Obesity and open-heart surgery in a developing country

Gelişmekte olan bir ülkede obezite ve açık kalp cerrahisi

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Abstract

Objective: The aim of the present study was to assess obesity as a risk of adverse outcomes following cardiac surgery.
Methods: The data of 324 consecutive patients who underwent elective procedures requiring cardiopulmonary bypass in a single cardiac center in South-Western Anatolia were retrospectively analyzed. There were 250 males and 74 females. Median age was 58.8 years (range 17 to 90 years). A body mass index (BMI)≥30 kg/m^2 was defined as obesity. Adverse outcomes analyzed included in-hospital mortality, chest tube drainage, reopening, inotropic support, arrhythmias, deep sternal wound infection, superficial surgical site infection and hospital stay duration. Multiple logistic regression analysis was performed to assess the relationship of obesity with clinical outcomes after cardiac surgery. Covariates considered in the logistic model included age, gender, pulmonary disease, cerebrovascular disease, smoking, hypertension, and diabetes.
Results: Fourteen percent of patients (47/324) were obese and this ratio is quite smaller than reported for industrialized countries. The results of multiple regression analysis demonstrated that obesity was a risk factor only for superficial sternal or harvesting site infection (odds ratio - 4.5, 95% CI- 1.404-14.679, p=0.012).
Conclusion: Obesity was associated with increased risk of superficial surgical wound infections following cardiac surgery. In comparison with industrialized countries, obesity may account for fewer adverse events in patients undergoing open-heart surgical procedures in South-Western Anatolia, a developing country sample. *(Anadolu Kardiyol Derg 2008; 8: 22-6)*
Key words: Obesity, body mass index, cardiac surgery, predictive models

Özet

Amaç: Bu çalışmanın amacı, obezitenin kalp cerrahisi sonrası ortaya çıkabilen istenmeyen sonuçlar ile ilişkisini incelemektir.
Yöntemler: Güney Batı Anadolu'da, tek merkezde kardiyopulmoner baypas altında elektif şartlarda opere edilen ardışık 324 hastanın verileri retrospektif olarak incelendi. Hastaların 250'si erkek, 74'ü kadındı. Yaş ortalaması 58.8 yıl olup yaş aralığı 17-90'dı. Vücut kitle indeksi (VKI) ≥30 kg/m^2 olanlar obez olarak kabul edildi. İstenmeyen sonuçlar olarak hastane içi mortalitesi, drenaj, revizyon, inotrop desteği, aritmi, derin sternal yara enfeksiyonu, insizyon yeri enfeksiyonu ve hastanede 14 günden daha uzun kalış dikkate alındı. Obezitenin klinik sonlanım noktaları ile ilişkisi çoklu regresyon analizi uygulandı. Lojistik modelde yer alan diğer bağımsız değişkenler yaş, cinsiyet, akciğer hastalığı, serebrovasküler hastalık, sigara, hipertansiyon ve diyabetti.
Bulgular: Hastaların %14'ü obez idi (47/324) ve bu oran gelişmiş ülkelerden bildirilen oranlara kıyasla oldukça düşük olarak değerlendirildi. Çoklu regresyon analizi sonuçlarına göre sadece insizyon yeri enfeksiyonu obezite ile ilişkili bulundu (odds ratio - 4.5, 95% CI- 1.404-14.679, p=0.012).
Sonuç: Obezite, kalp cerrahisi sonrası görülen insizyon yeri enfeksiyonu ile ilişkili bulunmuştur. Gelişmekte olan bir ülkenin bölgesi olan Güney Batı Anadolu'da, obezite, açık kalp cerrahisi sonrası ortaya çıkabilen istenmeyen sonuçlardan gelişmiş ülkelerdekine kıyasla daha az oranda sorumlu olduğu söylenebilir. *(Anadolu Kardiyol Derg 2008; 8: 22-6)*
Anahtar kelimeler: Obezite, vücut kitle indeksi, kardiyak cerrahi, prediktif modeller

Introduction

Obesity rate in the world population has continued to rise in the last two decades and has reached to 20-30% of adult population especially in the developed countries (1). Obesity is one of the major preventable risk factors for many conditions including cardiovascular diseases, diabetes, cancer and joint diseases. Furthermore, obesity has strong negative impact on the quality of life (2). Obesity has been considered as a risk factor for mortality in patients undergoing coronary artery bypass grafting and Parsonnet's risk stratification score employs body mass index (BMI) greater than 35 as three points (3). Even though, widely used risk stratification scores do not employ obesity as a risk of adverse outcomes, obesity has

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recently been reported as a risk factor for wound infections and atrial fibrillation, but not for mortality in large-scale studies from developed countries (4, 5).

