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The effect of obesity on functional capacity, anxiety and daily life activities in patients with coronary artery disease and phase II cardiac rehabilitation

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ABSTRACT

Objective. The aim of our study was to investigate the effect of cardiac rehabilitation (CR) program on obese and non-obese patients with coronary artery disease. ***Methods.*** The records of 60 coronary artery disease patients aged between 18-75 years, who were included in CR were evaluated. Of the study subjects, 20 had undergone coronary artery bypass grafting (CABG) and 40 had undergone percutaneous coronary intervention (PCI). The patients were divided into two groups by body mass index (BMI), with Group I being non-obese (BMI < 30 kg/m2) and Group 2 being obese (BMI ≥ 30 kg/m2). The effect of 30 session CR on the two groups were evaluated with 6-min walk test (6MWT), Short Form-36 (SF-36) and Beck Anxiety Inventory (BAI). ***Results.*** Baseline characteristics of the group 1 (39 patients) and group 2 (21 patients) were similar. Statistically significant improvement was detected in group 1 and group 2 patients by CR program in 6MWT, BAI and SF-36 parameters ($p < 0.05$). 6MWT, BAI and SF-36 parameters changes by cardiac rehabilitation were compared between the two groups. According to the comparison 6MWT (group 1; 60 (20-183) vs group 2; 34 (15-180), $p = 0.012$) and MET (group 1; 1.44 ± 0.56 vs group 2; 1.09 ± 0.41, $p = 0.015$ changes were significantly higher in group 1 than in group 2. However, the changes of BAI and SF-36 parameters were similar in two groups ($p > 0.05$). ***Conclusion.*** CR was found to be effective and safe in terms of functional capacity, daily life activities and anxiety in both obese and non-obese patients. Functional capacity gain in the obese group was less than non-obese patients.

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Keywords: cardiac rehabilitation, obesity, quality of life, functional capacity, anxiety

Introduction

Cardiovascular diseases are associated with high morbidity and mortality risk despite the recent innovations in diagnosis and treatment. The prevalence of coronary heart diseases in Turkey has

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increased 1.4-2.2 times between 1990-2006, and there is an increase of 5% per year in people over the age of 60 [1]. In patients with coronary artery disease (CAD), functional capacity is a strong predictor of mortality and morbidity. Daily activities and exercise capacities of these patients are often restricted because of their cardiopulmonary and musculoskeletal limitations. Many studies have shown that risk factors for active patients are reduced relative to patients who are sedentary for developing CAD [2-5].

The World Health Organization's description of cardiac rehabilitation (CR) can be summarized as follows: "ensuring that cardiac patients regain their pre-disease health physically, mentally and socially as much as possible" [6]. The main goal of CR is to increase the daily activity of the cardiac patient, change the natural course of the illness and improve their quality of life. CR not only increases the functionality but also reminds the patient and their family to make lifestyle changes [7, 8]. Effective CR is an effective method for protection from cardiovascular morbidity and mortality [9].

Prevalence of obesity worldwide has doubled in recent years due to changes in diet and daily life activities [10, 11]. Obesity is known to have negative effects on the increase in mortality and morbidity in cardiovascular diseases [12-14]. Increasing number of obese patients increases the number of CADs [15, 16]. Due to negative effects of obesity on cardiac wellbeing, it may affect the results of CR program [14, 17-20].

The aim of our study was to investigate the effect of CR on obese and non-obese patients with CAD that were included in CR program and to compare their results.

Methods

In our study, the records of 60 coronary artery patients aged between 18-75 years, who were included in CR program of Physical Medicine and Rehabilitation clinic. The approval of the ethics committee and informed consent from the patients were obtained. Of the study subjects, 20 had undergone coronary artery bypass grafting (CABG) and 40 had undergone percutaneous coronary intervention (PCI). Patients with congestive heart failure, malignancy diagnosis, chronic obstructive pulmonary disease (COPD), progressive worsening of rest or exercise tolerance over the last 3-5 days, marked ischemia at low workload (< 2 MET or ~ 50 Watt), uncontrolled diabetes, acute systemic disease or fever, newly diagnosed embolism, thrombophlebitis, active pericarditis or myocarditis, moderate or severe aortic stenosis, regurgitant valvular heart disease requiring surgery, myocardial infarction within the last 3 weeks, patients with new-onset atrial fibrillation and bypass surgery were excluded from the study. The patients were taken to the rehabilitation program 4 weeks after the intervention. All patients underwent treadmill exercise stress test (Schiller CS-200 Excellence, 2006, Swedish) using Bruce protocol in the presence of a cardiologist in the beginning and end of the CR. The exercise stress test allowed determination of metabolic equivalent (MET) hemodynamic response markers and evaluation of functional capacity.

