ORIGINAL RESEARCH PAPER
Volume - 10 | Issue - 07 | July - 2021 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

EFFECTIVENESS OF COMPREHENSIVE CARDIAC REHABILITATION IN POST CORONARY ARTERY BYPASS GRAFTING PATIENTS

Physical Medicine and Rehabilitation

Dr Md Anwar Sadat Halder — Assistant Professor and HOD, Department of Physical Medicine and Rehabilitation, College of Medicine and Sagore Dutta Hospital, West-Bengal, India. Previously attached with Department of Physical Medicine and Rehabilitation, Institute of Post Graduate Medical Education and Research, Kolkata, West-Bengal, India.

Dr Saumen Kumar De* — Assistant Professor and HOD, Department of Physical Medicine and Rehabilitation, Calcutta National Medical College and Hospital, Kolkata, West-Bengal, India. Previously posted at Institute of Post Graduate Medical Education and Research, Kolkata, Department of Physical Medicine and Rehabilitation, Kolkata, West-Bengal, India. *Corresponding Author

ABSTRACT

Introduction: Cardiovascular disease is leading cause of mortality and morbidity throughout the world. Despite optimum medical and surgical management, a large number of patients became unable to maintain normal activity of daily living due to inadequate rehabilitation. Rehabilitation cannot be regarded as an isolated form or stage of therapy. Coronary artery bypass surgery, also known as coronary artery bypass graft surgery, is a surgical procedure to bypass the obstructed coronary artery (the "target vessel"). India has a large number of patients of coronary artery disease who needs CABG operation. Over few decades post-operative rehabilitation of CABG patients is done though there is no separate national level guidelines for Indian population even in post myocardial infarction patients like western countries though socio economic profile, health infrastructure and need are different from rest of the world. So, our study is a humble attempt to examine the efficacy of rehabilitation programme followed in western world.

Material and methods: In this Open labelled parallel group prospective randomised trial, conducted in the Department of Physical Medicine and Rehabilitation in collaboration with the cardio-thoracic and vascular surgery (CTVS) unit of the Institute of Cardio-Vascular Sciences, at the Institute of Post Graduate Medical Education and Research (IPGMER) and SSKM Hospitals, Kolkata between January, 2014 to June, 2015 (18 months). Patients who undergone CABG operation in CTVS Department SSKM Hospital, Kolkata were included. Total 80 patients, 40 in each group were recruited. Patients were randomised to cardiopulmonary rehabilitation group (n=40); named as cases and usual care group (n=40); named as control. Institutional ethical committee clearance was taken. Informed consent was taken from each patient before including them in this study. Every patient was explained about the programme. Parameters used:1. Forced vital capacity (FVC), 2. Metabolic Equivalent (MET), 3. Functional assessment (6MWT). Patient will be assessed at the end of 1 week,6 week and 3month of operation. FVC and 6MWT were performed in each visit where MET assessment was done in 6 week and 3 months.

Results: Data will be summarised by routine descriptive statistics. Numerical variables will be compared between groups by Student's Unpaired 't' test if normally distributed or by Mann-Whitney's 'U' test if otherwise. Variation over time would be assessed through repeated measures Analysis of Variance (ANOVA) or by Friedman's ANOVA if otherwise. Chi-Square test or Fisher's Exact test would be employed for inter-group comparison of categorical variance. Analysis will be two-tailed and $p<0.05$ would be considered statistically significant.

In both the groups maximum number of patients are in the age group of 51-60. Most of study population are male (90%). There is statistically significant difference (Student unpaired T test p value <0.01) of MET between cases and controls at 6th week (4.41 vs 3.92) and 3 months (6.93vs 6.66). Result shows statistically significant difference (Student unpaired T test p value <0.01) of 6MWT between cases and controls at 1 week, 6 week and 3 months. **Improvement pattern of FVC over time in Rehabilitation group** shows that FVC improves in each visit when compared to previous one by Repeated measures ANOVA followed by Tukey's Multiple Comparison Test ($P < 0.001$Number of time points 3F value 121.85). **Comparison of FVC in usual care group in each visit shows** FVC improves in each visit when compared to previous one by Repeated measures ANOVA followed by Tukey's Multiple Comparison Test as post hoc test if ANOVA returns p value < 0.05 ($p<0.001$ No. of point 3F value 243.38). **Comparison of 6MWT in Rehabilitation group in each visit** shows 6MWT improves in each visit when compared to previous one by Repeated measures ANOVA followed by Tukey's Multiple Comparison Test as post hoc test if ANOVA returns p vale < 0.05 (Repeated Measures ANOVA $P < 0.001$Number of time points 3 F value 1498.0). **Comparison of 6MWT in usual care group in each visit** shows 6MWT improves over time when compared with previous visit by Repeated measures ANOVA followed by Tukey's test as post hoc test if ANOVA returns p value < 0.05 (p value 0.001 Number of time points 3 F value 580.83). **Comparison of MET in Rehabilitation group in each visit** show MET improves significantly (4.41 vs 6.93) when compared to earlier one by student paired t test ($p <0.01$). **Comparison of MET in usual care group in each visit** show MET improves significantly (3.92 vs 6.66) when compared to earlier one by student paired t test ($p <0.01$).

