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Effects of Group-Based Cardiac Rehabilitation on Cardiopulmonary Endurance of Coronary Artery Bypass Graft Surgery Patients

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ABSTRACT

Cardiac rehabilitation (CR) is an essential component of recovery following coronary artery bypass grafting (CABG). Group-based CR may provide outcomes comparable to conventional individual-based rehabilitation while improving resource utilization. To compare the effects of group-based and individual-based cardiac rehabilitation on functional capacity, health-related quality of life, physiological responses, and patient satisfaction following CABG surgery. This study is an RCT, with the sample size of 54 subjects in which 27 were in experimental group and 27 were in control group. Both male and female were included in the study. Inclusion criteria include the patient undergone with CABG. Experimental group was group based cardiac rehabilitation in a group of 3 subjects each, while in control group individual based cardiac rehabilitation was given. Variable determines were vitals, 6MWT, SF-12, and level of satisfaction. The vitals were taken as pre and post reading of each day/ week while SF-12 and 6MWT were performed on baseline and 4th week. The data was analyzed via SPSS. The mean and standard deviation of age (years) was 50.44 ± 6.363. 6MWT and SF-12 has shown non-significant difference in between the group analysis with the p-value >0.05, while in within the group analysis a significant improvement has been observed. In vitals significant improvements have been observed at different occasions with the p-value <0.05. Cardiac rehabilitation given in group or individual have shown improvement in cardiac endurance, pulmonary function and quality of life in CABG patients.

INTRODUCTION

A major contributor to non-communicable disease morbidity and death worldwide is cardiovascular disease (CVD). According to the Global Burden of Disease (GBD) framework, CVD was the leading cause of mortality worldwide between 1990 and 2015 (de Witte *et al.*, 2012; Roth *et al.*, 2017). The World Health Organization (WHO) estimates that 17.9 million fatalities (or 31 percent) in 2016 were entirely attributable to CVD. An estimated 2.3 million people in the United Kingdom (UK) have CHD, which causes one in five fatalities in males and one in ten deaths in women (Townsend *et al.*, 2012).

Unhealthy eating, inactivity, usage of tobacco products, and abusing alcohol are the main behavioural risk factors for heart disease and stroke. Individuals may experience elevated blood pressure, elevated blood glucose, elevated blood lipids, as well as overweight and obesity as a result of behavioural risk factors. These "intermediate risks factors" can be assessed in primary care settings and point to an elevated risk of consequences such heart attack, stroke, and heart failure (Dahlöf, 2010). Advanced coronary artery disease is commonly treated with coronary artery bypass graft surgery (Strong *et al.*, 2012).

A coronary artery bypass surgery is performed to alleviate or lessen symptoms associated with CAD, such as angina and fatigue decrease the risk of additional illness, improve the quality of life (QOL) of patients with myocardial infarcts.(Lee, 2009) Clinical evaluations of CABG results are based on an unbiased assessment of the patient's cardiovascular health and level of physical fitness. Exercise capacity has been found to be the strongest predictor of survival,(Eagle *et al.*, 2004) and peak VO2 is frequently measured during symptom-limiting before testing prior to a patient's enrolment in a cardiac program.(Ades *et al.*, 2006; Järvinen *et al.*, 2003) A meta-analysis of HR-QoL ratings revealed that both PCI and CABG patients had a comparable increase in quality of life, with only minor differences existing between the two groups (Eagle *et al.*, 2004).

Cardiac rehabilitation (CR) is a comprehensive set of interventions designed to give patients with cardiovascular disease the best possible physical and psychological support so they can either slow down or perhaps reverse the progression of their disease. (Goel *et al.*, 2015).

The American Heart Association (AHA) and the American College of Cardiology both recommend cardiac rehabilitation/secondary prevention program as useful and effective (Class I) in the treatment of patients with coronary artery disease because they are acknowledged as essential to the comprehensive care of patients with cardiovascular disease (Ades *et al.*, 2006).

