Effect of Step Aerobics Applied Early in Phase 2 Cabg Subjects on Functional Capacity and Exercise Tolerance

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Abstract

Background: In recent years, cardiovascular accidents are rising due to improper diet, ill habits, uncontrolled cholesterol levels, stress, etc. Coronary artery diseases are in the leading cause of death. After a coronary artery disease like myocardial infarction the individual's general health is week and the quality of life of these individuals is reduced and hence, morbidity starts building, causing reduced functioning and reduction in overall health and functional capacity. 30 individuals participated in this study who had undergone coronary artery bypass grafting and were under phase 2 of cardiac rehabilitation. The individuals had performed low intensity Step Aerobics for 12 weeks and were evaluated for the efficiency of step aerobics on functional capacity and exercise tolerance in such individuals.

Objectives: To find the effect of step aerobics on the functional capacity and on exercise tolerance.

Methodology: In this study, 30 subjects who had undergone CABG of age from 30-65 years. These individuals were selected on the basis of their inclusion criteria. They were treated with step aerobics as form of exercises for 12 weeks. After pre-post assessment, the data was analysed with help of proper statistical methods.

Results: According to the result, there is extremely significant difference among the subjects six- minute walk test distance scores (p-value < 0.0001). Among the vitals assessed pre and post six-minute walk test, there was significant difference between the respiratory rate (p-value=0.0219), there was also very significant difference between the heart rate (p-value < 0.001). There was not quite significant change in the blood pressure levels i.e. systolic and diastolic p-value=0.0559 and 0.0862 respectively. Also, there was seen extremely significant difference in the peak O_2 consumption levels according to DASI p-value < 0.0001) and also in the MET scores in DASI (p-value < 0.0001), making the difference to be extremely significant.

Conclusion: The results obtained by studying the effects post treatment suggest that in rehabilitation of the CABG patients, implementation of step aerobics early has greater effects on functional capacity, exercise tolerance and general health including the quality of life.

Keywords: *Coronary artery bypass grafting (CABG), step aerobics, functional capacity, exercise tolerance, peak oxygen consumption, Duke Activity Status Index (DASI).*

Introduction

Coronary artery bypass grafting (CABG) is the most common open-heart surgery for myocardial infarction patients with major coronary artery blockages due to plaques. According to the Acute Coronary Treatment and Intervention Outcomes Network Registry in 2012, the NSTEMI subjects who did not have a past surgical history of CABG and subjects with three-vessel or left main coronary disease during angiography approximately 40% underwent CABG[11]. Coronary artery disease is the leading cause of death worldwide. 3.8 million men and 3.4 million women die each year of coronary artery

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diseases on global scale. Over last 60 years, prevalence has increased from 1% to 9-10% in urban areas and from <1% to 4-6% in rural areas[6]. According to the survey of 2016, it was reported that 28.1% of total deaths due to coronary artery diseases. The prevalence of coronary artery disease in India was estimated about 23.8 million cases in 2016.

This surgery has complications such as postoperative pulmonary complications, changes in lung mechanics, restrictive breathing pattern and shallow breathing. Atelectasis is common in these cases causing reduced lung capacity and respiratory muscle strength. Due to sternotomy among these patients, immobility in bed and temporary dysfunction in diaphragm causes hypoxia and postoperative pulmonary dysfunction[3]. Ejection fraction is reduced in these patients due to left ventricular ischemia. These all factors cause reduced functional capacity further poor quality of life.

CABG causes reduced peak oxygen consumption (VO_{2max}). Due to reduced aerobic capacity, reduction in the functional capacity of these individuals is also reduced due to morbid state and less functioning. They have shown great effects on improving the aerobic capacity and functional capacity. They improve cardiac output, VO_{2max} and enhance the ability of the muscles to utilize the oxygen from blood. Studies have shown aerobic exercises to improve peak VO_2 up to 46%. Systolic function also increased by 35%, hence strengthening the advantages of aerobic exercises[17].

Physical activity is needed in these subjects along with fair interaction with the family and friends. Also, physical training causes decrease in body weight and improve emotional health and quality of life. Vascularity of muscles increases and peripheral oxygenation improves due to physical activity[3]. Physical activity guidelines recommend that every healthy adult should engage in 92 minutes or more of low to moderate intensity physical exercises for a week[13].

Aerobic exercises have great effects on the functional capacity and exercise tolerance. Aerobics has all the benefits of a general high intensity workout. Aerobic exercise is believed to play a part in lowering the risk of cardiovascular disease by increasing the serum levels of high-density lipoprotein cholesterol[14]. Effects of aerobic exercises on depression and anxiety are also seen. Mainly, it plays an important role in controlling the blood pressure and the blood sugar levels, reducing the risk of coronary artery diseases. In CABG subjects, aerobic exercises play an important role in most common contributory factor for morbidity, viz., peak oxygen uptake (VO_{2max})[15].