Conclusion: Our study shows most of our patient is male of 5th decade. Both conventional care and comprehensive rehabilitation after CABG shows statistically significant improvement in FVC and 6MWT throughout study. Rehabilitation group shows better improvement than usual care group FVC and 6MWT throughout study. Improvement pattern of MET is consistent from 6 week to 3 months in both the group. Rehabilitation group shows better improvement in METS from 6 week to 3 months.

KEYWORDS

CABG (coronary artery bypass graft surgery), Comprehensive Cardiac Rehabilitation, Forced vital capacity (FVC), Metabolic Equivalent of Task (MET), 6 Minute Walk Test (6MWT).

INTRODUCTION:

Cardiovascular disease is leading cause of mortality and morbidity throughout the world. Despite optimum medical and surgical management, a large number of patients became unable to maintain normal activity of daily living due to inadequate rehabilitation. Rehabilitation cannot be regarded as an isolated form or stage of therapy but must be integrated within secondary prevention services of which it forms only one facet.[1] Over the past centuries significant evolution in cardiac rehabilitation happened from initial bed rest to early mobilisation. By early of twentieth century bed rest of two month was recommended for acute attack of Ischaemic heart disease as activity was believed to be risk factor of heart failure, cardiac rupture and sudden ventricular death. By 1930, study demonstrated that stable scar formation by 6 weeks, hence bed rest was recommended for 6 weeks.[2] By 1950, it was reduced to 4 weeks and then to 14 days. Because similar outcome was observed with early ambulation in respect to re-infarct, angina, sudden death.[3,4,5] Wegner first described cardiac rehabilitation in respect of post MI patient. Patients was progressed from bed rest stair climbing within 2 weeks.[6] Due to advancement of medical and technological management hospital stay is reduced significantly. Patients are now being discharged within 5-7 days following CABG (Coronary Artery Bypass Grafting) surgery.[7] Coronary artery bypass surgery, also known as coronary artery bypass graft surgery, is a surgical procedure consisting of either diverting the

left internal thoracic artery (left internal mammary artery or "LIMA") to the left anterior descending (LAD) branch of the left main coronary artery; or a harvested great saphenous vein of the leg, attaching the proximal end to the aorta or one of its major branches, and the distal end to immediately beyond a partially obstructed coronary artery (the "target vessel"). India has a large number of patients of coronary artery disease who needs CABG operation.[8]

Over few decades post-operative rehabilitation of CABG patients is done though there is no separate national level guidelines for Indian population even in post myocardial infarction patients like western countries though socio economic profile, health infrastructure and need are different from rest of the world. So, our study is a humble attempt to examine the efficacy of rehabilitation programme followed in western world.

REVIEW OF LITERATURE:

An estimated 47 million Indians had coronary artery disease (CAD) in 2010.[8] Indian patients undergoing bypass surgeries are often young (average age of 60 years). There has been a steady 25-30 percent annual increase in the number coronary procedures over the past several years. About 60,000 coronary bypass surgeries are done annually in India.[9] Traditionally, cardiac rehabilitation is divided into three phases.[10] All phases of cardiac rehabilitation aim to facilitate recovery and to prevent further cardiovascular disease. **Phase I or inpatient phase** is initiated while the patient is still in the hospital. It consists of early progressive mobilization of the stable cardiac patient to the level of activity required to perform simple household tasks. The shorter hospital stay with modern cardiology makes it difficult to conduct formal inpatient education and training programs. Thus, inpatient cardiac rehabilitation programs are mostly limited to early mobilization to make self-care possible by discharge, and brief counseling about the nature of the illness, the treatment, risk factors management and follow-up planning. In most countries**, Phase II is a supervised ambulatory outpatient program** of 3 to 6 months duration which consists of outpatient monitored exercise and aggressive risk factor reduction. In some countries, especially in Europe, residential programs of 3 to 4 weeks duration are offered. **Phase III is a lifetime maintenance phase** in which physical fitness and additional risk-factor reduction are emphasized. It consists of home-or gymnasium-based exercise with the goal of continuing the risk factor modification and exercise program learned during phase II.[11] Elisheva Simchen et al. showed cardiac rehabilitation participant had self-perception of better HRQOL (Health Related Quality of Life), most significantly in social functioning. They emphasized for working out a policy to encourage participation in cardiac rehabilitation programme after CABG.[12] Only 25-30% patient are being enrolled in institution based cardiac rehabilitation programme after CABG.[13] Heather M. Arthur showed improvement in peak VO_2, peak work rate and peak MET level in both supervised and home based unsupervised group is seen.[14] Bilinksa M, Kosydar-Piechna M et al. concluded that short term dynamic training bring significant improvement and neurohormonal response to handgrip, cardiovascular fitness.[15] Trine T Moholdt. et al. showed aerobic interval training and continuous moderate exercise increases VO_2 max similarly in short term but better long-term effect was of aerobic interval training after CABG.[16] Dugmore LD, Tipson RJ et al. showed that 12 months weekly aerobic training programme could produce significant improvement in cardiorespiratory fitness.[17] Protocol guided phase 1 cardiac rehabilitation produces much faster return of heart rate and blood pressure to baseline following 6MWT. Comprehensive cardiac rehabilitation results significant improvement in work capacity and quality of life.[18]

