CARDIAC REHABILITATION IN PATIENTS WITH DIABETES MELLITUS

Marzieh Saeidi, Katayun Rabiei MD

Abstract

INTRODUCTION: Prevalence of cardiovascular diseases (CVD) is 19.4% in Iran and diabetes mellitus is an important CVD risk factor in this country. Non-insulin-dependent diabetes mellitus (type II DM) is associated with increased morbidity and mortality due to atherosclerosis. With cardiac rehabilitation (CR) we can modify CVD risk factors such as type II DM and play an important role in decreasing its mortality and morbidity. We investigated the effects of CR on cardiac patients with and without type II DM.

METHODS: In this retrospective before-and-after study we analyzed data from 496 cardiac patients (419 with type II DM and 77 without type II DM). All of the subjects completed demographic data questionnaires and underwent weight and height measurement, exercise test to assess exercise capacity (EC), echocardiography, and blood test to assess lipid profile and fasting blood glucose. The subjects then participated in a 24-session CR program. Each session consisted of 10 minutes warm-up, 40 minutes aerobic exercise, 10 minutes cool-down and 20 minutes relaxation. They also took part in 8 educational sessions on life style modification, diet therapy and stress management supervised by CR team (a cardiologist, a physician, a physiotherapist, a nurse, a nutritionist and a psychiatrist). At the end of the program, all measurements, exams and tests were repeated. Data were analyzed with SPSS11.5 using independent t-test at level of $P<0.05$.

RESULTS: We studied 419 non-diabetics (mean age: 55.61±9.41 years) and 77 diabetics (mean age: 58.59±7.76 years). Mean EC increased significantly after CR in both groups. In the diabetic group, EC increased significantly compared to the non-diabetic group (62.21±133.40 vs. 33.68±31/42, $P=0.02$). Mean levels of triglyceride, cholesterol, LDL-cholesterol, as well as body mass index and heart rate decreased significantly after CR in both groups. However, no significant difference was seen between the two groups in respect of these variables.

DISCUSSION: CR is an effective intervention in diabetics as well as non-diabetics especially given its remarkable effects in improving EC as a critical indicator of mortality and morbidity of diabetic patients. Hence we suggest these patients undergo CR programs.

Keywords • Cardiac rehabilitation • Exercise capacity • Diabetes mellitus •Cardiovascular risk factors

ARYA Journal, 2005, 1(3): 202-206

Introduction

The prevalence of cardiovascular diseases (CVD) is increasing in the world. The prevalence of CVD is 19.4% in Iran.[1] The prevalence of diabetes mellitus (DM) as a CVD risk factor is 0.05% in Iran.[2] Type II diabetes mellitus (DM II) is associated with atherosclerotic and vascular disease mortality and morbidity.[3]

corresponding author

Katayun Rabiei, Cardiac Rehabilitation Department
Isfahan Cardiovascular Research Center,
PO Box: 81465-1148, Email: k-rabiei@crc.mui.ac.ir

Mortality in diabetic cardiac patients with history of myocardial infarction (MI) is higher than in non-diabetics.[4,5] Several factors influence the incidence of DM II. These include positive family history of DM, obesity and lipid profile impairment. Most of these are modifiable except for family history.

Cardiac rehabilitation (CR) is a multidisciplinary program including exercise training, diet therapy, education and stress management to control CVD risk factors, prevent recurrence of cardiac events and improve cardiovascular and psychological status of patients.[6-8]

Studies have shown that exercise capacity is lower in diabetic patients without any other disease[9] and that cardiac output is decreased in these patients.[10]
The role of oxygen transportation dysfunction and myocardial dysfunction is also highly important in this context.[9] Kazohiro and colleagues have shown that chronothropic response in DM patients is lower than in non-DM patients and this is related to low myocardial function.[11] Thus it seems that CR can improve exercise capacity in DM patients by improving circulation. We evaluated the influence of CR in DM and non-DM cardiac patients.