Data of the patient who completed 30 sessions of phase II CR program 4 days a week were evaluated. CR included 5 minutes of warm-up exercises, 10 minutes of joint range of motion exercises, 10 minutes of stretching exercises, 30 minutes of cycling with aerobic exercise (Custo-med 2014, Germany) and 5 minutes of cooling exercises. After 2 weeks, the patients were continued on the 60-minute rehabilitation, to which resistive exercises were added, and the intensity of exercise was increased by 15% once every 2 weeks. During exercise, the patients' pulse oximeter, arterial blood pressure, heart rate and rhythm, oxygen saturation were monitored. All patients were included in the exercise program based on their maximum heart rate achieved. They were made to exercise with 60-85% of their maximum heart rate achieved. We did not observed any complication. The patients were divided into two groups by body mass index (BMI), with Group I being non-obese (BMI < 30 kg/m2) and Group 2 being obese (BMI ≥ 30 kg/m2).

In our study, using 6-min walk test (6MWT), SF-36 and Beck Anxiety Inventory (BAI), pre-treatment and post-30-session data of CAD patients who completed cardiac rehabilitation program were evaluated.

Evaluation Parameters

–The 6-minute walk test (6MWT):

The 6MWT is a test to measure exercise tolerance in people with lung or cardiac disease. The longer the walking distance, the better the patient's functional status [21].

–Short Form (SF-36):

The SF-36 is a recognized scale often used to evaluate quality of life. It is not specific to any disease group. It consists of 36 items and 8 subscales related to physical health (physical functioning, physical role, pain, general health) and mental health (energy, social function, role limitations due to emotional problems, mental health). Each subscale is scored in the range of 0 to 100. A high score indicates good health status. It was adapted for Turkish society and found to be valid and reliable in chronic low back pain. Kocyiğit et al. performed reliability and validity study of the scale in Turkey in 1999 [22].

–Beck Anxiety Inventory (BAI):

The inventory measures the frequency of anxiety symptoms. It is a 21-item self-report inventory that is scored in the range of 0-3. The person is asked to tick one of the following options "Not At All", "Mildly", "Moderately" and "Severely". The scoring range is 0-63. The higher the total score, the higher the level of anxiety of the person. A total score of 8-15 is interpreted as "Mild" level of anxiety; 16-25 as "Moderate", and 26-63 as "Severe". The BAI was created by Beck et al. (1988) and its validity and reliability study in Turkey was performed by Ulusoy et al. (1998) [23, 24].

Statistical Analysis

An IBM SPSS 22.0 Statistics software was used to analyze data obtained through the study. In assessment of the data, chi-square (χ^2) test was used to compare categorical data andFisher's exact test was used to assess differences in the comparison of gender. Descriptive statistical methods (frequency, percentage, mean, standard deviation, median, min–max) were used to assess the study data. Normal distribution of the data was tested using Shapiro-Wilk test. Independent Samples t test (t test for independent groups) was used in between-groups comparisons while variables were found normally distributed. When a normal distribution was not foundMann Whitney U test for comparisons between groups were used. Intra group repeated measurements (before and after CR) were analyzed with the Wilcoxon signed rank test. Values with a probability of (p) **a**< 0.05 was accepted as significant.

