalization. Moreover, this method is totally safe and has no particular adverse events.

It is currently obvious that PCI is an independent contributor for developing depressive symptoms in CAD patients.²² On the other hand, cardiac rehabilitation plays an important role in decreasing such symptoms in cardiac patients.²³ Therefore, it is presumable that cardiac rehabilitation can effectively reduce the risk of developing depression following PCI.

Our findings are consistent with several studies regarding the effect of cardiac rehabilitation on the depressive symptoms in cardiac patients. For example, in a clinical trial on patients with acute coronary syndrome, a significant change in the BDI score after one-year follow-up in patients who admitted cardiac rehabilitation was observed.²³ Another study suggested that even a short course of cardiac rehabilitation is a cost effective method to provide a better quality of life in patients who underwent cardiac rehabilitation. Similar studies in CABG patients showed a great improvement in the psychological characteristics and quality of life in patients who received cardiac rehabilitation.^{11,24} A recent before-after study on 120 patients who underwent coronary revascularization and took part in rehabilitation programme revealed a significant psychological improvement both in the depression and anxiety of the patients.

Overall, it is obvious that cardiac rehabilitation has an incontrovertible role in improving the physical and psychological health status of the cardiac patients, although a majority of patients do not take part in these programmes as mentioned in our study and the previous ones. Therefore, improving the physicians' knowledge, particularly cardiologists and cardiac surgeons, about the benefits of the cardiac rehabilitation program in patients with CAD and after cardiac interventions is crucial.²⁵ Also, patients with a positive family history of CAD were more likely to stop taking part in the program. This may indicate a social factor regarding their experience of the disease in their families that demands further study.^{26,27} Simultaneously, emphasis on motivational factors and encouragement of the patients can increase the patients' adherence to cardiac rehabilitation program.²⁸

4.1. Study limitations

The small sample size of this study is its main limitation. One of the limitations of this study was the limited follow-up period of the study. A longer follow-up could increase the validity of the study and describe the role of the rehabilitation program on long-term psychological outcomes of the patients. This study also lacks a qualitative assessment of the patients' mental status. Moreover, we did not record the medications of the patients before and after the procedure and we just excluded patients who were using antidepressants. Finally, this was a cohort study and we did not intervene the participation of the patients and therefore no randomization was done. As many factors, such as patients' decision and role of their family may affect their participation, it is important to consider these factors in the future studies.

5. Conclusion

In this study, we observed that not performing cardiac rehabilitation is an important risk factor for the development or improvement of depression in patients who undergo elective PCI

Table 2

Comparison of the baseline and follow-up BDI scores and degree of depressive symptoms between the study groups.

Characteristic	Rehabilitation group (n = 35)	Control group (N = 60)	P-value
Pre-procedural Beck score	10.0 [4.0, 18.0]	8.0 [0,10.0]	0.991
Follow-up Beck score	8.5 [3.2, 16.0]	10.5 [6.0, 20.0]	<0.001
Pre-procedural depression symptoms			0.872
None to mild	28 (80.0)	48 (81.4)	
Moderate to severe	7 (20.0)	12 (20.0)	
Follow-up depression symptoms			0.002
None to mild	34 (97.1)	43 (71.7)	
Moderate to severe	1 (2.9)	17 (28.3)	

*P-value < 0.05 was considered as statistically significant.

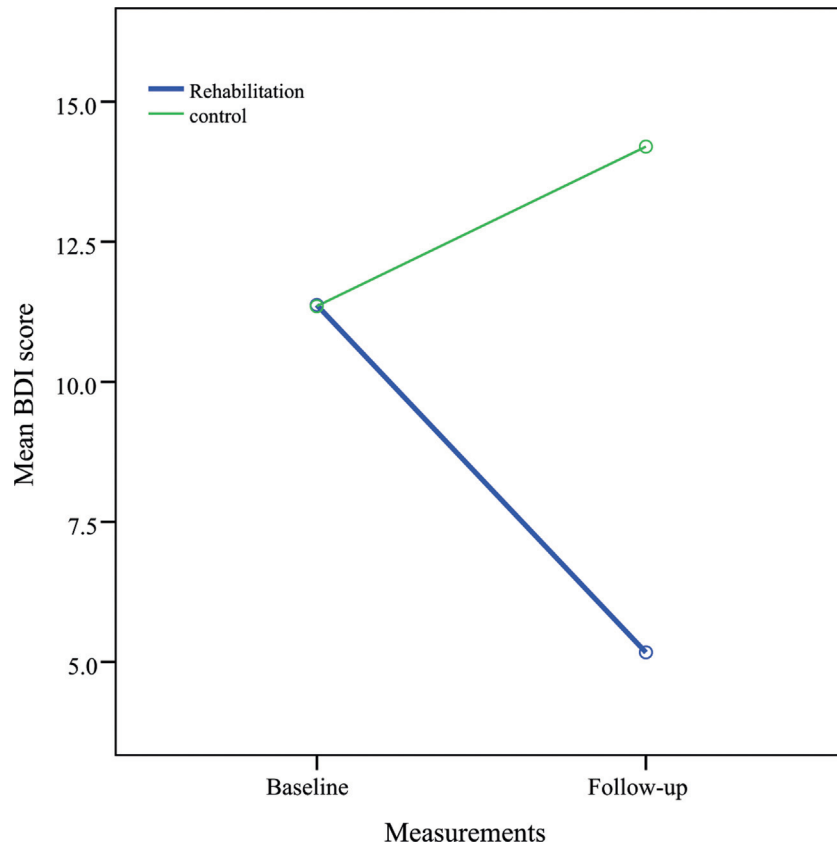


Fig. 1. Comparison of the changes of BDI scores at baseline and after follow-up between the rehabilitated patients and the control group.

and actively took part in the rehabilitation program. This improvement was regardless of age and gender. We suggest that clinicians should pay more attention to cardiac rehabilitation programs following cardiovascular events and interventions. However, understanding the exact effect of cardiac rehabilitation on the changes and severity of depression in PCI patients needs further evaluations.

Conflict of interest

None

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