



**Research Article**

## **EFFECT OF CHAIR AEROBICS ON FUNCTIONAL CAPACITY AND HAEMODYNAMIC VARIABLES POST CARDIAC SURGERIES**

**Poojalaxmi S Patil., Pooja Kesharwani and Vijaylaxmi Kathare**

SDM College of Physiotherapy A Constitute Unit of SDM University Sattur Dharwad, Karnataka

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### **ABSTRACT**

**Background:** Functional capacity has become an important clinical parameter in both as a pre-operative assessment and postoperative outcome measure in patients undergoing cardiac surgeries. Functional improvement was seen with the help of aerobic exercise across a wide spectrum of other patients with severe physiologic and functional limitations.

**Objective:** To evaluate the effect of chair aerobics on functional capacity and haemodynamic variables post cardiac surgeries and to overcome shortness of breath and to improve the tolerance level towards exercise.

**Method:** An experimental study consisting of 30 subjects operated for cardiac pathologies were recruited in the study. 6MWT was performed on the day 1 after surgery and noted down the distance along with the hemodynamic variables such as heart rate, blood pressure, oxygen saturation, rate of perceived exertion etc. Then subjects were given chair aerobics to be performed for a certain duration of time and again the outcome variables were noted to check for the difference.

**Results:** The results were statistically significant with respect to all the outcome measures. Results showed improvement in all the outcome parameters but significant improvement was seen in 6MWD with a mean difference of 53.6mtr with a p value of 0.0001.

**Conclusion:** Based on results obtained it proves that low intensity exercises have a positive approach towards patients who have underwent cardiac surgeries.

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### **INTRODUCTION**

The cardiovascular system is one of the major and important systems of the body which lies in the mediastinum between the pleura of both lungs. Mediastinum extends from sternum in the front and vertebral column in the back. Mediastinum is surrounded anteriorly by chest wall, laterally by lungs and posteriorly by spine.<sup>7</sup>

Disorders involving heart and blood vessels leading to cardiovascular disorders are coronary heart disease, cerebrovascular disease, peripheral vascular disease, congenital heart disease, rheumatic heart disease, deep vein thrombosis, pulmonary embolism. According to WHO in 2016, 31% represents of all global deaths i.e., around 17.9 million people died due to cardiovascular diseases. "The Global Burden of Disease study estimate of age-standardized CVD death rate of 272 per 100 000 population in India is higher than the global average of 235 per 100 000 population."<sup>11</sup> In India cardiovascular diseases (CVDs) have now become the leading cause of mortality. Due to CVDs a quarter of all mortality is attributable.

For >80% of CVD deaths ischemic heart disease and stroke are the predominant causes. Early age of onset, fast progression and high mortality rate are the causes of concern being faced in India.<sup>15</sup>

"Global Burden of Disease study estimated that RHD in India led to 395/100000 disability adjusted life years and 9.2/100000 deaths in 1990." In 2017 this declined to 270/100000 and 7.9/100000, respectively. The GBD study has also reported that, India contributes to one-third of global RHD burden. RHD in 1990 led to 3.44 million DALYs (disability-adjusted life year) and 80,470 deaths which has increased to 3.73 million DALYs and 108,460 deaths in 2017.<sup>10</sup>

Median Sternotomy is the incision used in CABG, AVR, MVR, DVR. Invasive procedures for cardiovascular surgeries like median sternotomy incision and cardiopulmonary bypass lead to a number of characteristic complications that include cardiac abnormalities, neurological damage, coagulopathies, renal failure or pulmonary complications.<sup>13</sup>

Cardiac surgeries can cause a series of clinical and functional complications that are linked to specific factors, such as general anesthesia, median sternotomy, cardiopulmonary

\*Corresponding author: **Pooja Kesharwani**

SDM College of Physiotherapy constitute unit of SDM university  
sattur, Dharwad, Karnataka

bypass and thoracic manipulation. Postoperative pulmonary complications are the most common complication type and in turn contribute directly to increased morbidity, mortality and longer hospital stay. The reduction in lung volumes and capacities result in pulmonary dysfunctions and altered breathing patterns contributing to the appearance of atelectasis and changes in the ventilation/perfusion ratio, which reduces the cardiorespiratory capacity.<sup>5</sup>

