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IMPACT OF BODY MASS INDEX (BMI) AND DURATION OF PHASE I CARDIAC REHABILITATION AFTER CORONARY ARTERY BYPSS GRAFT (CABG).

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ABSTRACT

Extremely thin and overly obese patients may not tolerate cardiac surgery as well as other patients. The exact relationship between BMI and duration of Phase I cardiac rehabilitation has not yet been defined. Our objective was to assess the influence of BMI on duration of Phase I cardiac rehabilitation after Coronary Artery Bypass Graft (CABG). Patients posted for CABG were divided in to 4 groups based on the BMI. After the surgery Phase I cardiac rehabilitation was administered. Arterial blood gas values and duration of hospital stay were collected from all four groups and analyzed. Pulmonary complications were more in underweight group when compared to the other groups and the normal weight group spend the least number of days in hospital when compared with the other groups (P=.000).The duration of Phase I cardiac rehabilitation will vary with the BMI of the patients.

KEYWORDS: Body Mass Index (BMI), Coronary Artery Bypass Graft (CABG), Phase-I Cardiac rehabilitation.

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INTRODUCTION

India has a large population of Coronary Artery Disease (CAD) patients. In many studies from India, the percentage of patients below the age of 45 years suffering from acute Myocardial Infarction is reported as high as 25-40%. At one point of time in the course of CAD, almost all patients undergo Coronary Artery Bypass Graft (CABG) surgery[1]. In India around 60,000 CABGs were performed in the year 2010[2]. Coronary artery bypass surgery remains an established form of treatment for coronary artery disease, and the majority of coronary surgical procedures are performed for multiple vessel disease. Overall, the mortality rate of coronary artery surgery is low. In general, CABG improves the chances of survival of patients who are at high risk (generally triple or higher bypass), though statistically after about five years the difference in survival rate between those who have had surgery and those treated by drug therapy diminishes[3,4,5]. Care after surgery may include follow-up visits with doctors, lifestyle changes to prevent further progression of CAD, and taking medicines as prescribed. Postoperative pulmonary complications (PPCs) are the most common complications observed and managed after cardiothoracic surgery[6]. Despite numerous advances in preoperative, intra operative, and postoperative care, PPCs continue to contribute to patient morbidity and mortality, length of stay, and overall use of resources. Other complications like poor wound healing, joint stiffness, muscle weakness and postural abnormalities are also common[7]. 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 post operative chest complications in patient groups with different BMI undergoing CABG remain unclear[8, 9]. Cardiac rehabilitation is a multidisciplinary program of education and exercise established 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 the 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 week) 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 (variable duration) 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.[10,11,12].

Phase I Cardiac rehabilitation, 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 are 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[13]. 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[14] BMI is a major predictor of prognosis after CABG. Studies showed that extremely thin patients showed poor prognosis after CABG. The aim of our study was to find out the duration of the hospital inpatient period, based on BMI, and in order to classify patients with a high risk and those with a low risk for developing complications in the Phase I period. This information can be important for the physical therapist to modify or to increase the frequency of the treatment according to the BMI of the patients.

METHODS

We recruited 246 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, 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. After discounting the dropouts in each group, the final outcome was measured, for 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 an hour after extubation. Physiotherapy was given twice daily postoperatively and included early mobilization, change of position, breathing exercises and coughing techniques. The vital parameters were noted every day, whereas the arterial blood gas analysis and chest X-ray was done once preoperatively before induction of anaesthesia and after surgery for three consecutive days till the third postoperative day. The blood sample for ABG was taken on the post operative days 4 hours after chest physiotherapy, through an arterial line by a trained nurse.

All the four groups patients had the same physiotherapy till discharge from the hospital. Before discharge all the patient underwent low level exercise training. Criteria for discharge from hospital to home included stable cardiac rhythm, an oral temperature of less than 37.5°C (99°F), a haematocrit value of 25% or more, oral intake of at least 1000 calories per day, successful completion of an exercise test that included independent ambulation and the ability to climb one flight of stairs, no significant wound complications, and adequate home support systems. Patients not meeting these criteria were not discharged from the hospital but referred to extended phase 1 cardiac rehabilitation. The individual surgeon was responsible for determining whether a patient should be sent home, have the hospital stay extended, or not be discharged. Once the patient was discharged from the hospital, we calculated the number of days spent in the Coronary care unit (CCU), ward and hospital, and found out which group had early discharge.

