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The Effect of Obesity on Mortality And Morbidity after Isolated Coronary Artery Bypass Grafting Surgery

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ABSTRACT

Background: A retrospective study was conducted to determine whether obesity is a predictor of mortality, morbidity or early readmission to hospital after coronary artery bypass graft (CABG).

Method: We analyzed a large cohort of 1057 patients who had undergone isolated CABG. BMI (body mass index) was used as the measure of obesity. The preoperative, intera operative and postoperative risk factors as well as the complication and 30-day mortality rates were compared between the two groups (624 (65.5%) normal-weight and 328 (34.5%) obese patients). Chi square test and logistic regression were used in univariate and multivariate respectively.

Results: Of the 1057 patients, 59% had a normal weight and 31% were obese. An increased BMI did not increase the risk of 30-day mortality. In addition, increased BMI was not a predictor of the major complications; arrhythmia, renal complications, neurological complications, pulmonary embolism (PE) except myocardial infarction(MI) (1.8% vs 0.3% with p-value= 0.015). Also investigation on mechanical ventilation time, Reintubation, length of stay in ICU, length of stay in hospital, and readmitting as postoperative variables revealed no significant difference on these two groups(normal-weight and obese patients)

Conclusion: Obesity increased myocardial infarction after CABG, but it did not affect the other situations.

► *Implication for health policy/practice/research/medical education:*
It is intended to determine whether obesity is a predictor of mortality, morbidity or early readmission to hospital after CABG.

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Introduction

The rate and number of obese persons in all societies have been increasing with epidemic speed (1) Obesity is defined by the American Heart Association (AHA) as a major risk factor for coronary artery disease (2) However, recent studies have shown no significant association between obesity and major cardiac surgical morbidity and mortality (3, 4). This study was designed to determine the influence of body size on operative mortality, morbidity, length of stay in hospital, and readmission after isolated CABG and to assess whether obesity was a risk factor for bypass surgery.

Materials and Methods

The present study relates to the collection and analysis of data of 1057 consecutive patients who underwent isolated CABG procedure at Seyed Al-shohada Cardiovascular Center and Imam Khomeini hospitals in Urmia, between July 2004 and November 2011.

The BMI is defined as the weight in kilograms divided by the height in meters squared (5) Initially, all the patients were divided into four groups on the basis of their BMI. These were underweight (BMI<20 kg/m^2), normal weight (BMI=20-30 kg/m^2), obese (BMI=30-40kg/m^2) , and severe obese(BMI> 40) (5) The patients with a normal weight and obese and not underweight and severe obese were then considered for the study.

Finally, the study included a total of 952 of 1057 patients in two groups of normal weight and obese were included

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Table 1. Preoperative patient's variables

Variable	Normal weight patients (n=624)	Obese patients (n=328)	P value
Age(year ± SD)	59±9	58±8	NS
Sex (m/f) (%)	77/23	56/43	<0.001
Hemoglobin	13±1	13±1	NS
LVEF [a]	42±10	43±10	NS
Hypertension (%)	37	43	<0.001
Smoking(%)	19	15	NS
Diabetes mellitus(%)	20.5	27.4	0.016
COPD [b](%)	8	6.1	NS
Renal failure (%)	1	2.4	NS

a=left ventricular ejection fraction, b=chronic obstructive pulmonary disease

in the study. The preoperative, operative and postoperative variables were prospectively collected and listed in Tables 1, 2 and 3.

Smokers were defined as using more than 15 cigarettes per day for more than 5 years (6) Diabetes was determined to be present in patients receiving medication to control blood sugar. Chronic obstructive pulmonary disease (COPD) was indicated if the patient was treated with medication for COPD. Preoperative renal failure was specified as serum Creatinin >2 mg/dL (6) Arrhythmia was recorded if associated with medication prescribed for hemodynamic compromise. Myocardial infarction (MI) was documented by a rise in cardiac isoenzyme values or electrocardiographic changes indicative of MI and confirmed by a physician. Postoperative bleeding was implied if the patient required re-exploration to assess bleeding. Renal complications included a rise in creatinin concentration of 1 mg/dL above the baseline values or the continued presence of preoperative renal failure. Postoperative neurological complications were recorded by a neurologic consultant and included both transient ischemia attacks and strokes. Infective complications included septicemia and deep sternal and leg wound infection as defined by positive culture and requiring antibiotic therapy (6) Finally, operative mortality was shown as any death occurring during the hospital stay or within 30 days after surgery.