Functional capacity has become an important clinical parameter in pre-operative assessment and also in postoperative outcome measure in patients undergoing cardiac surgeries. Exercise based cardiac rehabilitation in this modern era aims to improve aerobic and functional capacity which can be in the form of walking and stationary cycling, providing benefits of symptom improvement, attenuation of cardiac disease progression, reduced hospital admissions and mortality. Functional improvement was seen with the help of aerobic exercise across a wide spectrum of other patients with severe physiologic and functional limitations.<sup>6</sup>

Low exercise capacity has been found to be an independent predictor of death or hospitalization, despite of the positive effects of the surgery for individuals with CHD. Exercise capacities are not restored to normal values after cardiac surgeries. Low exercise capacities are credited to a combination of cardiopulmonary, muscular, and psychosocial limitations. Exercise training was considered to be effective in increasing peak VO<sub>2</sub>.<sup>9</sup> Several studies indicate that exercise training elicits favourable effects on the myocardium in stable HF patients receiving concomitant pharmacotherapy.<sup>4</sup> Chair Aerobics are aerobic exercises performed while sitting in a chair, which include upper and lower body movements led by an instructor while listening to music and sitting in a straight-back chair.<sup>20</sup> Usually, aerobic exercise has some dynamic components as it includes various activities like walking, jogging, cycling, treadmill training, etc. It becomes very difficult for elderly people to sustain in such activities for a longer period of time. To engage older people with compromised health and mobility in an accessible form of exercise, chair-based exercises are suggested.<sup>12</sup>

Compliance to chair-based programs is generally better than that of standing or dynamic exercise. As it stabilizes lower spine, minimizes load bearing and reduces balance problems it is better than standing. It minimizes load-bearing and prevents fall in patients with poor mobility and in degenerative conditions such as arthritis. It also increases confidence to those patients who are unable to perform standing exercises.<sup>18</sup> Functional exercise capacity, prognosis assessing and evaluating response to treatment across a wide range of respiratory diseases can be assessed by 6MWT. The 6MWT is a self-paced test of walking capacity where patients are asked to walk as far as possible for 6 min along a flat corridor. The distance is recorded in meters. Direct comparisons of the physiological demands of the 6MWT and CPET show that although measures of peak exercise performance (VO<sub>2</sub>peak and heart rate peak) are similar between the tests, 6MWT has substantially lower ventilatory requirements (peak carbon dioxide production, peak ventilation and respiratory exchange ratio). The 6MWD is the primary outcome of the 6MWT, which has good reliability and validity, as well as it has strong relationship to important clinical outcomes. HR, SPO<sub>2</sub>, dyspnea grading are the various outcomes taken before and after 6MWT.<sup>14</sup>

Primary goal of exercise is to prevent cardiac cachexia or skeletal myopathy. Study tells that exercising with continuous ionotrope infusion should be considered to prevent the negative effects.<sup>2</sup> According to American college of sports medicine (ACSM), Exercise plays an important role in the activity participation, medical evaluation and coronary revascularization post myocardial infarction. ACSM says 1ml.kg.min<sup>-1</sup> increase in aerobic capacity will decrease 9 to 10% of cardiac mortality. Less to moderate intensity exercises can be described as 40% to <60% of VO<sub>2</sub> reserve which noticeably increases heart rate and breathing. During physical activity the ability of respiratory and circulatory system to supply oxygen is known as cardiovascular endurance. Exercise testing is useful in determining the functional capacity.<sup>1</sup>

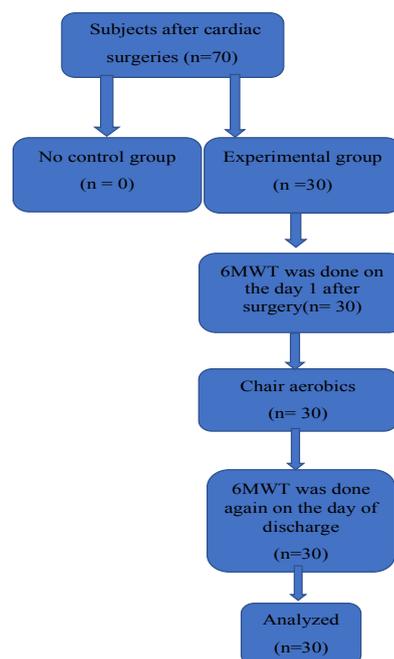
## MATERIALS AND METHODS

Study population consists of individual's age group of 40-80 years of age, who have undergone CABG and Valve replacements. It is an experimental study with random selection of patients with a study duration of 1 year. Ethical clearance was obtained from Ethical committee, S.D.M College of Medical Sciences and Hospital, Sattur, Dharwad. All the subjects were explained about the treatment procedure. A written consent was obtained from the subjects willing to participate in the study.

