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THE PROGRESSIVE AND SUCCESSIVE DAILY IMPROVEMENT IN HR AND BP IN PAKISTANI PATIENTS AFTER CORONARY ARTERY BYPASS GRAFTING

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ABSTRACT

To observe and record the progressive and successive daily improvement in HR and BP in some of post-CABG patients. A few selected cases of the total population studied for their cardiac responses (HR and BP) before, during and after the completion of exercise sessions daily/alternate day's basis showed significantly increasing differences both in the mean. In these patients there were significantly increasing difference of mean treadmill time (min) and distance (Km), mean Recumbent Bike time (min) over different visit. The progressive and successive daily improvement in HR and BP in some of post-CABG patients. The exercise training program is helpful for improving exercise competency linked with recovery cardiac function in Pakistani CABG patients.

Keyword: Heart rate, Rehabilitation, Coronary artery bypass grafting.

INTRODUCTION

Exercise has in recent years gained very important role in the maintenance of health and fitness not only for the sportsmen but also for common people in their day-today life (ACSM, 1995; Roberg and Roberts, 2000). However, its significant contribution in the rehabilitation of patients undergoing a number of diseases has also been emphasized (Braith and Edwards; 2000). Prominent among such diseases are various forms of cardiac dysfunction. Activity is an independent risk factor for CHD. Cardiac rehabilitation is a program that helps patients manage their heart diseases through education and promoting lifetime exercise. It is appropriate for anyone who has a heart attack, angina pectoris, coronary artery bypass graft surgery (CABGS), cardiac arrhythmias, myocardial infarction (MI), balloon angioplasties, and congestive heart failure (Kwok *et al*., 2001). These may be prescribed medications for particular purpose. Further, exercise intolerance has often been documented in-patients with heart failure (Piepoli *et al.*, 1999; Hambrecht *et al.*, 1999; Fang *et al*., 2003) as well as those after heart transplantation (Tegtbur *et al.*, 2003). A number of possible causes have been attributed for this physiological status of the body e.g., decrement in left ventricular systolic function, abnormalities involving chemoreceptors (Ponikowski *et al*., 1997), autonomic balance (Kinugawa *et al*., 1991), and skeletal muscle blood flow (Sullivan *et al*., 1989) and function (Adams et al., 1999). A few studies randomized trials have shown that exercise training can reverse the exercise intolerance that is common in such patients (Belardielli *et al*., 1999; Afzal *et al*., 1998). Many others have shown improvements in these patients after exercise, in their physiological functions including endothelial (Horning *et al*., 1996; Linke *et al*., 2001), local blood flow (Hambreht *et al*., 1995), enzyme activity (Tyni-lenne *et al*., 1998), and skeletal muscle fiber type (Tyni-lenne *et al*., 1997, Hambrecht *et al*., 1997). A few have devised nomograms based on variety of variables (Kwok, 2001). It is therefore, very pertinent to undertake a prospective study involving degree of improvement in specific physiological variables in patients with chronic heart failure and or those after heart transplantation, following prescribed exercise protocols in a clinical set-up, and the information obtained would be of immense help and provide guidelines for heart patients, the prevalence of which is on the increase in our population. The benefits of exercise has not been trickled down to patients in Pakistan and such an approach is almost negligible both inside and outside hospitals due to the lack of awareness and expertise both among physicians and patients and of course non-availability of resources.

The information about the effect of exercise training program in Pakistani cardiac patients after CABG is completely lacking. The purpose of the present study was 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 15 cardiac patients (40 ± 60) years male with a recent revascularization procedure who attended the department of Physical Therapy and Rehabilitation for cardiac rehabilitation program between 2008 and 2010. All the subjects gave informed consent and provided medical history Performa which included the risk factors involved. The study was approved by the Ethics Committee of Board of Advanced Studies and Research, University of 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 before, during and after the completion of exercise sessions daily/alternate days basis.

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.

Statistical formulae were applied to analyze the improvement in cardiac functional indicators. The analyses were performed using the Scientific Package for Social Sciences (version 16; SPSS, Chicago, IL). A p value <0.05 and <0.001 was considered statistically significant

RESULTS

Cardiovascular Variables on Successive Follow Up Till Post-CRET in Post-CABG Patients

An overall mean age of study participants was 40± 60 years. Pre exercise heart rate, systolic and diastolic blood pressure recorded was: 86.5±11.6, 120.7±11.6 and (73.2±5.9) respectively (Table.1).

