BODY MASS INDEX (BMI) AS A FACTOR INFLUENCING POST SURGICAL EVENTS IN PATIENTS WITH CORONARY ARTERY BYPASS GRAFTING (CABG)

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ABSTRACT

Objectives: *To study association between obesity and post surgical events such as length of ICU and hospital stay, morbidity and complications among CABG patients.*

Material and Methods: *The study was conducted in Iran during June - November 2006. 219 patients of elective CABG participated. Data regarding anthropometric indices, surgical and Post surgical observations for total time for surgery, time of stay in ICU; total length of Hospital stay; time of mechanical ventilation and occurrence of complications were obtained.*

Results: *Women were overweight (49.2%) and obese (34.4 %) in higher percentage than men (42.1 and 20.6%). Shoulder height; shoulder waist and waist height ratios were linearly proportional to increase in BMI. Waist hip ratio had poor association with BMI in both males and females (P< 0.5). Mean surgery time was 3.62 ± 0.553, 3.77 ± 0.522 and 4.22 ± 0.856 hrs for normal, over weight and obese patients. Mean ventilation time was significantly low (7. 64 ± 2.725 hrs.) for overweight subjects. Occurrence of Arrhythmia (34.7 Vs 2.7 %) delirium (11.6 & 4.0%), and need for re-intubation (9.3 and 0.0%) was also higher in obese. Mean time of ICU stay was 55.49 ± 18.381hrs, obese patients required significantly longer time (62.48 ± 20.494 hrs). This seemed to influence number of days in hospital. The mean morbidity rate was higher in ICU (22.0%) as compared to post surgical wards (1.2%). Subjects with normal BMI occupied the central position between obese and overweight subjects for most parameters.*

Conclusion: *Overweight subjects exhibited better performance than those who were normal or obese signifying influence of body weight on post surgical prognosis. Presence of small proportion of adipose tissue probably buffers against the traumatic effects of surgery.*

Key words: *BMI, shoulder height ratio, morbidity rate, ICU stay, surgery time, CABG.*

INTRODUCTION

Obesity is a common problem in the world with an estimated population of more than one billion over-weight adults, out of which 300 million are obese[1,2]. Prevalence of obesity has rapidly increased in both developed and developing countries[3,4]. Excess body fat around abdomen, gluteal, shoulders and sub-scapular regions is indicative of obesity. Reports from Islamic Republic of Iran suggest a high prevalence of obesity, which is expected to rise in near future[5-9]. Prevalence of obesity and overweight in population aged 20 years and above is 23 and 40 percent respectively in Tehran[5]. Further, overweight in Iranian women population is significantly higher than that in American counterpart (68.6% vs. 61.6%)[3, 5].

Recent data indicate an increasing rate of mortality from CVD in Islamic Republic of Iran; the major cause is attributed to obesity[10-12]. The risk for CVD among obese exhibits a linear relationship, since a strong association between degree of obesity and LV mass has been reported[13]. The outcome of surgical intervention for CVD is also demonstrated to be under the influence of body weights of patients. The association of obesity with utilization of coronary procedures is increasingly pertinent because certain procedures

DEMOGRAPHIC DETAILS: MARITAL STATUS, EMPLOYMENT AND EDUCATIONAL LEVEL OF SELECTED CARDIAC PATIENTS

Variables		Gender	
		Male	Female
Participants (%)		66.2	33.8
Age		58.3 ±10.38	62.1 ± 8.94
Marital status (%)	Married	95.9	82.4
	Not married	0	1.4
	Widowed	4.1	16.2
Employment (%)	Officer	32.7	5.6
	Laborers	18.3	3.7
	Housewife	0	83
	Business	20	3.7
	Unemployed	1.3	0
	Farmer	20.2	3.7
Education (%)	Illiterate	24.8	56.6
	Primary	36.2	28.3
	High school	13.3	9.4
	P U C	14.3	5.7
	Graduates	11.4	0
Living arrangement (%)	Spouse	59.8	48.2
	Children	2.8	17.9
	Relative	1.9	0
	Alone	35.5	10.7
	Spouse and children	27.4	23.2

Table 1

have been perceived as riskier as the patient's body weight increases[14].