After coronary artery bypass surgery, cardiac rehabilitation (CR) is advised for all patients; however, little is known regarding the long-term mortality implications of CR in this population. After coronary artery bypass surgery, CR attendance is linked to a significant drop in 10-year all-cause death (Pack *et al.*, 2013).

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In patients following coronary artery bypass graft surgery (CABG), the benefits of inspiratory muscle training (IMT) alone on inspiratory muscle strength and endurance, pulmonary function, pulmonary complications, and length of hospital stay are to be investigated. Patients who underwent CABG had improved pulmonary function, 6MWT, inspiratory muscle strength and endurance, and reduced postoperative pulmonary problems and duration of stay thanks to isolated IMT (Zhang *et al.*, 2023).

Previous research is on cardiac rehabilitation on quality of life and exercise capacity in population of CHF, included aerobic exercises such as Tai chi and musical exercises, moderate intensity continuous training with high intensity interval training, grouped based phase III.

The present study will focus on Cardiac rehabilitation on cardiopulmonary endurance in CABG patients provided in group. However, in the literature, there were not enough studies that examined the effects of Group based Cardiac rehabilitation on cardiopulmonary endurance and the QoL focusing on the methods together like Individualized standard hospital protocol and group based moderate intensity continuous training in Cardiac Rehabilitation phase II. Therefore, the need for this study arose. The group based cardiac rehabilitation will give confidence and motivation to CABG patients and will decrease the workload on Physiotherapist.

MATERIALS AND METHODS

It was a Randomized Control Trial completed in 1 year of duration. The study was conducted in Afridi Medical Complex, Peshawar and Hayatabad Medical Complex, Peshawar.

Participants

Sample size was calculated online through epi tool which was 54 then participants were divided into two groups. Non-probability convenience sampling was used to enroll in the subjects. Participants included on the basis of:

- Age of 40 to 60 years.
- Both males and females
- Had undergone CABG surgery.
- Hospital stays after CAGB as per protocols. (48 hours in ICU and 3 days in ward)
- Selective CABG surgeries. (Those patients have DV CAD or TV CAD and selected for CABG)
- The patient with CABG enrolled in phase II cardiac rehab.
- Stable vitals
- willing to participate in the study

Participants failing to fall in this category were excluded from the study.

- Patients who have a history of other Cardiac disorders that interfere with daily life before surgery and those having congenital cardiac anomalies, Tetralogy of Fallot.
- Having any comorbid lung disease
- Post CABG stroke.
- Infectious wound.
- Musculoskeletal and neurological disorders.

If during exercise there is drastic change in normal vitals e.g., (BP 100/70 and 130/90, SPO2 <95, 94 or 93, HR more than 130 and less than 60, RR more than 20 of patient) then exercises were stop.

Data Collection Procedure and Analysis

After the approval of research proposal from the Research and Ethical committee, the research was further execute. The subjects were enrolled by taking a consent and were divided into two groups (Group A and Group B) with random allocation by sealed enveloped technique. Group A was given group therapy while Group B was given individual therapy. Demographic detail was taken from the subjects and outcome measure tools were filled including SF-12, and 6MWT at baseline and 4th week. The frequency of the sessions were 3 days per week for