Materials and methods

In a retrospective before-and-after study we assessed data from 469 cardiac patients who had referred to Isfahan Cardiovascular Research Center and had completed phase-II CR program. The participants took a blood exam for assessment of lipid profile consisting of total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C) and triglyceride (TG) using an Elan 2000 machine and Friedwald formula. Exercise test (Naughton protocol) was preceded by echocardiography (Symson protocol) for risk stratification. Weight and height measurements were conducted barefoot in light clothing. The body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2). CR program included 24 sessions (3 sessions/week) of exercise training and 8 sessions of educational classes for patients and their families, consisting of CVD risk factor modification, diet therapy (food recall and step II of diet) and stress management. Each exercise session included 20 minutes warm-up (stretching), 40-60 minutes aerobic exercise (stationary bicycle and treadmill at 60-80% of symptom-limited maximum heart rate), 5 minutes cool-down and 20 minutes relaxation. The team of rehabilitation program included a cardiologist, a physiotherapist, a physician, a nurse, a nutritionist and a psychiatrist. At the end of the program all tests and exams were repeated and data were analyzed with SPSS11.5 using paired t-test and independent t-test at level of $P<0.05$.

Results

We studied 419 non-diabetic (fasting blood sugar: FBS<126 mg/dl) and 77 diabetic (FBS>126 mg/dl) cardiac patients. The mean age of these groups were 55.61±9.41 and 58.59±7.76 years, respectively. There were 42 diabetic males and 35 diabetic females. 24.9% of males and 3.7% of females were smoker.
Demographic data are shown in Table 1. Lipid profile, BMI, FBS, heart rate, and exercise capacity before and after CR in each group are shown in Table 2 (diabetics and non-diabetics). In DM group, cholesterol, TG, LDL-C, exercise capacity, BMI and FBS improved significantly, but HDL-C and heart rate did not. In the non-DM group, all variables improved significantly. The variables did not change significantly in percentages in any of the two groups, except for exercise capacity which increased significantly in the DM group (Table 3). Comparison of percentage of changes in variables in DM and non-DM patients based on sex subgroups showed no significant difference in males and females except for exercise capacity which was higher in DM males compared to non-DM males. In females, however, changes in variables (percentages) were not significant in DM and non-DM groups (Table 4).
Also comparison of variables after CR showed that in both sexes, all variables in DM groups improved significantly except for heart rate and HDL-C in males, and heart rate, HDL-C, TG and BMI in females. However, all variables improved significantly in non-DM subjects after CR except for HDL-C and FBS in both sexes (Table 5).

TABLE 1. Demographic data of study sample

Variables	Females (27%)	Males (73%)	Total
Diabetes mellitus	26.1%	11.6%	15.5%
Smokers	3.7%	24.9%	19.2%
Etiology			
MI*	7.5%	24.7%	20.3%
CABG**	56.4%	54.1%	54.6%
PTCA***	8.3%	11.5%	54.6%
Angina pectoris	19.5%	6.6%	10.4%
Coronary Artery Disease	1.5%	0.8%	1%
Angiographies	5.3%	1.9%	2.8%
Valvular	1.5%	0.3%	0.6%

*Myocardial Infarction, **Coronary Artery Bypass Graft, ***Percutaneous Transluminal Coronary Angioplasty

TABLE 2. Comparison of outcomes before and after cardiac rehabilitation in diabetics and non-diabetic cardiac patients

Variables	Before	After	P value
DM			
LDL-C	40.03 ± 145.70	127.66±35.18	0.00
HDL-C	39.69±9.05	40.85±9.81	0.02
Triglyceride	214.67±118.66	189.32±90.76	0.00
Cholesterol	225.85±48.54	203.88±42.17	0.00
Exercise Capacity	9.28±4.54	11.51±2.94	0.00
Hart Rate	95.42±21.78	89.90±23.59	0.00
BMI*	27.14±3.74	26.39±3.52	0.00
FBS**	94.11±13.92	96.21±19.54	0.04
Non- DM			
LDL-C	148.56±40.57	130.83±32.82	0.00
HDL-C	39.22±9.03	40.17±8.81	0.42
Triglyceride	245.13±137.87	220.64±116.07	0.04
Cholesterol	235.03±49.25	212.50±48.23	0.00
Exercise Capacity	7.69±2.43	10.19±2.69	0.00
Hart Rate	98.53±30.12	97.70±24.14	0.75
BMI*	28.01±4.36	27.46±4.39	0.00
FBS**	176.01±55.43	146.03±44.82	0.00

