

RESEARCH REPORT

EFFECTS OF CARDIAC REHABILITATION ON THE FUNCTIONAL CAPACITY AND HEMODYNAMIC PARAMETERS OF PATIENTS WITH CVD USING 6MWT

ABSTRACT

OBJECTIVE

To evaluate the effects of phase II cardiac rehabilitation (CR) on functional capacity and hemodynamic parameters of patients with CVD

STUDY DESIGN

Quasi Experimental Study

METHODOLOGY

121 individuals were recruited in cardiac phase II rehabilitation program by a simple random sampling, aged between 45-65 years, assessed on day 1 on the basis of medical history and 6 Minute Walk Test (6MWT). The patients were then enrolled into eighteen session of hospital based supervised exercise program according to ACSM's guidelines.

RESULTS

The statistical analysis shows the significant changes in the functional status and hemodynamic variables of the participants after exercise session, where the post exercise heart rate was decreased to around 2.2 ± 0.8 beats/minute with the p value of 0.001; systolic and diastolic blood pressure was plummeted to around 12.3 ± 2.5 and 46.1 ± 9.2 mmHg respectively with the p value of 0.00 and 0.001. The rate of exertion has been decreased by 6.2 ± 1.5 (p value = 0.0001) and the distance covered was increased to 111.9 meters (p value = 0.0002).

CONCLUSION

The study has concluded that potency of eighteen session of phase II cardiac rehabilitation is found to be effective in improving the functional status, hemodynamic variable and the myocardial workload of cardiac patients, determined by 6MWT.

KEYWORDS

Cardiac Rehabilitation, Six Minute Walk Test, Functional Capacity, Hemodynamic, Parameters, Cardiac Risk Factors

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INTRODUCTION

Cardiovascular disease (CVD) is a leading cause of universal morbidity and mortality with an estimated death of around 17.3 million in one year which is expected to be more than 23.6 million by 2030¹. About 80% of deaths are due to heart attack and stroke², out of that more than 75% of deaths occur in developing countries². As per Shifa International Hospital, Islamabad among 30 to 40 percent of all deaths in Pakistan due to non-communicable diseases, cardiovascular disease has the leading mortality rate that has reached to about 2lacs deaths per year estimated to around 410/100,000 of the population³. The risk factors of the cardiovascular disease are enormous and are divided into modifiable and non-modifiable risk factors⁴. Modifiable risk factors include hypertension, tobacco use, raised blood glucose, physical inactivity, unhealthy diet, cholesterol, and overweight/obesity whereas age, gender and family history non-modifiable risk factors⁵. As majority of the cardiovascular problem is account from the modifiable risk factors that can be controlled the health care system around the globe are now primarily working on a multidisciplinary approach in order to prevent, controlled and rehabilitate the patient from the complications that arises from this disease⁶.

Over a last few decades cardiac rehabilitation has evolved from the point of simple monitoring to a multidisciplinary approach⁷, where the optimization of medical treatment can be augmented by the inclusion of supervised exercised plan, individualized diet plan, individual counseling, patient and family education for management of diabetes, hypertension (HTN), dyslipidemia, smoking cessation, obesity and stress⁸. Sedentary lifestyle is a fourth leading risk factor of cardiovascular diseases, that accounts for 3.2 million deaths/year and 32.1 million DALYs (disability adjusted life year)⁴. Insufficient physical activity is referred to the moderate activity of less than 30 minutes per week or vigorous activity of less than 20 minutes⁹. Cardio-respiratory fitness has a direct relationship with the physical fitness, thus makes physical activity an integral part of cardiac rehabilitation¹⁰. According to a study, cardio-respiratory fitness decreases by 27% in individual after continuous 20 days of bed rest¹¹ and daily step count decreases from 10,051 to 1344 with estimated decreases in VO_2 max of 7%¹². Traditionally there are three phases of cardiovascular rehabilitation (CR) with the aim to smooth the progress of recovery and to prevent progression of the disease¹³. Phase-I is initiated when the patient is still in the hospital with the aim to improve early mobility of patient; Phase-II also called as a supervised ambulatory outpatient program having the duration of 6-8 months and is aimed to improve the cardiovascular and cardio-respiratory fitness of the patient; the final phase also called as the lifetime

maintenance phase or Phase-III is based on the intend to modify the risk factors through the exercises learned in Phase-II^{14,15}.

