

EFFECT OF CARDIAC REHABILITATION ON FUNCTIONAL CAPACITY OF PATIENTS AFTER CARDIAC SURGERY BY ASSESSING 6-MINUTE WALKING TEST

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Abstract

BACKGROUND: Cardiac rehabilitation is a well-established treatment for patients with coronary artery disease and it is beneficial for cardiac patients. It improves functional capacity and modifies risk factors of coronary artery disease such as hypertension, arrhythmia and others. The aim of this study was to investigate the effects of cardiac rehabilitation on functional capacity of patients after cardiac surgery by using the six-minute walking test which is a simple and well-tolerated test for cardiac patients compared with other stress tests.

METHODS: Thirty two patients were selected for this study. All patients had cardiac surgery, two months before admission. These samples allocated to two groups. Interventional group (n = 17, mean age: 62 ± 12 years) completed the cardiac rehabilitation programs for two months but, reference group (n = 15, mean age: 58.5 ± 12.5 years) didn't have any physical activity during this period. At the beginning of study, functional capacity of patients was evaluated by exercise test and six-minute walking test. After two months of cardiac rehabilitation, functional capacity was evaluated for the second time in each group. Cardiac rehabilitation consisted of exercise, nutritional and psychological consultation and risk factor management. Data were analyzed with SPSS software version 15. For comparing the mean of outcomes in repeating measures, the repeated ANOVA model was used.

RESULTS: A significant improvement was observed in the interventional group compared to the reference group in walking distance (472.62 ± 19.29 m vs. 412.24 ± 20.54 m, respectively, P = 0.04).

CONCLUSION: Cardiac rehabilitation significantly improves functional capacity and this evolution was shown by 6MWT which is an easy and safe and low cost test compared to other stress tests.

Keywords: Cardiac Rehabilitation, Functional Capacity, Stress Test.

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Introduction

The prevalence of cardiovascular disease is increasing worldwide. Cardiovascular disease is the leading cause of death and should be noted that its prevalence is 19.4% in Iran.¹ Cardiac rehabilitation program is a well-established treatment for patients with coronary artery disease.² In fact defini-

tion of cardiac rehabilitation is the enhancement and maintenance of cardiovascular health through individualized programs designed to optimize physical, psychological, social, vocational and emotional status.³ Hence, cardiac rehabilitation program is beneficial for these patients after myocardial infarction or cardiac surgery because it has

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effects such as increase in maximal work activity, reduction in lipid profiles, reduction of inflammation in the arteries, lowering of systolic and diastolic blood pressure and variability of heart rate, helping to keep blood vessels flexible and open and improvement in endothelial function so that, heart becomes stronger and larger as a result of exercise and it can pump more blood through the body with every beat.³ Many studies showed that physical activity is a successful way for the secondary prevention of cardiovascular disease and meta-analysis of 22 randomized controlled trials of cardiac rehabilitation indicated a 20% reduction in mortality after three years follow up.⁴ The aim of this study was to investigate the effect of exercise training to improve physical ability and tolerance that 6-minute walking test is a measuring indicator. The six-minute walking test (6MWT) was used by cardiologists, because it was simple and easy to perform and suitable for measuring functional limitation, in evaluating the effect of therapy and prognostic stratification of patients with chronic heart disease. The 6MWT is a safe test which does not require expensive equipment and only needs the ability to walk, also old and frail and limited patients can do it and there is little evidence in the use of 6MWT in this population.⁵⁻⁸ The first studies on the use of the 6MWT in chronic heart disease were published just over 20 years ago.⁷ Guyatt in 1985 and Lipkin in 1986 reported that the distance covered during the 6MWT can identify the most compromised patients and differentiate them from the less severe cases.⁷ The test also showed a good correlation with objective measures of effort tolerance such as exercise duration and oxygen uptake at the peak of exercise.⁷ The aim of this study was to assess the effect of 8-weeks cardiac rehabilitation program and improvement of functional capacity after cardiac surgery by using 6MWT as an easy and safe test compared to other stress test.