Studies have shown that aerobic exercises have great effects on the cardiovascular and physical functioning. Step aerobics also has shown great effects on cardiopulmonary functions and exercise tolerance. Previous studies have shown effects on cardiorespiratory fitness and cholesterol levels in young women with sedentary lifestyle, also some studies have shown the energy expenditure due to walking along with stair climbing and its effect on physical fitness[16].

Step aerobics is an up-tempo way to get your heart pumping and stay fit. Step aerobics training involves stepping up and down on a single bench/step in choreographed, group-led movements to music[10]. Step aerobics intensity can vary from low to moderate intensity in health compromised subjects and moderate to high intensity in obese to normal subjects[12]. It is a form of exercise to get benefits like high intensity cardio workout without putting stress on your joints. This can be done in presence or absence of music. It not only acts as a cardio workout but also has an effect on strength of legs.

Addition of low intensity exercises in phase 2, may induce increase in functional capacity and exercise tolerance. Hence, step aerobics should be incorporated in daily functional training for greater results.

Methodology

The ethical clearance was taken from ethical committee of Krishna institute of Medical Sciences, Karad. There were 30 participants in the study. The study was taken place in the Krishna Hospital. Treatment protocol was of 12 weeks. The subjects were assessed for functional capacity using six-minute walk test at first and exercise tolerance using the Duke Activity Status Index. The type of study was experimental study. The study design was pre-post.

Procedure

All the subjects for the study were selected according to the selection criteria. Demographic data and written consent were obtained from the subjects. The subjects

were explained about the protocol and demonstrated. Pre and post assessment were taken before and after 12 weeks of the treatment period respectively with the help of outcome measures. Pre-treatment exercise tolerance was assessed using 6-minute walk test. Pre-vitals, blood pressure, heart rate, respiratory rate was assessed before starting the test. The patient was asked to walk a distance of 30m to and fro for 6 min at normal pace. There were chairs kept at regular interval for the patient to rest if fatigue or breathless. After completion or before completion of 6 minutes i.e. when the patient was found to be restless while walking, the patient was again assessed for vitals and noted. The distance covered by the patient in 6 minutes was calculated and kept as pre-treatment record. The patients were also given Duke Activity Status Index for functional assessment and rough estimation of the oxygen uptake and exercise tolerance. The patients according to the exercise tolerance calculated were trained with step aerobics for 12 weeks. Every session lasted for 45 minutes of step aerobics including the warm up and cool down exercises. The warm up lasted for 5 minutes which included neck flexion-extension, rotation, arm rotations, trunk lateral flexion, trunk rotation and basic stretches arm and legs. Once done with warm up, the protocol was performed in the sequence of basic right, basic left, A-step move, across the top move with deep breathing. Each move lasted for 1 minute and repeated after every 5 minutes. The exercises continued for 25 minutes and then followed by cooling down of the body which consisted of arm shaking, legs shaking, deep breathing. After completion of 12 weeks, the subjects had to undergo 6-minute walk test and DASI for the exercise tolerance and functional capacity assessment respectively. The data was collected and recorded. Later statistical analysis was performed.

Results

1. Distribution according to demographic data

Table no. 1: Distribution according to demographic data in study.

AGE		**Participants**	**Percentage**	**Mean±SD**
		30	**100%**	**53.57±6.52**
GENDER	MALE	17	56.67%	-
	FEMALE	13	43.33%	-
BMI	NORMAL	13	43.33%	23.24±0.81
	OVERWEIGHT	15	50.0%	27.56±1.58
	G-1 OBESE	2	6.66%	32.55±1.77

Interpretation: The above table depicts a picture of demographic data distribution with components as Age, Gender and Body-Mass Index (BMI). Out of 30 subjects, 56.67% were male and 50% were overweight according to calculated BMI.

2. Distribution and association of scores of 6-min walk test

Table no. 2: Distribution and association of 6-min walk test scores

6-MIN WALK TEST	**Mean±SD**		**Paired t-test**	
	Pre intervention	Post intervention	t-value	p-value
	197.67±21.76	286.33±37.36	15.757	<0.0001(ES)

Interpretation: Above table represents mean score of 6-minute walk test distance scores pre and post intervention.

3. Distribution and association of Vital scores in Six-minute walk test

Table no. 3: Distribution and association of vital sign scores

Vitals	**Mean±SD**				**Paired t-test**			
	Pre intervention		**Post intervention**		**t-value**		**p-value**	
Blood Pressure	**Systolic**	**Diastolic**	**Systolic**	**Diastolic**	**Systolic**	**Diastolic**	**Systolic**	**Diastolic**
	132.23±1.36	94.41±2.48	126.05±1.42	87.17±0.89	2.019	1.796	0.0559 (NQS)	0.0862 (NQS)
	Pre intervention		Post intervention		t-value		p-value	
Heart Rate	106.14±4.65		88.32±1.41		7.139		<0.001(VS)	
Respiratory Rate	22.86±2.13		19.34±0.18		2.377		0.0219(S)	

Interpretation: Above table represents mean score of vitals i.e. blood pressure, heart rate and respiratory rate and its association pre and post treatment.