Abnormal body mass index (BMI) is frequently associated to operative mortality that includes causes like infections of both deep and superficial wounds, the opening at saphenous vein harvest site, pneumonia and sepsis. Other causes are atrial/ ventricular arrhythmias, stroke, renal failure, adult respiratory distress syndrome and pulmonary embolism. Need for prolonged mechanical ventilation is high among patients with abnormal body weights[14-17].

It has been demonstrated that obesity in general, causes prolonged sickness and delayed prognosis. In particular, there is ongoing debate about obesity as a risk factor for adverse outcomes after CABG[14, 15]. However, the exact relationship is yet to be defined. These indicate the need for an early re-exploration and cause effective management protocols.

The present study was therefore an attempt to analyze the operative and post operative events in patients after cardiac surgery to determine the probable association between obesity and complications leading to the need for intensive care extending hospital stay.

MATERIAL AND METHODS

The study was carried out during June to November 2006 in two hospitals from IRAN (government and private). After receiving approval from Ethical Committee (Mashhad Medical University), 1116 patients who were suggested cardiac surgery were contacted and 219 patients both males and females who fitted in to our selection criteria were included for the study. Following were the selection criterias:

Inclusion criteria: Men and women aged 30 years and above, those on their first surgical treatment - CABG Surgery and their voluntary willingness to participate in the study were included.

Exclusion criteria: Patients with complications such as acute respiratory problem, kidney problem, cancer, liver problem, amputation, neuro-psychopathy disease and prior cardiac surgery, or any other surgeries conducted within 6 months, patients on cortisone treatment were not included.

General information: Information about marital

COMPARISON OF SELECTED ANTHROPOMETRIC PARAMETERS AMONG THE CABG, SUBJECTS

Parameter	Gender	Mean	Std. Deviation	t	p
Height (cms)	Female	155.98	6.776	9.559	.000
	male	166.21	6.611		
Weight (Kg)	Female	69.54	11.084	1.824	.070
	male	72.89	11.875		
Shoulder(cms)	female	40.11	3.595	7.695	.000
	male	44.66	3.258		
MUAC (cms)	female	30.01	3.515	.487	.627
	male	29.71	3.529		
Hip Circumference	female	103.36	8.845	3.155	.002
	male	98.77	8.111		
Waist Circumference(cms)	female	100.56	11.610	1.241	.217
	male	98.02	11.712		
Triceps (mm)	female	21.65	5.804	6.323	.000
	male	15.51	5.321		
Biceps (mm)	Female	12.69	4.658	4.317	.000
	male	9.34	4.206		

Table 2

status, education, employment, living arrangements of the selected patients was obtained using a structured self-reporting questionnaire.

Anthropometric assessment: Height was measured using a standard height measuring scale; weight was measured using a digital balance (Seca 770). MUAC, Hip and Waist circumferences and shoulder width were measured using nonflexible fiber glace tape to the nearest of 0.1 cm. Skin fold at biceps and triceps were measured using skin fold caliper (Caliper C-120 make USA). Standard methods as described by Jelliffe (1966) were adopted[18].

Surgical and Post surgical observations and records: Each selected subject was screened for few selected criterias and the observations were carefully recorded. The following criteria were used:

Surgical events- Total time for surgery.

Post surgical events- Time of stay in ICU; Time of mechanical ventilation; Complications (Arrhythmia, Delirium, Re intubations, Hemorrhage & Re operation) and Total length of Hospital stay.

General information and the anthropometric assessment were obtained from each selected participant one-week before surgery. The data was analyzed for statistics using SPSS; t test and analysis of variance were used for comparing the means. Tukey's method for significance was employed. Pearson's correlation test was used to identify the relationship among few risk factors.

RESULTS

It is evident from the present study that the probable incidence of elective surgical intervention in patients for CABG without complications was 19.62% in the selected Iran province during the study period. Roughly the

CLASSIFICATION OF SELECTED SUBJECTS INTO NORMAL AND OBESE ACCORDING TO BMI

BMI classification		% Distribution : Gender		
		Female	Male	Total
Normal	18.5 - 24.99	16.4	37.4	29.8
Over weight	25.0 - 29.99	49.2	42.1	44.6
Obese	>30	34.4	20.6	25.6

