ORIGINAL ARTICLE

The psychological effects of cardiac rehabilitation after coronary revascularization

Koroner revaskülarizasyon sonrası kardiyak rehabilitasyonun psikolojik etkileri

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ABSTRACT

Objective: Prevalence of depression and anxiety increases following cardiac revascularization. The aim of this study was to examine the effects of a cardiac rehabilitation program on psychological status of patients after cardiac revascularization.

Methods: A total of 120 patients who underwent either coronary artery bypass grafting (CABG) or percutaneous coronary intervention (PCI) were enrolled in an 8-week rehabilitation program. A brief mood survey was administered before the program and repeated following its completion. Psychological state was assessed for depression, anxiety, panic symptoms, difficulty in adaptation, and relational satisfaction. Changes in mood scores were analyzed with paired t-tests and linear regression models to predict response.

Results: A total of 95 men and 25 women were enrolled. Average age was 60.0±8.4 years. Eighty-two patients underwent PCI, the remaining 38 underwent CABG. Following rehabilitation, depression reduced from 28.3% to 10.8% (p=0.002), anxiety decreased from 21.7% to 9.1% (p=0.012), panic symptoms reduced from 16.7% to 5.8% (p=0.014), and difficulty in adaptation decreased from 30.0% to 10.9% (p=0.0002). Changes in state of depression were not predicted by medical, social, or physical factors, while changes in anxiety were negatively affected by smoking. Psychological changes after rehabilitation were not influenced by presence of acute myocardial infarction (MI) before revascularization.

Conclusion: Enrollment in cardiac rehabilitation after coronary revascularization positively impacts psychological status of patients, as assessed by brief mood survey.

ÖZET

Amaç: Kardiyak revaskülarizasyon sonrası depresyon ve anksiyetenin prevalansı yükselmektedir. Bu çalışmanın amacı kardiyak revaskülarizasyon sonrası hastaların psikolojik durumuna kardiyak rehabilitasyon programının etkilerini incelemekti.

Yöntemler: Daha önce koroner arter baypas greftleme (KABG) veya perkütan koroner girişim (PKG) ameliyatları geçirmiş toplam 120 hasta sekiz haftalık rehabilitasyon programına alındı. Programdan önce kısa bir duygudurum araştırması yapıldı, rehabilitasyon programı tamamlandıktan sonra tekrarlandı. Depresyon, anksiyete, panik semptomlar, adaptasyon zorluğu ve ilişki memnuniyeti açısından psikolojik durum değerlendirildi. Yanıtı öngörmek için duygudurum skorlarındaki değişiklikler eşleştirilmiş t testleri ve doğrusal regresyon modelleriyle analiz edildi.

Bulgular: Toplam 95 erkek ve 25 kadın çalışmaya alındı. Yaş ortalaması 60.0±8.4 idi. Seksen iki hasta PKG ve geri kalan 38 hasta KABG geçirmişti. Rehabilitasyondan sonra depresyon oranı %28.3'den %10.8'e (p=0.002), anksiyete %21.7'den % 9.1'e (p=0.012), panik semptomlar (%16.7'den % 5.8'e (p=0.014) ve adaptasyon zorluk oranı ise %30.0'dan %10.9'a (p=0.0002) düşmüştü. Medikal, sosyal veya fiziksel faktörler depresyon durumundaki değişiklikleri öngörmedi, anksiyetedeki değişiklikler ise sigara kullanımından olumsuz etkilendi. Rehabilitasyon sonrası psikolojik değişiklikler revaskülarizasyon öncesi akut miyokart enfarktüsü (ME) varlığından etkilenmediği belirlendi.

Sonuç: Koroner revaskülarizasyon sonrası kardiyak rehabilitasyon programına katılım kısa duygudurum araştırmasıyla değerlendirildiği gibi hastaların psikolojik durumunu olumlu etkilemektedir.

