

Effect of Resistive-Endurance Exercises on Myocardial Tissue Creatine Kinase Isoenzyme, IL-6 and IL-10 Serum Changes in Male cardiovascular Patients

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Abstract

The aim of the present study was to investigate the effects of endurance-resistance (concurrent) training on changes of CKmb, interleukin-6, and IL-10 levels of heart disease in men. For this purpose, 38 patients referred to medical centers Cardiovascular Shahin Shahr city, were selected. The patients were underwent bypass surgery or angioplasty balloon. After, patients filled demographic questionnaire and tests were performed to determine risk factors. Also echocardiography (Simpson) and limited exercise test method (Noughton) were used to determine functional capacity and ejection fraction. Before and after the exercise, anthropometric measurements (weight, waist circumference, hip circumference and subcutaneous fat three regions), blood tests for IL-6, IL-10, CKmb and walk test for 6 min (for determining the physical capacity) were measured. The exercises were performed 3 days a week for 24 sessions, each session was one hour. After assuring the normality of data distribution by the Kolmogorov-Smirnov test, paired sample t-tests were performed using the SPSS program (version 17). The level of probability was set at $p < 0.05$ throughout. Results showed that rehabilitation programs reduce CKmb and inflammatory cytokines. Totally, the present study showed rehabilitation program having resistance- endurance (concurrent) training can be appropriate in order to perform functional capacity in patients. This method of training can cause improvement in muscular power, VO_{2max} and better cardiovascular performance and at last induce quality of life of patients.

Keywords: rehabilitation, endurance-resistance training, interleukin, homocysteine, heart patient

Introduction

Cardiovascular diseases are the most common diseases in the world and one of the leading causes of mortality. Studies suggest that the increased incidence of Coronary heart disease is due to changes in lifestyle (Rostami et al., 2014; Kumaran et al., 2008; Ritchie et al., 2001). In addition, patients' low welcoming cardiovascular rehabilitation centers due to lack of awareness of the positive effects of therapy (Choo et al., 2007) necessitates the research projects in this area.

It is well approved that rehabilitation program as a secondary prevention programs for acute coronary artery disease such as myocardial infarction and coronary artery bypass surgery has numerous clinical benefits which Leading to a significant reduction in mortality rates and specific mortality rates caused by cardiovascular disease (Leon et al., 2005; Thompson et al., 2007). Various studies indicate that 20-25% of all deaths and about 22-25% deaths from cardiovascular disease decreased after 3 years of following this program up (Taylor et al., 2004).

cardiovascular rehabilitation include physical exercise, lifestyle modification, appropriate medical treatment for men and women, young and old who have been diagnosed with heart disease. The effectiveness of this important therapeutic approach focuses on the wider use of it (Erfurt et al., 1991). Physical exercises generally affect cardiovascular risk factors and cardiovascular rehabilitation is a systematic method including exercises and treatment of risk factors and the regular assessment and control of the patients. However, most research has been done on the effect of endurance training (Shi et al., 1992; Choo et al., 2007; Mac Millan et al., 2007), and some research has focused on the role of stress resistance exercise (Freimark et al., 2007; Jankowska et al., 2007). It is evident that the above mentioned exercises have unique advantages, but recently the use of current training method has been considered in limited number of articles (Adams et al., 2006; Karpolat et al., 2007) but further research needs to be done on the effect of these training methods on cardiovascular disease. CK-MB isoenzyme is one of the most known and valid clinical parameters the increased level of which in blood means cardiac cells damage (Kida et al., 2008; Burtis et al., 2006). Most physicians and researchers use the consecutive analysis of this parameter for damage and myocardial infarction diagnosis and use the CK-MB as the key parameter. Some researchers use the ratio of CK-MB to total CK for detailed assessment of myocardial injury and consider the values above 3-5% as the CK-MB leakage of myocardial cells into blood and the values higher than 20% as the risk of myocardial cell damage (George et al., 1998).

Cytokines are a group of proteins that play essential roles in inflammatory responses to pathological stimuli such as inflammation and tissue damage. Cytokines are produced by a range of physiological stimuli such as exercise (Anderson et al., 2000). IL-6 as a proinflammatory cytokine involves in the development and progression of inflammation during and especially at the time of the patient's activities. IL-10 is also secreted in response to inflammation, and it is considered as an inflammation limiting factor. Both of these factors are predictor of inflammation in the disease. The aim of the present study is to investigate the effects of resistive-endurance exercises on the Homocysteine, serum IL-6 and IL-10 changes of male cardiovascular patient that has not been considered before. Another issue is to determine a strategy for possible changes in the answer. Thus if the rehab exercises can be combined with resistive-endurance exercises to limit heart cells damage parameters or not?

Materials and Methods

This study was a quasi-experimental research the number of the samples of which was 38 patients who referred to medical cardiovascular centers of Shahin Shahr city, chosen among the people who could be in contact.