Table 3

DISPERSION PATTERN OF SELECTED INDICES OF SUBJECTS IN DIFFERENT BMI CATEGORY

Indices	Gender	BMI classification			Mean ± SD	F	Sig
		18.5-24	24.1-30	>30			
S/Ht	Male	0.257 ± 0.019	0.270 ± 0.018	0.285 ± 0.019	0.268 ± 0.019	15.733	.000
	Female	0.248 ± 0.022	0.256 ± 0.018	0.269 ± 0.019	0.259 ± 0.20	5.354	.014
S /Wt	Male	0.694 ± 0.091	0.600 ± 0.066	0.540 ± 0.049	0.624 ± 0.094	35.47	.000
	Female	0.686 ± 0.075	0.601 ± 0.051	0.529 ± 0.062	0.591 ± 0.08	18.926	.000
S/Waist	Male	0.485 ± 0.098	0.446 ± 0.034	0.428 ± 0.032	0.458 ± 0.07	6.414	.003
	Female	0.442 ± 0.025	0.407 ± 0.048	0.386 ± 0.031	0.406 ± 0.043	7.174	.003
Waist/ Ht	Male	0.540 ± 0.063	0.607 ± 0.035	0.667 ± 0.057	0.592 ± 0.07	45.149	.000
	Female	0.561 ± 0.051	0.634 ± 0.076	0.700 ± 0.054	0.643 ± 0.08	16.892	.000
Waist/ hip	Male	0.970 ± 0.101	1.026 ± 0.057	1.028 ± 0.078	1.000 ± 0.084	5.83	.015
	Female	0.947 ± 0.076	0.971 ± 0.082	0.991 ± 0.073	0.973 ± 0.078	1.158	.389

Table 4

proportion of male to females undergoing CABG was 2:1. The demographic details of selected patients is presented in table 1, the mean age of males and females varied from 58.3 ±10.38 to 62.1 ± 8.94 years, females were older than males. Ninety-six and eighty two percent of males and females were married, wherein 48 and 60 percent lived with spouses and 23.2 and 27.4 percent of subjects respectively lived with spouses and children. More than fifty percent of females and twenty five percent of males were illiterate, only a small percent of males were graduates. Majority of females (83%) were housewives while men were laborers, farmers and unemployed, the other jobs held (32%) were officials or businessmen. Mean anthropometric measurements of the subjects and few selected indices are presented in tables 2 and 3. The mean height, weight, MUAC and shoulder width were significantly different for males and females. Females had lower values than those for men, however the hip and waist circumferences as well as the fat fold at biceps and triceps were

TOTAL TIME FOR SURGERY AND MEAN DURATION OF STAY IN ICU AND SURGICAL WARDS OF PATIENTS

VARIABLE	BMI Classification	Mean	Std. Deviation	F	SIG
Time for surgery. Hrs.	18.5-24.99	3.62 [a]	.55	10.979	.000
	25-29.99	3.77 [a]	.522		
	>30	4.22 [b]	.856		
	Mean	3.84	.669		
Time of ventilation In ICU Hrs	18.5-24.99	8.42 [a]	3.805	4.579	.012
	25-29.99	7.64 [a]	2.725		
	>30	9.23 [b]	3.551		
	Mean	8.28	3.337		
Length of stay in ICU Hrs.	18.5-24.99	53.40 [a]	20.926	4.365	.014
	25-29.99	52.88 [a]	13.994		
	>30	62.48 [b]	20.494		
	Mean	55.49	18.381		
Length of stay in hospital Days	18.5-24.99	7.87 [a]	1.213	4.648	.011
	25-29.99	7.78 [a]	1.306		
	>30	8.55 [b]	1.637		
	Mean	8.01	1.405		

Mean followed by different superscript are significantly different while those followed by same superscript are not different.

Table 5

COMPLICATIONS DURING THE ICU STAY IN POST SURGICAL CABG PATIENTS ACCORDING TO BODYWEIGHT

VARIABLE	Classification BMI			Mean
	18.5 - 24.99	25.00 - 29.99	>30	
Arrhythmia	12.0%	2.7%	34.9%	13.7%
Delirium	0%	4.0%	11.6%	4.8%
Re intubations	2.0%	.0%	9.3%	3.0%
Hemorrhage & Re operation	.0%	1.3%	.0%	.6%
Non complication	86.0%	92.0%	44.2%	78.0%
Total morbidity	7.0%	2.7%	18.6%	22.0%

Table 6

significantly higher in females compared to males. The mean BMI was 28.7 ± 4.575 to 26.5 ± 4.040 for female and males respectively wherein females had significantly higher BMI, similarly body fat percent was also found to be significantly higher (43.2± 6.138; 39.7±5.219) it is evidently the gender based differences. Indices such as shoulder height (0.25 ± 0.021, 0.27± 0.021) and shoulder waist ratios (0.40 ±0.038, 0.46 ± 0.075) indicated significant differences between the male and females. Values for males were higher than those for females suggesting them to be gender sensitive parameters. The mean morbidity rate was higher in ICU (22.0%) as compared to post surgical wards (1.2%). The type of complications remained similar except for a higher occurrence of infections in post surgical wards.

