

COMPARING FUNCTIONAL CAPACITY AFTER INPATIENT CARDIAC REHABILITATION PROGRAMME IN CORONARY ARTERY BYPASS GRAFT SURGERY PATIENTS WITH AND WITHOUT DIABETES.

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Abstract- Introduction -Functional Capacity (FC) is a valid measure of physical fitness in health and disease and should be evaluated at the start and at the end of Cardiac rehabilitation programs (CRPs). However after comprehensive literature search we have not come across any of studies on diabetic patients comparing FC after inpatient rehabilitation. So this study was undertaken with the aim to compare the FC after inpatient CRPs in coronary artery bypass graft (CABG) surgery patients with and without diabetes using 6 minute walk test.

Objective: Comparison of FC after inpatient CRPs in CABG patients with and without diabetes by performing 6 minute walk test (6MWT) using distance walked, % predicted distance and mean peak VO₂.

Methods and methodology: *observational type of study conducted at tertiary care hospital, total of 32 subjects {Experimental group-16 in diabetes (DM) and Control group-16 in non-diabetes (non-DM)}. Stable CABG surgery patient were included. Exclusive criteria were graft taken from leg, lower leg amputation, unstable hemodynamic, Peripheral Vascular Diseases (PVD), BMI >30 kg/cm² and Lower limb disability were excluded . FC using 6MWT was evaluated at the end of phase 1 CRP in both groups .6MWT was done using ATS guidelines. % predicted distance and mean peak VO₂ calculated using equation.*

Result- *The experimental group patients had statistically significantly less functional capacity as compared to the control group.*

Conclusion- *In experimental group i.e. DM Patients functional capacity is decreased after inpatient cardiac rehabilitation in CABG patients.*

Introduction:

Evaluation of functional capacity is one of the valid measure of physical fitness in healthy and in various disease patients (1). Patient's functional capacity can be assessed by performing various exercise tolerance tests (ETT) (2). 6 Minute walk test (6MWT) is easy, natural and non-invasive exercise tolerance test and is also reflection of daily activities (3). 6MWT is inexpensive and safe to assess the exercise capacity and is used for diagnostic, prognostic and to assess the effects of various treatment purpose.(2). It is one of the, simple assessment tools that is Cost effective and is beneficial to patients with chronic diseases such as diabetes and to physicians. (1). Average peak oxygen uptake or average peak aerobic capacity can be calculated using 6 MWT. Thus Prescription of various exercise therapy, monitoring exercises and measuring clinical improvement can be done by assessing the functional capacity of patients with diabetics. (1)

Cardiac rehabilitation programs (CRPs) are team approach from various disciplinary that focuses on patients with various cardiac diseases to improve and maintain their maximum physical capacities, improve Quality of life (QOL) and prevent psychosocial problems. (4) CR is indicated for patients after myocardial infarction , heart failure, revascularization surgeries, valve replacement surgeries, pacemaker, implantable and cardioverter-defibrillators.(5) As per European and American guidelines CRPs is includes various phases either three or four phases, respectively. The CR starts with admission of patients in non-operated case and immediately after surgery in operated patients and the ends when the patient is fully responsible and is capable of maintaining the independent responsibility and the QOL.(4)

Phase 1 of CR also known as hospital phase in CABG patients begins immediately after surgery and ends with the discharge of the patient .The phase 1 of CR aims at minimizing the postoperative complications and early mobility of patients to improve overall wellbeing and early resumption of their ADLS (6).Pre discharge 6MWT is done for appropriate recommendation regarding physical activity. The 6MWD corresponds to daily or functional activities regulation of walking time in home based CR(phase 2) can be done using 6 MWD.(7)Functional capacity evaluation during cardiac rehabilitation is done to evaluate the progression or treatment effects . Various studies had demonstrated that 6 MWD depends on age, gender, presence of comorbidities such as diabetes , type of surgery and other factors .(3)

In diabetic patient one of the major cause of death and morbidity is Coronary artery disease .(2). Risk of cardiovascular disease is 2-4 times more in Diabetes Patients even after adjusting other cardiovascular risk factor diabetics doubles the mortality associated with cardiovascular events(8).High prevalence of cardiac risk factor is observed in patients with diabetic enrolled for CR as compared to no diabetes patients.(9) so diabetic patient should be evaluated at periodic interval during CR for progression and monitoring so the study was undertaken with the aim of to compare the FC after inpatient CRPs in CABG patients with and without diabetes using submaximal stress test .