It is evident from the study that around 50% reduction in the risk of mortality occurs through exercise based cardiac rehabilitation programs¹⁶, whereas 28% reduction in the risk is achieved by other modifiable factors, particularly smoking¹⁷. Thus making phase-II cardiac rehabilitation as an important aspect in controlling and preventing cardiovascular disease, scientific data has clearly established that improvement of 1MET (Metabolic Equivalent to Task) in functional capacity reduces 12% of mortality risk due to CVD¹⁸. Similarly the role of nutritional counseling and weight management is also important, as studies have suggested dietary recommendations during cardiovascular rehabilitation phase-II. It includes reduction in saturated fat intake that is <7% of total calories, cholesterol <200mg/dl and increase in uptake of polyunsaturated fat for about 10% of total calories, monounsaturated fat approximately 20% of total calories with adequate repartition of calorie sources for about 50-60%, 15% and 25-35% of carbohydrates, proteins and fats respectively and the increase in fiber intake (about 20-30 g/d)¹⁹. The weight management with a body mass index of 18.5-24.9 kg/m² and waist circumference of <40 inches in men and <35 inches in women is recommended with an initial approach of reducing approximately 10% of weight from baseline during the rehabilitation phase. The role of psychosocial management is also essential as it affect both morbidity and mortality. Studies have revealed that 20% of patients following myocardial infarction suffer from, depression, anxiety, and denial²⁰. Moreover, 30% of the population during the phase-II of cardiac rehabilitation takes unnecessary stress resulting in hypertension, increased blood glucose, cholesterol levels and body weight ultimately increases the development of atherosclerosis²¹. Thus making cardiac rehabilitation a multidisciplinary approach where the role of physical therapy intervention can be augmented by the indulgence of other medical health care professionals like nutritionist, psychologist, nurses etc. in improving the patient's health and heart related concerns. The effects of phase II cardiac rehabilitation on functional capacity and hemodynamic variables of the participants using 6 Minutes-Walk Test (6MWT) as an indicator in patients with CVD.

METHODOLOGY

Study Setting

The study was conducted in the outpatient department of Tabba Heart Hospital, Karachi.

Target Population

Patient with cardiovascular disease enrolled in Phase-II Cardiac Rehabilitation program.

Study Design

Quasi Experimental Study

Duration of Study One year

Sampling Technique

Simple random sampling technique

Sample Size

Sample size of 121 patients have been included in the study

Inclusion Criteria

- Patients with diagnosed CVD
- Both male and female of age 45-65 years

Exclusion Criteria

- Medical red flags like tumor, uncontrolled hypertension
- Structural deformity like scoliosis, that limits the functional capacity of respiratory system
- Surgery that limits the inclusion of patient in Phase II cardiac rehabilitation

Training Protocol

The patient after being recruited in the training program for phase II cardiac rehabilitation would be assessed on day 1 on the basis of medical history, functional capacity and hemodynamic variables by using 6MWT. The patients were then placed into an eighteen session of supervised exercise program based on ACSM's protocol of Frequency, Intensity, Time and Type.

The protocol of the exercise was as follows:

• Frequency

6-8 weeks/ 3 sessions per week

• Intensity

Ranging from 20% to 59% of Target Heart Rate (HR) during exercise and RPE (Rate perceived Exertion) ranging from 10-13 during exercise.

• Time

Each session ranging from 30 minutes initially (with 10 minutes bouts) then gradually duration increased up to 60 minutes per session.

• Type

Treadmill, cycling and arm ergometer Telemetry monitor remain attached throughout sessions. Blood pressure (BP), heart rate (HR), pulse, rate of perceived exertion (RPE), Electrocardiograph (ECG), Oxygen Saturation (SpO_2) and physical symptoms has been observed throughout the

whole session, time to time specially (in start, during exercise and post session). Each recruited patient performed exercises within the prescribed intensity according to the exercise dosage plan of calculated target heart rate zone for each individual. Exercises were prematurely terminated on the basis of prescribed measures by American College of Sports Medicine (ACSM) on the basis of Oxygen Saturation, ECG monitoring and RPE scale. The effects of exercise protocols were measured by using the parameters of 6MWTs and were compared from the values taken on the first day of exercise session. Beside exercise session diet consultation has been offered and education has been provided time to time about stress management, dietary habits and life style modification for related risk factor.

Ethical Considerations

Ethical issues considered in my studies are following:

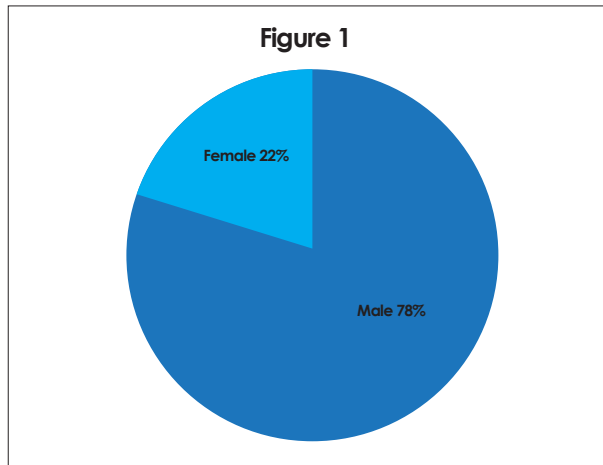
1. Confidentiality statement was issued to all participants because confidentiality and privacy of identity was an important aspect of personal security.
2. Consent will be obtained from the participants to ensure the risk and costs regarding the treatment
3. Participants had the right to withdraw from study at any time.
4. Data collection in the hospital/institute was done after permission from Head of department of Physiotherapy.