Received: July 03, 2015 *Accepted:* September 14, 2015

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Coronary revascularization is the only effective way to reestablish blood and oxygen supply to the ischemic myocardium for the purpose of improving symptoms and/or survival of patients with coronary artery diseases.[1] A report from the Cath PCI Registry of the National Cardiovascular Data Registry revealed that approximately 1 million people underwent percutaneous coronary intervention (PCI) in the United States between 2010 and 2011.[2] Although the number of surgical revascularizations has decreased over the past decade, approximately one-half of that population underwent coronary artery bypass grafting (CABG) in a 1-year period.[3]

Abbreviations:

ACS	*Acute coronary syndromes*
CABG	*Coronary artery bypass grafting*
CI	*Confidence interval*
MI	*Myocardial infarction*
PCI	*Percutaneous coronary intervention*

As many as 66% of patients hospitalized for acute coronary syndromes (ACS) have mild depression.[4] Prevalence of mood disorders reaches 30–40% among patients undergoing surgical revascularization.[5] Compared with prevalence of depression (5–6%) in the general population,[6] more patients suffer from this mood disorder following coronary revascularization. Approximately 20% of patients cared for by an inpatient cardiology service have depressive symptoms, but approximately one-half have shown spontaneous improvement at 2 weeks post-discharge. There is, however, the same percentage of new-onset, post-discharge depression.[7] Additionally, among psychosocial factors, anxiety and depression are associated with increases in both short-term and long-term mortality and morbidity after coronary revascularization.

While antidepressant medications and interpersonal psychotherapy have failed to show any beneficial effects, cardiac rehabilitation programs have been shown to improve depressive symptoms in cardiac patients.[8] It is likely that exercise training is helpful in the management of depression among cardiac patients. In this study, we offered an intensive rehabilitation program to patients undergoing coronary revascularization by means of PCI or CABG and evaluated their psychosocial status with a brief mood survey examining depression, anxiety, panic state, and coping difficulty before and after this rehabilitation program. Primary endpoints of this study were changes in cumulative brief mood survey scores following the cardiac rehabilitation program. We hypothesized that post-revascularization rehabilitation improved the mood of patients following PCI or CABG.

METHODS

Study protocol and informed consent agreements were reviewed and approved by the institutional review board of Tabriz University of Medical Sciences. Patients signed an informed consent after being fully informed of the research protocols. A total of 120 patients who underwent either percutaneous or surgical coronary revascularization, either following an acute coronary syndrome or in order to treat a stable coronary occlusive disorder, from March 2011 through February 2012 were enrolled in the study.

Brief mood survey

All patients with known diagnosis of depression and/or on antidepressant treatments were excluded from the study. Patients with dementia and neurocognitive disorder who were unable to complete the survey were excluded, as were those who refused or were incompetent to sign an informed consent. Prior to commencing rehabilitation program, all patients were interviewed by a psychologist, and the brief mood survey[9] regarding presence and severity of symptoms of depression, anxiety, panic disorder, and difficulty in adapting to new changes was completed. Survey included 5 questions, and patients were graded based on spectrum of symptoms, from 0 as "no symptom" to 4 as the most "extreme." Total sum of scores was added to 20, and scores of 15 or higher were considered clinically significant. In addition, patients were asked to evaluate level of satisfaction with their relationships with spouses or significant others. This section of the survey also included 5 questions and was graded from 0–6. Higher scores in this section indicated higher levels of satisfaction and maximized at 30 total. The survey was first administered by the interviewing psychiatrist 2 weeks after revascularization and was readministered 1 week after completion of rehabilitation program.

Cardiac rehabilitation protocol

All patients were asked to participate in an 8-week cardiac rehabilitation program after completion of brief mood survey. This program included a series of graded exercises administered by a board-certified rehabilitation medicine specialist at Tabriz Heart Center. During initial visit, patients were examined

for level of cardiovascular fitness. Level of physical exercise was determined in order to maintain 80% target heart rate. Exercises included a series of isotonic and isometric exercises performed for 1 hour a day, 3 days per week. All sessions were supervised by a certified cardiac rehabilitation technician. Each patient was also consulted and educated about cardiac risk factors and impact of lifestyle modifications on cardiac diseases. Consultations for diet and lifestyle modifications and smoking cessation, psychological consultations, and education regarding the nature of cardiac diseases were performed.