All of these patients underwent bypass surgery or angioplasty balloon. Patients initially were profiled, the personal data questionnaires were completed and tests were performed to determine their risk factors. Also echocardiography using Simpson method and limited exercise test symptoms using Noughton method were performed in order to determine functional capacity and ejection fraction and determine the risk of a heart disease to recommend an exercise program under the supervision of heart specialist (Bots et al., 1997). The cases of limitation of taking part in rehabilitation program included: atrial fibrillation, an abnormal sinus node function or in pacemaker patients and patients with severe thyroid disorder. Patient during the exercises should not have Angina and ST segment depression greater than 2 mL and develop severe chronic heart failure and ejection fraction less than 30% during the study of electrocardiography and chest radiography. Anthropometric parameters (weight, waist circumference, hip circumference and subcutaneous fat of the three regions), blood tests for IL-6, IL-10 and creatine kinase of myocardial tissue and 6 min walking test (for determining the physical capacity) were performed before and after the exercise program. The exercise program was 3 days a week for 24 sessions, each session was one hour (Pashkow et al., 1997). The subjects had referred to the center one week before the administrative procedures for the physical and physiological testing and besides filling the health history questionnaire (Ritchie et al., 2001) they filled the Testimonial Consent Form provided by the Ethics Committee of Isfahan University of Medical Sciences. In this study, physical endurance and resistance exercise based on rehabilitation training program recommended by the American Society of Heart and Lung, American Heart Association and the Medical College of Sports of America (Gayda et al., 2008) for the patient were used. The endurance exercises consisted of 5-10 minutes warm-up, 5-10 minutes cool-down period at the end of the workout and the bicycle ergometer 15-20 minutes at 70 to 50 percent of maximum heart rate at the first and then 60-80 percent of maximum heart rate based on Karenwon formula (Franklin et al., 2004). Then, for 15 to 10 minutes the resistance exercise with weights based on the type of heart disease in terms of the safety and effectiveness of the training was performed (Choo et al., 2007). The intensity of these exercises was based on 20-30% of maximum repetition and patients exercised 3 sessions a week and were encouraged to do aerobics such as walking for 30 to 45 minutes 1-3 times a week (Adams et al., 2006). The resistance exercises consisted of 11 moves recommended by the Sports - Cardiovascular College and Pulmonary Rehabilitation Medicine Association of America and the intensity of the exercises was in a way the patient could lift the weights 8-15 times and in case of 15 times of success they would gradually increase the amount of weight lifted (Glowacki et

al., 2004). Data gathering methods included demographic information form, health history questionnaire and record observations regarding the progress of the intensity and duration of exercise for patients. The data were analyzed using the Kolmogorov-Smirnov test and paired sample t-test with SPSS version 17 program.

Results

All subjects were male, and most of them had undergone coronary artery bypass graft surgery (50%). Also, 10% of patients had hypertension (Table 1).

Table 1: Distribution of the study sample in terms of medication and treatment

Variable	No	Percent
Medications	Antihypertensive	3 %10
	Anti-lipid	6 %15
	NTG group	15 %40
	Aspirin and anticoagulants.	14 %35
Type of treatment	Artery Bypass Surgery	19 %50
	Valve Replacement Surgery	1 %6
	Angioplasty	18 %44

As can be seen in Table 2, the ejection fraction (EF) of patients was reduced before rehabilitation programs and LV end-systolic diameter(LVESD) and LV end-diastolic echo dimensions (LVEDD) were almost high (normal ranges include: LVEDD<50 mm and LVESD<33mm).

Subjects showed lower aerobic fitness before beginning the rehabilitation program in such a way that the mean resting metabolic (MET) of these patients was only 1.9 based on maximal oxygen uptake (VO_{2max}) of 32.65 milliliters per kilogram per minute (Table 3).

Table 2: Echocardiographic parameters of the subjects before beginning a rehabilitation program

Variable	Mean	SD
Ejection fraction	51.45	12.31
Left ventricular end diastolic size (ml)	39.67	6.98
Left ventricular end-systolic size (ml)	51.45	6.61

Table 3: Parameters obtained by the subjects during exercise

Variable	Mean	SD
Resting systolic blood pressure (mmHg ml)	129.8	4
Resting diastolic blood pressure (ml)	71.6	6
Maximum systolic blood pressure	163.1	12
Diastolic Blood Pressure	84.6	5
Resting metabolic equivalent (MET)	9.1	2.76

Based on the anthropometric parameters, Table 4 shows that resistive-endurance exercises significantly reduced weight ($P=0.016$), abdominal circumference ($P=0.031$) hip circumference ($P=0.003$) and the total thickness of the subcutaneous fat in three areas ($P=0.028$) respectively. Also it is evident that there is a significant difference

between the distance that patients had passed within 6 minutes before and after the rehabilitation program (P=0.001).

