

Efficacy of Home versus Centre-Based Cardiac Rehabilitation in Improving Functional Capacity and Left Ventricular Ejection Fraction in Coronary Artery Bypass Graft (CABG) Patients

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Abstract

Background: Coronary Artery Bypass Grafting (CABG) surgery is the most commonly performed surgery for the coronary artery disease patients. Cardiac Rehabilitation (CR) is an essential, useful and safe part of the care for patients with coronary artery disease and who underwent CABG surgery. Regular physical activity can improve functional capacity in patients after CABG. **Objectives:** To determine the efficacy of home and centre-based cardiac rehabilitation in improving functional capacity and left ventricular ejection fraction (LVEF) in patients underwent CABG surgery.

Methods: Total twenty four (n=24) CABG surgery participants were selected. They were divided into 2 groups by utilizing convenient (purposive) sampling method. Group 'A' i.e. centre- based (n=12, mean age: 53.83±7.61) and Group 'B' i.e. home- based (n=12, mean age: 55.91±5.79). Both the groups received an eight (8) weeks of CR program. Group-A participants attended a supervised structured exercise training program for 3 days per week in hospital set-up. Group-B participants were given an individualized tailored program of aerobic exercises to do at home. All the participants were screened and evaluated for baseline measurements and all the values were recorded at the day of discharge from hospital. After 8 weeks of CR program participants were re-assessed for LVEF and functional capacity.

Results: Statistical analysis was done by using SPSS 22.0. After an eight week of CR program, significant improvements were observed in 6-MW distance, LVEF and Rate of Perceived Exertion (RPE) (**p=0.0001).

Conclusion: The home-based and centre-based cardiac rehabilitation programs were equally effective in improving functional capacity and left ventricular ejection fraction in CABG patients.

Keywords: Coronary Artery Bypass Grafting, Left Ventricular Ejection Fraction, 6-Minute Walk Distance, Centre-based Cardiac Rehabilitation, Home-based Cardiac Rehabilitation, Rate of Perceived Exertion (RPE)

INTRODUCTION

Coronary artery disease (CAD) is the primary cause of global mortality.^[1] Premature mortality due to cardiovascular disease in the India increased by 59% from 23.2 million (1990) to 37 million (2010). The commonest cause of myocardial ischemia is atherosclerosis of epicardial coronary arteries, which causes a local diminution in myocardial blood flow and perfusion from the concerned coronary artery.^[2]

This structural change causes reduction in ventricular systolic function (LVEF) and decreased functional capacity.^[3] This leads to an increased revascularization surgeries. Currently it represents for more than 60% surgeries, and 25,000 CABGs are performed each year.^[4]

During CABG surgery, novel routs are created around the narrowed and blocked arteries that allocate adequate blood flow to carry oxygen and nutrients to the heart.^[5]

The goal of CABG is to preserve and reinstate cardiac functions to normal by relieving myocardial ischemia^[6] National guidelines strongly recommend Cardiac Rehabilitation (CR) after CABG surgery.^[7]

According to United State Surveys, CR is described as a course involving medical assessment, monitored exercise training, counseling of the heart disease patients.^[8] For patients undergoing CR, the Six Minute Walk Test (6-

MWT) has confirmed to be a simple and effective measure of functional capacity. The investigated clinical program has efficiently enhanced patients' functional capacity as assessed by the 6-MWT.^[9]

Rate of Perceived Exertion (RPE) is reliable measure for directing and monitoring the exercise intensity. Borg scale makes it possible for participants to individually mark their exertion level in exercise tests and courses.^[10]

Left ventricular ejection fraction (LVEF) is a clinical index for myocardial contractility as well as for its pumping action. Echocardiography illustrates that cardiac dimensions, left ventricle volumes and ejection fraction are widely associated with heart disease progression.^{[11],[12]}

The research showed LVEF enhancement in patients attending the CR program as well as improvement in functional capacity.^[13]

After cardiac incidents, CR is prescribed to people to facilitate recovery and to prevent recurrence by optimizing risk prevention and promoting an active lifestyle. Including exercise training, it is suggested that CR programs provide lifestyle education on risk factor management for coronary heart disease (CHD) plus counseling so-called 'comprehensive CR'. These programs are intended to reduce physiological impacts of

CVD (e.g. by enhancing functional capacity to support early return).^[14] CR is prescribed as either Home or Centre-based. The Home-based rehabilitation programs were developed as a substitute for Center-based CR to extend the participation and access. The Home-based CR is a structured program with comprehensible participant goals, surveillance (monitoring), intermittent follow-up visits, phone calls, or at least monitoring diaries by patients themselves. The Center-based CR is a supervised program carried out at the community or hospital set up.^[14] Meta-analysis of the efficiency of mixed programs established that CR programs could reach a 20–26% reduction in cardiac mortality over a span of 1–3years.^[15] Home-based CR program has the ability to enhance CR uptake, reduce expenses, and enhance self management abilities. The home-based tele-monitoring instruction training has comparable short-term effects on exercise capacity as Center-based training.^[16] Since there are plenty of evidence about the CR program in CABG patients, but very few have been undertaken at rural set-up. The aim of this research was to determine the effectiveness of Home and Center-based cardiac rehabilitation in enhancing LVEF and functional capacity in patients underwent CABG surgery.

