

THE EFFECTS OF BODY MASS INDEX CATEGORY ON EARLY OUTCOMES OF CORONARY ARTERY BYPASS GRAFT

Parvin Dehbozorgi⁽¹⁾, Fariba Ghodsbin⁽²⁾
Mohammad Janati⁽³⁾, Kamran Aghasadeghi⁽⁴⁾

Abstract

INTRODUCTION: Deviation from normal body size, particularly extreme obesity is associated with increased postoperative morbidity and mortality. Obesity is often perceived to be a risk factor for adverse outcomes following coronary artery surgery bypass graft. The aim of this study was to evaluate the effect of body mass index on the early outcomes in patients undergoing coronary artery bypass graft (CABG).

METHODS: In a retrospective study, 772 patients undergoing CABG between 2005 and 2006 were evaluated in Shiraz university affiliated medical centers. The patients' body mass index (BMI) was measured and classified as underweight, normal-weight, obese and severely obese. The clinical data were evaluated with respect to early postoperative outcomes and mortality. The main early outcomes were postoperative myocardial infarction, sternal wound infection, respiratory and renal problems, atrial arrhythmia, bleeding, longer duration of mechanical ventilation, prolonged hospital stay, and increased operative mortality. The data were gathered using a demographic information form and a checklist to determine the number of main early outcomes. The forms were completed with data from the patients and their records. The effect of BMI on the early outcomes in patients undergoing coronary artery bypass graft (CABG) was assessed using odds ratio and the logistic regression model.

RESULTS: The results showed that of 772 patients, 13.6%, 2.6%, 75.4%, and 8.4% were obese, severely obese, normal-weight, and underweight, respectively.. Obesity and severe obesity increased the risk of sternal wound infection (odds ratio=9.761, $P<0.001$ and odds ratio=34.441, $P<0.001$, respectively). Obesity increased the risk of atrial arrhythmia (odds ratio=5.173, $P<0.001$). Obesity and severe obesity were significantly associated with respiratory problems and postoperative stay longer than 14 days. Severe obesity increased the risk of operative mortality (odds ratio=15.390, $P<0.001$). There was no difference between obese and severely obese patients in respect of the incidence of myocardial infarction, renal failure, and bleeding following operation.

CONCLUSIONS: Obesity and severe obesity are associated with increased early complications and operative mortality after CABG, and the degree of obesity plays a key role in adverse outcomes of this procedure.. Hence, weight loss can contribute to reduction of postoperative CABG complications and mortality.

Keywords: Body mass index, coronary artery bypass graft, obesity, morbidity, mortality.

ARYA Atherosclerosis Journal, 2007, 3(2): 100-103

Date of submission: 28 Oct 2006, *Date of acceptance:* 10 Mar 2007

Introduction

Extremely thin and overly obese patients may not tolerate cardiac surgery as well as other patients do. The extremes of body mass index (BMI) and cachexia increase the morbidity and mortality associated with cardiac operations.¹ In many studies it has been demonstrated that extreme obesity is associated with increased postoperative morbidity and worse long-term survival.² Obesity is still assumed to be an

important risk factor for morbidity and mortality in coronary artery bypass graft (CABG) operation.³ According to the reviews of literature, obesity increases the risk of adverse outcomes and prolonged hospitalization in patients undergoing this operation.¹ Patients with BMI>40 kg/m² are at increased risk of operative mortality, which reached statistical significance.⁴

(1) Parvin Dehbozorgi M.Sc. Department of health education, Fatemeh Nursing and Midwifery College of Shiraz University of Medical Sciences. Shiraz, IRAN. Tel :+98 7116279131-33, E-mail address: dehbozorgp@sums.ac.ir

(2) Fariba Ghodsbin M.Sc. Fatemeh Nursing and Midwifery College of Shiraz University of Medical Sciences.

(3) Mohammad Janati MD. Department of Surgery, Faghihi Hospital, Shiraz University of Medical Sciences.

(4) Kamran Aghasadeghi MD. Department of Medicine, Nemazee Hospital, Shiraz University of Medical Sciences.

Corresponding author: Parvin Dehbozorgi

As mentioned above, overweight and obesity are among the most important problems which predispose the patients to coronary artery occlusion and subsequent myocardial infarction (MI). These patients will likely suffer different complications following CABG. Hence weight control may prove to be of great benefit. The main objective of this study was to evaluate the effect of BMI on the early outcomes and in-hospital mortality of patients undergoing CABG. The specific objective of this study was to categorize the patients according to BMI, gender and age and to determine the effect of these parameters on early outcomes (sternal wound infection, MI, arrhythmia, respiratory and kidney problems and postoperative mortality) of this procedure.