Recently, obesity rate has been reported to be as high as 35% in developing countries as well (6). There is few data available reporting the impact of obesity on early outcome of cardiac surgical patients in developing countries. The aim of the present study was to assess obesity as a risk for adverse outcomes in patients who had open-heart surgery procedures in a single center in South-Western Anatolia.

Methods

A total of 324 consecutive patients who had open heart surgery at Adnan Menderes University Hospital in Aydın, Turkey were included. Patients who were operated on an emergent basis were excluded. All patients were operated by the same surgical team using the standard anesthesia and cardiopulmonary bypass techniques. Standard data have been collected during patients' admissions as part of routine clinical practice in our institution. Data were extracted from this database retrospectively.

Body mass index was calculated by using the following formula: BMI= weight (kg) / height^2 (m^2). A BMI value ≥30 kg/m^2 was considered as obesity (Nutritional Disorders, 1999; Clinical guidelines 1998). The patients were then grouped as obese and non-obese, accordingly. The patients were also grouped as coronary artery disease (CAD) patients who had coronary artery bypass grafting (CABG) associated with or without other procedures, and non-CAD patients who had other open-heart procedures not associated with CABG.

Preoperative data were extracted from the database for the following variables: age, gender, chronic obstructive pulmonary disease (COPD), cerebrovascular disease, left ventricular ejection fraction (LVEF), plasma creatinine and hemoglobin levels, smoking, hypertension, and diabetes.

The outcome measures extracted from the database for this study were in-hospital 30-day mortality, total chest tube drainage, re-opening for bleeding, need for inotropic support, use of intra-aortic balloon pump (IABP), atrial arrhythmias, deep sternal wound infection, superficial sternal or harvesting site infection and post-operative length of stay. Criteria for surgical site infections were in accordance with the Guideline for prevention of surgical site infection published in 1999 (7).

All patients underwent open-heart surgical procedures through mid-sternotomy incision by establishing standard cardiopulmonary bypass. Intermittent antegrade cold blood cardioplegia was used for myocardial protection during aortic cross clamping in all patients. In coronary patients, left internal thoracic artery was harvested as a pedicle and anastomosed to left anterior descending coronary artery while great saphenous vein was used as a graft for other coronaries.

Statistical analysis

Data were analyzed by using the Statistical Package for the Social Sciences program (SPSS for Windows Version 10.0, Chicago, IL, USA). Values are expressed as mean±SD. Comparisons of pre-operative patient characteristics were made with Pearson χ^2-test. Independent Samples test or χ^2 test was used to compare postoperative outcome. Multiple logistic regression analysis was used to examine the effect of obesity as the dependent variable on independent variables regarding to in-hospital mortality and morbidity such as superficial surgical site infection, arrhythmia, re-opening for bleeding, postoperative in-hospital stay, postoperative inotropic support. Gender, hypertension and smoking were also included as independent variables and results were given as "with adjustment for baseline clinical variables". Statistical significance was defined as $p<0.05$.

Results

There were 250 males and 74 females. The mean age of the patients was 58.8 ± 12.5 years (ranged from 17 to 90 years). A BMI of ≥ 30 kg/m^2 (obese) was registered in 47 patients (14.5%), while 277 patients had BMI below 30 kg/m^2 (non-obese). No difference was observed in preoperative patient and disease characteristics with respect to age, COPD, cerebrovascular disease, LVEF, plasma creatinine and hemoglobin levels, current smokers, and diabetes (Table 1). However, obese patients were more likely to be female ($p<0.001$) and hypertensive ($p<0.001$).

Smoking was more frequent among male patients that 69.6% of males were current smokers while only 5.4% of females had smoking habit. Hypertension was more frequently seen among female patients than in males (58% vs. 34%, $p<0.001$).

There were 239 CAD patients and 85 non-CAD patients. There was no difference in the ratio of obese patients between CAD and non-CAD patients (Table 2). Coronary artery disease patients were older ($p<0.001$), more likely to be current smoker ($p<0.001$), hypertensive ($p<0.01$), diabetic ($p<0.001$), and had higher creatinine levels ($p<0.05$) and lower mean LVEF ($p=0.001$) than non-CAD patients.

The incidence of in-hospital outcomes for all patients was as follows: mortality - 16 (4.9%), re-opening for bleeding -13 (4.0%), superficial sternal wound or harvest site infections - 12 (3.7%) and atrial arrhythmia - 49 (14.8%). Of the 324 patients in the study, 54 (16.4%) needed inotropic support and 15 (4.6%) needed