Statistical analysis and data management

All demographic, anthropometric, and surgical/procedural data were entered into a Microsoft Excel worksheet and transferred to an SPSS data sheet. SPSS software (version 18.0; SPSS Inc., Chicago, IL, USA) was used to perform all statistical analyses. Changes in scores of each mood survey category before and after rehabilitation program were the primary endpoint. Changes ±2 in brief mood survey scores were considered clinically significant. Cumulative survey scores were 9.6±5.6 prior to rehabilitation. A power analysis was performed using the mean difference of 30% (post-pre/pre *100) in cumulative scores considered to be significant. Analysis revealed that a minimum of 98 patients needed to be examined as paired analyses to produce a power of 0.80. Pre- and post-rehabilitation scores were compared using paired t-tests. Multivariate regression analyses were performed for factors with historical association with

Table 1. Changes in number and percentage of patients before and after rehabilitation within different categories

	Depression n (%)		Anxiety n (%)		Panic state n (%)		Difficulty in coping		Somewhat satisfied	
	Before	After	Before	After	Before	After	Before	After	Before	After
Gender										
Male	28 (29.5)	11 (11.6)*	21 (22.1)	9 (9.5)*	14 (14.7)	5 (5.3)*	28 (29.5)	10 (10.6)*	69 (72.6)	87 (91.6)
Female	6 (24.0)	2 (8.0)*	5 (20.0)	2 (8.0)	6 (24.0)	2 (8.0)	8 (32.0)	3 (12.0)*	21 (84.0)*	25 (100)
Revascularization Method										
PCI	19 (23.2)	9 (11.0)*	16 (19.5)	6 (7.3)*	11 (13.4)	4 (4.9)*	20 (24.4)	9 (11.1)	62 (75.6)	74 (92.2)
CABG	15 (39.5)	4 (10.5)**	10 (26.3)	5 (13.1)	9 (23.7)	3 (7.9)*	16 (42.1)	4 (10.5)	28 (73.7)	37 (97.4)
Obesity (BMI)										
BMI >30	21 (26.6)	8 (10.1)	15 (19.0)	5 (6.3)*	10 (12.7)	3 (3.8)*	22 (27.8)	8 (10.3)	31 (75.6)	38 (92.7)
BMI ≤30	13 (31.7)	5 (12.2)	11 (26.8)	6 (14.6)	10 (24.4)	4 (9.8)*	14 (34.1)	5 (12.2)	59 (74.4)	73 (92.4)
Job										
Employed	11 (28.9)	5 (13.2)*	9 (23.7)	5 (13.2)	7 (18.4)	2 (5.3)*	11 (28.9)	4 (10.5)*	31 (81.6)	35 (92.1)
Non/ret	23 (28.0)	8 (9.8)*	17 (20.7)	6 (7.3)*	13 (15.9)	5 (6.1)	25 (30.5)	9 (11.1)*	59 (72.0)	76 (92.7)
Diabetics	8 (26.7)	4 (13.3)	7 (23.3)	2 (6.7)	5 (16.7)	3 (10.0)	9 (30.0)	4 (13.3)	23 (76.7)	28 (93.3)
Non-Diabetics	26 (29.2)	9 (10.1)*	19 (21.3)	9 (10.1)	15 (16.9)	4 (4.5)	27 (30.3)	9 (10.2)	66 (74.2)	82 (92.1)
Smokers	5 (33.3)	1 (6.7)*	5 (33.3)	1 (6.7)	3 (20.0)	0 (0.0)	4 (26.7)	2 (13.3)	11 (73.1)	15 (100)
Non-smokers	29 (27.9)	12 (11.5)*	21 (20.2)	10 (9.7)	17 (16.3)	7 (6.7)*	32 (30.8)	11 (10.7)	78 (75.0)	95 (91.3)
ACS symptoms	19 (30.6)	8 (12.9)	14 (22.6)	7 (11.3)	13 (21.0)	3 (4.8)	21 (33.9)	8 (13.1)	44 (71.0)	57 (91.9)
Stable CAD	11 (33.3)	4 (12.1)	7 (21.2)	2 (6.1)	3 (9.1)*	1 (3.0)	9 (27.3)	4 (12.1)	26 (78.8)	31 (93.9)
Acute MI	11 (30.6)	6 (16.7)	10 (27.8)	5 (13.9)	8 (22.3)	3 (8.3)	13 (36.1)	4 (11.4)	23 (63.9)	33 (91.7)
No MI	19 (32.2)	6 (10.2)	11 (18.6)	4 (6.8)	8 (13.6)	1 (1.7)	17 (28.8)	8 (13.6)	47 (79.7)	55 (93.2)