Methodology:

The institutional ethical committee approved the study .A total of 32 participated {Experimental group -16 in diabetes group(DM) and Control group-16 in non-diabetes (non DM)}.stable CABG surgery patient completed phase 1 of cardiac rehabilitation were included. Patients having diabetes were grouped in diabetic group and those without diabetes into non diabetes group were enrolled. Exclusive criteria were graft taken from leg, lower leg amputation, unstable hemodynamic, PVD, BMI >30 kg/cm² and Lower limb disability were exclude .observational type of study with Duration of the study – 3 month and 6 MWT was performed at the end of phase 1 of cardiac rehabilitation. Phase 1 of cardiac rehabilitation includes breathing exercises, mobilization , risk modification and physical activity with exercise prescription depends on intensity was Perceived Exertion Below 13 (scale 6-20) or HR+30 BPM, DURATION SESSION FOR 3-5 MIN with total 20 min ,freq- 3-4 times per day (1-3 day)& 2 times after 4 th day .progression and control of intensity are subjective (6)

6 minute walk test (6MWT) protocol-test was performed as per ATS guidelines. A 15 minutes rest period was given to the patient before the start of 6MWT. Patients were explained about the 6MWT in a language that they understood. Patient's usual medicines were continued. The test was conducted in CVTS department. The walking straight corridor was 10 m in length. Marking were done at every 2 m distance. The end points of 10 metre were marked with a cone for turning purpose. A red colour tape was marked at both the ends of 10 metre pathway.

Patients were rested in a well-supported chair, near start point, for around 12-15 minutes. Basal parameters i.e. heart rate, blood pressure respiratory rate and rate of perceived exertion were recorded.

1. Then patient was made to walk so that they cover maximum distance in six minutes along 10 metre pathway with their self-selected pace. Instruction to the patient were given to report any discomfort, pain in chest, breathlessness, cramps in leg, walking unsteadily , sweating, pale appearance and allowed to stop if any of this symptoms produced. After Completion of the test immediately , the post-test parameters and total distance walked by the patient was recorded. 6 minute walk distance MWD was analyzed by multiplying number of laps x 20 meters + final partial lap distance. Monitoring was done till all the parameters recovered to normal. (10)

6 minute walk test was conducted baseline parameters were recorded and posttest parameters were recorded and distance was noted and percent prediction and mean peak oxygen uptake was calculated using equation (11).

Mean peak oxygen uptake “(mean peak VO₂)=4.948+0.023(6MWD)” as per Ross RM et al.

This equation can also be utilize for comparing the average peak aerobic capacity of patients with different diseases.(11)

The data was subjected to statistical analysis

Results:

Table 1

Shows Demographic data of subjects in Control and Experimental group

Variables	Experimental group	Control group	P values
	Mean ±SD	Mean ±SD	
Age	61.31±6.97	60.625±6.39	0.77
Height	161.56±7.42	161.75±7.13	0.94
Weight	62.56±8.57	63.25±6.60	0.80

Interpretation: No statistically significant difference in mean age, mean height and mean weight in between two groups

Table 2-Shows comparison of gender wise Distribution between Experimental and control groups .

Gender	Experimental group	Control group
Male	9(56.25%)	8(50%)
Female	7(43.75%)	8(50%)
Total	16((100%)	16 (100%)

No statistically significant difference in gender wise distribution between both groups . Thus gender distributions were matching at baselines.

Table 3 – distances walked during 6 MWT in Control and Experimental groups

Distances (metres)	Experimental group	Control group
100-200	4	1
201-300	1	2
301-400	7	6
401-500	4	7
500-600	0	0

Interpretation –distance walked in Experimental group was less as compared to Control group.

Table 4 –Comparing distance walked, % predicted distance and Mean peak VO₂ in Control and Experimental groups.

Parametres	Experimental group	Control group	P value
	Mean±SD	Mean±SD	
Distance walked (functional capacity)	312.62±108.99	381.81±77.3134	0.047
% predicted distance	61.46±22.84	75.44±11.99	0.038
Mean peak VO2 (ml/kg/min)	12.13±2.50	13.72±1.77	0.047

Interpretation –There is statically significant difference between Experimental group and Control group in mean distanced walked, % predicted distance walked and mean peak VO2

Discussion –

The study was conducted to compare the FC after Inpatient cardiac rehabilitation programme in CABG patients with and without diabetes using 6 minute walk tests. Study showed that mean distanced walked, % predicted distance walked and mean peak VO2 was statically significantly reduced in DM group as compared to non DM group.

Thus we have not came across any of the studies after phase 1 of CR so our results cannot be comparable with other studies but probable reason for decreased functional capacity may be related to previous activity levels of diabetic patients , number of other existing underlying pathology or co morbidities(neuropathy, hypertension, obesity autonomic dysfunction), low motivation for exercise, easy fatigability as mostly exercise intensity in phase 1 CR depends on self-perceived exertion , unhealthy lifestyle leading to reduced functional capacity .(1)

Most of the patient in DM group reported high rate of perceived exertion after completion of 6MWT test. Statically analysis of this parameter was not done but increased dyspnoea levels may be due to previous sedentary lifestyle or pathophysiology of DM .