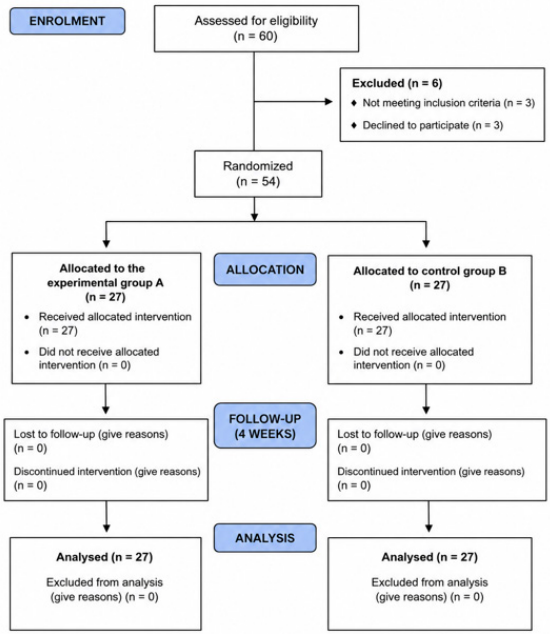

Figure 1: Study Flow Diagram

4 weeks and assessment was done at baseline, during and after treatment which includes, BP, borg scale, O2 saturation and heart rate.

Data was analyzed using SPSS version 21. Frequency and percentages were calculated for categorical variables. Mean and standard deviation was calculated for continuous variable. Depending on normality of data, for within groups and between-group comparisons was done.

RESULTS AND DISCUSSIONS

Descriptive Analysis

A total of 54 patients who underwent coronary artery bypass graft (CABG) surgery were included in the study and completed the 4-week intervention, with 27 participants in the experimental group and 27 in the control group.

Baseline Characteristics

The baseline demographic and clinical characteristics of the participants are presented in Table 1. The mean age was 50.44 ± 6.36 years in the experimental group and 50.81 ± 5.94 years in the control group. The experimental group comprised 13 (48.1%) males and 14 (51.9%) females, whereas the control group included 17 (63.0%) males and 10 (37.0%) females. The distribution of coronary artery disease was identical in both groups, with 14 (51.9%) participants diagnosed with triple-vessel coronary artery disease (TVCAD) and 13 (48.1%) with double-vessel coronary artery disease (DVCAD).

Table 1: Baseline Demographic and Clinical Characteristics of Participants

Characteristic	Experimental (n=27)	Control (n=27)	P value
Age (years), Mean ± SD	50.44 ± 6.36	50.81 ± 5.94	
Male, n (%)	13 (48.1)	17 (63.0)	
Female, n (%)	14 (51.9)	10 (37.0)	
Triple-vessel CAD, n (%)	14 (51.9)	14 (51.9)	
Double-vessel CAD, n (%)	13 (48.1)	13 (48.1)	
SF-12 Baseline, Mean ± SD	27.81 ± 4.95	28.30 ± 4.97	0.723
6MWT Baseline (m), Mean ± SD	207.70 ± 70.01	258.19 ± 59.19	0.006

Health-Related Quality of Life and Functional Capacity

At baseline, there was no statistically significant difference in SF-12 scores between the experimental and control groups (27.81 ± 4.95 vs. 28.30 ± 4.97; p = 0.723). Following the 4-week rehabilitation program, SF-12 scores improved in both groups, with no significant between-group difference (21.19 ± 3.03 vs. 20.59 ± 2.97; p = 0.472) (Table 2).

The 6-minute walk test (6MWT) distance was significantly lower in the experimental group at baseline compared with the control group (207.70 ± 70.01 m vs. 258.19 ± 59.19 m; p = 0.006). After four weeks of rehabilitation, walking distance increased substantially in both groups to 315.19 ± 85.96 m and 335.67 ± 72.18 m, respectively. However, the between-group difference at follow-up was not statistically significant (p = 0.347) (Table 2).

Within-group analysis demonstrated significant improvements in both outcome measures. In the experimental group, significant improvements were observed in SF-12 scores (p = 0.038) and 6MWT distance (p < 0.001). Likewise, the control group demonstrated significant improvements in SF-12 (p < 0.001) and 6MWT (p < 0.001) from baseline to Week 4 (Table 2).