6MWT in meters was made to perform on the day 1 after surgery by the subjects in an indoor corridor of 30 mtr long. Subjects were asked to walk for 6minutes according to their own speed for 6 minutes completely, subjects can rest in between if they feel tired or stop the test if they feel any sort of discomfort. After checking for 6MWD patients will be given a set of exercises to be done on chair called as chair aerobics which has to be continued by the subject until they get discharged from the hospital. Again, the 6MWT will be made to perform by the subject on the day of discharge and check for the difference. RPE, RPP, SPO<sub>2</sub> were also assessed on the basis of modified Borg's scale on the day 1 in ICU and on the day of discharge to check the impact of chair aerobics on them.

### Excluded

- Not meeting inclusion criteria (n=25)
- Patient refused (n= 15)



All the patients were initially examined for the compliance with the inclusion and exclusion criteria and written informed consent was taken. Demographic and baseline data was taken on day 1 after cardiac surgery of each subject. 6MWT (in meters) was made to perform by all the subjects. Before performing the test haemodynamic variables such as heart rate, blood pressure, RPE and saturation levels of all the subjects were recorded of all subjects in sitting position. Subjects should be wearing comfortable clothing to perform this test. Subjects were asked to walk in 30mtr long corridor and were instructed to stop the test if he/she feels any warning signs such as chest pain, excessive sweating, breathlessness, syncope, dizziness, nausea and vomiting, claudication. A stopwatch was used to keep the time of 6 minutes and an external operator counted the number of laps performed, before the beginning of the walk and at the end of the 6 min. All haemodynamic variables are again recorded after 5 minutes of recovery time.<sup>3</sup>

All the subjects were given incentive spirometer, breathing exercises and active range of motion exercises for bilateral upper limb and lower limb as warmup exercises. A set of exercises were designed which can be done by sitting on an arm rest chair hence called chair aerobics. The intensity of the exercises will be low and as tolerated by the subject based on RPE based on Modified Borg’s scale. These exercises have to be continued by the patient till the day of discharge. Frequency and intensity will be decided on the capacity of the subjects. The 6MWT will again be done the day of discharge by all the subjects to see the effect of chair aerobics on 6MWD and haemodynamic variables.

**Outcome Measures**

- 6MWT
- Changes in haemodynamic variables
- Modified borg’s scale

**Chair Aerobics** given to the subjects were as follows:

- Toe raises
- Heel raises
- Bicep curls
- Hammer curls
- Leg raises
- Alternate heel digs with bilateral biceps curls
- Knee lift

**RESULTS**

The data was subjected to statistical analysis by using statistical package for the social sciences software (SPSS) version 22.0. Data collection mainly focused on Age, gender, weight, height, BMI as the primary outcome variables of the study groups Mean and standard deviation were computed for all the variables used in the Investigations. Most relevant diagrams and figures were also used to present the data. Data collected during the investigation were subjected to check whether followed normal distribution using visual inspection of histograms. Kolmogorov-Smirnov test was also conducted to assess normal distribution. The data was compared using mean values between the groups of normally distributed quantitative parameters employing t-test. Statistical significance was considered as  $p < 0.05$ . The gender distribution pattern was slightly biased in favour of male as 53% of them were male and remaining 47% were female

whereas mean age of the subjects included in the study was  $56.87 \pm 10.4$ . Post operatively there was improvement in all outcomes but majorly seen in 6-minute walk distance. The mean difference of 53.6 m and standard deviation difference of 20.3 that existed was statistically significant improvement in the walked distance. A p value of 0.0001 obtained is statistically significant

Parameters	Times	Z-value	p-value
6MWT (mts)	ICU	1.4800	0.0250
	Discharge	0.7330	0.6560
	Difference	0.7490	0.6300
RPP	ICU	0.7190	0.6790
	Discharge	0.7610	0.6080
	Difference	1.1240	0.1450
SPO2	ICU	0.6550	0.7830
	Discharge	1.0020	0.2670
	Difference	0.6920	0.7240
Dyspnea scale	ICU	0.9850	0.2870
	Discharge	1.1060	0.1730
	Difference	1.1050	0.1740
VO2max	ICU	0.4860	0.9720
	Discharge	0.6240	0.8320
	Difference	0.7510	0.6250

Note that, the ICU and discharge scores of different parameters follow a normal distribution.