Table 1. Pre-operative characteristics of obese and non-obese patients

Variables	Non-Obese (n=277)	Obese (n=47)	p*
Age at operation, years	58.7±12.6	59.9±11.9	NS
Female sex, n (%)	54 (19.5)	20 (42.6)	0.001
Diabetes, n (%)	65 (23.5)	15 (31.9)	NS
Hypertension, n (%)	98 (35.4)	30 (63.8)	<0.001
Cerebrovascular disease, n (%)	5 (1.8)	1 (2.1)	NS
COPD, n (%)	18 (6.5)	6 (12.8)	NS
Current smoker, n (%)	159 (57.4)	19 (40.4)	0.04
Creatinine, mg/dL	1.4±1.5	1.3±0.8	NS
Hemoglobin, g/dL	13.1±1.7	12.9±2.2	NS
LVEF, %	53.5±9.9	55.8±12.5	NS

Data are represented as Mean±SD and proportions/percentages
* - Pearson Chi-square test and independent samples t test
COPD- chronic obstructive pulmonary disease, LVEF- left ventricular ejection fraction, NS- non-significant

intraaortic balloon pump support in the postoperative period. No deep sternal wound infection was observed. In-hospital outcome of obese and non-obese patients is summarized in Table 1. Duration of hospital stay was similar in obese and non-obese patients.

Results of multiple logistic regression analysis are shown in Table 4. There was no association between obesity and in-hospital mortality, re-opening for bleeding, post-operative atrial arrhythmias, inotropic need and length of hospital stay. Obesity was however associated with superficial sternal or harvesting site infection (odds ratio - 4.5, 95% CI- 1.404-14.679, p=0.012). After adjusting for differences in patient baseline clinical variables, which were gender, hypertension and smoking, obese patients were 2.8 times more likely to have superficial surgical site infection but it did not reach to statistical significance.

Discussion

Obesity is becoming one of the most important contributors to ill health in 21st century according to the WHO report (8). The prevalence of obesity and overweight has an increase rate of almost 10% over the last two decades and has been reported to range 40-60% in industrialized countries and in substantial number of developing countries (9). Obesity is recognized as a major risk factor for CAD and epidemic obesity may diminish the gain achieved in reducing coronary heart disease by controlling cholesterol and hypertension (10). Since obesity has also been considered a significant determinant of impaired quality of life and the ratio of obese patients among cardiac surgical patients has increased with time, there is considerable ground for concern that obesity may adversely affect the hospital outcomes of open-heart surgery.

The results of the present study showed that obesity was a risk factor only for superficial sternal or harvesting site infection following open-heart surgery. Obesity was not found as a risk factor for in-hospital mortality. These findings are consistent with the findings of previous studies reported mainly from industrialized countries (4, 11-19). However, there are conflicting data existing in the literature that some studies have found evidence of BMI above 30 is predictive of an increased chance of morbidity (15, 20, 21). Others have found that being underweight rather than obese carries higher risk of death and other complications after cardiac surgery (22, 23).

The preoperative characteristics of our patients showed that obese patients were more likely to be female, hypertensive and current smoker compared to non-obese patients. When these differences in baseline clinical variables were taken into account while performing logistic regression analysis for determining the effect of obesity on post-operative outcomes, the association of obesity with surgical site infection did not reach to statistical significance. However, obese patients were

Table 2. Preoperative characteristics of CAD and non-CAD patients

Variables	CAD (n=239)	non-CAD (n=85)	p*
Age at operation, years	61.5±9.0	51.13±15.0	<0.001
Female sex, n (%)	35 (14.6)	39 (45.9)	<0.001
Obese, n (%)	36 (15.1)	11 (12.9)	NS
Diabetes, n (%)	72 (30.1)	8 (9.4)	<0.001
Hypertension, n (%)	106 (44.4)	22 (25.9)	0.003
Cerebrovascular disease, n (%)	5 (2.1)	1 (1.2)	NS
COPD, n (%)	19 (7.9)	5 (5.9)	NS
Current smoker, n (%)	153 (64.0)	25 (29.4)	<0.001
Creatinine, mg/dL	1.43±1.40	1.32±1.50	0.018
Hemoglobin, g/dL	13.2±1.8	12.7±1.7	NS
LVEF, %	52.6 ± 10.0	56.9 ± 10.0	0.001

Data are represented as Mean±SD and proportions/percentages
* - Pearson Chi-square test and independent samples t test
CAD - coronary artery disease, COPD- chronic obstructive pulmonary disease, LVEF- left ventricular ejection fraction, NS- non-significant

Table 3. In-hospital outcomes following open-heart surgery in obese and non-obese patients

Variables	Non-Obese (n=277)	Obese (n=47)	p*
Chest tube drainage, ml/24h	815 ± 617	683 ± 284	NS
Blood transfusion, units of RBC	3.2 ± 2.3	3.7 ± 3.1	NS
Length of hospital stay, days	11.18 ± 5.3	12.5 ± 6.4	NS
Re-opening for bleeding, %	3.6	6.4	NS
Superficial infection, %	2.5	10.6	<0.05
Atrial arrhythmias, %	15.5	10.6	NS
Mortality, %	5.4	2.1	NS