PCI: Percutaneous coronary intervention; CABG: Coronary artery bypass grafting; Non-OB: Non-obese; Non/ret: Unemployed/retired; ACS: Acute coronary syndrome; CAD: Coronary artery disease; MI: Myocardial infarction. Asterisks indicate statistical significance between independent variables regardless of the rehabilitation.

outcome variable and those with a p value <0.15 in univariate analyses. Regression coefficients with 95% confidence interval (CI) were provided for all these variables in each dependent variable. All continuous variables were expressed as mean±SD, and analyzed by t-tests for binomial groups and by analysis of variance for polynomial groups. When data did not follow normal distribution, non-parametrical analysis Mann-Whitney U test was used to compare the median, and the data were expressed as median and interquartile range. Categorical data were expressed as count and percentage, and were analyzed with chi-square and Mantel-Haenszel tests; p values <0.05 were considered statistically meaningful.

RESULTS

A total of 120 patients who underwent cardiac rehabilitation following coronary revascularization from March 2011 through February 2012 were enrolled. Ninety-five patients (79.2%) were male, the remaining 25 (20.8%) female. Average age was 60.0±8.4 years, and the majority (68.3%) were either retired or not officially employed. Average body mass index was 28.6±5.8 kg/m^2, and 41 patients (34.2%) were classified as obese, with body mass index >30 kg/m^2. One-fourth of the patients (30 patients) carried a diagnosis of diabetes mellitus. Fifteen patients (12.5%) were actively smoking at the time of rehabilitation. Eighty-two patients (68.3%) underwent PCI (balloon angioplasty with or without placement of coronary stent), and the remaining 38 patients (31.7%) underwent coronary artery bypass surgery. The average ejection fraction of the left ventricle was 47.4±9.3%. Table 1 depicts individual scores of brief mood survey for each category of patients.

Prior to start of rehabilitation protocol, 34 patients (28.3%) had significant depressive symptoms, 26 patients (21.7%) had significant anxiety, 20 patients (16.7%) demonstrated panic symptoms, and 36 patients (30.0%) reported to have difficulty in adapta-

Table 2. Changes in the survey scores of patients before and after rehabilitation within different categories

