

## To Study the Response of Treadmill Walking and Cycle Ergometer on the Hemodynamic Changes of Post CABG Surgery Patients during Immediate Post-Operative Days

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### ABSTRACT

**Background & Objective:** Cardiovascular diseases are an important public health problem worldwide nowadays and it is a leading cause of death, cause of disability. CABG is performed as an effective treatment in different scenarios of CAD and aims to improve survival. The aim of the study was to assess the effects of treadmill and cycle ergometer exercise training on the hemodynamic responses of the post CABG surgery patient during immediate post-operative days.

**Method:** 53 patients aged between 40 to 75 years who underwent CABG surgery 5 days ago were selected. The ETT was performed before the discharge on the 5<sup>th</sup> day, and the outcome of vitals was documented. After discharge the patients were informed to visit the CVPRC department of “Shree B D Mehta Mahavir Heart Institute” for 3 sessions within 10 days. Each session consisted of warm up exercises and treadmill walking and cycle ergometer supervised by professionals. The pre and post vitals-SBP, DBP, HR and SpO<sub>2</sub> were measured during each session.

**Conclusion:** After CABG surgery, during immediate post-operative days, the treadmill and cycle ergometer exercise training shows significant changes in patient's response of DBP and SpO<sub>2</sub> while, SBP and HR showing no significant changes.

**Keywords:** CABG, hemodynamic changes, treadmill walking, cycle ergometer

### INTRODUCTION

Cardiovascular diseases (CVDs) have now become the leading cause of

mortality in India. 23.8 million prevalent cases of ischemic heart disease were estimated and the disease contributed 28.1% of the total deaths in India, 2016 [1] The Global Burden of Diseases study reported that the disability adjusted life years lost by CHD in India during 1990 was 5.6 million in men and 4.5 million in women; the projected figures for 2020 were 14.4 million in men and 7.7 million in women. [2] Cardiac rehabilitation or exercise training has been proven to improve functional capacity and risk factor profiles, as well as to reduce mortality from heart disease. Encouraging patients to engage in physical activities or to participate in cardiac rehabilitation help them return to a normal life and to reduce sudden cardiac death after acute heart attack or heart surgery. [3-5] These benefits may be obtained because of improving cardiopulmonary capacity, recovered or maintained muscle strength, as well as the generation of positive emotions, all of which promoted better exercise capacity and lowered oxygen consumption of submaximal exercise. [6]

The American Heart Association defined the cardiac rehabilitation as, “The Coordinated, multifaceted interventions designed to optimize a cardiac patient's physical, psychological, and social functioning, in addition to stabilizing, slowing or even reversing the progression of the underlying atherosclerotic process, thereby reducing morbidity and mortality.” [7] At the beginning of the twentieth century,

the treatment of heart disease was based on few medicines and unconditional rest over weeks or months. The idea that exercise could overload cardiac pump and increase mortality changed facing the evidence that maintaining physical training and activity under supervision quickly reinsert patients to social-economic life. [8]

World Health Organization defines cardiovascular, pulmonary and metabolic rehabilitation as the integration of interventions called “non-pharmacological actions,” to ensure the best physical, psychological and social conditions for the patient with cardiovascular, pulmonary and metabolic diseases. The CR program aims to improve physiological, clinical and psychological state of the cardiac patient, based on a multidisciplinary intervention of physician, surgeons, physiotherapists, nutritionists, nurses, physiologists, and psychologists. As the prevalence of CVDs has increased in India, the CABG has become the successful option of the treatment to improve survival. Coronary artery bypass grafting (CABG) is a major surgical operation where atheromatous blockages in a patient’s coronary arteries are bypassed with harvested venous or arterial conduits. The bypass restores blood flow to the ischemic myocardium which, in turn, restores function, viability, and relieves anginal symptoms. [9] Occlusion of Coronary artery not only normally affect physical activities, endurance, muscle strength, working performance and quality of life, but also often leads to myocardial infarction and sudden death. [10] CABG is one treatment for coronary artery disease; however, lots of complications emerge after surgery, including bedridden, extremities edema, wound pain, the decrease of abilities to physical activities. [11]

Many studies have shown the hemodynamic responses variation of patient during the cardiac rehabilitation program beginning after the weeks of the CABG surgery. But fewer studies are found for vital changes response of patients during cardiac rehabilitation during immediate post-

operative days. So With an aim to study and compare the improvements in different vitals by early cardiac rehab immediate post-operative days this study was undertaken.

### **Aim of Study:**

This study is aimed to assess the effects of treadmill walking and cycle ergometer on the hemodynamic response of patient after CABG surgery during immediate post-operative days.