*Body Mass Index, **Fast Blood Glucose

TABLE 3. Comparison of the percentage of changes in variables after cardiac rehabilitation in the two groups

LDL-C	Diabetics	Non-diabetics	P value
HDL-C	-11.82±21.13	-10.36±26.97	0.75
Triglyceride	4.09±22.44	8.03±33.47	0.45
Cholesterol	-2.31±41.52	-7.18±39.50	0.44
Exercise Capacity	-9.94±17.65	-8.05±19.57	0.53
Hart Rate	63.21±133.40	33.68±31.42	0.00
BMI*	-2.23±19.75	-3.86±22.83	0.06
FBS**	2.31-1.96±3.39	-2.62±3.86	0.27
LDL-C	13.44±26.58	-10.48±145.56	0.00

*Body Mass Index, **Fast Blood Glucose

TABLE 4. Comparison of the percentage of changes after rehabilitation in the two groups according to sex

Variables	Diabetics	Non-diabetics
Males		
LDL-C	-11.10±17.41	-10.28±26.20
HDL-C	1.65±20.60	7.91±34.47
Triglyceride	-5.32±44.37	-6.68±40.132
Cholesterol	-11.03±14.19	-7.80±18.84
Exercise Capacity	76.34±171.09	32.88±31.40
Hart Rate	1.19±14.16	-2.72±22.74
BMI*	-1.96±2.72	-2.54±3.92
Females		
LDL-C	1.91±37.89	-9.33±37.2
HDL-C	-13.11±27.25	-10.73±30.66
Triglyceride	7.96±25.25	8.52±29.08
Cholesterol	-8.43±21.92	-9.13±22.61
Exercise Capacity	44.16±34.24	37.19±31.68
Hart Rate	-7.51±25.65	-7.50±22.88
BMI*	-1.96±4.26	-2.97±3.64

Body Mass Index*, Fast Blood Glucose**

TABLE 5. Comparing variables after and before cardiac rehabilitation in both groups according to their sex

	Non-diabetics			diabetics		
Variables	Before	After	P Value	Before	After	P Value
Males						
LDL-C	143.04±38.08	124.22±33.32	0.00	142.58±38.49	129.00±27.91	0.03
HDL-C	39.00±9.07	40.04±10.07	0.07	40.46±9.50	40.12±9.29	0.79
Triglyceride	209.80±119.21	186.89±93.42	0.00	247.12±159.40	218.02±105.40	0.10
Cholesterol	220.62±46.24	199.82±38.93	0.00	230.50±50.50	209.50±36.68	0.00
Exercise Capacity	10.03±4.81	12.34±2.59	0.00	8.38±2.33	11.15±2.30	0.00
Hart Rate	93.23±21.14	89.18±14.12	0.00	95.03±26.57	92.37±22.64	0.33
BMI*	26.47±3.40	25.76±3.17	0.00	26.47±3.31	25.95±3.24	0.00
FBS**	93.62±14.42	94.75±16.29	0.28	174.81±57.58	148.21±45.60	0.00
Females						
LDL-C	154.73±45.12	139.31±38.87	0.00	157.31±42.67	133.50±233.88	0.00
HDL-C	41.88±8.69	43.41±8.46	0.11	37.58±8.23	4.23±8.28	0.20
Triglyceride	230.22±116.12	197.06±81.63	0.00	242.68±107.82	233.88±129.60	0.27
Cholesterol	242.60±52.06	216.87±49.18	0.00	240.62±47.79	216.21±59.90	0.00
Exercise Capacity	6.85±2.12	8.81±2.35	0.00	6.84±2.32	8.98±2.68	0.00
Hart Rate	102.38±22.45	92.18±21.82	0.00	104.09±34.98	106.18±24.52	0.68
BMI*	29.92±3.85	29.01±3.71	0.00	30.31±4.80	29.72±4.98	0.08
FBS**	95.37±12.07	100.34±26.70	0.53	177.53±53.41	44.143±49.26	0.01

Discussion

The results showed that CR improved lipid profiles, exercise capacity, BMI and heart rate in DM and non-DM cardiac patients and had the same effects in both groups; meanwhile the increase in exercise capacity was significant in the DM group.