4. Distribution and association of peak O_2 scores of Duke Activity Status Index (DASI)

Duke Activity Status Index (DASI)	**Mean±SD**		**Paired t-test**	
	Pre intervention	**Post intervention**	**t-value**	**p-value**
	16.81±2.51	20.42±2.41	10.866	<0.0001(ES)

Table no 4: Distribution and association of DASI scores for peak O2

Interpretation: Above table represents the mean score of peak oxygen consumption levels pre and post intervention calculated using DASI.

5. Distribution and association of MET scores of Duke Activity Status Index (DASI)

Table no. 5: Distribution and association of DASI scores for MET

Duke Activity Status Index (DASI)	**Mean±SD**		**Paired t-test**	
	Pre intervention	**Post intervention**	**t-value**	**p-value**
	4.80±0.71	5.83±0.69	10.856	<0.0001(ES)

Interpretation: Above table represents the mean score of metabolic equivalents (MET) pre and post intervention calculated using DASI.

Discussion

Aerobic exercises are the type of exercises which have effects of the aerobic capacity and improve the oxygen supply and avoid early fatigue. Step aerobic exercises not only improve the aerobic capacity but also helps in building the balance and agility in middle aged and old age population. It mainly has effects on the body composition in young and adult population. The repetitive stepping up and down improves the lower and upper body strength In this study, 30 individuals were selected on the basis of the inclusion and exclusion criteria. The mean age of these participants was 53.57 years. Out of the total participants, 13 (43.33%) were female and 17 (56.67%) were male.

6-min walk test was used to assess the participant's functional capacity. It was performed at the commencement of the treatment i.e. in the beginning of 1st week and at the completion of treatment i.e. at the end of the 8th week. The mean score of participant's distances covered pre intervention was 197.66 metres and the mean score of participant's distance post intervention was 286.33 metres. Thus, there was a considerable increase in the distance traversed by the participants post administration of treatment.

The vitals of the participants were also assessed during the 6-minute walk test. Blood pressure (BP), heart rate and respiratory rate were the vitals assessed. The mean score of systolic BP pre intervention was 132.23 mmHg and mean systolic BP score post intervention was 125.05 mmHg. Similarly, mean diastolic BP score pre and post intervention were 94.41 mmHg and 87.17 mmHg respectively. The mean score of heart rate were also calculated similarly, mean score of heart rate pre intervention was 106.14 beats/min and that post intervention was 88.32 beats/min. Respiratory rate mean scores were also calculated in the same way, the pre intervention mean score was 22.86 breaths/min and the post intervention mean score was 19.34 breaths/min.

Duke Activity Status Index (DASI) was used to assess the participant's estimate peak oxygen consumption and their exercise capacity on the basis of Metabolic Equivalent of Task (MET).

The questionnaire was provided to the participants before the commencement and after completion of the treatment protocol. The scores were then calculated. The mean score for peak oxygen consumption pre intervention 16.81 was and the mean score post intervention was 20.42. This shows that there was an increase in the peak oxygen consumption levels of the participants in turn improving their functional capacity.

The mean score pre intervention of MET was 4.80 and the mean score post intervention for MET was 5.83. Therefore, there is considerable improvement in the ability of the participants capacity to perform tasks as a result of the increased exercise tolerance.

Intra-group association for score of 6-min walk test within the population; pre and post intervention was done. Paired t-test was used which had a p-value of <0.0001 which was extremely significant with a t-value of 15.757. Thus, there is a significant increase in the distance covered by the participants post administration of our exercise protocol. Similarly, paired t-test was used to calculate the association between the vitals i.e. systolic BP which had a p-value of 0.559 which was not quite significant with a t-value of 2.019, diastolic BP with a p-value of 0.0862 which was not quite significant with a t-value of 1.796, heart rate with a p-value of <0.001 which was very significant with a t-value of 7.139 and lastly the respiratory rate which had a p-value of 0.0219 which was significant with a t-value of 2.377.

Association of DASI scores for peak oxygen consumption was also analysed, which had a p-value of <0.0001 which was extremely significant with a t-value of 10.866. DASI scores for MET also had a p-value of <0.0001 which is extremely significant with a t-value of 10.856.

In this study, we can say that there is a significant improvement in all the parameters, general health and vitals of the participants. This results in an overall increase in the functional capacity, quality of life and exercise tolerance of the participants. Hence, implementation of our treatment protocol may help individuals undergoing CABG recover faster and turn out healthier than the average patient. It may also improve the confidence in physiotherapists in turn promoting our profession as well improve the patient's confidence in himself leading to a speedy recovery.

Conclusion

On the basis of the result of the study it is concluded that in rehabilitation of CABG subjects, early implementation of step aerobics has a number of effects on the functional capacity, exercise tolerance and quality of life.

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Krishna Institute of Medical Sciences Deemed to be University, Karad.

Conflict of Interest: There was no conflict of interest in my study.

Ethical Clearance: The Institutional Ethical Committee has hereby given permission to initiate the research project titled, "Effect of step aerobics applied early in phase 2 CABG subjects on functional capacity and exercise tolerance"

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