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Influence of Body Mass Index (BMI) and Early Physiotherapy on Functional Exercise Capacity Following Coronary Artery Bypass Graft (CABG)

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ABSTRACT

Background: Extremely lower and extremely high body mass index (BMI) has been discussed as substantial risk factors for postoperative pulmonary complications and reduced functional capacity after cardiac surgery. The exact relationship between BMI and reduced functional capacity has not yet been defined.

Objective: To find out the relationship between BMI and functional exercise capacity measured by 6MWD following coronary artery bypass graft (CABG).

Methods: Patients posted for CABG were divided in to 4 groups based on the BMI. After the surgery Phase I cardiac rehabilitation was administered; the six minute walk test (6MWT) was performed preoperatively and on the 7th postoperative day.

Results: The distance walked during 6MWT was significantly reduced postoperatively in all the groups (P=.000). When multiple comparisons were done, the underweight subjects fared significantly worse when compared with the other groups. (P= .000).

Conclusion: There is marked reduction in functional exercise capacity following CABG. The most marked reduction was seen in the underweight group followed by the obese group.

KEYWORDS : Coronary artery bypass graft (CABG), Body Mass Index (BMI), Physical therapy, Functional exercise capacity

INTRODUCTION:

Coronary artery bypass grafting (CABG) is the major coronary artery revascularization procedure after any major vessel block. The advent of CABG was a landmark in the history of cardiac surgery that saved the lives of millions of people afflicted by coronary artery disease [1,2].The coronary artery bypass graft (CABG) surgery is the routine procedure for the treatment of patients who present with symptoms of myocardial ischemia. Annually, about 1 million surgeries are carried out in the world [3].

Respiratory complications following open heart surgery includes infections of the lung tissue, consolidation or collapse, pneumothorax and haeamothorax. Cardiovascular complications include deep vein thrombosis, pulmonary embolism, cardiac arrest, cardiac arrhythmias, tamponade, and emboli resulting in stroke. Infected or unhealed wound and adherent scar are also complications following CABG. Joint stiffness may involve the shoulder and shoulder girdle, thoracic spine and costovertebral joints. The muscle incised along with the leg and abdominal muscles become weak. Postural deformity includes protraction of the shoulder after sternotomy, scoliosis, and concavity on the operation site after lateral thorocotomy [4]. Postoperative pulmonary complications (PPCs) are the most common complications observed and managed after cardiothoracic surgery [5]. The functional exercise capacity of the patient will suffer a reduction after surgery because of the above mentioned problems.

Body Mass Index (BMI) expresses nutritional status, metabolic abnormalities, and general organ function of patients. Extremely thin (BMI< 18.5) and overly obese (BMI >30) patients may not tolerate cardiac surgery as well as other patients. They also respond differently to chest physical therapy. However the incidence and course of post operative chest complication in patient groups with different BMI undergoing CABG remains unclear [6].

Early physiotherapy otherwise known as phase I cardiac rehabilitation after CABG is necessary to assist individuals with heart disease in achieving optimal physical, psychological and functional status within the limits of their disease (WHO). According to American Heart Association (AHA), Phase I cardiac rehabilitation is the hospital inpatient phase and it's duration is 5-7 days. Phase I aims to minimize the effects of restriction to bed and ends with hospital discharge. Phase II (up to 12 wk) starts immediately after discharge and is known as the early out-patient phase. The aim of Phase II is to develop activities that simulate the metabolic expense of everyday activities. Phase III, known as the late out-patient phase is of variable duration and aims to develop exercises with more intensity. The fourth and final phase is known as the preventive phase and should have a starting date but not a finishing one, where the patient will choose a cyclical activity of greater intensity, carrying out the program at least 3 times a week throughout one's lifetime [7,8,9].

Early physiotherapy, including early ambulation during hospitalization, prescription of outpatient exercise, family education, and dietary and risk factor modification counselling, has been shown to improve outcomes after CABG. The benefits include better physical mobility and perceived health. A higher proportion of rehabilitated patients have been seen to be working at 3 years after CABG. The benefits of rehabilitation extend to the elderly and to women. Cardiac rehabilitation reinforces pharmacological therapy and smoking cessation and should be offered to all eligible patients after CABG[10]. Protocol guided, Phase I cardiac rehabilitation produces a much faster return of heart rate and blood pressure to baseline following the 6MWT, which suggests a training benefit among the patients [11]. Cardiac rehabilitation has important role in patient's recovery process.