The American Heart Association, the American College of Cardiology Foundation and the American Association of Cardiovascular and Pulmonary Rehabilitation have outlined the core components of contemporary cardiac rehabilitation and secondary prevention programs and produced guidelines for detection, management and prevention of cardiovascular disease. These core components include patient assessment, exercise training, physical activity counselling, tobacco cessation, nutritional counselling, weight management, aggressive coronary risk-factor management and psychosocial counselling.[19] Other subjects often raised by patients discussed during cardiac rehabilitation visits include sexual dysfunction, alcohol consumption and stress management. Traditional concepts revolved around exercise and did not really help in making people change the lifestyle habits. Study was conducted to look into the efficacy of a comprehensive Cardiac Rehabilitation Program encompassing the psychological, social and physical well-being of the patient.[20] A J Rajendron et al. undertaken **DREAM** programme; which includes **D**iet, **R**elaxation, **E**xercise, **A**ttitude and **M**otivation.[21]

AIMS AND OBJECTIVES:

1. To explore the effect of cardiac rehabilitation on functional quality of life.
2. To measure change in aerobic capacity due to effect of cardiac rehabilitation.

MATERIAL AND METHOD:

Before starting the study, Institutional ethical committee clearance was taken. Informed consent was taken from each patient before including them in this study. Every patient was explained about the programme.

STUDY DESIGN: Open labelled parallel group prospective randomised trial

STUDY AREA: This study was conducted in the Department of Physical Medicine and Rehabilitation in collaboration with the cardio-thoracic and vascular surgery (CTVS) unit of the Institute of Cardio-Vascular Sciences, at the Institute of Post Graduate Medical Education and Research (IPGMER) & SSKM Hospitals, Kolkata.

STUDY POPULATION:

Patients who undergone CABG operation in CTVS Department SSKM Hospital, Kolkata

STUDY PERIOD: January, 2014 to June, 2015 (18 months).

SAMPLE SIZE: Being an observational study no formal sample size calculation was done. We planned to recruit total 80 patients, 40 in each group.

INCLUSION CRITERIA:

Patient undergoing CABG operations at Dept. of Cardiothoracic and vascular surgery at SSKM Hospital, Kolkata.

EXCLUSION CRITERIA:

1. Ventricular arrythmia
2. Uncontrolled hypertension
3. Severe LV dysfunction
4 Cardiac failures
5. Shock
8. Neuromuscular disorder.

PARAMETERS TO BE STUDIED:

1. Forced vital capacity (FVC)
2. Metabolic Equivalent (MET)
3. Functional assessment (6MWT)

ASSESSMENT:

Patient will be assessed at the end of 1 week, 6 week and 3month of operation. FVC and 6MWT were performed in each visit where MET assessment was done in 6 week and 3 months.

STUDY TOOLS

1. Spirometer
2. Treadmill
3. Expired gas analyser
3. Stop watch.
4. Stethoscope
5. Sphygmomanometer.

STUDY TECHNIQUE:

Eligible patients were randomised to cardiopulmonary rehabilitation group (n=40); named as cases and usual care group (n=40); named as control. There are forty patients in each group. Taking complete medical history physical examination and cardiovascular examination done. Routine haemogram including lipid profile and blood sugar were investigated along with chest X ray and ECHO and ECG. After operation those patients assigned to control group, received routine nursing care and breathing exercise but were not exposed to specific graduated motor physical intervention. Those randomised to rehabilitation group (named as cases) received structure rehabilitation programme as per table below in intensive phase apart from usual care. Routine medications were prescribed equally to both groups. Both groups were counselled regarding dietary modification, stress management and avoidance of smoking and other risk factor.

Table 1: shows structured rehabilitation programme

Post-Operative Day	Breathing Activities	Walking	Other Exercises (supervised)	Activities	Counselling
Day of Operation	Weaning from ventilator - huffing and assisted coughing	-	Passive range of motion. Active Foot-ankle exercises (target HR up to 30 bpm above baseline)	Encouraged to sit up	-
1	Huffing and assisted coughing	-	Range of motion Exercises	Sit up in chair	Reorientation about programme
2	Do	Walk short Distances	Range of motion Exercises (increase frequency)	Read newspaper in chair, self feeding, bedside commode	Dietary advice
3	Do	Walk up to bathroom	Exercise with light weight	Partial self-bath in bed+ above	Cessation of smoking
4	Breathing Exercise	Increase walking	Exercise with light weight (Gradual increase in weight)	As above + out of bed for 3-4 hours	Life style modification
5	Do	Stair climbing. Increase distance of walking	Increase intensity of exercise	Do (Increase duration)	ADL training. Relaxation Training.
6	Do	do- (increase extent and frequency of stair-climbing)	Continue to increase resistance in exercise.	Do	Participation in peer-support groups discharge planning
7	Do	Walk up and down two flight stairs	Exercises as above	Do	Discussion about post discharge issue, follow up