Materials and Methods

This clinical trial study was conducted in Isfahan Cardiovascular Research Center. From all patients that consecutively referred to the rehabilitation

center since February until August 2009, randomly 32 patients were selected who had cardiac surgery two months before admission. This population was allocated to two groups. In interventional group, 17 patients (13 men and 4 women) with the age of 62 ± 12 years old, entered and completed cardiac rehabilitation programs for two months; reference group consisted of 15 patients (13 men and 2 women) with the age of 58.5 ± 12.5 years old, who didn't have any physical activity during this period. In this study, medications which were prescribed to all patients were as usual such as Aspirin, B-blocker, and statins. It should be noted that medical treatment did not change during cardiac rehabilitation period. All patients' appropriateness for participation in the study was evaluated. Four inclusion criteria were used:

1. Ability to tolerate walking without depending to another person or device such as cane or walker or...
2. Not having chest pain, shortness of breath, angina, arrhythmia or hypertension
3. Not having muscle skeletal disorders
4. Not smoking

At first before starting rehabilitation program, two groups performed 6 minute walking test and then their walked distance was measured. To assess left ventricular ejection fraction (LVEF) echocardiography was done by the cardiologist. Exercise test (Naughton protocol) was performed to determine functional status by indicating metabolic equivalent (MET). In fact, risk stratification of patients was done by the cardiologist on the basis of exercise test and LVEF. Then interventional group began cardiac rehabilitation program which lasted two months (24 sessions) for three times a week that included exercise training sessions, nutritional and psychological consultation and risk factor management. Exercise training was performed in cardiac rehabilitation center under supervision of physician, exercise physiologist and a nurse by using treadmill, ergometer, stair climbing, rowing, step, jogging and some resistance device. Each session lasted up to 90 minutes, beginning with a 20-minute warm-up followed by 60 minutes aerobic and resistance training and finally

10 minutes cool-down. The intensity of training was established according to the clinical condition and calculated between 60-85% of maximum HR. In fact risk stratification of patients (low, intermediate, and high risk) was done by the cardiologists on the basis of Naughton exercise test. During each session rest and maximum heart rate, and rest and maximum systolic and diastolic blood pressure of patients were controlled and recorded. It should be noted that the demographic data of the patients were available. After passing two months and finishing rehabilitation program, 6-MWT, echocardiography and exercise test were done by each group again and results were comprised.

Six-minute walking test

The patients were instructed to walk as far as possible along a 21 meter straight, flat cardiovascular research center corridor in 6 minutes. During the test encouragement was not given and only asked about their conditions.⁵ Before and after the test, resting heart rate and blood pressure of patients were controlled in sitting position by sport physiologist and a nurse. At the end, total walked distance was measured and recorded.

At the end of the program all data were collected and analyzed with SPSS software version 15 and the effects of exercise training were evaluated. For comparing the mean of outcomes, like distance and blood pressure, in repeating measures the repeated ANOVA model was used.

The research was undertaken under the medical ethics standards.

Results

Thirty two cardiac patients were studied. The mean age of interventional and reference group were 62 ± 12 and 58.5 ± 12.5 years, respectively. At baseline, there were no significant differences in demographic data between two groups and no events occurred during the exercise training. A significant improvement was observed in walked distance in the interventional group compared to reference group (472.62 ± 19.29 m vs. 412.24 ± 20.54 m; $P = 0.04$) and also, in comparing pre- and post-test, a significant change in both groups was observed ($P < 0.05$). On the other hand, functional capacity which obtained exercise test had significant differences between two groups (8.85 ± 0.53 m vs. 6.5 ± 0.56 m; $P = 0.005$) but results did not show significant improvement in pre- and post-test for each groups ($P = 0.23$).