RESULTS

In this study base line assessment was done 246 subjects, after drop out in each group final outcome was measured from 224 subjects. . The demographic data is illustrated in Table 1

Table 1
Demographic distribution of patients

	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

The mean age of the population ranged from 53.91-57.84. There were total 184 males and 40 females. Pre operative ABG was taken before induction of the anaesthesia; preoperatively there were very few patients with respiratory acidosis and alkalosis. Pre operatively 28% of the patients in the obese group had respiratory acidosis and 12% of the obese group had respiratory alkalosis. None of the patients in the other groups had either respiratory acidosis or respiratory alkalosis pre operatively. But on the third post operative day the incidence of respiratory acidosis in the underweight group was 53%, in normal weight group 1%, overweight group 2% and obese group 23%. The incidence of respiratory alkalosis in underweight group was 23% and in obese 12% with the other two groups having no cases of respiratory alkalosis (Table 2).

Table 2
ABG Analysis of four groups

	Respiratory acidosis (%)				**Respiratory alkalosis (%)**			
	Group 1	Group 2	Group 3	Group 4	Group 1	Group 2	Group 3	Group 4
Pre-operative	0	0	0	28%	0	0	0	12%
Post-operative	53%	1%	2%	36%	23%	0	0	12%

The length of stay in CCU, ward and total hospital duration was tabulated and multiple comparison done using the Bonferroni test. The results showed that the normal weight group spent less days in CCU and ward and their total duration of hospital was very less compared with the underweight and obese groups. When the duration of stay in CCU was analysed, the difference from underweight to normal weight and overweight and obese was highly significant (P= .000). There was no significant difference between normal weight to over weight (Table 3). The length of stay of patient in the ward was highly significant (P=.000) when the underweight and normal weight groups were compared. There was no significant difference between underweight to overweight and obese. Finally we analysed the total number of days the patients spent in hospital post operatively till discharge. The difference was highly significant when underweight and normal weight were compared, and also when overweight and obese were compared (P=.000) Normal weight to overweight and obese was also highly significant (P=.000). There was no significant difference between overweight to obese (Table 3)

Table 3
Duration of hospital stay -Multiple comparisons

Dependent Variable	**(I) Groups**	**(J) Groups**	**Mean Difference (I-J)**	**Std.Error**	**P**	
CCU	Group 1	Group 2	1.202	.122	.000	HS
		Group 3	.899	.130	.000	HS
		Group 4	.605	.132	.000	HS
	Group 2	Group 3	-.303	.123	.086	
		Group 4	-.597	.124	.000	HS
	Group 3	Group 4	-.294	.132	.163	
Ward	Group 1	Group 2	1.657	.174	.000	HS
		Group 3	.162	.186	1.000	
		Group 4	.405	.188	.193	
	Group 2	Group 3	-1.496	.175	.000	HS
		Group 4	-1.252	.177	.000	HS
	Group 3	Group 4	.243	.189	1.000	
Total Hospital	Group 1	Group 2	2.840	.214	.000	HS
		Group 3	.984	.229	.000	HS
		Group 4	.991	.231	.000	HS
	Group 2	Group 3	-1.856	.215	.000	HS
		Group 4	-1.849	.218	.000	HS
	Group 3	Group 4	.007	.232	1.000	

DISCUSSION

In contrast to earlier studies, our results indicate that the presence or absence of certain preoperative risk factors can be used to predict which patients will require prolonged Phase I cardiac rehabilitation after CABG. We found length of stay and CCU stay were the longest in the underweight group. Previous research has reported that underweight patients had longer length of stay after surgery than did overweight or obese patients [15, 16, 17]. Time spent in the intensive care unit and length of hospitalization was decreased in the normal weight group. The incidence of respiratory acidosis in Underweight group on third postoperative day was 53%, followed by 36% in patients. The incidence of respiratory alkalosis was maximum (23%) in the underweight group followed by 12% in the obese group on the third post operative day. The 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. These complications therefore resulted in longer hospital length of stay and CCU staylf. Our findings, however, imply that the obese and underweight patient require more pre operative as well as postoperative care. The frequency and duration of chest physical therapy can be increased in these two groups to reduce the hospital stay and to reduce the economical burden of the patient. This study only examined postoperative inpatient outcome, which was relatively short period. Additional research using longer term follow-up is recommended.

CONCLUSION

This study concludes that patients with low BMI are seen to be at higher risk for postoperative complications after cardiac surgery than normal or overweight patients and that result in increased duration in the phase 1 cardiac rehabilitation program. 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 only examined Phase I cardiac rehabilitation outcome, which was relatively short period. Additional research using longer term follow-up is recommended. This study recommends further research to find out the pulmonary complications based on pulmonary function test values and to find out the difference in post pulmonary complications in two different types of CABG. Further research is needed to analyse the 6 minute walk test performance (6MWT) in underweight, normal weight and obese patients with CABG to find out the functional limitation and thus a predictor of mobility.

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