After intensive phase patients were shifted to phase II. Patients perform 10 min warm up and 10 min cool down before and after exercise. Under vitals monitoring and supervision of therapist and exercise physiologist. [22]

A general outline is given below-
Aerobic exercise: Frequency-3-5 days/weak, Intensity: 60% of maximum heart rate, Duration: 20-60 minutes, and M=walking, treadmill, cycling, rowing, stair climbing, arm/leg ergometry, and others using continuous or interval training as appropriate

For resistance exercise: Frequency 2-3 days/weak; Intensity 10-15 repetitions per set to moderate fatigue; duration 1-3 sets of 8-10 different upper and lower body exercises; and using, elastic bands, cuff/hand weights

The initial supervised exercise programme gave way to an unsupervised exercise programme with the proper precautions, which the patients were to follow at home. The patients were taught to take their pulse, and at each visit a target heart rate, based on Karvonen's formula[7], was set — the patients told to stop if that was exceeded, or if they felt chest pain or constriction or shortness of breath. The exercise intensity was fixed at a rating of perceived exertion of "somewhat hard" to "hard", that is between 13 to 15 on the Borg scale of perceived exertion.[23]

In maintenance phase (III) patient performs self-directed aerobic training 3-5 time a week. Training principle and progression are same as phase II.

Fig 1: Treadmill with monitor

Fig 2: Spirometer

RESULT ANALYSIS:
Data will be summarised by routine descriptive statistics. Numerical variables will be compared between groups by Student's Unpaired 't' test if normally distributed or by Mann-Whitney's 'U' test if otherwise. Variation over time would be assessed through repeated measures Analysis of Variance (ANOVA) or by Friedman's ANOVA if otherwise. Chi-Square test or Fisher's Exact test would be employed for inter-group comparison of categorical variance. Analysis will be two-tailed and $p<0.05$ would be considered statistically significant.

Table 2: Comparison of age distribution between groups

Group	Minimum	Maximum	Mean	Standard Deviation
Case(n-40)	**46**	**71**	**55.4**	**6.55**
Control(n-40)	**45**	**71**	**56.2**	**7.52**

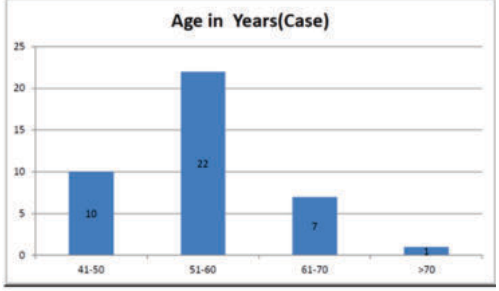

Figure 3: Distribution of cases according to age

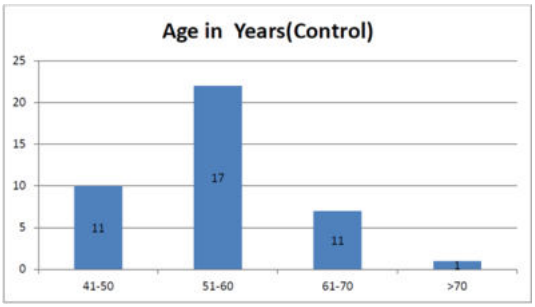

Figure 4: Distribution of controls according to age

Comments: Above table and diagrams show comparison of age distribution between groups. In both groups maximum number of patients are in the age group of 51-60. However, there is no statistically significant difference between groups.

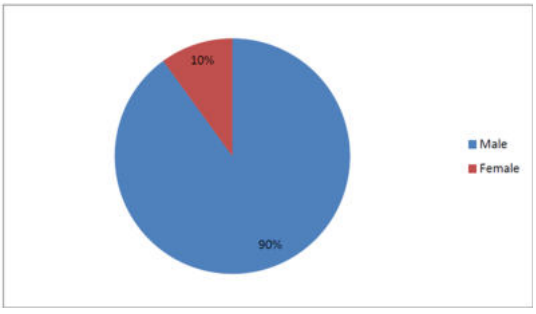

Figure 5: Distribution of study population according to sex

Table 3: Descriptive statistics for age in years

Group	Male	Female	Total	Fisher's exact test two tailed P value 1
Case (n=40)	36(90%)	4(10%)	40	
Control (n=40)	36(90%)	4(10%)	40	
Total	72	8	80	

Comment: The above table and diagram show most of study population are male (90%). However, there is no statistically difference between groups with regard to sex as Fisher's exact test two tailed P value is 1.