BMI is a major predictor of prognosis after CABG. Studies have showed that extremely thin patients showed poor prognosis after CABG [12].

The six-minute walk test (6MWT) is now used routinely to demonstrate the physical and physiological benefits of CR following coronary intervention. 6MWT is commonly used to assess the functional status of patients with severe cardiopulmonary disease. In cardiac rehabilitation, functional capacity or functional status is most frequently associated with evaluation of physical capabilities through implementation of 6MWT.The six-minute walk test is a simple, inexpensive, and reproducible method for the assessment of exercise capacity. Implementation of the test does not require any advanced equipment or training for technicians. During the test, the patient walks the longest possible distance within the time of 6 minutes on a flat surface and can stop or slow down at any time and then resume walking during the test. The main result of the 6MWT is the distance covered by the

patient in 6 minutes. The 6MWT shows good correlation with the peak VO2 from cardiopulmonary exercise test and is much easier to perform, and it reflects well the daily activities of the patients.[13]

6MWT is a major predictor of prognosis after CABG. The 6MWT was well established to evaluate the functional capacity, especially in elderly patients with co morbidities. The 6MWT is a valid instrument to assess the progression of functional capacity for exercise in different clinical interventions[14]. Several studies have reported that the 6MWT is a reliable measure of increased mortality among cardiac patients, with the distance of less than 300 meters being a strong indicator of poor prognosis The aim of our study was to evaluate change of functional capacity based on BMI before and after CABG by using 6MWT, and in order to classify patients with a high risk and those with a low risk for developing complications in the inpatient and discharge phase. This information can be important for the physical therapist to prescribe and modify exercise in the immediate discharge or phase II cardiac rehabilitation.

METHODS:

We recruited 224 subjects who were posted for CABG, which included male and female subjects; subjects were selected from the population group satisfying the inclusion criteria from the patients of the department of cardiothoracic surgery in a teaching hospital, by using purposive sampling. The study was approved by the University ethics committee and informed written consent was obtained from all the subjects before recruitment into the study.

We included subjects whose age was between 40 to 70 years and patients with isolated CABG. We excluded the patients aged above 65 years and those with Chronic Obstructive Pulmonary Disease (COPD) recent myocardial infarction, renal failure, those with surgical procedures in addition to isolated CABG (e.g.CABG + valve replacement), and non co-operative patients.

BMI of patients posted for Coronary artery bypass grafting was calculated by the Quetelet Index {BMI=weight (kg)/height^2 (m^2)} and divided in to 4 groups. Group 1 BMI< 18.5, Group 2 BMI 18.5-24.9, Group 3 BMI 25-30 and Group 4 BMI >30. There were 53 patients in Group 1, 69 patients in group 2, 52 patients in group 3, and 50 patients in group 4.

All patients were seen before surgery by a physical therapist, who helped to expectorate excess bronchial secretions and explained the need for physiotherapy after surgery. Chest physical therapy (Incentive spirometer, coughing, huffing, chest manipulation, segmental expansion and mobilization) was given. All the patients received general information about postoperative routines from the physical therapist. Postoperatively the rehabilitation started 1 hour after extubation. Physiotherapy was given twice daily postoperatively and included early mobilization, change of position, breathing exercises and coughing techniques. 6MWT was done preoperatively and 5th post operative day, for 6MWT the subjects were instructed to walk as far as possible over the 50 meter marked corridor for six minutes. Subjects were asked to walk back and forth around the blocks kept in the corridor. Heart rate, blood pressure and rate of perceived exertion were noted at the start and end of the test. No encouragement was provided during the test. The distance covered in six minutes was calculated by using lap counter and markings in corridor in feet with fractions of less than 6 inch rounded to previous unit and more than 6 inch to the next [15,16].The 6MWT was well tolerated by all patients and no cardio pulmonary complications were reported.

All the four groups patients had the same physiotherapy till discharge from the hospital. Once the patient was discharged from the hospital, we calculated the difference in 6MWT distance pre operative to post operative in each group; comparison was done between the groups as well.

RESULTS:

Table 1 shows that there was no significant difference in the mean age of the study subjects in four groups and of the total sample, 82.1% was male and 17.9% female. The mean BMI of the underweight group was 17.47, normal weight group was 22.7, over weight group was 26.50 and obese was 31. 18 (Table-1).