MATERIAL AND METHODS

The study was conducted after taking approval from Institutional Ethics Committee clearance DMIMS (DU) / IEC / 2018-19/ 7201).

Study design: This was an experimental (comparative) study in which the effectiveness of early structured individually tailored exercise training on functional capacity and LVEF in CABG patients was studied. Eligible patients who gave a written informed consent were allocated into two groups by utilizing convenient (purposive) sampling method.

Subjects: Total number of 24 (n=24) post CABG surgery patients were recruited between April- 2018 to March-2019 from the Department of Cardiovascular and Thoracic Surgery.

Duration of intervention: 3 days per week, for total 8 weeks.

Inclusion Criteria: CABG Patients of both genders were screened at the time of discharge from the hospital for eligibility criteria, including age group of 30–60 years with LVEF \geq 40%.

Exclusion criteria: High-risk group patients (AACVPR-99): LVEF of < 40%, survivor of cardiac arrest or sudden death.^[17] Or any systemic, musculoskeletal or neurological conditions that restrict participating in aerobic exercise and hemodynamic instability.

Procedure:

The institutional ethics committee clearance DMIMS (DU) / IEC / 2018-19/ 7201) was obtained before the start of the study. Total 34 CABG Patients were screened for the study, out of which the 30 participants were

discovered to be eligible as per inclusion criteria. Out of that 30, the 6 participants denied to participate. Therefore, 24 (n=24) participants included in this study and divided into two groups by utilizing purposive sampling method.

1. Group-A: Center-based program (n=12)

2. Group-B: Home-based program (n=12)

The procedure was explained to all the eligible participants and they signed an informed written consent before allocating them into two groups.

Base-line data was collected and recorded for all the outcome measures at the day of discharge from hospital on 9th-10th post-operative day. Functional capacity was measured by 6MW distances (in meters). Borg scale was used to measure the RPE after the 6MWT. LVEF was evaluated by 2D-Echocardiography.

An eight week structured exercise training program was offered to the participants either in the form of Center or Home-based.

Exercise was prescribed according to the Karvonen's formula, and the achieved HR max (peak) was used for exercise prescription as baseline.

After 8 weeks of exercise training program, participants were reassessed for LVEF, 6-MWT and RPE.

Outcome Measures:

1. LVEF:

LVEF was evaluated by a cardiologist with Two-Dimensional and M-mode Echocardiography.

2. 6-MWT:

The 6-MWT was conducted indoors along a wide, straight, enclosed 30 meter corridor with a traffic cone marked for the turning points.^[18]

The total distance covered in 6 minutes was recorded in meters.

3. RPE (BORG SCALE):

The original Borg (Category) scale (scale 6 to 20) was used.^[10] After 6 minute walk test, RPE score was taken as the outcome measure.

Group 'A'- Center-Based Cardiac Rehabilitation:

This group received a supervised, structured exercise training program 3 days per week for total 8 weeks in the hospital set-up.

Patients were assessed for BP, HR and SPO2 before the exercise program. The exercise program comprised of 10 minutes of warm up (stretching exercise, breathing exercise, and walking on the treadmill) with 15-20 minutes of graded aerobic training and 10 minutes of cool down.

Graded aerobic training was mainly treadmill walk for 3-times per week, with an intensity of 40–70% of HRR achieved in the exercise test applying the Karvonen's formula, and RPE of 11–13 for a duration of 15-20 min with intermittent rest. ACSM^[19]

Karvonen's formula= [(HRmax- HRrest) \times % intensity desired] + HRrest
(HRmax= 220-age)^[19]

Patients were re-assessed for all the outcome measures after the exercise program. A total of 70-80% attendance was mandatory for this group (A).

Group 'B'- Home-Based Cardiac Rehabilitation:

An individualized tailored aerobic exercise program was given for this group which included aerobic exercises; brisk walking, as the literature shows, brisk walking is an activity that is sufficiently intense to improve aerobic capacity in both healthy sedentary and cardiac patients.

