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Early complications associated with obesity following coronary artery bypass graft surgery

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Abstract

Background: One of the major health concerns and possible risk factors in open heart surgery is the increasing prevalence of obesity among patients.

Objective: To evaluate the impact of obesity [body mass index (BMI) ≥ 30 Kg/m^2] on the early post-operative (coronary artery bypass graft surgery) outcome.

Methodology: Over a period of sixteen months (February 2017 to June 2018), 246 patients underwent coronary artery bypass graft surgery (CABG) in Slemani Cardiac Hospital (SCH). The patients were divided according to the WHO classification into two groups: The obese (BMI ≥ 30) and the non-obese (BMI < 30) and were compared in regard to the rate of occurrence of early postoperative complications.

Results: The mean age was 69.0 years in the non-obese and 58 years in the obese group. Females constituted 46.7% of the obese group and 33.1% of the non-obese group. Both groups nearly got similar ejection fraction percentage of 58%, while hypertension was observed in 36.4% and 38.8% of the obese and non-obese groups respectively. Diabetes mellitus (DM) was reported in 54.2% of obese vs. 39.5% of non-obese patients. Cardiopulmonary bypass (CPB) time (72 min), aortic cross clamp time (59 min), mean perfusion pressure (67 mmHg) and number of grafts (3) were the same in both groups. Atelectasis rate (6.5%) and chest infection (5.6%) were significantly increased in obese patients. In contrast, other early post-operative complications were not statistically associated with being obese.

Conclusion: There was a higher prevalence of obesity in referred patients for CABG as well as an increased rate of early post-operative complications in the obese.

Keywords: Coronary artery bypass graft, obesity, cardiopulmonary bypass, complications, atelectasis, and chest infection.

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Introduction:

The prevalence of overweight and obesity has doubled over the last few decades world-wide in such a way that nearly 33% of the world population is classified as obese or overweight nowadays (1). The rate of obesity amongst referred patients for heart operations appears to reflect that observed in the general population (2). The world health organization (WHO) defined obesity and overweight as excessive fat accumulation that presents a danger to health. BMI ≥ 25 kg/m^2 is regarded overweight, whereas a BMI ≥ 30 kg/m^2 is regarded to be obese. On the other hand, an individual is regarded as underweight if her/his BMI ≤19.9 kg/m^2 and normal weight if the BMI is 20-24.9 kg/m^2 (3). Waist circumference can also be used to determine overweight and obesity with their influence on the morbidity and mortality, especially post-operatively (4). Both overweight and obesity are high rated growing problem of the world in developing and developed countries (5, 6). Many studies world-wide declared the significant association between obesity and mortality, with a decrease in the life expectancy of 5-10 years (7, 8). However, the declaration of obesity as a disease is still controversial (9). The World Obesity Federation very recently stated that "obesity is considered as a chronic, progressive, and relapsing disease process" requiring interference. In contrast, despite the fact of obesity biological background (e.g. biology of adipose cells, so-called obesity genes) and pathological changes associated with the disease process have been described, still there is no scientifically appropriate definition of a disease. Hence, obesity was not acknowledged as a disease (10, 11). All aspects of healthcare are significantly affected by obesity, including perioperative care. Furthermore, obese persons are more likely to be at a higher risk for perioperative problems including all systems. Nevertheless, to decide whether this situation is a risk factor or an indicator of risk remains difficult. In addition, the nature and uniqueness of the cardiac surgical setting further increase this doubt (12, 13). On the other hand, the use of heart lung machine perioperatively induces significant systemic changes involving nearly all organs of the body such

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as the renal, pulmonary, coagulation, and proinflammatory cascade in turn might mask the post-operative outcome and complications that are due to obesity alone (14). Post-cardiac surgery complications are many; each with its incidence, but one of the commonest post-operative complications is pulmonary dysfunction, in which there will be a decrease in functional residual capacity, vital capacity and lung compliance. It might be manifested as lung atelectasis and collapse, chest infection, or in extreme situation respiratory failure that mandates ventilator support (15). The purpose of this study is to assess the impact of obesity on the early outcome after coronary artery bypass graft procedures.