	Depression (Mean±SD)		Anxiety (Mean±SD)		Panic state (Mean±SD)		Difficulty in coping (Mean±SD)		Relation satisfaction (Mean±SD)	
	Before	After	Before	After	Before	After	Before	After	Before	After
Gender										
Male	9.5±5.6	6.0±5.6	9.4±7.0	6.3±4.9	7.6±6.1	4.9±5.0	10.6±5.8	7.8±5.3	17.6±5.2	20.6±4.1
Female	10.3±5.7	7.5±4.6	9.7±5.6	6.2±4.8	8.4±6.1	5.0±4.7	11.5±5.1	8.5±4.8	19.1±3.5	21.8±3.5
Revascularization Method										
PCI	9.2±6.3	6.3±5.2	8.9±5.7	6.1±4.8	7.6±5.8	5.0±4.9	10.4±5.6	8.0±5.3	17.8±4.4	20.4±3.9
CABG	10.7±6.5	6.5±5.9	10.7±8.5	6.6±4.9	8.1±6.8	4.8±5.2	11.5±5.8	7.9±5.2	18.2±5.9	21.8±4.1
Obesity (BMI)										
BMI >30	10.7±5.8	7.4±5.1	9.2±7.2	6.0±4.7	7.3±6.0	4.5±4.8	10.6±5.5	7.8±5.3	17.8±5.3	20.8±4.0
BMI ≤30	9.1±6.7	5.8±5.5	9.9±5.9	7.0±5.2	8.6±6.2	5.8±5.1	11.0±5.8	8.4±5.1	18.1±4.0	21.0±3.6
Job										
Employed	10.1±6.6	7.1±5.8	9.9±8.4	6.5±5.3	8.3±6.1	5.6±4.9	11.4±5.6	8.5±5.4	17.8±5.3	20.5±3.9
Non/ret	9.5±6.3	6.0±5.2	9.3±5.8	6.2±4.6	7.5±6.1	4.6±4.9	10.5±5.7	7.7±5.1	17.9±4.8	21.0±4.0
Diabetics	11.0±5.8	7.7±5.2	10.0±5.5	6.9±4.7	8.8±5.5	5.7±5.1	11.3±5.2	8.2±5.2	17.8±3.9	20.3±3.7
Non-Diabetics	9.3±6.5	6.0±5.4	9.4 ±7.1	6.1±4.9	7.5±6.2	4.7±4.9	10.7±5.8	8.0±5.2	17.8±5.2	21.0±4.1
Smokers	12.2±4.0	9.7±4.0	14.1±9.6	8.3±3.9	9.8±5.2	6.3±3.8	13.1±3.2	10.7±2.6	16.9±3.3	19.7±2.7
Non-smokers	9.4±6.6	5.9±5.4	8.9±6.0*	6.1±4.9	7.5±6.2*	4.8±5.1	10.5±5.8	7.7±5.4	17.9±5.1	21.0±4.1

SD: Standard deviation; PCI: Percutaneous coronary intervention; CABG: Coronary artery bypass grafting; Non-OB: non-obese; Non/ret: unemployed/retired; ACS: Acute Coronary Syndrome; CAD: Coronary Artery Disease; MI: Myocardial infarction. Asterisks indicate statistical significance between before and after rehabilitation.

Table 3. Mood changes associated with rehabilitation after coronary revascularization

