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CARDIAC FUNCTIONAL IMPROVEMENT FOLLOWING EXERCISE TRAINING PROGRAM IN PAKISTANI PATIENTS AFTER CORONARY ARTERY BYPASS GRAFTING SURGERY

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ABSTRACT

The aim of the present study was to evaluate the effect of exercise training program on cardiac function indicated by heart rate (HR) and blood pressure (BP) in the patients who had undergoing coronary artery bypass grafting (CABG) surgery. The study was conducted in 100 cardiac patients of both sexes (age: 57-65 years) who after CABG surgery, were referred to the department of Physiotherapy and Rehabilitation between 2008 and 2010 at Liaquat National Hospital & Medical College, Karachi. The patients undertook exercise training program (using treadmill), keeping in view the Borg's scale of perceived exertion, for 6 weeks. HR and BP were measured at the start and end of the exercise training program. Exercise significantly restored the values of HR and BP (systolic) from the baseline to the last session of the training program. There appeared significant improvement in cardiac function four to six weeks of treadmill exercise training program.

Keyword: Heart rate • Rehabilitation • Coronary artery bypass grafting

INTRODUCTION

Cardiovascular disorders are the leading cause of mortality and morbidity in the industrialized and developing countries, accounting for almost 50% of all deaths annually. Coronary artery surgery including coronary artery bypass graft (CABG) is one of well accepted approach. Cardiac rehabilitation is a well established treatment in patients with coronary artery disease. Cardiac rehabilitation aims to reverse limitations experienced by CABG patients. Met-analysis of pooled data from clinical trials and cohort studies has demonstrated significant reductions in all-cause and cardiovascular mortality of patients undertaking cardiac rehabilitation programs. (O'Connor *et al*., 1989; Fletcher *et al*., 2001; Jolliffe *et al*., 2001; Oldridge *et al*., 1988).Exercise is long known to be of great value in all categories of prevention in cardiac disease. It has been shown that exercise training modifies the autonomic control of cardiovascular function. An early falls in the heart rate after exercise is thought to result from increased vagal activity. Heart rate recovery (HRR) has been demonstrated to be a powerful predictor of all-cause mortality. (Cole *et al*., 1999; Nishime *et al*., 2000). Cardiac rehabilitation has been associated with an improvement in HR in patients with heart failure, CABG, or prior myocardial infarction. (Streuber *et al*., 2006 ; Tsai *et al*., 2005 ; Kligfield *et al*., 2003 ; Duru *et al*., 2000 ; Oya *et al*., 1999 ; Giallauria *et al*., 2006 ; Tiukinhoy *et al*., 2003 ; Myers *et al*., 2007). The information about the effect of exercise training program in Pakistani cardiac patients after CABG is completely lacking.

The purpose of the present study is to evaluate and compare the effects of cardiac exercise training program on HR in CABG patients and to clarify whether exercise training could result in different improvements by certain approaches

MATERIALS AND METHODS

Our study population comprised of 100 cardiac patients (57.2 ± 6.5 years; both sexes) with a recent revascularization procedure who attended the department of Physical Therapy and Rehabilitation for cardiac rehabilitation program between 2008 and 2010. The study was approved by the Ethics Committee of Board of Advanced Studies and Research, University of Karachi. All the subjects gave consent and provided medical history pro forma which included the risk factors involved.

The complete cardiac rehabilitation program was 30 minutes of cardiovascular exercise on a treadmill for 16 weeks. There were approximately 5 minutes of stretching for warm-up, and the session finished with 5 minutes of stretching for cool-down. The total duration of a session was approximately 1 hour. The intensity of the aerobic

exercise was patient-dependent. The training intensity was increased as tolerated by the patients. Heart rate, blood pressure, and exercise intensity were monitored and supervised by a senior cardiopulmonary physical therapist during the exercise session.