Initial exercise prescriptions and the training sessions were provided in the hospital under the physiotherapist's supervision, and then the participants were given the program protocol for 8 weeks to do at home.

Patients were also taught to palpate the pulse and calculate the HR and rate the RPE at grade of 11–13.

The exercise program was of 5–10 minutes warm up, including stretching exercise, breathing exercise, and gentle active exercise, to larger muscle groups like the trunk and lower limb followed by graded aerobic training and 5-10 minutes of cool down.

Graded aerobic training was brisk walking 3-times a week with an intensity of 40–70% of HRR by using the Karvonen's formula, converted to a walk speed and RPE of 11–13 for a duration of 15-20 min with intermittent rest.^[19]

Home-Exercise group participants were regularly approached by telephone every 2 weeks to find out their adherence to the program, and guidance or program modifications and to monitor progress. The log of the exercise was evaluated every 15 days.

Participants were also recommended to contact the physiotherapist if any guidance was required.

- **Monitoring:** RPE provides a subjective means of monitoring exercise intensity.

- **Do's and Don'ts:** "During the exercise we want you to pay close attention to how hard you feel the exercise rate is. This feeling should reflect your whole amount of exertion and fatigue, combining all sensations of physical strain. Do not concern yourself with any one factor such as leg pain, shortness of breath or exercise intensity, but try to concern on your total inner feeling of exertion. Try not to underestimate or overestimate your feeling of exertion. Be as accurate as you can."^[19]

Indications For Termination Of Exercise:

Detailed awareness of the signs and symptoms during the exercise and the criteria for terminating the exercise were well explained to the participants.

Exercise Intensity Progression: As the RPE grading decreases with improving functional capacity, the intensity of exercise was increased at 5–10% of the maximum heart rate and by maintaining RPE of 11–13 throughout the 8 weeks duration. For the initial 4 weeks, patients performed the exercise training for 15–20 minutes, from the 5th to 8th week it was increased to 20–30 minutes. (The progression of exercise was individualized according to the patient's tolerance).^[19]

RESULT

Statistical analysis was done by using descriptive and inferential statistics using student's unpaired t test and paired t test and software used in the analysis was SPSS 22.0 version and the results were concluded to be

statistically significant with * $p < 0.05$, ** $P < 0.001$ is very significant and $p < 0.0001$ is highly significant.

A total of 24 (19 male, 5 female) participants, with mean age of participants in group A was 53.83 ± 7.61 and in group B was 55.91 ± 5.79 . (Table-1)

In group-A: 10 male, 2 female

In group-B: 9 male, 3 female

Table 1: Distribution of participants according to their age in years

Group	N	Minimum	Maximum	Mean	Std. Deviation
Group A	12	40	60	53.83	7.61
Group B	12	43	60	55.91	5.79

Subjects completed their course of exercise training with a minimum of 70%- 80% attendance in the exercise sessions. Both groups had similar demographic and clinical characteristics at baseline with respect to the LVEF, 6-MWD, RPE.

Baseline LVEF in group-A was 42.08 ± 2.57 and in group-B was 40.83 ± 1.94 . There was a significant improvement in LVEF after an 8 weeks of exercise training in both the groups (** $p = 0.0001$), group-A (42.08 ± 2.57 to 58.33 ± 6.85) and in group-B (40.83 ± 1.94 to 54.16 ± 6.33). By using Student's unpaired t test statistically no significant difference was found in LVEF (%) between two groups ($t = 1.54$, $p = 0.13$). (Table-2)

Table 2: Comparison of LVEF (%) in two groups by Student's unpaired t test

Group	N	Mean	Std. Deviation	Std. Error Mean	t-value
Group A	12	58.33	6.85	1.97	1.54 P=0.13
Group B	12	54.16	6.33	1.82	

*LVEF: Left Ventricular Ejection Fraction

Baseline 6-MWD in the group-A was 272.50 ± 43.30 and in the group-B was 275 ± 42.10 . There was a significant improvement in 6-MWD after an 8 weeks of exercise training in both the groups (** $p = 0.0001$), group-A (272.50 ± 43.30 to 527.50 ± 39.34 .) and in group-B (275 ± 42.10 to 505 ± 28.12). By using Student's unpaired t test statistically no significant difference was found in 6MWD score between two groups ($t = 1.61$, $p = 0.12$). (Table-3)

Table 3: Comparison of 6-MWD score in two groups by Student's unpaired t test

Group	N	Mean	Std. Deviation	Std. Error Mean	t-value
Group A	12	527.50	39.34	11.35	1.61 P=0.12
Group B	12	505	28.12	8.11	