Results

Mean age of 60 patients included in the study was 52.65 ± 10.81, and the patients were divided into two groups by BMI. Thirty-nine patients had a BMI of 30 kg/m2 and less (Group 1) and 21 patients had a BMI of 30 kg/m2 and more (Group 2). Only 10 patients in Group 1 had a BMI less than 25 kg/m2. 18 (30%) patients had hypertension, 15 (25%) had diabetes, 11 (18.3%) had hyperlipidemia and 14 (23.3%) were

Table 1. Baseline demographic characteristics of the groups

Characteristic	Group 1 (n=39)	Group 2 (n=21)	*p* value
Age	50.56 ± 10.42	56.19 ± 10.59	0.076
Gender			0.528
Female	6 (15.4%)	2 (9.5%)	
Male	33 (84.6%)	19 (90.5%)	
Cigarette			0.485
Current smoker	8 (20.5%)	6 (28.6%)	
No-oldsmoker	31 (79.5%)	15 (71.4%)	
Diagnosis			0.574
CAD	27 (69.2%)	13 (61.9%)	
CABG	12 (30.8%)	8 (38.1%)	
Disease duration (year)	3.90 (1-10)	5.57 (1-15)	0.122
Additional disease			0.234
HT	10 (25.6%)	8 (38.1%)	
DM	8 (20.6%)	7 (33.3%)	
Hiperlipidemia	7 (17.9%)	4 (19%)	
BMI (kg/m^2)	26.29 ± 2.60	31.62 ± 1.05	**< 0.001**

The values were presented as mean ± SD (standard deviation) or number (percent. BMI = body mass index, HT = hypertension, DM = diabetes mellitus, CABG = coronary artery bypass grafting, CAD = coronary artery disease, MET = metabolic equivalent, $p < 0.05$ statistically significant

Table 2. The baseline 6MWT, BAI and SF-36 parameters of the two groups

Pre-treatment	Group 1 (n = 39)	Group 2 (n = 21)	*p* value
6 minwalk test (m)	428 (340-545)	405 (330-585)	0.828
MET	8.56 ± 1.14	8.53 ± 1.02	0.907
BECK anxiety inventory	12 (1-33)	10 (3-34)	0.624
SF-36 physical functıon	52.82 ± 25.72	54.52 ± 21.14	0.864
SF-36 physical role	12.50 (0-50)	12.50 (0-50)	0.306
SF-36 emotional role	16.66 (0-85)	16.66 (0-83.33)	0.961
SF-36 energy-vitality	53.48 ± 20.38	52,92 ± 23,46	0.938
SF-36 mental health	62.50 (16-96)	68 (16-92)	0.544
SF-36 social function	62.50 (12.50-100)	75 (25-100)	0.382
SF-36 pain	67.50 (20-100)	57.50 (20-100)	0.803
SF-36 general health	51.28 ± 19.62	48.57 ± 15.74	0.619

The values were presented as mean ± SD (standard deviation) or median (maximum-minimum). 6MWT = 6 min walk test, BAI = Beck anxiety inventory, CR = cardiac rehabilitation, MET = metabolic equivalent, SF-36 = short form 36, $p < 0.05$ statistically significant

smokers. Comparative values of both groups by demographic characteristics and by initial assessment parameters are shown in Table 1 and 2, respectively. No significant difference was determined between the groups.

When Group 1 patients were assessed at the end of 30 sessions of CR program, a statistically significant improvement was detected in 6MWT, BAI, MET, SF-36 physical functioning, physical role, mental health, social functioning and pain subparameters (Table 3).

When Group 2 patients were assessed at the end of 30 sessions of CR program, a statistically significant improvement was detected in 6MWT, BAI, MET, SF-36 physical functioning, physical role and pain subparameters (Table 4).

When the groups were compared by difference scores, a statistically significant difference was determined in 6MWT and MET value in favor of group 1; no significant difference was identified in other assessment parameters (Table 5).

Discussion

We aimed to investigate whether obesity changes the effect of phase ll CR on functional capacity, daily life activities and anxiety or not. According to our results, CR had favorable effects on functional capacity, anxiety and daily life activities of all patients, however, functional gain in non-obese group was

Table 3. The effect of cardiac rehabilitation program on 6MWT, BAI and SF-36 parameters in group 1