Table 4: Comparison of MET between two groups in each visit

	Case (Mean ± SD)	**Control** (Mean ± SD)	P value
MET at 6 weeks	4.41±0.607	3.92±0.662	0.001
MET at 3 months	6.93±0.525	6.66±0.409	0.001

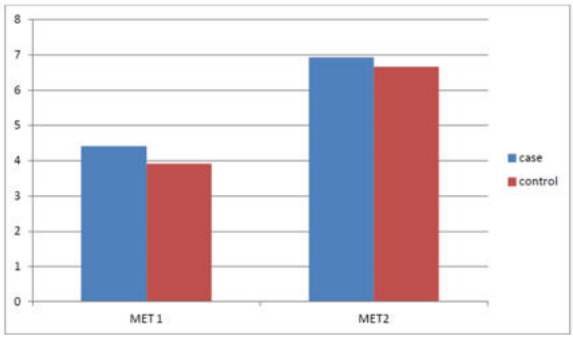

Fig 6: Comparison of MET between groups

Comment: The above table and diagram show statistically significant difference (Student unpaired T test p value <0.01) of MET between cases and controls at 6th week (4.41 vs 3.92) and 3 months (6.93vs 6.66).

Table 5: Comparison of 6MWT between two groups in each visit

	Case (Mean± SD)	Control (Mean± SD)	P value
6MWT at 1week	239.25±23.9	200.93±21.95	<0.001
6MWT at 6 weeks	338.32±30.11	258.58±32.06	<0.001
6MWT at 3 months	416.65±27.342	318.75±20.415	<0.001

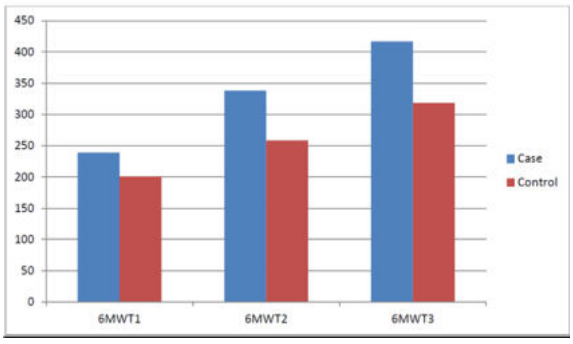

Fig 7: Comparison of 6MWT between groups

Comment: The above table and diagram show statistically significant difference (Student unpaired T test p value <0.01) of 6MWT between cases and controls at 1 week, 6 week and 3 months.

COMPARISON OF VARIABLE IN GROUPS OVER PERIOD OFTIME

Table 6: Improvement pattern of FVC over time in Rehabilitation group

Tukey's Multiple Comparison Test	Mean Diff.	q	P value	95% CI of diff
FVC_1week vs FVC_6week	-0.523	10.449	< 0.001	-0.69248 to -0.35352
FVC_1week vs FVC_3month	-1.104	22.007	< 0.001	-1.2740 to -0.93502
FVC_6week vs FVC_3month	-0.582	11.618	< 0.001	-0.750 to -0.412

Comments: Above table shows FVC improves in each visit when compared to previous one by Repeated measures ANOVA followed by Tukey's Multiple Comparison Test.

(P < 0.001 Number of time points 3 F value 121.85)

Table 7: Comparison of FVC in usual care group in each visit

Tukey's Multiple Comparison Test	Mean Diff.	q	P value	95% CI of diff
FVC_1week vs FVC_6week	-0.39650	14.097	< 0.001	-0.49174 to -0.30126
FVC_1week vs FVC_3month	-0.87625	31.154	< 0.001	-0.97149 to -0.78101
FVC_6week vs FVC_3month	-0.47975	17.057	< 0.001	-0.57499 to -0.38451

Comment: Above table shows FVC improves in each visit when compared to previous one by Repeated measures ANOVA followed by Tukey's Multiple Comparison Test as post hoc test if ANOVA returns p value < 0.05.

(p<0.001 No. of point 3 F value 243.38)

Table 8: Comparison of 6MWT in Rehabilitation group in each visit

Tukey's Multiple Comparison Test	Mean Diff.	q	P value	95% CI of diff
6MWT_1week vs 6MWT_6week	-99.075	43.133	< 0.001	-106.85 to -91.297
6MWT_1week vs 6MWT_3month	-177.40	77.233	< 0.001	-185.18 to -169.62
6MWT_6week vs 6MWT_3month	-78.325	34.100	< 0.001	-86.103 to -70.547

Comment: Above table shows 6MWT improves in each visit when compared to previous one by Repeated measures ANOVA followed by Tukey's Multiple Comparison Test as post hoc test if ANOVA returns p vale < 0.05.

(Repeated Measures ANOVA P < 0.001 Number of time points 3 F value 1498.0)

Table 9: Comparison of MET in usual care group in each visit

Tukey's Multiple Comparison Test	Mean Diff.	q	P value	95% CI of diff
6MWT_1week vs 6MWT_6week	-57.650	23.173	< 0.001	-66.074 to 49.226
6MWT_1week vs 6MWT_3month	-117.83	47.360	< 0.001	-126.25 to 109.40
6MWT_6week vs 6MWT_3month	-60.175	24.188	< 0.001	-68.599 to 51.751

Comment: Above table shows 6MWT improves over time when compared with previous visit by Repeated measures ANOVA followed by Tukey's test as post hoc test if ANOVA returns p value < 0.05.