Data are represented as Mean±SD and proportions/percentages
* - Chi-square test and independent samples t test
NS- non-significant, RBC – red blood cell

Table 4. Effects of obesity on postoperative outcomes in patients undergoing open heart surgery: logistic regression analysis data*

Variable	OR	95% CI	p
Superficial surgical site infection			
Without adjustment	4.539	1.404-14.679	0.012
With adjustment	2.886	0.677-12.310	NS
Re-opening for bleeding			
Without adjustment	1.541	0.371-6.404	NS
With adjustment	0.949	0.174-5.172	NS
Atrial arrhythmias			
Without adjustment	0.581	0.196-1.728	NS
With adjustment	0.570	0.203-1.597	NS
Postoperative inotropic support			
Without adjustment	0.661	0.264-1.656	NS
With adjustment	0.795	0.305-2.071	NS
Postoperative stay > 14 days			
Without adjustment	1.002	0.903-1.111	NS
With adjustment	1.012	0.976-1.050	NS
Mortality			
Without adjustment	1.310	0.250-6.869	NS
With adjustment	0.229	0.027-1.976	NS

(*) With adjustment and without adjustment for baseline clinical variables: female sex, hypertension and current smoker.
CI – confidence interval, NS- non-significant, OR – odds ratio

still 2.8 times more likely to have surgical site infection. This finding might be explained by the close relationship between obesity, female gender and hypertension observed in the present study.

Recently, obesity has been shown to be independently associated with an increased risk of morbidity including respiratory failure, arrhythmias, renal insufficiency and leg wound infection in diabetic patients, but not in non-diabetics (24). Even though, diabetes was more frequent among obese patients in our study, it did not reach to statistical significance and we did not find any difference between diabetic and non-diabetic obese patients. This may be due to either small volume of our study or the difference between patient populations. Likewise, we did not find an association between obesity and chest tube drainage or re-opening for bleeding unlike some previous reports (5, 12). The incidence of postoperative atrial arrhythmia has been reported to increase in obese patients (15, 17), however we could not find any significant effect of obesity on postoperative atrial arrhythmias.

The most common form of coronary artery disease is atherosclerosis. Being overweight or obese is a well documented major risk factor for coronary artery disease (10). In addition, obese men and women carry considerably higher risk of morbidity and mortality related to coronary heart disease (9). Higher incidence of hypertension, high cholesterol and diabetes in obese individuals have been accounted in part for this increase in risk. The rest was believed to be related to unconventional CAD risk factors such as increased inflammatory cytokines and risk of thrombosis (9). In an effort to assess the effect of obesity on the outcome of patients undergoing coronary artery bypass grafting, we compared CAD patients with non-CAD patients in the present study. Even though, there were more hypertensive and more diabetic patients, we failed to show that obesity was more common in CAD patients. This is an interesting data on that the ratio of obesity in patients undergoing coronary artery bypass grafting in Western Anatolia may differ from the patient populations in industrialized countries. In a study from USA, the ratio of obese patients was reported as 25% of all patients undergoing cardiac surgical procedures requiring cardiopulmonary bypass (15). However, only 14% of patients were classified as obese in the present study. This difference becomes even more prominent for patients with extensive CAD requiring surgical revascularization. In a recently published study from Texas Heart Institute, the ratio of obese patients was up to 34% of the patients undergoing CABG (24) while this ratio remained at 15% in our study. Similarly two large studies, one form United Kingdom and the other from USA, have reported obesity rates of patients undergoing coronary artery bypass grafting as 37% (4, 5). A relatively large study from Canada reported that 35% of patients who underwent cardiac surgery were obese and only sternal dehiscence was more frequently seen in obese patients (14). In our study, it was remarkable that obesity rate was lower in cardiac surgical patients compared to industrialized countries. This result should draw our attention to other adverse events beside obesity and lower obesity ratios observed in cardiac surgical patients in Western Anatolia, where Mediterranean life style is prominent, should be investigated further.

A recently published population based study conducted on 15468 Caucasian adult inhabitants from all over Anatolia has delineated that obesity prevalence has reached to 35% of the population in Turkey (6). Furthermore, the ratio of women among obese patients was significantly higher than in non-obese patients. This finding is consistent with previous studies from Turkey where women undergoing open-heart surgery had higher BMI values (25). This might be related to higher prevalence rates of obesity among Turkish women (26). We also found that hypertension was significantly more frequent among obese patients, which is also consistent with previous reports (27).

Conclusion

In conclusion, the data of the present study demonstrated that obesity was associated with increased risk of superficial surgical wound infections following cardiac surgery. In addition, when compared to industrialized countries, obesity may account for fewer adverse events in patients undergoing open-heart surgical procedures including coronary artery bypass grafting in South-Western Anatolia, a developing Mediterranean country sample. Obesity is a cardiovascular risk factor and should be prevented and treated especially in easily accessible primary care settings.

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