Table 1. Clinical characteristics of the patients

Characteristic	Rehabilitation group (n = 17)	Reference group (n = 15)	P value
Age (years) (mean \pm SD)	62 ± 12	58.5 ± 12.5	Not significant
Male/Female (no)	13/4	13/2	Not significant
Walked distance (mean \pm SD)	472.62 ± 19.3	412.24 ± 20.54	0.04
Mets (mean \pm SD)	8.85 ± 0.53	6.5 ± 0.56	0.005

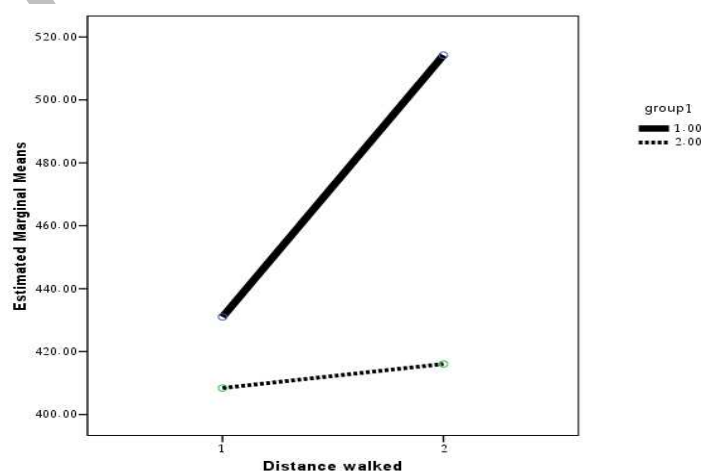


Figure 1. Walked distance in the first and second time for each group

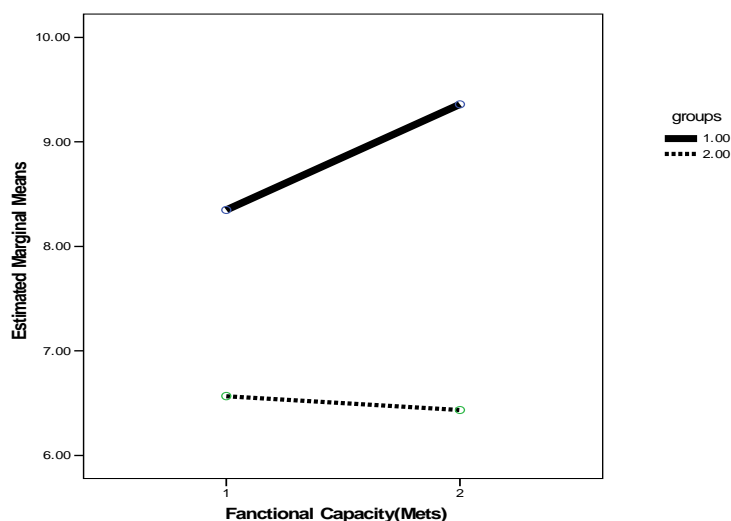


Figure 2. Functional capacity obtained from exercise test in the first and second time for each group

Discussion

This study showed that cardiac rehabilitation program improved walked distance in interventional group by measuring 6 minute walking test, but this favorable difference in reference group was not observed in this study. This result is similar to other studies. Nilsson study showed that walking distance improved significantly after 4 months in exercise group compared to control group.⁹ Another study suggested that resistance training improves muscle strength and exercise capacity that assessed using a distance during 6 minute of walking test.¹⁰ Another studies showed combined aerobic and resistance training was more effective to improve exercise tolerance, decrease skeletal muscle fatigue and correct neuromuscular alternations in men with coronary heart disease.¹¹⁻¹³ The results indicated that the functional capacity is reduced after cardiac surgery and quickly improves after exercise training as measured by walked distance during the 6MWT.⁵ In the last years, the 6MWT has become one of the most popular clinical exercise tests for evaluating functional capacity. This test should be performed in standardized manner to provide useful information about physical conditions of patients. It is simple, safe and low cost test and does not require any exercise equipment or advance training or medical supervision compared to the exercise test.⁵⁻⁸ The advantages of 6MWT over exercise test

(Naughton) are similar to activities of daily living and old and disable patients can do it after surgery and it is also well accepted by patients.⁶ It should be noticed that exercise test had low sensitivity and patients may not continue it; for the reason of shortness of breath or increasing blood pressure or arrhythmia and other problems, so attention to the results, suggest no significant improvement by this way. Also the walked distance during the walking test has demonstrated the effects of ventricular assistance devices on functional capacity and resistance training is a suitable method of training for patients with coronary heart disease since it does not cause a reduction of left ventricular contractility function or enhance myocardial deterioration as measured by ejection fraction; also in these patients exercise training is associated with reduction of peripheral resistance and results in small but significant improvements in stroke volume.^{14,15} So left ventricular ejection fraction should be assessed and like the present study showed, this parameter improved with exercise training but it was independently associated with the walked distance.