Alteration in HR

A few cases of the total population enrolled for the program were studied for their cardiac behavior observing them and recording their HR activity before, during and after the complete sessions of exercise protocols on daily/alternate days basis. The data y were There were found significantly increasing differences in the mean HR made over among before, during and after heart rate (p<0.005). There is a no reduction of mean heart rate committed over visit (p<0.3541). The Significance of source = visit*time is 0.101 which means that there is no time*group interaction, i.e. Among before, during and after Heart rate had a reduction in the number of errors made over visits.(Table 2)

Alteration in SBP

There were found significantly increasing differences in the mean systolic blood pressure made over among before, during and after systolic blood pressure (p<0.038). There is a no reduction of mean systolic blood pressure committed over visit (p<0.197). The Significance of source = visit*time is 0.390 which means that there is no time*group interaction, i.e. Among before, during and after systolic blood pressure had a reduction in the number of errors made over visits.(Table 3)

Alteration in DBP

There were no significant differences in the mean diastolic blood pressure made over among before, during and after diastolic blood pressure (p<0.259). There is a no reduction of mean diastolic blood pressure committed over visit (p<0.315). The Significance of source = visit*time is 0.490 which means that there is no time*group interaction, i.e. Among before, during and after diastolic blood pressure had a reduction in the number of errors made over visits.(Table 4)

Alteration in Treadmill and Recumbent Bike

There were significantly increasing difference of mean treadmill time over different visit (p<0.001), mean treadmill length (kilometer) over different visit (p<0.001) and also found a significantly increasing difference in mean Recumbent Bike time (min)(p<0.001).(Table 5)

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

Patient characteristics	Frequency *	Percentage
Age (Years)	40 ±60	
Male	15	100
Pre Exercise Heart (bpm)	76.27±11.6	
Pre Exercise Systolic Blood Pressure Level (mmHg)	118±11.6	
Pre Exercise Diastolic Blood Pressure Level (mmHg)	78±5.9	

*(Mean± Standard deviation)

Table 2. HR at Pre and Alternative Follow Up Visits of CRET After CABG Patients (n = 15).

Variables	Visits									
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Before Activity Heart Rate	76.27± 5.147	77.13± 6.501	74.93± 4.559	75.40± 6.150	76.80± 5.747	74.40± 4.032	74.86± 3.439	74.21± 4.492	75.93± 6.765	73.93± 3.772
During Activity Heart Rate	81.87± 4.673	85.67± 6.894	86.40± 8.034	89.40± 17.137	86.13± 5.357	86.40± 6.685	86.43± 3.345	88.29± 5.797	87.00± 3.803	88.71± 4.548
After Activity Heart Rate	79.13± 5.489	78.60± 4.733	77.47± 6.446	79.27± 9.027	75.67± 5.447	76.87± 4.422	77.71± 4.027	77.86± 3.997	77.00± 3.595	77.43± 3.877

Table 3. SBP At Pre and Alternative Follow Up Visits of CRET After CABG Patients (n = 15).

Variables	Visits									
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Before Activity Blood Pressure	118.00± 12.649	114.00± 9.856	120.00± 13.093	116.67± 12.344	114.67± 13.020	118.00± 11.464	115.71± 8.516	115.71± 10.163	114.29± 8.516	115.71± 9.376
During Activity Blood Pressure	119.33± 12.799	121.33± 10.601	126.00± 13.522	126.00± 18.048	121.33± 14.573	120.67± 10.328	123.57± 12.157	124.29± 10.163	124.29± 10.163	125.71± 10.163
After Activity Blood Pressure	116.00± 12.421	112.67± 12.228	114.67± 12.459	113.33± 8.997	113.33± 10.465	116.67± 17.182	112.86± 9.139	115.00± 8.549	113.57± 7.449	114.29± 7.559

Table 4. DBP at Pre and Alternative Follow Up Visits of CRET After CABG Patients (n = 15).

Variables	Visits									
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Before Activity Blood Pressure	78.00± 9.411	76.67± 8.997	76.67± 11.127	77.33± 8.837	74.67± 9.904	76.67± 8.997	76.43± 10.082	77.86± 8.018	75.71± 17.41	78.57± 6.630
During Activity Blood Pressure	82.00± 7.746	76.67± 10.465	81.33± 6.399	81.33± 9.904	80.00± 10.690	80.00± 10.690	83.57± 7.449	81.43± 9.493	81.43± 9.493	80.57± 7.325
After Activity Blood Pressure	80.00± 6.547	78.67± 6.399	77.33± 7.037	76.67± 10.465	74.67± 9.155	78.67± 8.338	77.14± 7.263	77.14± 7.263	77.14± 8.254	75.71± 6.462

Table 5. Treadmill Time and Recumbent Bike Reading at Pre and Alternative Follow Up Visits of CRET After CABG Patients (n = 15).