Table 2 shows pre to post operative comparison of four groups, postoperatively the distance covered by the patients significantly reduced in all the four groups, with the underweight group showing the most reduction (figure 1).

When the groups were compared, the difference in 6 minute walk distance from the underweight group to normal weight group, overweight group and the obese groups were highly significant (P= .000). The normal weight to overweight group 6MWD was also highly significant. There was no significant difference in 6MWD from the overweight to obese group(Table 3).

DISCUSSION:

Our results indicate that post operatively the functional aerobic capacity, as expressed by distance walked during the 6MWT, is significantly reduced after CABG in all the four groups. Claudia Fiorina et al stated that that the functional capacity, as expressed by distance walked during the 6MWT, is significantly reduced shortly after cardiac surgery and quickly improves after physical training [17]. When multiple comparisons were done postoperatively in between the groups it was seen that the underweight group subjects covered very less distance compared to the other groups. This shows functional outcome in terms of six minute walk distance (6MWD) was significantly reduced in underweight group.

When we compare the other variables, incidence of atelectasis, pleural effusion and added sounds were more in underweight and obese group in the first 5 post operative days, when compared to the other groups.If additional risk factors are present besides an extreme low or high BMI, additional perioperative care may be needed. The investigations done showed that patients in the underweight BMI group experienced the greatest pulmonary complications after CABG. Our findings, however, imply that the obese and underweight patients require more pre operative as well as postoperative care. The frequency and duration of physical therapy can be increased in these two groups to reduce the hospital stay (phase 1 cardiac rehabilitation) and to reduce the economical burden of the patient.

CONCLUSION:

This study concludes that patients with low BMI are seen to be at higher risk for reduced functional outcome after cardiac surgery than normal or overweight patients. Low body weight (BMI <18.5 kg/m2) should be considered as a risk factor in preoperative risk stratification scores in cardiac surgery. This study recommends further research to evaluate the pulmonary complications based on pulmonary function test values and to find out the functional out come by using other scales.

Table- 1: Demographic distribution of patients

Variable	Group I (BMI < 18.5) No: 53	Group II (BMI 18.5-24.9) No: 69	Group III (BMI 25-30) No: 52	Group IV (BMI > 30) No:50
Age Mean	53.91	54.94	55.17	57.84
Gender M: F	33:20	64:05	48:04	39:11
BMI Mean	17.47	22.27	26.50	31.18
E F Mean	47.34	53.57	51.94	44.62

Table- 2: Pre- Post comparison of 6MWT

		N	Mean	Std. Deviation	change (%)	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	t value	p
Group 1	6MWTpre	53	367.45	45.134	20.47	355.01	379.89	11.397	.000
	6MWTpost	53	292.25	55.930		276.83	307.66		HS
Group 2	6MWTpre	69	385.94	47.560	5.67	374.52	397.37	7.566	.000
	6MWTpost	69	364.06	50.848		351.84	376.27		HS
Group 3	6MWTpre	52	386.98	40.571	13.06	375.69	398.28	9.136	.000
	6MWTpost	52	336.44	46.845		323.40	349.48		HS
Group 4	6MWTpre	50	367.82	45.022	10.36	355.02	380.62	6.827	.000
	6MWTpost	50	329.70	56.019		313.78	345.62		HS

Figure -1: Pre-Post Comparison of 6MWT

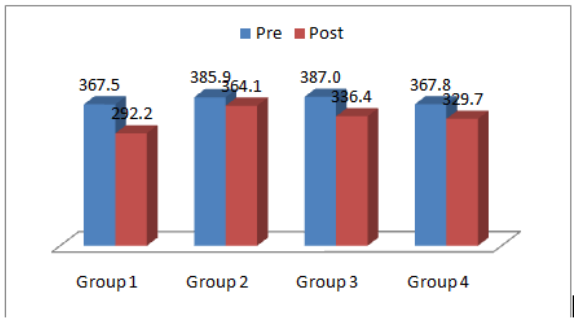

Table- 3: Comparison of 6MWD between the groups
Bonferroni : change 6mwt
Multiple Comparisons

		p	
Group 1	Group 2	.000	HS
	Group 3	.006	HS
	Group 4	.000	HS
Group 2	Group 3	.000	HS
	Group 4	.133	
Group 3	Group 4	.599	

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