At the end we concluded that rehabilitation program improves functional capacity and increases muscle strength of patients with coronary heart disease so, it is a useful and beneficial program and this evolution was shown by six minute walking test which is a feasible, reasonable and

well tolerated test on cardiac patients shortly after cardiac surgery and because of its similarities to the daily activity, it is well accepted by the patients and it is superior to other exercise tests.

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Conflict of Interests

Authors have no conflict of interests.

References

1. Saeidi M, Rabiei K. Cardiac rehabilitation in patients with diabetes mellitus. *ARYA Journal* 2005; 1(3): 202-6.
2. Soleimani A, Salarifar M, Kasaian SE, Sadeghian S, Nejatian M, Abbasi A. Effect of completion of cardiac rehabilitation on heart rate recovery. *Asian Cardiovasc Thorac Ann* 2008; 16(3): 202-7.
3. Eshah NF, Bond AE. Cardiac rehabilitation programme for coronary heart disease patients: an integrative literature review. *Int J Nurs Pract* 2009; 15(3): 131-9.
4. O'Connor GT, Buring JE, Yusuf S, Goldhaber SZ, Olmstead EM, Paffenbarger RS, et al. An overview of randomized trials of rehabilitation with exercise after myocardial infarction. *Circulation* 1989; 80(2): 234-44.
5. Fiorina C, Vizzardi E, Lorusso R, Maggio M, De Cicco G, Nodari S, et al. The 6-min walking test early after cardiac surgery. Reference values and the effects of rehabilitation programme. *Eur J Cardiothorac Surg* 2007; 32(5): 724-9.
6. Opasich C, De Feo S, Pinna GD, Furgi G, Pedretti R, Scrutinio D, et al. Distance walked in the 6-minute test soon after cardiac surgery: toward an efficient use in the individual patient. *Chest* 2004; 126(6): 1796-801.
7. Faggiano P, D'Aloia A, Gualeni A, Brentana L, Dei CL. The 6 minute walking test in chronic heart failure: indications, interpretation and limitations from a review of the literature. *Eur J Heart Fail* 2004; 6(6): 687-91.
8. Wright DJ, Khan KM, Gossage EM, Saltissi S. Assessment of a low-intensity cardiac rehabilitation programme using the six-minute walk test. *Clin Rehabil* 2001; 15(2): 119-24.
9. Nilsson BB, Westheim A, Risberg MA. Long-term effects of a group-based high-intensity aerobic interval-training program in patients with chronic heart failure. *Am J Cardiol* 2008; 102(9): 1220-4.
10. Jankowska EA, Węgrzynowska K, Superlak M, Nowakowska K, Lazarczyk M, Biel B, et al. The 12-week progressive quadriceps resistance training improves muscle strength, exercise capacity and quality of life in patients with stable chronic heart failure. *Int J Cardiol* 2008; 130(1): 36-43.
11. Gayda M, Choquet D, Ahmaidi S. Effects of exercise training modality on skeletal muscle fatigue in men with coronary heart disease. *J Electromyogr Kinesiol* 2009; 19(2): e32-e39.
12. Fleg JL. Exercise therapy for elderly heart failure patients. *Heart Fail Clin* 2007; 3(4): 529-37.
13. Levinger I, Bronks R, Cody DV, Linton I, Davie A. Resistance training for chronic heart failure patients on beta blocker medications. *Int J Cardiol* 2005; 102(3): 493-9.
14. Levinger I, Bronks R, Cody DV, Linton I, Davie A. The effect of resistance training on left ventricular function and structure of patients with chronic heart failure. *Int J Cardiol* 2005; 105(2): 159-63.
15. Hambrecht R, Gielen S, Linke A, Fiehn E, Yu J, Walther C, et al. Effects of exercise training on left ventricular function and peripheral resistance in patients with chronic heart failure: a randomized trial. *JAMA* 2000; 283(23): 3095-101.