Variables	Visits									
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Treadmill time (min)	6.79± 2.694	9.07± 3.634	11.27± 3.615	12.67± 3.559	14.73± 3.936	16.40± 3.621	18.71± 3.688	20.43± 3.975	22.07± 3.970	24.21± 4.209
Treadmill kilometer (km)	1.16± .231	1.40± .300	1.63± .274	1.80± .305	1.95± .297	2.08± .328	2.29± .225	2.44± .250	2.65± .250	2.91± .262
Recumbent Bike Time(min)	7.67± 3.677	7.40± 2.473	8.87± 3.502	10.07± 3.973	11.47± 4.565	10.80± 2.933	12.57± 2.738	13.07± 3.149	12.79± 2.940	15.14± 3.461

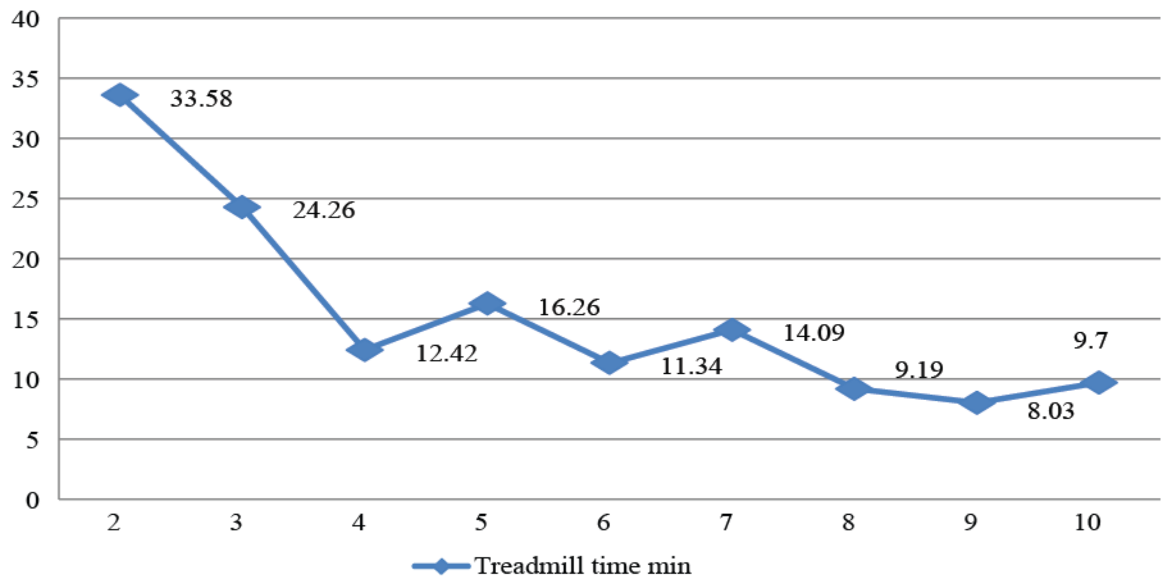

Fig. 1(a). Treadmill time(min) % Change at different visit.