Table 2: Changes in Health-Related Quality of Life and Functional Capacity

Outcome	Experimental Group Mean ± SD	Control Group Mean ± SD	Between-group P value	Within-group P value (Experimental)	Within-group P value (Control)
SF-12 Baseline	27.81 ± 4.95	28.30 ± 4.97	0.723		
SF-12 Week 4	21.19 ± 3.03	20.59 ± 2.97	0.472	0.038	<0.001
6MWT Baseline (m)	207.70 ± 70.01	258.19 ± 59.19	0.006		
6MWT Week 4 (m)	315.19 ± 85.96	335.67 ± 72.18	0.347	<0.001	<0.001

Cardiovascular Responses

Heart rate remained comparable between the groups throughout most rehabilitation sessions. Significant between-group differences were observed only at selected assessment points, including Week 2 Day 3 pre-exercise (p = 0.001), Week 2 Day 2 post-exercise (p = 0.037), Week 2 Day 3 post-exercise (p = 0.010), Week 3 Day 3 post-exercise (p = 0.024), Week 4 Day 3 pre-exercise (p = 0.003), Week 4 Day 1 post-exercise (p = 0.001), and Week 4 Day 2 post-exercise (p = 0.014) (Table 3).

Oxygen saturation remained stable throughout the intervention, and no statistically significant between-

group differences were observed at any assessment point (all p > 0.05) (Table 3).

Similarly, Borg Rating of Perceived Exertion scores were comparable between groups across the intervention. A statistically significant difference was observed only during Week 2 Day 2 pre-exercise (p = 0.045), whereas all other comparisons were not significant (Table 3).

Systolic blood pressure showed no significant between-group differences at most assessment points. A significant difference was observed only during Week 3 Day 3 post-exercise (p = 0.011) (Table 3). Likewise, diastolic blood pressure remained comparable throughout the intervention, with no statistically significant differences between groups at any assessment point (all p > 0.05) (Table 3).

Table 3: Summary of Physiological Outcomes During the Four-Week Intervention

Variable	Main Finding	Significant Between-Group Difference
Heart Rate	Comparable during most rehabilitation sessions	Yes; significant at selected Week 2 and Week 4 assessments
Oxygen Saturation (SpO_2)	Remained stable throughout intervention	No
Borg Rating of Perceived Exertion	Similar between groups	Only Week 2 Day 2 Pre-exercise (p = 0.045)
Systolic Blood Pressure	Similar throughout intervention	Only Week 3 Day 3 Post-exercise (p = 0.011)
Diastolic Blood Pressure	Stable throughout intervention	No

Participant Satisfaction

Overall participant satisfaction was high in both rehabilitation groups (Table 4). Regarding the overall quality of services, 81.4% of participants in the experimental group and 85.1% in the control group rated the program as good or very good. Most participants reported that the rehabilitation technology was easy or very easy to use (experimental: 81.4%; control: 96.3%). Healthcare services met participants' expectations for most patients, with 92.5% of the experimental group and 96.2% of the control group responding very much or somewhat. Furthermore, 81.5% of participants in the experimental group and 81.5% in the control group indicated that they would recommend the rehabilitation program to others, while 81.5% and 77.8%, respectively, expressed willingness to participate in the program again in the future.

Table 4: Participant Satisfaction Following the Rehabilitation Program

Question	Response	Experimental n (%)	Control n (%)
Overall service	Very good	11 (40.7)	13 (48.1)
	Good	11 (40.7)	10 (37.0)
	Adequate	4 (14.8)	3 (11.1)
	Very bad	1 (3.7)	1 (3.7)
Ease of technology use	Very easy	16 (59.3)	9 (33.3)
	Easy	11 (40.7)	17 (63.0)
	Not so easy	2 (7.4)	1 (3.7)
	Not at all easy	0	0
Healthcare met expectations	Very much	12 (44.4)	13 (48.1)
	Somewhat	13 (48.1)	13 (48.1)
	Little	2 (7.4)	1 (3.7)
	Not at all	0	0
Recommend program	Definitely yes	8 (29.6)	5 (18.5)
	Yes	14 (51.9)	17 (63.0)
	Little	5 (18.5)	5 (18.5)
	Not at all	0	0
Repeat program	Definitely yes	6 (22.2)	2 (7.4)
	Yes	16 (59.3)	19 (70.4)
	Little	5 (18.5)	6 (22.2)
	Not at all	0	0