Patient and Methods

This cross-sectional study was conducted in Slemani Cardiac Hospital (SCH), Sulaymaniyah, Kurdistan, Iraq over a sixteen month period (February 2017 to June 2018). A total of 246 patients, of whom 96 were females, were enrolled. Age ranged between 44 and 71 years with a mean of 60.2 years. All patients underwent CABG surgery with the use of CPB machine (on-pump). Patients with ejection fraction (EF) <50%, history of renal disease, chronic obstructive airway disease, and patients with pre-operative cardiac arrhythmias were excluded. Furthermore, concomitant valve surgery and emergency CABG were also excluded. Transthoracic echocardiography (TTE), coronary angiography and measurement of height and weight for the measurement of body mass index were performed for all patients. All surgeries were performed via median sternotomy incision and CPB was achieved with a cannula in the ascending aorta and two-stage venous cannula through the right atrium. Myocardial protection was achieved via antegrade blood cardioplegia and moderate hypothermia (32˚C). Left internal mammary artery (LIMA) was harvested and anastomosed to the left anterior descending artery (LAD) while the great saphenous vein was used as a graft for other coronary vessels. Proximal anastomoses were done with aortic side-clamping. Nearly three grafts were used for all patients. All patients were monitored intra-operatively by electrocardiography, invasive arterial pressure, central venous catheter, pulse oximeter, and esophageal temperature probe. In all patients, the mean perfusion pressure was kept within 60-70 mmHg. The formula used for the calculation of the body mass index was: Weight in kilogram divided by the square of the height in meters. Patients were categorized into a non-obese group with a BMI<30 kg/m^2, and obese group with a BMI ≥ 30 kg/m^2. Data was managed using IBM SPSS for windows version 25 software and variables of the two groups were compared, and associations were tesred. P-values <0.05 were regarded as significant.

Results

A comparison of preoperative variables between the two groups is demonstrated in Table 1.

Table 1: Pre-operative Characteristics of Both Groups in Relation to BMI

Variable	BMI < 30 (n=139)	BMI≥ 30 (n=107)	P-value
	Mean ± (SD)	Mean ± (SD)	
Age (Years)	63.9 ± 6.74	58.0 ± 5.21	< 0.05
EF%	58.5 ± 5.78	58.3 ± 5.75	0.77
LDL (mg/dL)	120.8 ± 20.68	129.0 ± 23.37	0.001
S. Creatinine (mg/dL)	1.1 ± 0.30	1.0 ± 0.26	0.83
	Number (%)	Number (%)	
DM	55 (39.5)	58.0 (54.2)	0.02
Gender (female)	46 (33.1)	50 (46.7)	0.03
Hypertension	54 (38.8)	39 (36.4)	0.7

Patients' ages ranged between 44 and 71 years, but those with BMI ≥30 tend to be younger with the mean age of 58 years. The same was true regarding women who were significantly higher among obese patients 50 (46.7%). In addition, a significantly high LDL level (mean: 129 mg/dl) was noticed in patients with high BMI, particularly more than 30 kg/m^2. Other pre-operative variables such as the ejection fraction, serum creatinine, and hypertension were not significantly different / associated between / with the two groups.

The operative variables are shown in Table 2.

Table 2: Operative Variables in Relation to BMI

Variable	BMI < 30 (n=139)	BMI≥ 30 (n=107)	P-value
	Mean ± (SD)	Mean ± (SD)	
CPB Time (minutes)	72.2 ± (4.21)	71.8 ± (4.18)	0.54
Cross clamp time (minutes)	59.1 ± (4.16)	58.9 ± (4.20)	0.63
Perfusion pressure (mmHg)	67.4 ± (4.51)	67.5 ± (4.52)	0.95
Number of Grafts	2.9 ± (0.47)	3.0 ± (0.50)	0.38

It is evident that both groups had almost very similar operative variables like mean number of coronary anastomoses (≃3), CPB time (≃71 minutes), cross clamp time (≃59 minutes) and mean perfusion pressure (≃67 mmHg). The post-operative complications in the two groups of patients are demonstrated in Table 3.