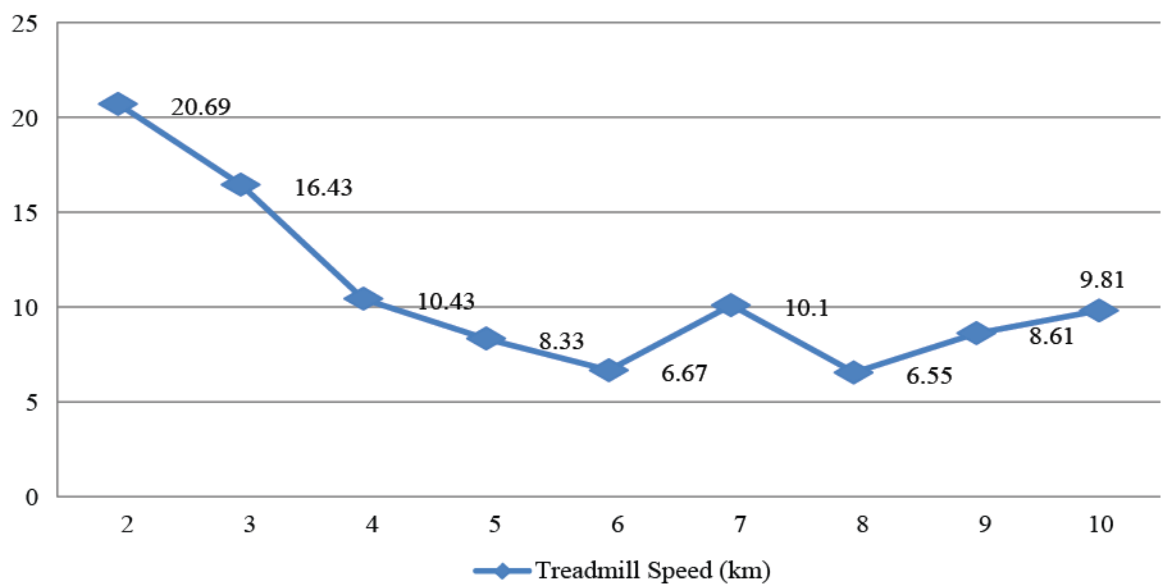

Fig. 1(b). Treadmill speed (km) % Change at different visit.

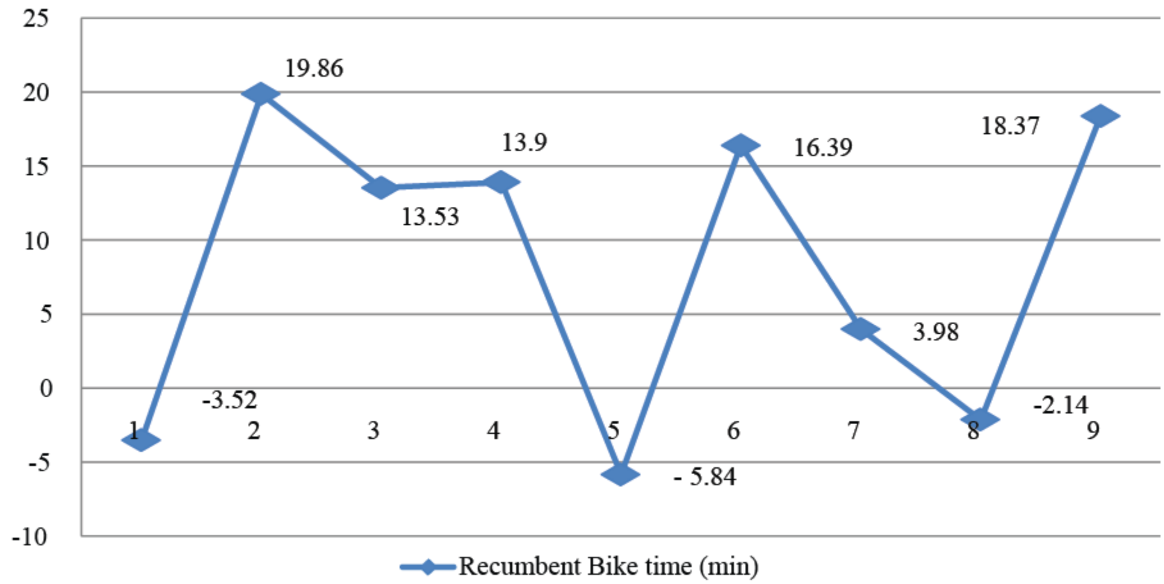

Fig. 1(c). Recumbent Bike time (min) % Change at different visit.

DISCUSSION

CR program assists patients to return to their normal activities as early as possible while secondarily preventing a recurrent episode. It consists of three phases. Phase one takes place during hospital admission where the patient is counseled besides giving information about the upcoming second phase. The second phase assists patients to return to their normal daily routine by helping them recover through a structured exercise program. Phase three is maintenance of physical activities started in phase two. We selected patients from the second phase and gave them simple exercises to perform. Our study showed a significant improvement in most of the cardiovascular parameters in all patients. The heart rate, systolic blood pressure and diastolic blood pressure all showed a significant decline ($p < 0.001$) before, during and after coronary artery bypass grafting.

A few selected cases of the total population studied for their cardiac responses (HR and BP) before, during and after the completion of exercise sessions daily showed significantly increasing differences both in the mean HR ($p<0.005$) and SBP ($p<0.038$), but not in the mean DBP ($p<0.259$). However, here is a no reduction of mean HR ($p<0.354$), mean SBP ($p<0.197$), mean DBP ($p<0.315$) committed over visit. The Significance of source = visit*time for HR, SBP and DBP was 0.101, 0.390 and 0.490 respectively indicating no time*group interaction, i.e. among before, during and after diastolic blood pressure had a reduction in the number of errors made over visits. In these patients there were significantly increasing difference of mean treadmill time (min) and distance (Km) ($p<0.001$), mean Recumbent Bike time (min) ($p<0.001$) over different visit ($p<0.001$).