These results are similar to those of Banzer study in 2004, which reported improved exercise capacity after CR in the DM group, but in his study controlling other factors like lipid profiles, weight and blood sugar required more effective strategies such at exercise with higher intensity.[12]

In the present study, lipid profiles in the DM group had improved even more notably than in the non-DM group. Suresh showed that the influence of the standard CR program on the DM group was less than on the non-DM group, and that the DM groups needed more effective medical interventions after MI.[13]

Ya and Colleagues evaluated factors affecting mortality and morbidity after CR in a 3-year follow up study. They found low exercise capacity and diabetes mellitus to be independent indicators for re-hospitalization. They also found DM to be associated with increasing length of hospital stay, hence controlling diabetes mellitus and increasing exercise capacity via CR decreases re-hospitalization in patients.[14] Our study confirms these results.

In addition to risk factor control, we recommend that diabetic cardiac patients be referred to CR programs so that their exercise capacity can be increased.

References

1. Sarraf-Zadegan N, Sayed Tabatabaei FA, Bashardoost N. The prevalence of coronary artery disease in an urban population in Isfahan Iran. Acta Cardiol 1999;54(5):252-63.

2. Mohammadi-fard N, Sadri GH, Sarraf-zadegan N, Baghaei AM, Shahrokhi Sh, Hoseini Sh, et al. The prevalence of cardiovascular risk factors in rural and urban population of Isfahan and Markazi provinces. The Journal of Qazvin Univ. of Med. Sci. 2003;26:5-14.

3. Aronson D, Rayfield EJ, Chesebro JH. Mechanisms determining course and outcomes of diabetic patients who have had acute myocardial infarction. Ann Intern Med 1997;126:296-306.

4. Grossman E, Messerli FH, Diabetic and hypertensive heart disease. Ann Intern Med 1996;125: 304-10.

5. Miettinen H, Lehto S, Salomaa V. Impact of diabetes on mortality after the first myocardial infarction. The FINMONICA Myocardial infarction Register Study Group. Diabetes Care 1998;21:69-75.

6. Lavie CJ, Milani RV. Effects of cardiac rehabilitation programs on exercise capacity, coronary risk factors, behavioral characteristics, and quality of life in a large elderly cohort. Am J Cardiol l995;76: 177-l79.

7. Shiran A, Kornfeld S, Zur S, Laor A, Karelitz Y, Militianu A, Merdler A, Lewis BS. Determinants of improvement in exercise capacity in patients' undergoing cardiac rehabilitation. Cardiology 1997;88:207-213.

8. Beniamini Y, Rubenstein JJ, Zaichkowsky LD, Crim MC. Effects of high-intensity strength training on quality-of-life parameters in cardiac rehabilitation patients. Am J Cardiol 1997; 80: 841-846.
9. Regensteiner JR, Sippel J, Mcfarling ET. Effects of non-insulin dependent diabetes on oxygen consumption during treadmill exercise. Med Sci Sports Exerc 1995; 27:875-81.
10. Roy TM, Peterson HR, Snider HL. Autonomic influence on cardiovascular performance in diabetic subjects. Am J Med 1989; 87:382-8.
11. Izawa K, Tanaba K, Omiya K, Yamada S, Yokoyama Y, Ishiguro T et al. Impaired chronotropic response to exercise in acute myocardial infarction patients with type 2 diabetes mellitus. Jpn Heart J 2003;44(2):187-198.
12. Banzer JA, Maguire TE, Kennedy CM, O'Malley CJ, Balady GJ. Results of cardiac rehabilitation in patients with diabetes mellitus. 12 Am J Cardiol. 2004 Jan 1;93(1):81-4.
13. Suresh V, Harrison RA, Houghton P, Naqvi N. Standard cardiac rehabilitation is less effective for diabetics. Int J Clin Pract. 2001 Sep;55(7):445-8.
14. Yu CM, Lau CP, Cheung BM, Fong YM, Ho YY, Lam KB, Li LS. Clinical predictors of morbidity and mortality in patients with myocardial infarction or revascularization who underwent cardiac rehabilitation, and importance of diabetes mellitus and exercise capacity. Am J Cardiol. 2000 Feb 1;85(3):344-9.