		Depression n (%)	Anxiety n (%)	Panic state n (%)	Coping problems n (%)
Male	Improved	42 (44.2)	44 (46.3)	43 (45.2)	41 (43.6)
	No change	52 (54.7)	48 (50.5)	51 (53.7)	48 (51.1)
	Deterioration	1 (1.1)	3 (3.2)	1 (1.1)	5 (5.3)
Female	Improved	12 (48.0)	14 (58.3)	14 (58.3)	12 (50.0)
	No change	13 (52.0)	10 (41.7)	10 (41.7)	11 (45.8)
	Deterioration	0 (0.0)	0 (0.0)	0 (0.0)	1 (4.2)
Employed	Improved	15 (39.5)	18 (47.4)	16 (42.1)	17 (44.7)
	No change	22 (57.9)	19 (50.0)	21 (55.3)	19 (50.0)
	Deterioration	1 (2.6)	1 (2.6)	1 (2.6)	2 (5.3)
Unemployed or retired	Improved	39 (47.6)	40 (49.4)	41 (50.6)	36 (45.6)
	No change	43 (52.4)	39 (48.1)	40 (49.4)	40 (49.4)
	Deterioration	0 (0.0)	2 (2.5)	0 (0.0)	4 (5.0)
Obese	Improved	17 (41.5)	21 (52.5)	19 (46.3)	17 (41.5)
	No change	24 (58.5)	18 (45.0)	22 (53.7)	22 (53.7)
	Deterioration	0 (0.0)	1 (2.5)	0 (0.0)	2 (4.8)
Non-obese	Improved	37 (46.8)	37 (46.9)	38 (48.7)	36 (47.9)
	No change	41 (51.9)	40 (50.6)	39 (50.0)	37 (46.9)
	Deterioration	1 (1.3)	2 (2.5)	1 (1.3)	4 (5.2)
Non-diabetics	Improved	40 (44.9)	42 (47.7)	42 (47.7)	38 (43.2)
	No change	48 (53.9)	44 (50.0)	47 (52.3)	45 (51.1)
	Deterioration	1 (1.2)	2 (2.3)	0 (0.0)	5 (5.7)
Diabetics	Improved	14 (46.7)	16 (53.3)	16 (53.3)	14 (46.7)
	No change	16 (53.3)	13 (43.4)	13 (43.4)	14 (46.7)
	Deterioration	0 (0.0)	1 (3.3)	1 (3.3)	1 (3.3)
Acute coronary syndrome	Improved	30 (48.4)	34 (54.8)	34 (54.8)	28 (45.9)
	No change	31 (50.0)	26 (41.9)	28 (45.2)	31 (50.8)
	Deterioration	1 (1.6)	2 (3.2)	0 (0.0)	2 (3.3)
Elective stable angina	Improved	19 (57.6)	15 (46.9)	20 (62.5)	13 (40.6)
	No change	14 (42.4)	16 (50.0)	11 (34.4)	18 (56.3)
	Deterioration	0 (0.0)	1 (3.1)	1 (3.1)	1 (3.1)
Acute myocardial infarction	Improved	17 (47.2)	23 (63.9)	23 (63.9)	16 (47.2)
	No change	18 (50.0)	12 (33.3)	13 (36.1)	19 (52.8)
	Deterioration	1 (2.8)	1 (2.8)	0 (0.0)	0 (0.0)
No acute myocardial infarction	Improved	32 (54.2)	26 (44.8)	31 (53.5)	25 (44.1)
	No change	27 (45.8)	30 (51.7)	26 (44.8)	30 (51.7)
	Deterioration	0 (0.0)	2 (3.5)	1 (1.7)	3 (5.2)
Overall	Improved	54 (45.0)	58 (48.7)	57 (47.9)	53 (44.9)
	No change	65 (54.2)	58 (48.7)	61 (51.3)	59 (50.0)
	Deterioration	1 (0.8)	3 (2.5)	1 (0.8)	6 (5.1)

Changes in survey scores from -2 to +2 were considered as no change.

Table 4. Mood score changes associated with rehabilitation after coronary revascularization in patients with acute coronary syndrome and myocardial infarction

	Acute coronary syndrome		Elective stable angina	
	Pre-Rehab	Post-Rehab	Pre-Rehab	Post-Rehab
	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Depression	10.1±6.4	6.8±5.4	11.0±6.2	6.8±5.8
Anxiety	10.0±6.0	7.1±4.9	9.8±8.3	5.9±5.0
Panic disorder	8.2±6.3	4.9±4.8	8.2±5.3	4.9±4.9
Difficulty in coping	11.2±5.8	8.3±5.3	10.9±5.4	8.3±5.3
Relation satisfaction	17.1±5.2	20.6±3.8	18.2±4.0	20.7±4.4
	Acute myocardial infarction		No acute myocardial infarction	
	Pre-Rehab	Post-Rehab	Pre-Rehab	Post-Rehab
	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Depression	10.1±6.6	7.2±5.7	10.6±6.6	6.6±5.4
Anxiety	10.8±6.1	7.5±5.1	9.5±7.2	6.2±4.8
Panic disorder	9.0±6.2	5.8±5.1	7.7±5.8	4.4±4.5
Difficulty in coping	11.4±6.0	8.5±5.3	10.9±5.5	8.2±5.3
Relation satisfaction	16.4±5.5	20.2±3.8	18.2±4.3	20.9±4.1

SD: Standard deviation.

tion. A total of 110 patients (91.7%) were favorably satisfied with their relationships. Upon completion of rehabilitation program, the number of patients with depressive symptoms decreased to 13 (10.8%; p=0.002). Similarly, the number of the patients with anxiety decreased to 11 (9.1%; p=0.012), the number of patients with panic disorder decreased to 7 (5.8%; p=0.014), and the number of the patient with difficulty in adaptation decreased to 13 (10.9%; p=0.0002). At the same time, more patients were satisfied with their relationships after completion of rehabilitation program. A paired analysis of pre- and post-rehabilitation scores indicated a significant reduction in all categories of depression, anxiety, panic, and difficulty in adaptation, as well as a rise in relational satisfaction scores (p<0.001; Table 2).