RESULT

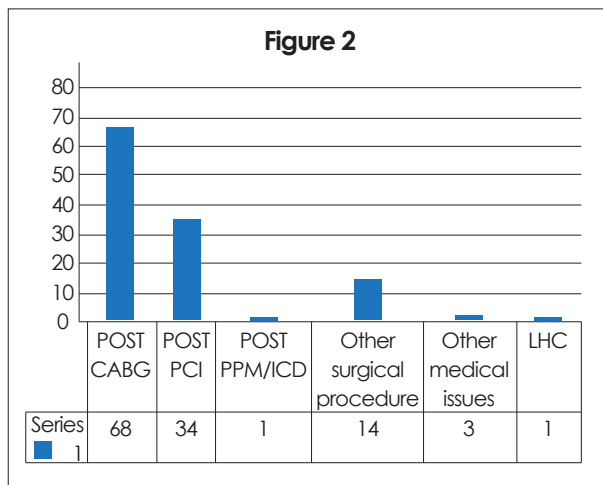
A total number of 121 patients were recruited in this study. The demographic characteristics of the patient recruited are shown in Table 1.

Variables	Mean \pm SD
Age (years)	56.6 \pm 10.0
Height (cm)	164.8 \pm 8.5
Weight Pre (kg)	70.8 \pm 13.1
Weight Post (kg)	69.5 \pm 12.4
BMI Pre (kg/m ²)	26.0 \pm 4.1
BMI Post (kg/m ²)	25.5 \pm 3.9

The mean age and height of the patients recruited in the study were 56.6 years and 164.8cm respectively. Out of them, 95 were males and 26 were females. The description of the participants according to gender is shown in Figure 1.



Out of 121 subjects that were recruited in the study, 68 were with the history of post Coronary Artery Bypass Grafting (CABG), 34 with post Percutaneous Coronary Intervention (PCI), 1 each for both post Implantable Cardioverter Defibrillator (ICD) and left heart catheterization and the rest had some other surgical and medical issues. The details are shown in Figure 2.



At baseline, the hemodynamic variables of the participants were taken after performing the 6MWT that includes heart rate, oxygen saturation rate, blood pressure, rate of perceived exertion using Borg scale and total distance covered in meters during 6MWT. The baseline information obtained was compared with the values after performing cardiac rehabilitation session on the same day. The details are shown in Table 2. The values from 6MWT before and after performing a single day session of phase II cardiac rehabilitation shows no changes with the p-value of 0.00. However some changes were observed in oxygen saturation level that has been dropped to 90±12.2 with the p-value of 0.03 after performing exercises prescribed for phase II cardiac rehabilitation.

Table 2: Variables after performing 6MWT at Day 1 of Cardiac Rehabilitation (CR) Session

Variables	Before CR Session Mean ± SD	After CR Session Mean ± SD
Heart Rate	78.0±11.5	86.0±12.2
Oxygen Saturation	98.5±1.4	90±12.2
Systolic BP	130±10.3	140±12.5
Diastolic BP	110.8±14.2	120.6±18.5
RPE	5.7±2.4	8.7±3.6
Distance covered during 6MWT	274.3±60.9	363.5±64.7

The 6MWT was finally performed by the participants on final day of sixth week before and after the exercise session. The values of the hemodynamic variables obtained before and after cardiac rehabilitation session are shown in Table 3. The values of the hemodynamic variables obtained during the test were compared to the values from the baseline data.

Variables	Before CR Session Mean ± SD	After CR Session Mean ± SD
Heart Rate	74.8±12.7	83.8±12.4
Oxygen Saturation	98.5±1.2	98.8±1.2
Systolic BP	120.7±11.0	127.7±12.4
Diastolic BP	80.6±8.5	74.5±8.9
RPE	1.6±1.1	2.5±1.1
Distance covered during 6MWT	476.4±20.7	475.4±10.3

The statistical analysis shows significant changes as the resting heart rate of the patient decreases by 3.2±1.2 beats per minutes with a p value of 0.002. The resting systolic and diastolic BP also falls to around 9.3±1.8mm of Hg and 30.6±5.2mm of Hg respectively having the p value of 0.004. The significant changes were also observed in RPE scale and a distance covered during 6MWT with the p-value of 0.001. The values were compared with the values taken at the post exercise session on first day. The statistical analysis shows that significant changes

were occurred in the hemodynamic variables of the participants after exercise session as well where the post exercise heart rate was decreased to around 2.2 ± 0.8 beats per minute with the p value of 0.001 and systolic and diastolic BP were plummeted to around 12.3 ± 2.5 and 46.1 ± 9.2 mm of Hg with the p value of 0.00 and 0.001 respectively. The changes were also observed on RPE scale where the rate of exertion has been decreased by 6.2 ± 1.5 (p value 0.0001) and the distance covered was increased to 111.9 meters (p value 0.0002).