Materials and methods

This is a retrospective study of 772 consecutive patients undergoing CABG between January 2005 and January 2006. Of the commonly used measures of obesity, BMI (kg/m^2) is the body size measurement that best correlates with body fat content.⁵ BMI values were categorized into 4 groups, namely normal weight (BMI 20-30 kg/m^2), underweight (BMI <20 kg/m^2), obese (BMI >30 kg/m^2), and severely obese (BMI \geq 35 kg/m^2). The clinical data of the 4 groups were evaluated with respect to early postoperative outcomes and mortality. We compared normal-weight patients (582 patients, 75.4%) with those who were underweight (65, 8.4%), obese (105, 13.6%) and severely obese (20, 2.6%). The main early outcomes were postoperative MI, sternal wound infection, atrial arrhythmia, more ventilation days, prolonged postoperative stay,

bleeding, increased respiratory and renal problems, and increased operative mortality. Operative mortality was defined as any death in patients who had not been discharged following the operation in hospital.⁶ Respiratory problems included chest infection, ventilation failure, re-intubation and tracheostomy.⁷ Renal problems included postoperative creatinine >200 $\mu\text{mol}/\text{l}$.⁸ Demographic characteristics of patients and the number of main early outcomes were documented. Data were statistically analyzed. The effect of BMI on the early outcomes and in-hospital mortality of patients undergoing CABG was assessed using odds ratio. The effect of independent variables (i.e. gender, age and BMI) on was determined using the regression model. After adjusting for age and gender, BMI remained a significant independent predictor of early complications and operative mortality. Regression model was used to estimate odds ratios, 95% confidence interval to evaluate the effect of underweight, obesity and severe obesity on the outcomes of interest in comparison with the normal-weight group. SPSS version 11.5 was used. $P < 0.05$ was considered as significant.

Results

Of 772 patients, 65 (8.4%) were underweight, 582 (75.4%) were normal-weight, 105 (13.6%) were obese, and 20 (2.6%) were severely obese (Table 1).

The distribution of BMI according to gender was similar in all BMI categories, without any significant difference in terms of gender (Table 2). Obesity increased the risk of atrial arrhythmia (odds ratio=5.173, $P < 0.001$), sternal wound infection (odds ratio= 9.761, $P < 0.001$), and postoperative stay longer than 14 days (odds ratio=17.351, $P < 0.001$).

TABLE 1. Distribution of body mass index categories in patients undergoing coronary artery bypass graft surgery.

Body mass index (BMI)	n	%
Underweight (BMI <20 kg/m^2)	65	8.4
Normal weight (BMI: 20-30 kg/m^2)	582	75.4
Obese (BMI >30 kg/m^2)	105	13.6
Severely obese (BMI \geq 35 kg/m^2)	20	2.6
Total	772	100

TABLE 2. Distribution of body mass index categories by gender.

	Underweight		Normal-weight		obese		Severely obese		Total	
	n	%	n	%	n	%	n	%	n	%
Women	26	8.7	224	75.7	41	13.3	9	3%	300	100%
Men	40	8.3	356	75.7	65	13.8	11	2.3	472	100%

TABLE 3. The effect of body mass index on the main early outcomes and operative mortality of patients undergoing coronary artery bypass graft surgery.

Main early outcomes	Patients, body mass index (BMI)			
	Obese patients		Severely obese	
	Odds ratio (95% CI*)	P	Odds ratio (95%CL)	P
Atrial arrhythmia	5.173(2.821-9.485)	P<0.001	3.235 (0.906-11.552)	0.71
Sternal wound infection	9.761(5.073-18.782)	P<0.001	34.441(11.038-107.470)	P<0.001
Respiratory problems	16.152 (9.132-28.567)	P<0.001	306.357(38.616-243.446)	P<0.001
Duration of ventilation >3days	19.046(10.625-43.512)	P<0.001	348.307 (43.512-2788.154)	P<0.001
Hospital stay >14 days	17.351 (10.117-29.759)	P<0.001	258.425(32.808-2035,588)	P<0.001
Operative mortality	0.983(0.216-4.481)	0.983	15.390(4.151-57.061)	P<0.001

*Confidence interval

Severe obesity was significantly associated with sternal wound infection (odds ratio= 34.441, P<0.001) and respiratory problems (odds ratio=306.357, P<0.001), as well as greater likelihood of remaining on mechanical ventilation for more than 3 days (odds ratio=348.307, P<0.001) and postoperative stay longer than 14 days (odds ratio= 258.425, P<0.001) (Table 3). The hospital stay was longer in underweight than in normal-weight patients. Severe obesity increased the operative mortality (odds ratio= 15.390, P<0.001). There was no significant difference between obese and severely obese patients in respect of MI, renal failure and bleeding following operation; neither was there any significant difference between the two groups in respect of morbidity and mortality following CABG according to gender and/or age.