Lower functional exercise capacity is observed in Experimental group patients as compared with Control group patients as assessed by mean peak oxygen uptake i.e average peak aerobic capacity. The probable reason for decreased Exercise capacity in Experimental group patients are related to many causes, such as decrease in myocardial perfusion, altered mitochondrial function, resistance to insulin, dysfunction of endothelial, and decreased tissue hemoglobin oxygen saturation,.(12).

Various previous studies also reported one of the determinant of oxygen uptake in patients with DM during exercise is peripheral mechanism and ability of skeletal muscles to extract oxygen for exercising. Presence of vascular dysfunction causing impaired vasodilation during exercise results in decreased exercise capacity in type 2 DM patient .(13)

Decrease in exercise capacity may be associated with poor glucose metabolism in DM patients . expression of GLUT4 -The transporter protein at the plasma membrane is related to skeletal muscle fibre volume.in DM patients .Increased stiffness of large conduit vessel related to Poor glycemic control . Aortic compliance plays an essential part by the modulation of coronary blood flow thus affecting the myocardial work capacity and resulting in reduced exercise capacity. Reduction in functional exercise capacity in type 2 DM is due to reduced perfusion of muscles at cellular level results in decreased ability to utilize oxygen by the body for carrying out various activities. Thus decreased ability of skeletal muscle to

utilize oxygen is one of the major limitation to exercise and for reduced distance in diabetic patients (13).

Studies had shown that exercise intolerance is seen in T2DM patients with Chronotropic Incompetence during exercise leading to a decreased quality of life and resulting in reduction in motivation to exercise. Reduction in motivation to exercise, results sedentary lifestyle, leading to increasing of various cardiovascular disease risk factors such as obesity, hypertension etc a vicious cycle develops which increases the risk factors and associated exercise intolerance. Exercise training results in modulating the balance of sympathetic and parasympathetic tone at rest and during exercise resulting in Improvement in exercise related chronotropic responses. baroreceptor sensitivity and HR variability are affected positively with exercise (14)

A study conducted by Sofia Toste concluded that at the completion of outpatient CRPs that both diabetes and non-diabetic groups responded similar in all the risk factors and evaluation of functional capacity which was statistically observed. The study also stated that functional capacity before start of phase 2 was less in diabetic group but latter improvement was seen. This is in accordance to our study where functional capacity is decreased at the end of phase 1 and i.e. before the start of phase 2.(8)

A study conducted by Mitchell St. Clair and concluded that significant benefit was seen in quality of life, weight reduction, exercise capacity, and modification of cardiac risk factors in Diabetics group, but was less improvement when compared with non-diabetics following CR. The factor for poorer improvement was non cardiac factors in diabetic group(9). Ray et al studied the effects of alirocumab on cardiovascular and metabolic outcomes after acute coronary syndrome in patients with or without diabetes (15). Similar studies on Alirocumab were reported by Jukema et al (16), Roe et al (17,18) and Steg et al (19). Bittner et al studied effect of alirocumab on lipoprotein(a) and cardiovascular risk after acute coronary syndrome (20). Goodman reflected on effects of alirocumab on cardiovascular events after coronary bypass surgery (21).

In other study in post MI after CR concluded that following acute MI, exercise capacity was lower in diabetic patients than did non-diabetic patients. After completing 8 week hospital-based cardiac rehabilitation after acute MI, both groups resulted in same improvement in outcome measure, however Diabetes patients has less capacity than the non-DM patients. This is because before the start of CR patient with DM had already reduced exercise capacity.

Conclusion-

Functional capacity as measured by 6MWT is statically significantly reduced in DM group as compared to non DM patients after phase 1 of cardiac rehabilitation. special attention should be given to this patients. So functional capacity evaluation and exercise training before CABG operation should be started to increase the functional exercise capacity to prevent various morbidities associated with diabetes. Special consideration should be given in such patients with co-morbidities during phase 1 rehabilitation and exercise limitation based on perceived exertion should not always be used. This patients also can have autonomic dysfunction so even HR to monitor exercise intensity is difficult. So due to this limitation we can start exercise training preoperatively to improve their functional capacity, improve autonomic dysfunction, also decrease the feeling of easy fatigability and to increase the adherence to exercise.

Limitations –

1. The left ventricular diastolic dysfunction and functional capacity correlation was not studied in both the groups as left ventricular diastolic dysfunction is good indicator of functional capacity..
2. Preoperative functional capacity was not measured and correlated.

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