Statistical analysis was performed using SPSS, version19 statistical software. The study groups were compared using the Student's t-test for the continuous variables and the χ^2 test or Fisher exact test where appropriate for the categorical variables. The continuous variables were presented as mean±standard deviation. In all the cases, P values<0.05 were considered significant. Analyses were done by χ^2 test test for Univariate and logistic regression test to determine the significant predictive factors for Postoperative length of hospital stay>10 days and Death.

Results

Having excluded 58 (5.4%) underweight and 47 (4.4%) severely obese patients from 1057cases, the remaining 952 patients were classified into two groups of 624 (65.5%) normal-weight and 328 (34.5%) obese patients. Table 1 compared the data for preoperative patient variables. The obese and normal weight groups had no significant incidence of chronic obstructive pulmonary disease (COPD), Renal failure (RF), left ventricular ejection fraction (LVEF), and hemoglobin (Hb).There were significant differences in relation sex, diabetes mellitus (DM), hypertension (HTN) between the two groups. The data represented male gender was more than female and BMI in the men was lower than women, whereas obese females and males were 51.1% and 27.5% respectively.

Regarding the operative factors exhibited in Table 2, no significant differences were found between the normal-weight and obese patients in the rates of aortic cross clamp (min), and the frequency of coronary grafts. But regarding operation time ,significant difference was found between the foregoing groups, as obese patients had longer operation time.

Also investigation on mechanical ventilation time (hour), Reintubation, arrhythmia, renal complications, neurological complications, pulmonary embolism (PE), and postoperative re-admittance, variables revealed no significant difference between two groups but myocardial infraction (MI) was significantly higher in obese compared with normal weight patients.

In addition, there was no significant difference between the length of stay in ICU and hospitalization between two groups. Although as indicated in Table 3, the patients with normal weight had more reoperation for bleeding and infective complications. Also regarding mortality rate, there was no significant difference between obese and

Table 2. Operative patients' variables

Variable		Normal weight patients (n=624)	Obese patients (n=328)	P value
Operative time (min)		420±79	433±72	0.014
Aortic cross clamp (min)		83±31	82±23	NS
No. of coronary grafts (%)	**One**	4.5	3	NS
	Two	18.3	20.2	
	Three	76.9	75.6	
	≥ Four	0.3	1.2	

Table 3. Postoperative patients' variable

Variable	Normal weight patients (n=624)	Obese patients (n=328)	P value
Emergency case (%)	2.9	1.2	NS
Reintubation (%)	3.2	2.4	NS
Arrhythmia (%)	15.1	12.8	NS
Myocardial infarction (%)	0.3	1.8	0.015
Reoperation for Bleeding (%)	8.7	4.3	0.013
Renal complications (%)	1.9	3	NS
Neurological Complications (%)	O.6	0	NS
Infective Complications (%)	5.4	2.4	0.032
Days in ICU (day)	3.6±1.8	3.8±1.5	NS
Hospital stay(day)	10±7	11±9	NS
Death (%)	3.2	3	NS
PE[a] (%)	3.8	5.5	NS
Mechanical ventilation time (hour)	6±9	6±6	NS

a:pulmonary embolism

normal weight patients.

In connection with females, a logistic regression analysis for the variables predicted a significantly higher rate of deaths, re-operation, infective complications, and increasing length of stay in ICU, and rising age (Table 4).

Multi-variable analysis showed that female gender, smoking, renal complications, reoperation, re-admittance, reintubation, ventilation time, and increasing length of ICU stay was predictive of postoperative hospitalization of longer than 10 days.(Table 5)

Discussion

It is commonly assumed that obesity (BMI more than 30) is a risk factor for a poor outcome of operative mortality following CABG, because of the increased incidence of co-morbid factors such as diabetes, hypertension, changes in pulmonary function, and technical difficulty of performing surgery and homeostasis (6). But according to other reports and the findings of our studies, there was no significant relationship between obesity and mortality (7, 8), whereas other investigations showed that obesity decreased the mortality rate (5, 9) Some studies indicated that obesity increased morbidity following CABG (4, 10-14), but consistent with our findings other studies showed no association ,other than myocardial infarction, between obesity and operation morbidity following CABG (4, 15). Multiple mechanisms account for the absence of increasing morbidity risk in patients with high BMI, who had undergone cardiac operations. Obese patients may be adversely affected by having larger coronary arteries and receiving larger valves (5). Patients with a low BMI may also be more hemodiluted by a fixed bypass circuit during cardiopulmonary bypass (5). This may result in greater postoperative weight gain, transfusion requirements, and length of hospitalization (5).