When degree of changes was adjusted according to >2-point decrease or increase of post-rehabilitation scores from respective pre-rehabilitation values, patients were divided into 3 groups: 1) those reporting an improvement; 2) those reporting no significant changes; and 3) those reporting worsening of symptoms of depression, anxiety, panic, and difficulty in adaptation. A total of 54 patients (45.0%) reported an improvement in depressive symptoms, while 65 patients (54.2%) reported no change, and only 1 patient (0.8%) reported worsening of these symptoms. Anxiety was improved in 58 patients (48.7%), did not change in 58 patients (48.7%), and was exacerbated in 3 patients (2.5%). Table 3 depicts these changes in all components of brief mood survey and relational satisfaction. Mood score changes associated with rehabilitation after coronary revascularization in patients with ACS and in those who underwent revascularization for chronic stable angina are shown in Table 4.

Linear regression analyses of changes in depression scores were performed, including age, gender, and history of myocardial infarction (MI), but none were identified as independent variables predicting changes in depression scores after cardiac rehabilitation. Anxiety, smoking, type of revascularization, and presentation with ACS were included in multivariate linear regression model because of their lower p values in univariate analyses (p <0.015). Smoking was identified as an independent factor. Patients who were active smokers had significantly smaller decreases in their anxiety score after cardiac rehabilitation (B: 3.53, 95% CI -6.13 to -0.921; p=0.009). In terms of

relational satisfaction, panic, and difficulty in adjustment, multivariate regression analysis was not performed, as none of these factors had a p value <0.15 in univariate analysis.

DISCUSSION

Enrollment of patients after major cardiac event in various rehabilitation programs has been associated with early recovery and reduced rates of readmission to hospital.[10] In addition to physical recovery, there was significant psychological improvement in patients enrolled in cardiac rehabilitation programs after coronary events.[11] Results of the present study indicate that cardiac rehabilitation improves psychometric parameters of patients following coronary revascularization. These patients are at increased risk of depression and anxiety disorders, compared to the general population.

This observation is confirmed by the results of the present study, which also demonstrate that improvement of psycho-behavioral symptoms occurs uniformly among men and women, regardless of patient age and type of revascularization.

The brief mood survey used in this study has been widely administered in both clinical and research practices, and has been validated by others.[8,9,12,13] In spite of its simplicity, it provides an important insight into presence and severity of symptoms of depression, anxiety, panic state, and difficulties in coping and adaptation. In a more recent publication, Cronbach's α scores of this tool for anger, anxiety, and depression subscales were 0.82, 0.85, and 0.90, respectively.[13] The survey includes a 5-item relational satisfaction scale that demonstrates good convergent and discriminate validity with a Cronbach's α score of 0.97.[9,13] One of its advantages is that it can be used and administered by any health professional. However, we confirmed our findings with a specialist in psychiatric medicine to avoid any erroneous interpretation of findings. Additionally, this survey can be administered repeatedly to a single patient in order to monitor progress or improvement of symptoms related to anxiety and depression, though it should not be administered more than once a week.

Anxiety and depression usually go hand in hand, and the presence of one condition may lead to the other. Anxiety is a state that one experiences during a perception of danger, and in more severe forms it may result in panic states that generally block the subject from perceiving and organizing other environmental sensory inputs. Many individuals consider a coronary event as a warning that their life will end, their activity levels will be limited, or, at the very least, that their lifestyle will be affected.[14] As with any of life's stressors, coronary events may cause transient sadness and apprehension. Persistence of these reactions in these patients leads to development of general anxiety and/or depression.[15] Thoughts of reinfarction or sudden death are anxiety-provoking after acute coronary events. In more severe cases, they may even manifest as panic attacks.