Group 1 (n = 39)	Before CR	After CR	*p* value
6 min walk test (m)	428 (340-545)	517 (360-611)	**< 0.001**
MET	8.56 ± 1.14	10.01 ± 1.16	**< 0.001**
Beck anxiety inventory	12 (1-33)	7 (1-30)	**< 0.001**
SF-36 physical function	52.82 ± 25.72	61.98 ± 23.50	**0.002**
SF-36 physical role	12.50 (0-50)	25 (0-50)	**0.002**
SF-36 emotional role	16.66 (0-85)	33.33 (0-50)	0.151
SF-36 energy-vitality	53.48 ± 20.38	58.84 ± 17.70	0.100
SF-36 mental health	62.50 (16-96)	76 (12-100)	**0.012**
SF-36 social function	62.50 (12.50-100)	87.50 (25-100)	**0.001**
SF-36 pain	67.50 (20-100)	87.50 (32-100)	**< 0.001**
SF-36 general health	51.28 ± 19.62	53.33 ± 23.09	0.304

The values were presented as mean ± SD (standard deviation) or median (maximum-minimum). 6MWT = 6 min walk test, BAI = Beck anxiety inventory, CR = cardiac rehabilitation, MET = metabolic equivalent, SF-36 = short form 36, $p < 0.05$ statistically significant

Table 4. The effect of cardiac rehabilitation program on 6MWT, BAI and SF-36 parametersin group 2

Group 2 (n = 21)	Before CR	After CR	*p* value
6 min walk test (m)	405 (330-585)	446 (364-600)	**< 0.001**
MET	8.53 ± 1.02	9.62 ± 1.13	**< 0.001**
Beck anxiety inventory	10 (3-34)	4 (2-21)	**0.003**
SF-36 physical function	50 (25-85)	70 (37.50-85)	**0.001**
SF-36 physical role	12.50 (0-50)	25 (0-50)	**0.034**
SF-36 emotional role	16.66 (0-83.33)	33.33 (0-50)	0.727
SF-36 energy-vitality	52.92 ± 23.46	56.90 ± 19.58	0.302
SF-36 mental health	63.47 ± 18.45	65.71 ± 18.48	0.603
SF-36 social function	75 (25-100)	75 (37.50-100)	0.297
SF-36 pain	57.50 (20-100)	77.50 (45-100)	**0.001**
SF-36 general health	48.57 ± 15.74	52.61 ± 16.47	0.225

The values were presented as mean ± SD (standard deviation) or median (maximum-minimum). 6MWT = 6 min walk test, BAI = Beck anxiety inventory, CR = cardiac rehabilitation, MET = metabolic equivalent, SF-36 = short form 36, $p < 0.05$ statistically significant

more prominent.

Being overweight and obesity have been reported to have many negative effects on hemodynamicand cardiovascular status and function. According to World Health Organization, a BMI ≥30 kg/m^2 indicates obesity, 25-29.99 kg/m^2 the overweight range, 18.50-24.99 the normal range, and <18.50 underweight range [11, 25]. 80% of cardiac rehabilitation patients consists of obese and overweight patients [26, 27]. In the case of our patients, in line with the literature, only 10 (16.6%) patients were in the normal range (BMI <25 kg/m2), with 29 (48.33%) patients being overweight and 21 (35%) patients being obese. No extremely obese patient was observed.

In a previous study, initial and post-CR work capacities of obese patients were found to be less [27]. Similarly, Seres et al. [28] identified a decrease in exercise performance in the case of obesity and observed lesser functional gain in each session of CR in the case of obesity. Contrary to this study, Lavie and Milan [18] reported equal level of post-CR improvement in obese and non-obese patients groups. In another study on the assessment of the effect of CRP on obese and non-obese patients who had acute MI, a significant increase was observed in MET values of both groups, and no superiority of the results of one group over the other could be detected [20]. Similarly, we found an equal level of functional capacity in obese and non-obese patient groups in initial assessment

Table 5. Comparison of 6MWT, BAI and SF-36 parameters changes with cardiac rehabilitation between the two groups.