The baseline and post-training exercise parameters were defined as the values of the first session & last session (i.e., resting heart rate, post-exercise heart rate) in which the patients had attended. The main outcome measures, namely resting heart rate, post training heart rate achieved during treadmill exercise, post-exercise heart rate were analyzed and compared using the Student's t-test and paired t-test. The analyses were performed using the Scientific Package for Social Sciences (version 16; SPSS, Chicago, IL). A p value <0.05 was considered statistically significant

The patients were considered according to NYHA (New York Heart Association) functional and therapeutic classification for prescription of physical activity for cardiac patients. Majority of the patients belonged to class I (68%) and II (27%) where none was under class III or IV: classified according to the following recommended features:

Class	Feature
I	Patients with no limitation of activities; they suffer no symptoms from ordinary.
II	Patients with slight, mild limitation of activity; they are comfortable with rest or with mild exertion activities.
III	Patients with marked limitation of activity; they are comfortable only at rest.
IV	Patients who should be at complete rest, confined to bed or chair; any Physical activity brings on discomfort and symptoms occur at rest

RESULT

An overall mean age of study participants was 57.2± 6.5 years. Pre exercise heart rate, systolic and diastolic blood pressure recorded were: 86.5±11.6, 120.7±11.6 and (73.2±5.9) respectively (Table 1).

At baseline, mean heart rate (86.5±11.66 bpm) and after cardiac rehabilitation program (77.32±5.40 bpm) was significantly different with p-value(p=<0.001),at baseline, mean systolic blood pressure (120.7±11.6mmHg) and after cardiac rehabilitation program (110.50±9.16mmHg) was significantly differ with p-value (p=<0.001).At baseline, mean diastolic blood pressure (73.25±5.90mmHg) and after cardiac rehabilitation program (72.15±6.34mmHg) was significantly differ with p-value (p=<0.001).(Table 2)

At baseline the majority of bypass surgery patients 22(27.5%) patients had been rated 3 at rate perceived exertion scale and in after Cardiac Rehabilitation plan Majority 43(53.8%) were change their rate at zero on rate perceived exertion (Table 3).

The descriptive statistics of the resting heart rate, post-exercise heart rate, and systolic and diastolic blood pressures at baseline and post-training, There was no significant difference in the mean resting or post-exercise diastolic and systolic blood pressures. The CABG group had higher resting heart rate and post-exercise heart rate. After four to six weeks of rehabilitation significant improvement in end-exercise heart rate. In the CABG group, resting heart rate was significantly reduced between the first and the last session.At baseline the majority of bypass surgery patients 22(27.5%) patients had been rated 3 at rate perceived exertion scale and in after Cardiac Rehabilitation plan Majority 43(53.8%) were change their rate at zero on rate perceived exertion (Table 4).

Table 1. Demographic and cardiac function features of CABG patients.

Patient characteristics	**Frequency ***	**Percentage**
Age (Years)	57.2±6.5	
Female	5	6.2
Male	75	93.8
Pre Exercise Heart (bpm)	86.5±11.6	
Pre Exercise Systolic Blood Pressure Level (mmHg)	120.7±11.6	
Pre Exercise Diastolic Blood Pressure Level (mmHg)	73.2±5.9	
*(Mean± Standard deviation)		

Table 2. Cardiac function indicator (HR & BP) at the start and completion of exercise training program in CABG patients.

Characteristics	Mean	SD	t-statistics	P- value
Pre Heart Rate (bpm)	86.5250	11.66730	9.937	<0.001
Post Heart Rate (bpm)	77.3250	5.40692		
Pre Exercise Systolic BP (mmHg)	120.75	11.66787	8.012	<0.001
Post Exercise Systolic BP (mmHg)	110.50	9.16101		
Pre Exercise Diastolic BP (mmHg)	73.2500	5.90537	1.280	0.204
Post Exercise Diastolic BP (mmHg)	72.1500	6.34075		

Table 3. Changes in rate perceived exertion in bypass surgery patients at Baseline and After Cardiac Rehabilitation plan.

Rate Perceived Exertion	Frequency	Percentage
Before Cardiac Rehabilitation plan		
0.5	1	1.2
1	5	6.2
2	10	12.5
3	22	27.5
4	14	17.5
5	13	16.2
6	7	8.8
7	5	6.2
8	3	3.8
After Cardiac Rehabilitation plan		
0	43	53.8
0.5	1	1.2
1	20	25.0
2	14	17.5
3	2	2.5

Table 4. Comparison of Treadmill Exercise Features (Duration & Speed) at pre and post exercise training program in CABG Patients.