Assessment of blood pressure is an important part of cardiac rehabilitation, where the subjects are categorized according to the Seventh Report of the Joint National Committee (JNC7; Chobanian *et al*., 2003) as well as assessed for orthostatic hypotension. The goal is to reduce the blood pressure to less than 140/90 mmHg. In subjects who are having CAD, as in this study, the goal is to reduce the blood pressure to less than 130/80 mmHg. In case of ventricular systolic dysfunction, this level is further reduced to less than 120/80 mmHg (Rosendoff *et al*., 2007).

We demonstrated a significant decrease in heart rate and systolic blood pressure after exercise training. The heart rate product, an important calculated variable of exercise training, is a product of heart rate and systolic blood pressure. In angina patients, it has been observed that cardiac rehabilitation increases the pain threshold and resolves angina, thus increasing the exercise capacity further (Ades *et al*., 1989).

Relationship four BP indexes (PP, SBP, DBP, and MAP) with mortality rates for CHD, CVD, and all causes in patients of different age groups and of both sexes and the data indicated that the long-term risk of high BP should be assessed mainly on the basis of SBP or of SBP and DBP together, not on the basis of PP, in apparently healthy adults (Miura *et al*., 2001).

Almost all patients improved treadmill and Recumbent Bike duration beyond 30 and 60 minutes duration respectively. Similarly, speed at post-CRET was almost 3 times more for these exercise prescriptions compared to pre-CRET values. The values for time and speed for both Treadmill and Recumbent Bike between pre and post-CRET were significant ($p <0.001$).

A recumbent bike is a stationary bicycle that places the body in a reclining position therefore taking the load off the back and neck area and also works the abdominal muscles and hamstrings. It is recommended for patients with back problems or cerebral palsy, those who are overweight and obese, and most importantly for cardiac rehabilitation purposes. During the exercise the legs are positioned at heart level thus keeping the blood pressure low.

Quinn *et al*. (1995) compared the response of nine stable male cardiac patients performing stationary cycling in all the three positions, supine, recumbent and upright. They found heart rate to be significantly below ($p < 0.05$) in the supine position when performing workout at a sub-maximal level.

Bonzheim *et al*. (1992) also compared the results of upright exercise testing with recumbent exercise and found heart rate, systolic blood pressure, oxygen consumption Vo2 max, rate pressure product and rating of perceived exertion to be greater in the upright position. However, at peak level of intensity this distinction between upright and recumbent exercise was not significant. In one study the exercise capacity improved after cardiac rehabilitation exercise performed on treadmill at an intensity of 70 to 85 percent of MHR. After three months the study showed an improvement of exercise tolerance by 30 to 50 percent and peak oxygen consumption increase by 15 to 20 percent (Wenger *et al*., 1995). Another study compared the performance of elderly persons (> 65 years) with younger adults (< 65 years) on treadmill exercise and found work-load as a strong variable associated with outcome having a prognostic effect equal in both the groups (Goraya *et al*., 2000). Pollock *et al*. (1976) compared different protocols used for treadmill exercise testing: Balke, Bruce, Ellestad, and a continuous multistage running protocol, and found no significant difference between them when comparing them with MHR and metabolic oxygen requirement (VO2 max).

The observations presented here for recumbent bike exercise prescription – time & speed document that these values are very similar to those observed previously in post-CABG patients.

Many patients requiring CR exercise are unable to perform active treadmill exercise or the recumbent bike exercise. This may be due to poor cardiac function or factors local to the muscles or joints. In these cases, stretching exercises designed to help increase the length of the muscles, combined with exercise program that increases the strength and endurance of the specific muscles, elevate the heart performance. Exercise training protocol involving localized small muscle groups, improves the metabolic performance of these muscles. This was demonstrated in our study where the subject's mean exercise capacity improved significantly from pre-CRET to post-CRET level ($p < 0.001$). Ohtsubo (2000) demonstrated significant improvement in calf muscle metabolism on phosphorus-31 nuclear magnetic resonance spectroscopy, after specific training that involved unilateral calf planter flexion. The study also demonstrated a subjective improvement in fatigue score of the patients.

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