Prevalence of obesity and overweight according to BMI is presented in table 3. Nearly 70% of the subjects had body weights above desirable level. Women were overweight (49.2%) and obese (34.4 %) in higher proportions than men (42.1 and 20.6%), insinuating women to supersede men in over weight and obesity. It can be seen (table 4) that shoulder height; shoulder waist and waist height ratios were linearly proportional to the increase in BMI while shoulder weight ratio was inversely related. The differences in indices across the BMI categories were highly significant statistically. This indicates that the indices based on shoulder width are competitive and can be suitable candidate to identify the risk of CHD. Waist hip ratio that is widely used parameter for assessment exhibited poor association and the differences within the BMI category for females were not significant (P< 0.5). It can be said that the high shoulder height and shoulder waist ratios may be valuable indicators for CVD.

Important events that followed surgery were compared among the patients with different BMI; it can be seen from table 6 that the time required for surgery was influenced by BMI. Mean surgery time for patients with normal body weights (BMI 18.5 – 25) was 3.62 ± 0.553 hours, which increased significantly with increase in BMI (3.77 ± 0.522 and 4.22 ± 0.856 hrs for over weight and obese respectively). It is further glaring fact that the mechanical ventilation time required immediate post surgically was also significantly higher for subject with BMI > 30. Mean time for ventilation for patient with normal BMI and also those with BMI 25 - 30 (over weight) was 8.42 ± 3.805 and 7. 64 ± 2.725 hours. A perusal of table 5 suggests that length of ICU stay was high in-patient with BMI >30 thereby extending total hospital stay. Although statistically not significant, there was a marked difference in the time of ventilation required, ICU stay and total days of hospital stay among normal and overweight individuals. It appeared that over weight subjects (25.00-29.99)fared better than those with normal BMI.

Table 6 also indicates the frequency of occurrence of post-surgical complications and mean morbidity rate in subjects during ICU stay. The common problems encountered were arrhythmia, delirium, re-intubation and hemorrhage requiring re operations in order of occurrence. It is note worthy that 78% of subjects recovered without any complications, majority of these subjects were overweight followed by normal weight. Arrhythmia was the major event and occurred in 13.7% of patients, subjects with BMI >30 appeared to suffer at higher frequency (34.7 Vs 2.7 % in obese and overweight subjects). The problem of next importance was delirium, although overall occurrence was 4.8%, obese subjects experienced in markedly higher percentage (11.6) than the overweight subjects (4.0). Re-intubations were also seen in higher percentage of obese subjects. The least occurrence was hemorrhage-requiring re-operation (1.3%); readmission to ICU after one to two days from the ward was less frequent in normal and obese subjects.

Pearson`s correlation between few selected

variables such as BMI, gender, age, number of arteries grafted, length of stay in ICU and hospital and the complications encountered during the stay brought forth interesting results (table 8). It is evident that BMI is an important factor affecting post surgical events. Among the selected variables length of stay in ICU and complications in ICU correlated significantly to BMI. Age was yet another factor that exhibited correlation with complications in the ICU and affected ICU stay thereby length of hospital stay was longer. Female patients were highly susceptible to post surgical events than those of male subjects.

DISCUSSION

Body weight is often considered to influence peri-operative events and postoperative prognosis. Body weights on either extreme, indicating under weight and obesity are frequently associated with worst prognosis. Literature suggests that cachectic patients with CHF have physiologic, biochemical and nuero-hormonal effects leading to hemodynamic, immunologic, endocrine, metabolic and muscular abnormalities[19]. A logistic comparison of BMI and risk adjusted mortality in a large population of 16,218 CABG patients, Ranucci et al[20] reported that higher proportion of under weight patients had post operative cerbrovacular accidents and required blood transfusion, re-operation while those with higher BMI had deep sternal infections[14,20]. The present study brought forth results similar to the studies reported, the mean surgery time and mechanical ventilation time increased linearly with BMI and was highest in subject with BMI > 30.