Table 3: Post-operative complications in Relation to BMI

Variable	BMI < 30 (n=139)	BMI≥ 30(n=107)	P-value
	Number (%)	Number (%)	
Arrhythmia	3 (2.1)	2 (1.9)	0.87
Cardiac shock	5 (3.6)	4 (3.7)	0.95
Re-exploration	4 (2.8)	3 (2.8)	0.97
Atelectasis	2 (1.4)	7 (6.5)	0.03
Chest infection	1 (0.7)	6 (5.6)	0.02
Acute kidney injury	4 (2.8)	3 (2.8)	0.97
Wound infection	3 (2.1)	2 (1.9)	0.87

Apart from atelectasis and chest infection, the early postoperative problems were not statistically associated with any of the two groups. Both atelectasis and chest infections were more frequent among the obese patients.

Discussion:

The major public health concern in most developed and developing nations is the increasing rate of obesity and its associated health hazards. Precisely, BMI ≥ 30 kg/m^2 is supposed to be greatly related with more surgical hazards (1, 16). Overweight and obesity prevalence differ from one country to another, but generally, 39% of world adults were overweight, and 13% were obese in 2016(17). In Iraq the prevalence of overweight and obesity in 2015 was 31.8% and 33.9% respectively (18). Of course, this prevalence seems to be higher among those patients referred for cardiac surgery in our study (43.5%), since there is a correlation between obesity and cardiovascular diseases, especially ischaemic heart disease, with more obese patients tending to have coronary artery disease and subsequent referral for cardiac surgery. In our study, younger patients tended to be significantly more obese than older patients, in contrast to a recent study which showed no significant association between age groups and the prevalence of obesity (19). A study from Saudi Arabia found a significant association between increasing BMI and increasing age (20). These two studies looked at the rate of overweight and obesity in the general population and not among those who were sent for CABG. In our study, more than half of those with BMI ≥ 30 were diabetic, significantly higher than those with lower BMI. Similar findings were reported by the earlier mentioned study from Saudi Arabia (20). Some studies link type 2 DM strongly with obesity suggesting that about 90% of type 2 DM is causally related to excess weight, and that most of the obese patients got glucose intolerance. Slight information is existing in regard to the metabolic syndrome and glucose metabolism disorders among the obese patients undergoing cardiac surgery in the postoperative period. It had also been shown that the incidence of hypertension in obese patients is five times higher than normal weight people (21, 22). However, our study showed no significant association between obesity and incidence of hypertension, in consistence with the findings of Wigfield et al (22). Regardless of their BMI, female patients comprise less than 30% of all patients complaining of coronary artery disease that requires CABG; nevertheless, they are at increased risk for post-operative morbidity and death than men (23). In our study, the proportion of females among the obese group was higher than that among the non-obese. Some studies have shown similar results, in addition to female patients with DM, and high LDL levels, comprising most of the obese group (24). However, more recent studies showed that referred patients for CABG with high BMI than 30 were more likely to be males than females (25). Most of the perioperative variables, like CPB time, aortic cross clamp time, perfusion pressure, and grafts number showed no significant differences between the two groups in our study, which was similar to the results of another study except for the total number of the grafts (24). In our study the only post-operative complications which were significantly associated with obesity were atelectasis and lung infection. This can be explained by the fact that obese patients are more expected to have a low breathing reserve with a ventilation/perfusion mismatch and reduced functional residual capacity. Other post-operative complications were not significantly associated with obesity. One study showed that wound infection was significantly prevalent in obese patient after CABG (24). Shirzad et al reported that underweight patients are at increased risk for getting post-operative problems than those with overweight or obesity, and some researchers have proposed that obesity is a protective factor in patients undergoing CABG (26-28). Although there was no significant dissimilarities among the two groups regarding the incidence of acute kidney injury (AKI), but it is expected to be increased in non-obese elderly patients. Since AKI is more common in old patients, pulsatile CPB is recommended in this age group (29). The commonest post-operative arrhythmias seen in our study was atrial fibrillation, but not significantly associated with any of the two groups, similar to other studies (30-32). Some studies reported no differences in the occurrence of complications in relation to BMI (33, 34). Although many studies, including ours, showed significant associations between obesity and post-operative outcome in CABG, obesity was not counted as a risk factor in many scoring systems (35, 36). Moreover, the highly prognostic EuroSCORE does not include BMI grouping for cardiac surgical risk (37-39).