Characteristics	Mean	SD	t-statistics	P- value
Initial Exercise Prescription Treadmill (minute)	10.1250	.89124	50.865	<0.001
Final Exercise Prescription Treadmill (minute)	29.1375	3.41532		
Initial Exercise Prescription Treadmill (mph)	0.9913	.91544	11.223	<0.001
Final Exercise Prescription Treadmill (mph)	2.7112	.81846		

At baseline the majority of bypass surgery patients 67(83.8%) had Treadmill Exercise Prescription of 10 min and after Cardiac Rehabilitation plan Majority of patients 65 (81.2%) have improved their Treadmill Exercise Prescription of 30 min. (Table 4 & 5).

Table 5. Changes in Treadmill Exercise Prescription in bypass surgery patients at Baseline and After Cardiac exercise training program.

Treadmill	Frequency	Percentage
Before Cardiac Rehabilitation plan Exercise Prescription (minute)		
7	3	3.8
10	67	83.8
11	1	1.2
12	9	11.2
After Cardiac Rehabilitation plan Exercise Prescription (minute)		
10	2	2.5
23	2	2.5
25	1	1.2
26	2	2.5
28	4	5.0
30	65	81.2
31	2	2.5
32	2	2.5

DISCUSSION

Over the last several years, HR after treadmill exercise testing and training has been frequently employed with particular interest in respect to clinical evaluation of not only for healthy subjects, athletes, but also for patients with cardiovascular disease. HR is a simply and readily obtainable clinical parameter which has accepted as a strong predictor of prognosis and mortality among different categories of disease populations including patients with heart failure and those with coronary artery disease (Tsai *et al*., 2005; Kligfield *et al*., 2003; Duru *et al*., 2000; Oya *et al*., 1999; Giallauria *et al*., 2006; Tiukinhoy *et al*., 2003; Myers *et al*., 2007)

The ability of the heart rate to recover after exercise is related to the capacity of the cardiovascular system to reverse the autonomic nervous system (withdrawal of vagal activity) and baroreceptor (detection of changes in blood pressure and inhibition of sympathetic discharge) adaptations that occur during exercise, often termed vagal reactivation.

Because of the strong association between HR and mortality, and the link between HR and exercise capacity or physical activity patterns, HR has the potential to be an additional marker of training efficacy and risk stratification in patients undergoing cardiac rehabilitation.(Cole *et al*., 1999; Nishime *et al*., 2000; Cole *et al*., 2000; Imai *et al*., 1994)

Our study extends current information on HR to patients with coronary revascularization who undergo exercise training in as much as we sought to examine the effects of cardiac rehabilitation on heart rate parameters in CABG. In light of the studies on patients with coronary artery disease, we showed that exercise training in a structured cardiac exercise training program was associated with significant improvements in post exercise heart rate. This effect was witnessed in CABG subject, who attended the cardiac exercise training program within one week before and after discharge and completed the entire rehabilitation program.

The data obtained during our study, reflected improvement in HR and systolic blood pressure, after rehabilitation in our patients was remarkable. Although heart rate, blood pressure, and exercise intensity were monitored and supervised by a senior cardiopulmonary physical therapist for all the patients, baseline and follow-up exercise stress tests were not performed and the data were recorded during treadmill exercise training. Nevertheless, these findings seem to be indicative of the parameters of exercise stress test. Ideally, because of a lack of data concerning the association between the study outcomes and subsequent mortality, this relation requires further investigation, specifically using a prospective study design. Our clinical data do not permit clarification of the

reasons underlying the major differences in survival between our patients, who entered cardiac rehabilitation after CABG. Also, it is worthy of note that our groups were not assigned randomly to treatment, but rather attended for exercise training after original treatment options had been made individually by their referring physicians.

In conclusion, our findings suggest that patients after exercise training in a cardiac rehabilitation program significantly benefit in terms of heart rate and blood pressure regardless of revascularization modalities.

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