DISUSSION

The study involve the use of 6MWT as an indicator to identify the effects of phase-II cardiac rehabilitation exercises on patients underwent different cardiac surgical procedures as 6MWT is a predictor of incidence for re-hospitalization of patients who fails to cover a distance of more than 240 meters²². The result of this study shows that not only cardiac rehabilitation improves the hemodynamic variables of the patients but also improves their functional status. The result is according to the study conducted by Wenger N which stated that multidisciplinary approach involving the psychological parameters in CR improves the exercise tolerance in cardiac patients²³. Study conducted Araya-Ramírez F found that initial walk test has an inverse relation ($r=0.47$ $p<0.001$) with 6MWT as lowest initial 6MWT exhibit greater improvement than those who have initially high 6MWT²⁴. Audelin MC et al found that Phase II cardiac rehabilitation is safe even in patient of >75 years of age as it decreases the incidence of re-hospitalization of patients after heart surgeries²⁵. Achttien RJ aims a meta-analysis to found the effectiveness of exercise-based CR in patients with coronary heart disease (CHD) and found the strong evidence regarding the effectiveness of exercise-based CR during all phases of CR²⁶. Patient attended cardiac rehabilitation achieved a significant improvement in health-related quality of life as their functional status gets improved and they get better control on their hemodynamic responses. The strongest effect occurred in the first 8 weeks, when patients were receiving the most intense phase of the intervention²⁷. Ramin Shabani et al in his study effect of CR program on exercises capacity in women undergoing coronary artery bypass graft concluded that effects of 12 weeks of training using cardiac rehabilitation protocol significantly improves the myocardial work load of women undergone coronary artery bypass graft than those who did not received any rehabilitation interventions the study also analyzed the effects of phase II CR program on Peak Rate Pressure Products (PRPP) and suggested that not only cardiac rehabilitation aims to improves the resting parameters of patients but focus should also be given to improves the hemodynamic parameters during and after every

session of exercise²⁸. Fiorina et al showed that 6MWT was well accepted in patients who had undergone a supervised cardiac rehabilitation phase²⁹. In another study Vincent et al concluded that incorporation of resistance exercises regimen into supervised exercises program during phase-II cardiac rehabilitation provides additional benefits in terms of improving muscular strength, cardiorespiratory functions and physical functions³⁰. Effects of phase-II cardiac rehabilitation has also been observed on exercise capacity and quality of life in different studies which provide evidences that six weeks of exercises significantly improves the distance covered during 6MWT and also concluded that metabolic equivalents of exercises stress test and 6MWT has a strong direct positive correlation ($r=0.87$)³¹. Ching-Huang Hung found that supervised cardiac rehabilitation was more effective in comparison to home based exercises program in improving the fitness of the patients after post CABG³². The study involves the assessment of fitness parameters by incorporating ACSM elements of fitness included body composition, flexibility, muscle strength, endurance and cardiopulmonary function³². Study by Ragawanti P et al found that a significant difference in the functional capacity was observed in patient before and after coronary revascularization, however greater improvement are found in patients who underwent CR for four to six weeks for 30-60 minutes and treated with 11 series of exercises³³. Craciun et al 2011 had emphasized on the importance of intensive cardiac rehabilitation program in cases in which patients had low functional capacity <45%³⁴, thus making cardiac rehabilitation program as an integral part of preventing the patient from the post cardiac surgical complications. The sample of the study includes greater number of male participants in comparison to female which may be due to the cultural barriers which limits the enrollment of female participants in phase-II CR hence same reflects in the present study as well³⁵. However not all patients with cardiac disease are apposite for such an exercise program, this care component needs to be modified according to the requirement of the individual making the aspect of clinical decision making as an integral part in evaluating the complexity of disease in terms of its impact on an array of patient outcome.

CONCLUSION

The study concluded that potency of phase II cardiac rehabilitation is found to be effective in improving the functional status, hemodynamic variable and the myocardial workload of cardiac patients determined by 6MWT. The variables of 6MWT improve after the completion of cardiac rehabilitation program.

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