*6-MWD: 6-Minute Walked Distance

Baseline RPE in the group A was 10.75 ± 1.60 and in the group B was 11.41 ± 1.08 . There was a significant difference (** $p=0.0001$) in RPE score after an 8 weeks of exercise training in group-A (10.75 ± 1.60 to 6.25 ± 0.45 .) as compare to group-B (11.41 ± 1.08 to 7.08 ± 0.79). By using Student's unpaired t test statistically significant difference was found in RPE score in patients of two groups ($t=3.16$, $*p=0.005$). (Table-4)

Table 4: Comparison of RPE score in two groups by Student's unpaired t test

Group	N	Mean	Std. Deviation	Std. Error Mean	t-value
Group A	12	6.25	0.45	0.13	3.16
Group B	12	7.08	0.79	0.22	* $P=0.005$

*RPE: Rate of Perceived Exertion

By using students unpaired t test, the results showed that there was no significant difference between the two groups for the LVEF and 6MWT i.e. Home-based CR is equally effective as the Centre-based CR program.

DISCUSSION

The present study aims to find out the efficacy of home versus centre-based cardiac rehabilitation in improving functional capacity and left ventricular ejection fraction in coronary artery bypass grafting patients.

This study was an experimental study and total twenty four ($n=24$) CABG patients of age between 30 to 60 years were included. They were conveniently divided into two groups: Group A- Centre based ($n=12$) and Group B- Home based ($n=12$) and the outcome measures i.e. LVEF, 6-minute walked distance and RPE were recorded.

The results were significant and showed that the CR was beneficial in improving the functional capacity and LVEF in CABG surgery patients in both the groups (A and B).

LVEF: Decreased left ventricular systolic function is a well-established independent predictor of mortality in CAD patients; little information is available regarding the effect of exercise training on LVEF.

In our study, by using Student's paired 't' test statistically significant difference between pre and post test LVEF (%) values was found in both the groups. In group A (** $p=0.0001$, $t=9.26$), and in group B (** $p=0.0001$, $t=8.00$). By using Student's unpaired t test statistically no significant difference was found in LVEF (%) between two groups ($t=1.54$, $p=0.13$).

In a randomized controlled trial study of Mohammad Haddadzadeh et al in CAD patients, found that a twelve-week structured individually tailored exercise training substantially enhance LVEF in post-event CAD patients.^[20]

6MWT: After cardiac incidents, the functional capacity decreases. The 6-MWT assesses the submaximal level of functional capacity. 6-MWD better reflect the functional exercise level for physical activities.

After CR, statistically significant difference was found in 6-MWD values in both groups i.e. ** $p=0.0001$. By using Student's paired t test, it showed significant difference in

pre and post values, in group A it was (272.50 ± 43.30 to 527.50 ± 39.34 .) and in group-B (275 ± 42.10 to 505 ± 28.12). By using Student's unpaired t test statistically no significant difference was found in 6-MWD score between two groups ($t=1.61$, $p=0.12$).

Fatemeh E. Ghashghaei et al, also proved that CR enhance the functional capacity and some post-CABG hemodynamic outcomes. The walk test distance of the rehabilitation group ($P < 0.01$) compared with the reference group ($P = 0.33$) was significantly improved after CR.^[21]

RPE: RPE is a valid way to regulate training intensity, independent of exercise duration. It is a self-rating measurement method to rate the exertion.^[10]

In our study by using Student's paired 't' test statistically significant difference was found in RPE score at pre and post test in both the groups (** $p=0.0001$). By using Student's unpaired 't' test, statistically significant difference was found in RPE score in group 'A' (6.25 ± 0.45) as compare to group 'B' (7.08 ± 0.79). ($t=3.16$, $*P=0.005$).

Our study observed the significant difference in all outcome measures after CR. But on comparing two groups, there is no any difference found.

Likewise, S. Shagufta et al found that Home based phase II CR is equally efficient in enhancing HRR as compared to supervised group in CABG patients.^[22]

All the above evidences of different studies and the present study results suggested that an eight week cardiac rehabilitation program whether it is centre or home-based are equally beneficial to all the participants who underwent CABG surgery.

CONCLUSION

The results of the present study were significant in both the groups i.e. A (Centre-based) & B (Home-based). Therefore, the present study concludes that an eight week structured individually tailored Home-based exercise program is equally effective as the Center-based exercise program in improving functional capacity and LVEF in CABG patients.

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Ethical Clearance – It has been obtained by Institutional Ethics Committee (DMIMS (DU)/ IEC / 2018-19/ 7201), Sawangi (M), Wardha.

Conflict Of Interest: NIL

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