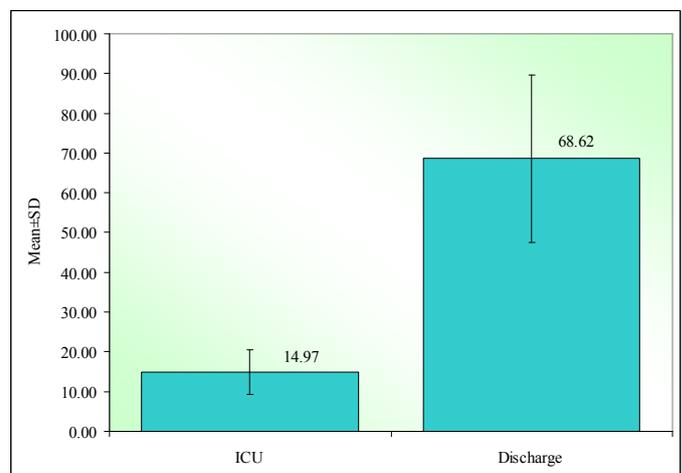
Hence, the parametric test i.e., dependent t test was applied to compare the data.

**Comparison of ICU and Discharge Scores of 6MWT**

Times	Mean	SD	Mean Diff.	SD Diff.	% ofchange	t-value	p-value	Effect size
ICU	14.97	5.63						
D/C	68.62	21.09	-53.65	20.34	-358.46	-14.447	0.0001	0.8780

D/C= Discharge

6MWT is employed to assess exercise tolerance in patients who have underwent cardiac surgeries it is an absolute value measured in meters. The mean distance walked by subjects on the 1<sup>st</sup> day of cardiac intervention was  $15 \pm 5.6$  mtr. However, the 6MWT which was repeated on the day of discharge showed remarkable improvement as mean distance covered by them was  $68.6 \pm 21.1$  mtr with a mean difference of 53.6 mtr. The Effect size which is a quantitative measure of the magnitude was large at 0.8780 indicating a stronger relationship.



**DISCUSSION**

The above results suggest low intensity exercises which was given in the form of chair aerobics shows significant

improvement in 6MWD and other outcome variables. Utilization of cardiac rehabilitation is relatively low despite the many documented advantages associated with it.<sup>19</sup> 6MWT is used as a prognostic tool to diagnose all-cause hospitalization and mortality among stable New York heart association (NYHA) functional class II and III heart failure patients.<sup>8</sup> When compared to any form of static or dynamic exercise compliance to chair-based programs are generally better. Chair based aerobic exercises improve cardiovascular endurance and reduce fatigue in elderly.<sup>17</sup> According to study done 2020 says that it improves quality of life by enhancing physical fitness, reducing anxiety and stress in sedentary people.<sup>16</sup>

Studies say that it is necessary to mobilize patient within first 48 hours after surgery depending on individual's capacity by monitoring the post-operative processes. Early mobility starting in intensive care unit which requires  $\geq 3$  METS, is necessary in preventing post-operative pulmonary complications by improving saturation levels, decreasing rate of perceived exertion and respiratory rate resulting in reduction of length of stay in hospital.<sup>21</sup>

Exercise training with continuous inotrope support should be considered as it has a positive effect on subjects performing exercises and also increases the exercise capacity. Anti-arrhythmic drugs, beta blockers, calcium channel blockers have nil effect on low to moderate level of exercise or activity, It aids in decreasing VO<sub>2</sub> max, rate of pressure product and improving SPO<sub>2</sub>.<sup>21,22</sup>

There was no control group to compare the effects of chair aerobics. Due to COVID 19 the duration of in hospital stay of subjects was reduced as well as the sample size is also decreased are few of the limitations in the above study. Future scope of the study can be to study the long-term effects of the exercises and further studies using shuttle walk test and 12min walk test can also be carried out in such population. Virtual cardiac rehabilitation can be given a thought in these pandemic situations for long term follow up.

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