Variation	Group 1	Group 2	*p* value
6 min walk test (m)	60 (20-183)	34 (15-180)	**0.012**
MET	1.44 ± 0.56	1.09 ± 0.41	**0.015**
Beck anxiety inventory	-4 (-27-1)	-5 (-31-3)	0.674
SF-36 physical function	12.50 (-45-40)	10 (0-40)	0.814
SF-36 physical role	11.32 ± 21.02	8.73 ± 17.57	0.723
SF-36 emotional role	0.0 (-51,67-50)	0.0 (-66.67-33.33)	0.714
SF-36 energy-vitality	7.5 (-38-49)	5 (-35-32.0)	0.950
SF-36 mental health	8 (-60-47)	4 (-60-48)	0.079
SF-36 social function	12.50 (-17.50-67.50)	0 (-25-50)	0.143
SF-36 pain	5 (-30-30)	12.50 (-22.50-47.50)	0.937
SF-36 general health	2.05 ± 12.28	4.04 ± 14.80	0.314

The values were presented as mean ± SD (standard deviation) or median (maximum-minimum). 6MWT = 6 min walk test, BAI = Beck anxiety inventory, MET = metabolic equivalent, SF-36 = short form 36, $p < 0.05$ statistically significant

parameters. This may be ascribed to the fact that BMIs of the patients in non-obese group fell within the overweight range (25-30 kg/m2). Post-CR exercise tolerance and functional capacity increased in both obese and non-obese patients, however, this increase was more significant in the non-obese group.

In a study evaluating post-CR exercise capacity and quality of life in patients with left ventricular dysfunction, the MET values increased from 8.00 ± 2.56 to 10.08 ± 3.00 MET, with a significant improvement in the SF-36 physical and psychological component of the patients [29]. In our study, we observed a significant difference in the MET values and quality of life scales of both groups of patients, however, the increase in MET values was more prominent in the non-obese group.

6MWT is a test frequently used to evaluate functional capacity, follow-up and prognosis in CAD patients. 6MWT was found to have a strong level of evidence in a meta-analysis performed to evaluate the efficiency of CR [21]. In a prospective, longitudinal observational study, 6MWT was again reported to be a repeatable, effective and reliable method to evaluate the results of CR [30].

Obesity is associated with reduced exercise performance, which could ultimately result in smaller gains in functional work capacity during CR program. The lower exercise capacity gain with CR in obese patients might be related with these patients limited functional capacity.

In a study evaluating post-CR quality of life of patients using SF-36, a significant improvement was observed in physical functioning, role limitations due to physical problems, emotional role, energy, social function and pain, with no difference in general health perception and mental health [31]. In another study using SF-36, a significant increase was identified in post-CR physical role, physical functioning, energy, pain and emotional, social, mental wellbeing [32]. In line with the said study, we found a significant improvement in physical role, physical functioning, mental health, social functioning and pain, which are SF-36 parameters, in the non-obese group. There was no significant difference in emotional role, energy and general perception of health. In the obese group, a significant difference was observed only in physical role, physical functioning and pain, whereas there was no significant difference in other parameters.

In a study evaluating anxiety using BAI in phase II CR, mild (BAI > 8) level of anxiety was reported in 41% of the patients and BAI was found to be a valid method in CR [33]. In an exercise-based rehabilitation program evaluating post-MI depression and anxiety levels, a decrease was detected in depression and anxiety levels of females, with no difference in males [34]. In our study, 39 patients had a BAI > 8 and 8 female patients all had a BAI > 8. In post-CRP period, a significant improvement was observed in anxiety levels of all patients.

In a study on the assessment of 30 sessions of CR on quality of life, functional capacity in CAD patients who underwent CABG, a significant improvement was observed in exercise capacity, functional capacity, quality of life scales. Only CAD patients had significant improvement in depression level after CR [35]. Similar to that study, we observed a significant improvement in SF-36 quality of life scale and functional activity in our patients. We also identified a significant improvement in anxiety scores.

Previous studies reported cardiac arrest, myocardial infarction, sudden cardiac death as complications during CR [36, 37]. As a result of our 30-session cardiac rehabilitation program, no complication was observed.

The Limitations of the Study

The main limitation of this study was relatively small number of patients. The study patients consisted of two different groups, CABG and PCI patients. So, the inclusion of a larger and more consolide group of patients would provide a more comprehensive picture. There was not follow up, medium and long-term follow-up results may be more descriptive about clinic effects.

Conclusions

In this study, CR was found to be effective and safe in terms of functional capacity, daily life activities and anxiety in both obese and non-obese patient groups. Functional gain in the obese group was less than non-obese group. Further studies based on larger populations are needed.

Authorship declaration

All authors listed meet the authorship criteria according to the latest guidelines of the International Committee of Medical Journal Editors, and all authors are in agreement with the manuscript.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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