Another explanation may be that patients with high BMI, and a higher percentage of body fat have more nutritional reserve, which may allow them to better cope with the complications. A number of studies indicated that proper nutrition and obesity decreased the rate of morbidity (16-18). In addition, women represented a greater percentage of patients in the high BMI group relative to normal weight group.

In this study we found that mechanical ventilation time (MVT) in obese group was comparable to normal weight group. Other studies have reported that in obese group MVT was longer than in the normal weight group (10, 19, 20).

Yazdanian and associates (6) suggested similar hospitalization and ICU periods between obese and normal-weight patients group which was in agreement with our findings, but according to other reports obese patients had longer hospital stay (8, 10, 14, 19, 21). In contrast to other studies (6, 9, 10, 19, 20, 22), our findings showed no statistically significant differences between obesity and increasing risk of atrial arrhythmia. Another research carried out in IR Iran (19) indicated that arrhythmia in obese patients was less than other patients. Our findings are borne out by similar studies including one conducted by Fasol et al. (20) . They concluded that myocardial infarction following CABG was more common in obese than in non-obese patients, but according to other reports there was no significant relationship between obesity and MI (10, 13, 14, 22). Our results indicated that obesity was not associated with renal complications, a finding consistent with previous studies (10, 19). However, other

Table 4. Multivariable analysis of the predictors of 30-day death

Variable	Coefficient Regression	Odds ratio	95% CI*	P value
Female gender	0.79	2.2	0.8-5.63	0.046
Reoperation	2.11	8.2	3.3-20.7	< 0.001
Infective Complications	1.59	4.9	1.3-19.3	0.023
Icu stay	0.44	1.4	1.3-1.8	< 0.001
Age	0.58	1.06	1.002-1.12	0.043

*95% confidence interval for OR

Table5. Multi variable analysis of the predictors of postoperative length of hospital stay>10 days

Variable	Coefficient Regression	Odds ratio	95% CI*	P value
Female gender	0.88	2.43	1.72-3.42	< 0.001
Smoking	0.44	1.56	1.01-2.38	0.02
Renal complications	1.37	3.96	1.04-15.05	0.043
Operation time	0.09	1.009	1.007-1.011	< 0.001
Reoperation	0.68	1.99	1.05-3.77	0.35
Readmitting	0.94	2.58	1.41-4.69	0.002
Reintubation	0.95	2.59	0.84-7.98	0.049
Icu stay	0.42	1.53	1.34-1.75	< 0.001

*95% confidence interval for OR

investigations reported high rates of renal complications after operation in obese patients (9, 23).

Moulton et al. (3) showed that the prevalence of pulmonary embolism was not different in their study groups, which was similar to our findings. Our study was similar to that of Birkmeyer and colleagues (4) in demonstrating that neurological complications were not different in two groups of patients. According to another study (6) the obese patients had the same high rates of re-admittance as another group which was contrary to the results of another report on obese patients (9)**.** On the other hand, obesity may be protective against some adverse outcomes (15, 24) Interestingly, the obese patients, compared to the normal-weight group was significantly less likely to experience postoperative bleeding. This result was confirmed by several reports (6, 11, 15, 16).

Previous investigations have shown that obese patients had a higher incidence of infectious complications (3, 4, 12-14, 20, 25, 26) . The higher incidence of diabetes mellitus in the obese, and the decreased perfusion of subcutaneous fat tissue ,postoperative hemorrhage , prolonged operation time, age, renal failure, and low cardiac output syndrome may lead to increasing infectious complications (6, 9, 10, 14, 20, 23, 27). We found a different result as the rate of infective complications in normal-weight group were higher than obese group, which was consistent with that of Yazdanian et al.,findings (6). In patients with diabetes mellitus, the treatment of hyperglycemia in the postoperative period may reduce infection. Also, in our study, risk factors for infection including age, renal failure, COPD, post operative hemorrhage, low cardiac output (4, 12, 20) were not high in obese group in contrast to previous studies (3, 4, 12-14, 20, 25, 26) that showed significant association between obesity and infection, which was attributed to greater extent of these factors in obese group.

In patients undergoing isolated CABG, obesity was not associated with adverse outcomes other than myocardial infraction. Therefore, there is no need to lose weight before CABG, if other risk factors for myocardial infarction are reduced.

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The authors declare that they have no conflicts of interest.

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