### **METHODOLOGY**

This study was conducted in Cardiovascular And Pulmonary Rehab Centre of “Shree B. D. Mehta mahavir heart institute”. Institutional ethics comitee of Shree Bhartimaiya College of Optometry and Physiotherapy has approved the study. Among all the patients referred for the cardiac rehabilitation, 64 patients with the age between 40 to 75 who had the CABG surgery 5 days ago were selected, amongst which 11 patients were dropped out, as they were not able to visit the CVPRC follow ups. The subjects were informed about the study and written consent was taken prior to the study. During this period the patients were on their routine medication which included statins, antiplatelets, beta blocker, and diuretics. All patients had suitable condition to participate in the study.

### **Inclusion criteria:**

Patient between the age group of 45 to 75 years

Patients who had the CABG surgery recently 5 days ago and patients with stable hemodynamic condition

### **Exclusion criteria:**

Patients with other abnormalities like neurological disorders, musculoskeletal disorders, unstable hemodynamic condition and any other complications

### **Tools and materials:**

Data recording sheet, Pen, Sphygmomanometer, Pulse oximeter, Stethoscope, Treadmill, Cycle ergometer and Chair

### **Procedure:**

Before starting the study, the patients were evaluated for the LVEF and exercise tolerance test was performed. The exercise tolerance test was performed on the 5<sup>th</sup> post-operative day during hospital stay. The exercise tolerance test provided an opportunity to detect body's hemodynamic response. The patients were instructed for the ETT which was performed on cycle ergometer (no resistance) or treadmill (1 Kph) for 6 minutes. Before starting the ETT, resting vitals (BP, HR, and SpO<sub>2</sub>) and after the ETT, post Vitals (BP, HR, and SpO<sub>2</sub>) were measured. The systolic and diastolic blood pressure was measured with the instrument sphygmomanometer; heart rate and SpO<sub>2</sub> were measured with the instrument pulse oximeter. The whole ETT was monitored for hemodynamic changes. Based upon the ETT response of the heart rate, target heart rate was calculated as per 40% to 70% of maximum heart rate.

The patients were asked to visit the CVPRC for 3 sessions within 10 days post discharge from the hospital for the study. Each session lasted for 30 to 45 minutes, which included warm up exercises, treadmill walking and cycle ergometry, cool down period. During each session the pre and post vitals (for treadmill and cycle ergometer separately) – SBP, HR, SpO<sub>2</sub> were measured and documented. The protocol for treadmill walking was of 6

minutes with the speed of 1.5 Kph. and the cycle ergometer protocol was of 6 minutes without any resistance. Each session was supervised by the professionals. At the end of the program all data were collected and analyzed.

### Outcome Measure

Blood pressure – SBP, DBP, Heart rate, Oxygen saturation (SpO<sub>2</sub>)

## RESULTS

At the end of the program all data were collected and analyzed by openepi 3.01. Independent t-test for showing mean differences and standard deviations was used. Paired t test was used to compare the difference at two time period-at baseline (post-operative 5<sup>th</sup> day) and at the end of 3<sup>rd</sup> session (post-operative 10<sup>th</sup> day). The level of significance was set at P <0.05 and confidence interval was set at 95%.

Among 64 patients, 53 (43 males and 10 females) patients were able to complete the program. The 2 independent sample t test was used to investigate the difference. Variation of hemodynamic responses of baseline (post vitals of ETT) and at the end of the program (post vitals of 3<sup>rd</sup> session) were analyzed. The hemodynamic responses to be analyzed involved vitals, Blood Pressure (Systolic and Diastolic), Heart rate, SpO<sub>2</sub>.

**Table-1 Variation in hemodynamic changes response in total population**

HEMODYNAMIC RESPONSE	MEAN±SD		p-VALUE
	PRE-SESSION	POST-SESSION	
SBP	123.67±12.95	120.03±12.75	0.1478
DBP	75.79±10.09	70.6±9.08	0.00636
HR	91.07±11.42	95.79±13.93	0.05919
SpO <sub>2</sub>	97.22±1.5	98±0.85	0.001352

The above table shows the difference between pre and post data in the total participants. The analysis showed significant results for DBP and SpO<sub>2</sub>. The HR and SBP changes were not significant as their p values are 0.05919 and 0.1478 respectively. The p-value of DBP is 0.00636 and SpO<sub>2</sub> is 0.001352 which shows p-value <0.05 and significant improvement.

## DISCUSSION

An essential finding of our study is that during immediate post-operative 5 days period after the CABG surgery, short term duration treadmill and cycle ergometer exercises training has shown the effects in significantly improving the hemodynamic changes response. The hemodynamic parameters included SBP, DBP, HR, and

SpO<sub>2</sub>. And the very early cardiac rehabilitation helps to improve DBP and SpO<sub>2</sub> responses after the exercise.

Many previous studies have been done but, some have shown favorable results and some have not. In our study the cardiac rehabilitation program included limb exercises, treadmill and cycle ergometer training. The treadmill and cycle ergometer are the equipment for the aerobic training which improves overall physiological response of the body.