(p value 0.001 Number of time points 3 F value 580.83)

Table 10: Comparison of MET in Rehabilitation group in each visit

Time	MET (Mean ± SD)	P value <0.01 by student paired t test
At 6week	4.41±0.6	
At 3month	6.93±0.52	

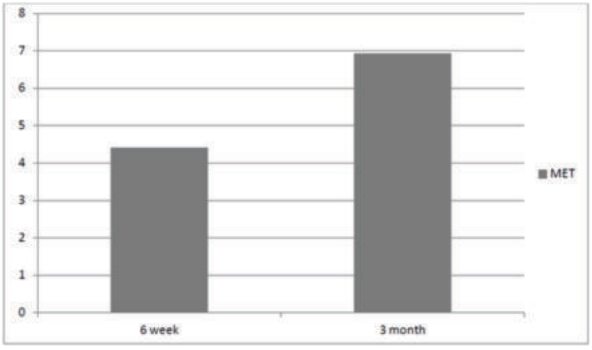

Figure 8: Comparison of MET in Rehabilitation group in each visit

Comment: The above Table and diagram show MET improves significantly (4.41 vs 6.93) when compared to earlier one by student paired t test (p <0.01)

Table 11: Comparison of MET in usual care group in each visit

Time	MET (Mean± SD)	P value <0.01 by student paired t test
6weeks	3.92±0.66	
3 months	6.66±0.40	

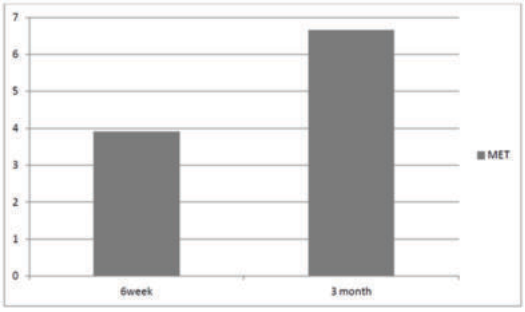

Figure 9: Comparison of MET in usual care group in each visit

Comment: The above Table and diagram show MET improves significantly (3.92 vs 6.66) when compared to earlier one by student paired t test (p <0.01)

DISCUSSION:

This open labelled prospective study was conducted over a period of 18 month from January 2014 to June 2015 in the department of Physical medicine and rehabilitation and department of Cardiothoracic and Vascular Surgery, IPGME&R, SSKM Hospital, Kolkata to explore the effectiveness of comprehensive cardiac rehabilitation in post CABG patient. After getting Institutional Ethical Committee clearance, we included total 85 patients in our study among which five patients were dropped out from study. We have 40 patients in both comprehensive rehabilitation group and usual care group. Among study population mean age is 55.4 years in rehabilitation group and 56.2 years in usual care group. Maximum number of patients are in age group is 51-60 years. Most of the study shows more or less age pattern like our study. In a study by Bilinska et al.[15] mean age was 55, whereas a study by Lan C. et al. found mean age of 56.[24] In our study, most of the patients (90%) are male which is corroborating most of the previous study. Similarly study by Abraham SB, et al.[18] showed 82.5 % patients are male whereas Fatemeh Esteki Ghashghaei, et al.[25] reported 81% of their study population were male.

Limitation of aerobic and functional capacity is common after post CABG. So, in our study we have taken 6 Minute walking test (6MWT) which represent functional capacity and MET which represent aerobic capacity and FVC which is an important parameter of lung function. Previous study took this parameter/ parameters to see the effectiveness of cardiac rehabilitation.[26] Impairment of pulmonary function is common in post CABG patient. After statistical calculation, we got significant difference in mean FVC in between rehabilitation group and usual care group from initial visit (3.03 vs 2.66) up to final visit (4.14 vs 3.54). Our finding is supported by study by David A. Kaminsky et al.[27] that showed improvement of lung function following cardiac rehabilitation. Ricardo Stein et al.[28] also found similar result. There is also statistically significant improvement of FVC in both group when we consider separately over a period of time. Study by Shubhada A. Gade et al.[29] showed sequential improvement of FVC over a period of time from seventh day to one month (71.6%) and one month to four months (84.2%). According to literature, post-operative respiratory muscle dysfunction may contribute reduction of FVC and this change augment the incidence of atelectasis in basal segment.[30]

In our study, we have found statistically significant improvement of 6MWT in both group over times. But when we compare between these two groups there is significant improvement of 6MWT in rehabilitation group in each visit. Mean difference of distance in 6MWT is maximum at three months (416.65 vs 318.75).

In rehabilitation group improvement is more in the period of 1 week to 6 weeks whereas in usual care group more improvement happened in the period of 6 weeks to 3months. The study by Ricardo Stein et al.[28] showed patients in rehabilitation group covered significantly longer distance in 6MWT within one week, whereas study by Fatemeh et al.[25] showed this improvement of 6MWT even persists after two months of cardiac rehabilitation programme. This early and persistent improvement of 6MWT is simulating our study. Study by Jankowska EA et al.[31] showed similar type of result.