Depression is a common response to past tragedy, and anxiety is the most commonly expected response to an unknown or uncertainty. Dealing with prolonged anxiety generally leads to development of depression.[16] Although the observation of depression and anxiety is not novel among patients following acute coronary events and among those who require coronary intervention for ischemic heart diseases,[17] it is important to note that conventional treatment of depression and anxiety has not been effective in decreasing depression-associated morbidities, and has not improved the clinical outcome of these patients.

Our findings confirm higher prevalence of depression and anxiety among patients undergoing revascularization procedures. Despite a higher overall prevalence of depression in women and a report by Mitchell et al. describing women as being at higher risk of developing depression after CABG,[6,18] our data has failed to show any increased occurrence of depressive symptoms in female patients after coronary revascularization, as approximately a quarter of both male and female patients had depression. Reported in a recent news release from the American College of Cardiology, Samad and her colleagues at Duke University studied 254 men and 56 women with stable heart disease. They observed that hypercoagulability increases and blood flow to the myocardium decreases more often in women in response to stress. This observation underscores gender differences in handling stressful and emotional stimuli associated with cardiovascular diseases that may lead to anxiety.[19]

In contrast to others, we failed to show any difference in the frequency of anxiety, depression, panic symptoms and coping issues between patients who

were revascularized following ACS and those who were revascularized due to elective chronic myocardial ischemia. Similarly, we were unable to show any difference between the psychological states of patients who suffered from MI and those who were revascularized for angina symptoms without evidence of myocardial tissue loss. This lack of difference could be due to the fact that many of our patients were not aware of the extent of their myocardial damage.

Moreover, as in most studies that have examined the incidence of depression or anxiety after MI, the present study lacked information regarding psychological state of patients prior to coronary event. Therefore, it is very difficult, if not impossible, to differentiate between preexisting anxiety or depressive symptoms and those that have been precipitated by the most recent coronary event and/or coronary revascularization. A thorough psychological history of patients will be able to partially address this limitation. It is quite possible that recovery and improvement noted following cardiac rehabilitation will be meager among patients who had suffered from these symptoms chronically, independent of their coronary events.

Tully et al. demonstrated that in patients with clinical depression or anxiety, the incidence of delirium increases after cardiac surgery.[20] Rafanelli et al. showed that risk of future cardiac events increases within 8 years following CABG surgery in patients with minor depressive symptoms, compared to those who do not report similar symptoms.[21] Non-adherence to medical treatment is about 2.8 times more common among cardiac patients with depression, compared to non-depressed patients.[22] This lack of patient compliance may contribute to the observed risk of cardiac events.

Relational satisfaction was a major component of the brief mood survey and was examined in our patient population. Overall, regardless of gender, our patients reported a significant improvement in relational satisfaction. Several factors may affect relational satisfaction among patients suffering from coronary events. Chronic erectile dysfunction has been reported in men following use of beta-blockers and several other medications used to treat cardiovascular diseases.[23,24] Fear of inadequate sexual performance, presence of angina symptoms during sex, or fear of reinfarction and sudden death during intimacy may precipitate anxiety and/or depression in both partners, and ultimately lead to relational dissatisfaction.[25] Successful completion of a cardiac rehabilitation program may reassure patients that some of these fears are unfounded, and improve their sexual lives and relationships with partners.

A limitation of the present study is that it lacked a control group. It would have been useful to reevaluate psychological status of a group of post-revascularized patients who did not undergo exercise training in order to examine potential effects of passage of time on psychological status.

Conclusion

The data of the present study suggests that cardiac rehabilitation significantly improves psychological state of patients after both percutaneous and surgical coronary revascularization. Programs mitigate symptoms related to depression, anxiety, and panic disorder, while enhancing adaptation and significantly improving levels of relational satisfaction after CABG and PCI.

Conflict-of-interest issues regarding the authorship or article: None declared

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Keywords: Acute coronary syndrome; cardiac rehabilitation; myocardial infarction; psychological changes.

Anahtar sözcükler: Akut koroner sendrom; kardiyak rehabilitasyon; miyokart enfarktüsü; psikolojik değişiklikler.