Age is a powerful influencing factor for operative risks, subjects both men and women aged 65 to 80 yrs required longer hospitalization. However the risk associations become compounded when BMI more than 35kg/m^2 co-occur in aged subjects[21-24]. Gender was also a contending variable affecting disease events and prognosis[23]. Our observations demonstrated that influence of age per se was small while gender based influence was significant. Female patients had higher proportions of complications as compared to males (correlation results). It could be probable because age structure of the participants was 58.3 ±10.38 and 62.1 ± 8.94 years for males and females respectively. Younger age of subjects may have shown lower incidences of complications. Further, a higher proportion of women were over weight (49.2%) and obese (34.4%) as compared to men, perhaps this could be a reason for the higher occurrence of complications among women.

Prognostic factors include preoperative LVEF < 35%, non-elective operation, and prolonged cardiopulmonary bypass time, arrhythmia was the most common complication reported[25]. We observed that the length of ICU and hospital stay was proportional to increased body weights; however the overweight subjects had shorter stay. Incidence of arrhythmia and delirium were13.7% and 11.6%, the rate of occurrence were essentially similar to those reported by others[25]. This had affected total days of stay in ICU and hospital. Occurrence of infection, re-admission to ICU was found proportionately higher among normal and obese subjects; observations were essentially similar to those reported by others[20, 21].

Although BMI is widely used parameter for assessment and prediction for CVD, is often merited as a poor tool. Waist circumference and waist hip ratio are the alternative parameter employed, nevertheless it is often expressed a need for an additional tool. Our results suggests shoulder height and shoulder waist ratios to be

COMPLICATION DURING THE POST SURGICAL PERIOD OF CABG PATIENTS WHILE STAYING IN WARD * ACCORDING TO BMI

Complications	Classification BMI%			Mean
	18.5 - 24.99	25.00 - 29.99	>30	
Arrhythmia	16.0%	2.7%	11.6%	8.9%
Delirium	2.0%	.0%	2.3%	1.2%
Hemorrhage	.0%	.0%	2.3%	.6%
Infection	4.0%	.0%	9.3%	3.6%
Pneumonia	.0%	.0%	4.7%	1.2%
Pneumothorax & Re ICU	2.0%	.0%	2.3%	1.2%
Non complication	76.0%	97.3%	67.4%	83.3%

Table 7

PEARSON CORRELATION MATRIX SHOWING ASSOCIATIONS BETWEEN IMPORTANT FACTORS INCLUDING BMI

Variable	BMI	Age	Gender	NO graft	LO ICU	LOH	C.ICU	C.WARD
Age	.036	1.00						
Gender	-.242(**)	-.176(**)	1.00					
NO graft	.061	.044	-.004	1.00				
LO ICU	.203(**)	.272(**)	-.174(*)	.257(**)	1.00			
LOH	.123	.230(**)	.272(**)	-.174(*)	.257(**)	.000		
C .ICU	-.365(**)	-.245(**)	.153(*)	-.001	-.291(**)	-.245(**)	1.00	
C.WARD	-.146	-.119	-.041	077	-.167(*)	-.033	.241(**)	1.00

** p<0.01, * p< 0.05

LOH = length of Hospital stay, LO ICU = length of ICU stay

C.ICU = Complication of ICU, C.WARD = Complication of ward

Table 8

valuable indicators for CVD and require further investigation to establish its validity.

The present study also demonstrated a high correlation between age of the patients and important factors like complications in the ICU, length of stay in ICU and the total length of hospital stay. Thus the study revealed the importance of obesity and age as factors affecting peri-surgical events and post surgical prognosis. The striking observation from the study was that the 'no-complication' group included higher percentage of subjects from over weight followed by normal. Over weight subjects exhibited better performance than those who were normal or obese signifying influence of body weight on post surgical prognosis. Lower percentage of complications seen in over weight subjects exhibited a safety edge that is accorded by the presence of adipose tissue as buffer against the traumatic effects of surgery.

CONCLUSION

Overweight subjects exhibited better performance than those who were normal or obese signifying influence of body weight on post surgical prognosis. Presence of small proportion of adipose tissue probably buffers against the traumatic effects of surgery.

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