Table 4: The effect of rehabilitation on anthropometric parameters for 6-minute walk test in patients

Variable	Before rehabilitation program		after rehabilitation program		Level of significance
	Mean	SD	Mean	SD	
Weight (kg)	81.3	19.1	72.6	5.6	0.016
Abdominal circumference (cm)	97.6	11.2	88.1	7.6	0.031
Hip circumference (cm)	117.4	13.6	9.8	8.7	0.003
the sum of the thickness of subcutaneous fat (mm) in 3 areas	78.9	68.5	59.8	18.9	0.028
Walk test (m)	478	29.6	598	63.9	0.001

According to Table 5, the rehabilitation program was effective in reducing inflammatory cytokine and creatine kinase of myocardial tissue and has resulted in a significant reduction in their levels.

Table 5: The effect of rehabilitation on the levels of inflammatory cytokines and CKMB

Variable	Before rehabilitation program		after rehabilitation program		Level of significance
	Mean	SD	Mean	SD	
CK-MB (Ng mL)	259.6	78.4	149.8	98.1	0.001
IL-6 (Ng mL)	6.6	2.4	2.1	2.6	0.004
IL-10 (Ng mL)	10.7	2.9	3.8	1.7	0.026

Discussion and Conclusion

Based on the results of the patients before exercise stress test subjects showed lower aerobic fitness before beginning the rehabilitation program in such a way that the mean resting metabolic (MET) of these patients was only 1.9 based on maximal oxygen uptake (VO_{2max}) of 32.65 milliliters per kilogram per minute and this value belongs low to moderate aerobic fitness category based on the Cooper Research Institute classification (1998) (Glowacki et al., 2004) however, after the rehabilitation program various measurements indicated the increased aerobic fitness among the patients. The effectiveness of the exercise program on the antropometric parameters indicated that the rehabilitation program was effective in reducing weight, which led to a significant reduction in the inflammatory cytokine. Also the rehabilitation program was effective in the reduction of the total thickness of the three areas of body fat, especially abdominal fat thickness (abdominal area in men), while the thickness of the fat in the area is associated with cardiovascular diseases. These findings were in line with Lavie et al (2008) who investigated that after the rehabilitation program, patients had significant improvements in measures of obesity, including weight and body fat percentage and also it led to increased exercise capacity (Heyward et al., 1998). Also Sikis et al found that 24 sessions of aerobic exercise resulted in significant reductions in weight, body fat and waist circumference of cardiovascular patients (Lavie et al., 2008) and also Schmitt et al (Sykes et al., 2004) case study is in line with the results of this research.

The results showed that the activity of CK-MB isoenzyme has decreased significantly. In this regard most studies are focused on the impact of physical activities on the mentioned parameters and few of them have considered the long-term effects of exercise rehabilitation on cardiovascular patients. There is a possibility of myocardial cell membrane vulnerability and increased risk of CK_MB isoenzyme leakage into the bloodstream after the outbreak of the disease (similar to strenuous and long term activities) which will drop to lower values after adjustment to the exercise. The results of previous studies on exercise and rehabilitation exercises with low

intensity are different. However some investigation after the Triple Iron Men competitions, Alps trekking for two days and 100 kilometers of racing, have shown the increase in the parameter that are not in line with this research (Schmidt et al., 2001; Ford et al., 2002). Perhaps one of the reasons for this is the high endurance nature of those investigations. Also other studies with endurance nature did not show significant differences. This might be due to the type of activity. However, CK-MB as marker of myocardial damage in these patients is high and due to the long-term activities the primary level has been reduced.

The results of our study showed that this method of exercise decreased the IL-6 and IL-10. Several studies have been studied the relationship between physical activity and plasma levels of inflammatory parameters. For example Velpato et al observed that IL-6 levels are inversely associated with exercise tolerance in the older and disabled women (Selhub et al., 1999; Danesh et al., 2009). Some researchers have stated that individuals who are more physically active and physically ready to do more have less concentrations of inflammatory index compared with the passive and immobile people. Possible mechanisms that reduce the sources of inflammation may be because obesity (due to the production and expression of TNF- α , IL-6 gene and its receptors) is a factor that is strongly associated with high levels of inflammation (Christensen et al., 2006). Therefore, reducing body fat and increasing lipolysis in rehabilitation exercises (stimulating HSL hormone-sensitive lipase) could be a mechanism by which inflammation is reduced. Generally, this study while confirming the results of the previous studies, indicated that the rehabilitation program using resistive-endurance exercises and based on the effectiveness of these methods, may be an effective method for improving functional capacity in coronary patients. This exercise method can improve the lifestyle of the coronary patients through improving muscular strength and greater impact on cardiovascular improvement induced by power exercises and improving maximal oxygen uptake and higher cardiopulmonary readiness induced by endurance exercises. Also, due to the effect of resistance exercises on left ventricular structure and hypertension, it is recommended that similar research be done on the impact of these two methods of rehabilitation training on left ventricular structure, heart rate and high blood pressure of cardiovascular patients.

Conflict of interest

The authors declare no conflict of interest

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