Discussion

Obesity, notably its severe type, is a significant independent predictor of postoperative morbidity and mortality after CABG.

The major postoperative complications, especially atrial arrhythmia, sternal wound infection, respiratory problems, and prolonged hospital stay were more prevalent in obese and severely obese patients. Our findings are borne out by similar studies including one conducted in 2002 by Kuduvalli et al.⁶ They concluded that atrial arrhythmia following CABG was more common in obese patients than in non-obese ones. In this study, atrial arrhythmia in obese patients was higher than in other groups. In the study of Totaro et al,⁷ those patients with a BMI of more than 30 kg/m² were at higher risk of sternal wound infection following CABG, compared to other patients. In other studies performed by Bhati⁸ and Orhan et al.,⁴ and Spelman,⁹ the risk of sternal wound infection after CABG in obese patients was shown to be higher than in non-obese patients. This study also

showed the rate of sternal wound infection after CABG in obese and severely obese patients to be higher than in normal-weight patients. In a study conducted by Habib et al.,² severely obese patients were shown to suffer more respiratory problems after CABG than other patients. Our results are in line with the study of Engelman in finding a higher hospital stay in obese patients.¹ Consistent with some previous studies^{1,6} we found that the rate of respiratory machine dependency after CABG was significantly higher in severely obese patients than in other groups. Barnaby showed that underweight patients had more postoperative complications and longer hospital stays after CABG than other patient groups.¹⁰ In the current study, underweight patients had longer hospital stays than normal-weight patients did. Susman demonstrated that patients with BMI >40 kg/m² had a 42% higher mortality risk after CABG.⁴ We also found mortality rate after CABG to be higher in severely obese patients than in other groups.

In our study, there was no significant difference between morbidity and mortality after CABG in terms of gender and/or age. Similarly, in studies conducted by Noyes¹¹ and Kuduvalli,⁶ no difference was seen between obese and severely obese patients with respect to MI, renal problems and/or bleeding following CABG.

Obesity, notably its severe type, increased the risk of early complications and operative mortality following CABG. The degree of obesity plays a key role in increasing the postoperative morbidity and mortality.

Acknowledgments

We thank all the colleagues and staff involved in data collection. We also extend our thanks to the personnel of the cardiac surgery wards and filing clerks of hospitals who helped us in this study.

References

1. Engelman DT, Adams DH, Byrne JG, Aranki SF, Collins JJ Jr, Couper GS, Allred EN, Cohn LH, Rizzo RJ. Impact of body mass index and albumin on morbidity and mortality after cardiac surgery. *J thorac cardio vascular surgery*. 1999;118:866-873.
2. Habib H, zacharias A, Schwann A, etal. Effects of obesity and small body size on operative and long-term outcomes of coronary artery bypass surgery. *Ann thorac surg*. 2005;9:1976-1986.
3. Orhan G, Bicery, Aykut Akas, etal. coronary artery by pass graft operations can be performed safely in obese patients *Eur J cardio thorac surg*. 2004;25:212-217.
4. Susman Ed. Obesity increases risks in patients undergoing coronary artery by pass. [http://www.PSLgroup. Com/dg/21400A.htm](http://www.PSLgroup.Com/dg/21400A.htm) Doctor's Guide January 31,2002.
5. Criqui MH, Klauber MR, Barrett-Connor E, Holdbrook MJ, Suarez L, Wingard DL. Adjustment for obesity in studies of cardiovascular disease. *Am JEpidemiol*. 1982;116:685-691.
6. Kuduvalli M, Grayson AD, Oo AY, Fabri BM, Rashid A. Risk of morbidity and in-hospital mortality in obese patients undergoing coronary artery bypass surgery. *Eur J cardio thorac surg*. 2002;22:787-793.
7. Totaro P, Degno N, Argano V. CABG in obese patient: is the degree of obesity the key factor ? *European Journal of cardio-Thoracic surgery* 27 (2005)529-532.
8. Bhatia JY, Pandey K, Rodrigues C, Mehta A, Joshi VR. Post operative wound infection in patients undergoing coronary artery by pass graft surgery. *Indian J Med Microbiol* 2003;21(4):246-251.
9. Spelman DW, Russo P, Harrington G, Davis BB, Rabinov M, Smith JA, Spicer WJ, Esmore D. Risk factors for surgical wound infection and bacteraemia following coronary artery bypass surgery. *Aust N Z J Surg* January. 2000;70(1):47-51.
10. Bhatia JY, Pandey K, Rodrigues C, Mehta A, Joshi VR. Effect of body mass index on early outcomes in patients undergoing coronary artery by pass surgery. *Aust N Z J Surg*. 2000;70(1):47-51
11. Noyesl. CABG in obese patient. *Eur J cardio-thor surg*. 2005;27:529-532.