Conclusions:

Patients with BMI higher than 30 kg/m^2 are liable for postoperative complications, especially chest infection. Special attention should be paid at the time of presentation, regarding good control of patient's diabetic state. We suggest that high BMI should be included in the risk stratification scoring systems.

Authors' Contribution:

Both authors have equally contributed to study conception, study design, acquisition of data analysis, interpretation of data, drafting of manuscript and critical revision as well as the clinical management of the patients.

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المضاعفات المبكرة المرتبطة بالسمنة بعد عملية ترقيع الشرايين التاجية

امانج كمال محمد /مستشفى السليمانية لامراض و جراحة القلب و كلية الطب في جامعة السليمانية
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الخلاصة :
الخلفية : إن أحد المخاوف الصحية الرئيسية وعوامل الخطر المحتملة في جراحة القلب المفتوح هو الانتشار المتزايد للسمنة. كان الهدف من هذه الدراسة هو تقييم تأثير السمنة (مؤشر كتلة الجسم BMI ≥30 كجم/م^2) على النتائج المبكرة بعد جراحة ترقيع الشرايين التاجية.
الطرق : على مدى 16 شهرا (فبراير 2017 الى يونيو 2018)، خضع 246 مريضا لعملية ترقيع الشرايين التاجية في مستشفانا. تم تقسيم المرضى حسب تصنيف منظمة الصحة العالمية الى مجموعتين. تمت مقارنة مجموعات السمنة (مؤشر كتلة الجسمBMI ≥ 30 كجم /م^2) وغير البدينين (مؤشر كتلة الجسم BMI> 30 كجم/م^2) فيما يتعلق بمعدل حدوث مضاعفات ما بعد الجراحة في وقت مبكر.
النتائج : كان متوسط العمر 69 سنة في المجموعة غير البدينة و 58 سنة في المجموعة البدينة. شكلت النساء 46.7٪ من مجموعة البدناء و 33.1٪ من مجموعة غير البدينين. حصلت كلتا المجموعتين على EF% متشابهة بلغت 58٪ ، بينما لوحظ ارتفاع ضغط الدم في 36.4٪ و 38.8٪ من مجموعتي البدينين وغير البدينين على التوالي. تم تشخيص داء السكري في 54.2٪ من البدناء مقابل 39.5٪ من غير البدناء. كان زمن المجازة القلبية الرئوية (CPB) (72 دقيقة) ، ووقت التثبيت الأبهر المتقاطع (ACT) (59 دقيقة) ، وضغط التروية المتوسط (mean perfusion time) (67 مم زئبق) وعدد الطعوم (grafts) (3) متماثلاً في كلا المجموعتين. زاد معدل الانكماش الرئوي (6.5%) وخمج الصدر (5.6%) بصورة مهمة احصائيا في المرضى البدينين. في المقابل، لم تكن المضاعفات المبكرة الأخرى بعد الجراحة مختلفة إحصائيًا بين المجمو
الاستنتاج: كان معدل السمنة عاليا بين المرضى المحالين لاجراء عملية ترقيع الشرايين التاجية و كذلك كان معدل المضاعفات المبكرة بعد التداخل الجراحي عاليا بين المرضى المصابين بالسمنة.
الكلمات المفتاحية :عملية ترقيع الشرايين التاجية، السمنة، الانكماش الرئوي، الخمج الصدري.