Discussion

The primary objective of this randomized controlled trial was to compare the effects of group-based and individual-based phase II cardiac rehabilitation on functional capacity, health-related quality of life, physiological responses, and patient satisfaction following coronary artery bypass grafting. The principal finding was that both rehabilitation models produced significant improvements in functional capacity and health-related quality of life over the four-week intervention. However, no statistically significant differences were observed between groups at follow-up, suggesting that group-based cardiac rehabilitation is comparable to conventional individual-based rehabilitation for patients recovering from CABG.

To investigate the kind and quantity of data about group-based cardiac telerehabilitation therapies and the health outcomes of patients with coronary artery disease. A peer-reviewed journal paper about group-based cardiac telerehabilitation in adult patients with coronary artery disease that was published in English between 1 January 2017 and 15 August 2022—and later modified to cover until 15 July 2023—met the inclusion criteria. Every form of health result and group-based cardiac telerehabilitation intervention was mapped out and summarised. Group-based cardiac telerehabilitation interventions proved very beneficial for patients with social support and a variety of technical applications. Regarding the risk factors for cardiovascular disease, the patients received advice. Among the included research, quality of life, psychiatric problems, and physical fitness were frequently measured results (Jacobsson *et al.*, 2023). The quality of life of the subjects have been improved from group based cardiac rehabilitation in the present study.

There have been suggestions that the metabolic syndrome and autonomic system function can have a major impact on a patient's prognosis. The current study set out to find out how patients with coronary artery disease's autonomic system balance was affected by their cardiac rehabilitation programme. In individuals with coronary heart disease, the cardiac rehabilitation programme may assist to improve HRR and many aspects of the metabolic syndrome (Anari *et al.*, 2015). The benefits of ambulatory CR programmes for enhancing clinical outcomes and emphasises the significance of CR usage widely in order to lower cardiovascular mortality and hospitalisation rates throughout the course of a long-term follow-up (Doimo *et al.*, 2019). The present study concludes that cardiac rehabilitation given on group or individual has a positive effect on heart rate thus improving cardiac functions.

In order to facilitate recovery from cardiovascular (CV) sickness, cardiovascular rehabilitation (CR) is the process of achieving and preserving an optimal degree of physical, social, and psychological well-being. This multidisciplinary approach includes patient counselling, education, supervised exercise training, and nutritional advice, all of which have the potential to improve quality of life. Positive impacts for cardiovascular health may include reversing cardiac remodelling, boosting exercise capacity, improving metabolism, and improving systemic oxygen delivery (Kachur *et al.*, 2017). A sophisticated intervention known as cardiac rehabilitation aims to enhance the functional ability, general well-being, and health-related quality of life of those suffering from heart disease. Heart rehabilitation is a clinically and financially beneficial strategy for patients with acute coronary syndrome, heart failure with a reduced ejection fraction, and following coronary revascularization, supported by a substantial body of evidence (Taylor *et al.*, 2022). Cardiac rehabilitation can improve cardiac function, endurance and quality of life of the subjects with CABG, proven from the current study.

CONCLUSION

The study was based on the objective to find the comparison between group based cardiac rehabilitation and individual based cardiac rehabilitation in subjects undergone with the procedure of CABG. The study concludes that both ways of rehabilitation techniques has improved values in endurance, pulmonary function and quality of life indicating that cardiac rehabilitation can be provided in group or individual on CABG subjects.

Limitation

The limitation of the study says that area distribution of research which include the group based cardio rehab was conduction on only a limited area of Peshawar.

Recommendations

- Studies should be conducted on long-term follow-up.
- Group strategy should be applied on other diseases, to analyze its affects.

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