In our study, we have got statistically significant difference of improvement of MET over a period of time in rehabilitation group. Mean difference of MET between two groups is maximum at 6 weeks (3.92 vs 4.41) than at 3 months (6.66 vs 6.92). Same type of improvement after long duration of time was shown by Rajendran AJ, Manoj S et al.[21] following 2-months period of cardiac rehabilitation comprising of exercise programme diet, relaxation, motivation. Instead of MET, VO_2 is also used by some study because both are related and denotes aerobic capacity. J Kodis , K M Smith, et al.[32] also demonstrated similar improvement in peak VO_2 and peak MET both a supervised and home-based group even after 6month period but Ricardo Stein et al.[28] demonstrated earlier improvement (in 30days) of VO_2 in rehabilitation group. There is also improvement of MET in usual care group when we compare with previous one. The improvement of aerobic capacity in usual care group is supported by study done by Hirschhorn et al.[33] who reported spontaneous recovery of functional capacity may occur after CABG.

Hence this prospective study showed significant improvement of all parameter (FVC, 6MWT, and MET) after rehabilitative care in post CABG patients in our study population.

LIMITATION:

1. No preoperative lung function, aerobic capacity or functional assessment done.
2. No submaximal exercise stress test done within 6 weeks.
3. Follow up not done after 3 months.

CONCLUSION:

Our study shows most of our patient is male of 5th decade. Both conventional care and comprehensive rehabilitation after CABG shows statistically significant improvement in FVC and 6MWT

throughout study. Rehabilitation group shows better improvement than usual care group FVC and 6MWT throughout study. Improvement pattern of MET is consistent from 6 week to 3 months in both the group. Rehabilitation group shows better improvement in METS from 6 week to 3 months.

REFERENCES:

1. WHO Definition, Report of WHO Expert committee on Disability prevention and Rehabilitation: Rehabilitation of Patients with cardiovascular disease. Geneva, Switzerland: WHO 1964.
2. Mallory G, White P, Sacedo-Salgar J. The speed of healing of myocardial infarction: a study of the pathological anatomy in seventy-two cases. *Am Heart J.* 1939:**18**; 647-671.
3. Abraham A, Sever Y, Weinstein M, et al. Value of early ambulation in patients with and without complications after acute myocardial infarction. *N Engl J Med.*1975; **292**:719-722.
4. Brummer P, Linko E, Kasanen A. Myocardial infarction treated by early ambulation, *Am Heart J.* 1956;**52:**269-272.
5. Newman L, Andrews M, Koblish M. Physical medicine and rehabilitation in acute myocardial infarction, *Arch Intern Med.* 1952 ;89:552-561.
6. Wenger N, Gilbert C, Skoropa M. Cardiac conditioning after myocardial infarction, an early intervention program, *J Cardiac Rehabil.* 1971; 2:17-22.
7. Randall L Braddom, Physical Med. And Rehabilitation,4th edition, page 713. ISBN-13 978-1437708844. Publisher: Saunders.
8. Enas EA, Singh V, Gupta R, Patel R, et al. Recommendations of the Second Indo-US Health Summit for the prevention and control of cardiovascular disease among Asian Indians. *Indian Heart J.* 2009; **61:**265-74.
9. Kaul U, Bhatia V. Perspective on coronary interventions & cardiac surgeries in India. *Indian J Med Res*. Nov 2010;**132**(5):543-548.
10. Squires RW, Gau GT. Cardiovascular rehabilitation: status. *Mayo Clin Proc.* 1990 May; **65(5):**73155.
11. Warner M. Mampuya. Cardiac rehabilitation past, present and future: an overview *Cardiovasc Diagn Ther.* 2012 Mar; **2(1):** 38–49.
12. Elisheva Simchen, Irit Naveh et al. Rehabilitation and Quality of life after CABG, *IMAJ, **Vol 3**,* June 2001.
13. King KM, Humen DP, Teo KK. Cardiac rehabilitation: the forgotten intervention. *Can. J Cardiol.***15**:979-985,1999.
14. Heather M. Arthur, Kelly M Smith, Jennifer Kodis et al. A controlled trial of hospital versus home based exercise in cardiac patients. *Medicine & Science in Sports and Exercise. **2002*** Oct;***34***(10):1544-1550. doi: 10.1097/00005768-200210000-00003.
15. Bilinska M, Kosydar-Piechna M et al. Influence of dynamic training on haemodynamic, neurohormonal responses to static exercise and inflammatory markers in patients after CABG. *Circ J.* 2010 Nov;**74(12):**2598-2604. doi: 10.1253/circj. cj-10-0104. Epub 2010 Oct 9. PMID: 20953063.
16. Trine T Moholdt, Brage H Amundsen et al. Aerobic Interval training versus continuous moderate exercise after CABG: A randomized study of cardiovascular effects and quality of life. *Am Heart J.* 2009, Dec;**158(6):**1031-7.
17. Dugmore LD, Tipson RJ et al. Changes in cardio respiratory fitness, psychological wellbeing, quality of life and vocational status following 12-month cardiac exercise rehabilitation programme. *Heart* 1999; **81**:359-366.
18. Abraham Samuel Babu, Manjula Sukumari Noone, Mohammed Haneef, Shijoy M. Naryanan. Protocol guided Phase 1 cardiac rehabilitation in Patients with STEMI in a Rural Hospital. *Heart Views*. 2010, Jun-Aug; **11(2):**52-56. doi: 10.4103/1995-705X.73209.
19. Randal J Thomas, Marjorie King et al. AACVPR/ACC/AHA 2007 performance measures on cardiac rehabilitation for referral to and delivery of cardiac rehabilitation/secondary prevention services. *J Cardiopulm Rehabil Prev.* 2007, Sep-Oct; **27(5):**260-90. doi: 10.1097/01.HCR.0000291295.24776.7b.
20. Philip A. Ades. Cardiac rehabilitation and Secondary prevention of Coronary heart disease, *N Engl J Med,* 2001 Sep 20; **345 (12):** 892-902. doi: 10.1056/NEJMra001529.
21. Rajendran AJ, Manoj S et al. Cardiac Rehabilitation for Coronary Artery Bypass Grafting Patients in South Indian Setup: A Prospective Study. *IJPMR* 2004; **15**: 23-33.
22. Mitchell H, Whaley H, Mitchell MH, Brubaker PH, Otto RM. 7th ed. USA: Lippincott Williams and Wilkins; 2006. ACSM's guidelines for exercise testing and prescription; pp. 174–204.
23. Moldover JR, Bartels MN. Cardiac Rehabilitation. In: Braddom RL, ed. Physical Medicine and Rehabilitation. Philadelphia-USA: WB Saunders; 2000: 665-686.
24. Lan C, Chen SY, Hsu CJ, et al. Improvement of cardiorespiratory function in patients with percutaneous transluminal coronary angioplasty or coronary artery bypass grafting during outpatient rehabilitation. *Am J Phys Med Rehabil.* 2002; **81**:336-41.
25. Fatemeh Esteki Ghashghaei , Masoumeh Sadeghi, Seyed Mohammad Marandi, Samira Esteki Ghashghaei. Exercised based cardiac rehabilitation improves haemodynamic responses after coronary artery bypass graft surgery *ARYA Atheroscler*. 2012 Winter;**7(4):**151-6. PMID: 23205048, PMCID: PMC3413083.
26. Philip A Ades, Patrick D Savage, Clinton A Brawner, Caroline E Lyon, Jonathan K Ehrman, Janice Y Bunn, Steven J Keteyian. Aerobic capacity in patients entering cardiac rehabilitation. *Circulation*.2006 Jun;**113:**2706-2712.PMID: 16754799.
27. David A Kaminsky, Patrick D Savage, Peter W Callas, Philip A Ades. Lung function and cardiovascular risk: effect of cardiac rehabilitation. *J Cardiopulm Rehabil*. 2010 Nov-Dec; **30(6):**384-90.
28. Stein R, Maia CP, Silveira AD, Chiappa GR, Myers J, Ribeiro JP. Inspiratory Muscle Strength as a Determinant of Functional Capacity Early After Coronary Artery Bypass Graft Surgery. *Arch Phys Med Rehabil.* 2009; **90:** 1685 -1691.
29. Shubhada A. Gade, Mohan M. Sagdeo, Purushottam K. Deshpande, Anagha V. Sahasrabuddhe. Sequential Changes In Pulmonary Functions After Coronary Artery Bypass Graft Surgery. *JK Science.* 2011 Jan-March; **13(1)** :11-14.
30. Erik H J Hulzebos , Paul J M Helders, Nine J Favié, Rob A De Bie, Aart Brutel de la Riviere, Nico L U Van Meeteren. Preoperative intensive inspiratory muscle training to prevent post-operative pulmonary complication in high-risk patients undergoing CABG surgery: a randomised clinical trial. *JAMA.* 2006 Oct 18; 296(15):1851-7.
31. Ewa A Jankowska, Kinga Wegrzynowska Malgorzata et al. The 12-week progressive quadriceps resistance training improves muscle strength, exercise capacity and quality of life in patients with stable chronic heart failure. *Int J of Cardiol*. 2008 Oct 30;**130**(1):36-43.
32. J Kodis , K M Smith, H M Arthur, C Daniels, N Suskin, R S McKelvie. Changes in exercise capacity and lipids after clinic versus home based aerobic training in coronary artery bypass grafting patients. *Journal of Cardiopulmonary Rehabil*, 2001 Jan-Feb:**21(1)** :31-36.
33. Andrew D Hirschhorn, David Richards, Sean F Mungovan, Norman R Morris, Lewis Adams. Supervised moderate intensity exercise improves distance walked at hospital discharge following coronary artery bypass graft surgery: a randomised controlled trial. *Heart Lung Circul*. 2008 Apr; **17(2):** 129–138.