Fabricio Edler Macagnan et al, compared the efficacy of a cycle ergometer-based exercise program to a standard protocol which was begun within 24 hours of CABG surgery in 24 patients. The 6 MWT did not show any significant improvement in vitals (SBP, DBP, HR) in comparing the results at the end of the 2 programs. Though the cycle ergometer protocol had a superiority tendency because of its other greater benefits. [12] In other study done by Gina Silvini et al, patients started aerobic exercise training on treadmill on 5<sup>th</sup>/6<sup>th</sup> day. During that hemodynamic changes were: resting and exs HR remained constant, and SBP increased by 5mmHg, whereas in our study SBP and DBP (DBP significantly) both were decreased after the exs and HR was increased but not significantly. [13]

Very short term effect of exercise training on CPET parameters for 3 weeks clinical and 6 month outpatient cardiac rehabilitation was studied by Dejan Spiroski. The program consisted of cycle ergometer and walking. At the end of the program during comparison of CPET parameters the changes were as follows: from 0 to 3 weeks-no significant changes in SBP (p value 0.24) and DBP (p value 0.94) (in both resting and post/peak exs). But changes were there from 0 to 6 month (p value <0.0001, <0.05 SBP & DBP respectively) and 3 weeks to 6 months (p value <0.05, <0.05 in both SBP & DBP) comparison. For HR, no significant change in resting HR in comparison from 0 to 3 weeks, 0 to 6 months, 3 weeks and 6 months. But post/peak exs HR had significant

improvement during 0 to 3 weeks, 0 to 6 month, 3 weeks to 6 month. (p value 0.65, 0.23, 0.11 respective of time period) [14] In our study, the treadmill and cycle ergometer both were used with the protocol of 6 minutes, 1.5 kph speed and 6 minutes, no resistance respectively along with the warm up exercises. And it showed significant improvement in DBP and SpO<sub>2</sub> but not in SBP and HR after the 3 sessions within 10 days of 5 days post CABG surgery.

Fatemah Esteki Ghashghai et al's study demonstrated significant improvement in hemodynamic response in patients who received 2 months CR program, after the 2 months of CABG surgery. The results showed the significant improvement in resting and post/peak exs SBP (p values of rSBP 0.006 & pSBP 0.002), DBP (p values of rDBP 0.002 & pDBP 0.001), HR (p values of rHR 0.006 & pHR 0.02 with the significant difference < 0.05) from baseline to the end of the program. It favoured our study only for DBP, but not in correspond of SBP and HR. [15] Alexiev et al showed changes in vitals on 11<sup>th</sup> and 15<sup>th</sup> post operative days of CABG surgery. It showed significant changes in resting and peak/post exs SBP and HR. But our study showed changes in vitals in 3 sessions within 10 days after the 5 days of CABG surgery, and showed significant improvement in DBP and SpO<sub>2</sub> and not in SBP and HR. [16] Dolfa et al demonstrated a positive association between SpO<sub>2</sub> at rest, during and after the exercise (final SpO<sub>2</sub> 95±7.2, p value < 0.001) And same for the HR (final HR 88±13.8, p value < 0.001). It also stated that the more low the value of baseline SpO<sub>2</sub> and the more high the resting HR, more the time to recovery of these values after exercise. However in our study, HR did not show significant improvement but, SpO<sub>2</sub> did. [17]

It should be noted that heart becomes stronger as a result of exercise. Therefore, it can pump more blood through the body with every beat which in turn, keeps the blood vessel flexible; ensure proper flow and delivers O<sub>2</sub> to cardiac

and skeletal muscles. And then strengthening the muscle increases the work capacity. Early rehabilitation after cardiac surgery acts as a bridge between the acute post-operative phase and a more structured rehabilitation program that will lead towards the full functional program. CR participation significantly associated with 20% reduction in all cause mortality after phase 1 CR and 40% reduction of phase 2 CR. Therefore CR is an essential part of care for cardiac patients after any cardiac incidence and even after the cardiac surgery. [18] It aims to improve functional status of patients and moreover aims to prevent the secondary complication.

According to many studies, the results in relation to hemodynamic response to CR program and exercise training may vary excessively. There are numerous factors which affects the hemodynamic response, amongst them are prescribed medicine, intensity of exercise, age, gender, number of sample size, geographical area may cause variation.

At the end, we conclude that regular physical activity develops submaximal work tolerance through lessening contractility, reducing cardiac work and myocardial oxygen demand. In addition, it enhances hemodynamic response such as resting and maximum SBP, DBP, HR as well as EF.

## CONCLUSION

Even in very short term duration (after immediate post-operative days) after CABG surgery, the treadmill and cycle ergometer exercise training shows significant changes in patient's response of diastolic blood pressure and oxygen saturation while, systolic blood pressure and heart rate does not. The longer duration is required to obtain significant changes in all 4 hemodynamic parameters in this study.

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