ORIGINAL ARTICLE

Effect of Body Mass Index on Postoperative Complications in Beating Coronary Artery Surgery

Feridoun Sabzi[1], Reza Faraji[1]

ABSTRACT

BACKGROUND: Body Mass Index (BMI) is considered as an important risk factor in cardiovascular surgery. We designed a* historical cohort *study for the evaluation of perioperative complications related to BMI in patients who underwent off-pump coronary artery bypass grafting (OPCAB).

METHODS: We studied 1120 consecutive patients who underwent OPCAB between January 2008 and December 2011 in Imam Ali Hospital, Kermanshah, Iran. Patients were divided into four groups according to BMI: underweight/low BMI (< 18.5 kg/m²), healthy weight (between 18.5 kg/m² and 24.9 kg/m²), overweight/high BMI (between 25 kg/m² and 30 kg/m²), and obese/very high BMI (> 30 kg/m²).

RESULTS: In multivariable regression analysis, an important correlation between the underweight/low BMI group and mortality was observed (p=*0.037*). Postoperative stroke, postoperative atrial fibrillation (AF) and intra-aortic balloon pump (IABP) use were not associated with BMI. In linear regression analysis, significant correlations between low BMI, reintubation, ICU stay time and intubation time were found. Re-exploration for bleeding was significantly correlated with having a low or high BMI.

CONCLUSION: Having a low BMI (which is association with malnutrition and respiratory muscles weakness) was significantly associated with reintubation, prolonged intubation time and ICU stay time. The obese group was also associated with postoperative atelectasia and fever.

KEYWORDS: Coronary Artery Bypass, Body Mass Index, Postoperative Complications

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INTRODUCTION

Manson et al. were the first that have been to reveal a relationship between obesity and operative complications. However, in a few studies, relation between OPCAB complication and obesity was examined (1). On the other hand, most available studies related to on pump CABG could not be omitted on the outcome. In the OPCAB, the effect of cardiopulmonary bypass has been removed from postoperative outcomes so that the results are much reliable than on pump cases (1). Nutritional status can be evaluated using BMI and is calculated using the following formula (2): BMI= weight (in kilograms)/height (in meters)^2. Engelman et al. showed increased morbidity and mortality in patients with low BMI following cardiac surgery (2). On the other hand, being overweight or obese is commonly thought to be a risk factor for post CABG complications. There are many controversies about the effect of BMI on postoperative cardiac complications. Reeves et al. found no significant correlation between obesity and mortality following cardiac surgery (3). However, a study by Simopoulos et al.revealed that a high BMI was associated with postoperative superficial, deep sternal wound infection and postoperative mortality (4). In this study, we sought to identify if a patient's BMI could be a predictor of risk of postoperative complications in off-pump CABG.

[1]Preventive Cardiovascular Research Centre Kermanshah, Kermanshah University of Medical Sciences, Kermanshah, Iran

Corresponding Author: Reza Faraji, Email: r.faraji61@gmail.com

MATERIALS AND METHODS

Between 1 December 2009 and 1 December 2011, a total of 1120 patients underwent CABG with off-pump coronary artery bypass grafting (OPCAB) in Imam Ali Hospital, Kermanshah, Iran and were included in this study. Patients with missing data, on-pump CABG or complex surgery were excluded from the study. Twenty patients were excluded in total, and 1100 patients were enrolled. Four nurses collected and recorded patients' data in data sheets. The data included preoperative variables: age, sex, and BMI. BMI was divided into four weight categories: underweight/low BMI (< 18.5 kg/m^2), normal weight (18.5 kg/m^2 to 24.9 kg/m^2), overweight/high BMI (25 kg/m^2 to 30 kg/m^2), and obese/very high BMI (> 30 kg/m^2)(5-8). Data relating to emergency operations, left ventricular ejection fraction (EF), opium use, smoking, chronic obstructive pulmonary disease (COPD), hypertension (defined as diastolic blood pressure > 90 mmHg or use of anti-hypertension medication), preoperative renal failure (PORF, serum creatinine > 1.5 mg/dL) (5), diabetes, the number of previous grafts, left main disease (LMD), peripheral vascular disease (PVD) and hypercholesterolemia were also recorded. Postoperative respiratory variables included fever (a temperature > 37.5^{o}C), cough, bronchodilator use, smoking, opium use, mean expiratory pressure (MEP ≤ 75%), force vital capacity (FVC ≤ 75) and forced expiratory volume in first second (FEV1 ≤ 75%). Other postoperative variables included postoperative respiratory infection (PORI), postoperative inotropic drug use (POIDU), postoperative bleeding (POB) volume of transfusion, volume of drainage, intra-aortic balloon pump (IABP) use, reintubation, atrial fibrillation (AF), postoperative myocardial infarction (POMI), postoperative stroke, (POS) ventilation time, ICU stay time and dehiscence. The anesthesia protocol included a combination of fentanyl and pancuronium bromide supplemented with isoflurane to permit early extubation. Arterial and central venous lines were the standard. OPCAB was performed through a sternotomy incision. Intravenous heparin (1 mg/kg) was given to maintain activated clotting time (ACT) between 200 and 300 seconds. The target coronary artery was occluded proximal and distal sides to the proposed arteriotomy site by widely placing double-looped 5-0 Viline sutures or bulldog. These sutures were snuggled, and arteriotomy was made. Distal coronary anastomosis was performed using a running 7-0 monofilament prolene suture. Proximal anastomosis to aorta was made with a punch aortotomy after applying a side clamp to the ascending aorta. Visualization of the anastomosis was enhanced with the use of a humidified carbon dioxide blower. Following surgery, the patient was admitted to the ICU.

Statistical analysis: Statistical analysis was performed using SPSS version 11.5 (SPSS Inc, Chicago, US). Continuous variables are presented as a mean ± standard deviation (SD). Comparisons between the four BMI groups with continuous variables were performed using one-way analysis of variance (ANOVA), and significant relation between specific groups was defined by post hockey analysis. Chi-squared and *t*-test analyses were used to compare categorical and continuous variables between the BMI groups. Logistic regression was used to examine the effect of BMI (as an independent factor) and other dependent variables on each significant categorical outcome (i.e. AF, stroke, mortality, IABP) while adjusting for significant risk factors. Linear regression was used for comparison of the continuous outcome variables. BMI was included in this procedure as a quadratic term. Due to the small number of patients, the level of significance was set at p = 0.05.

RESULTS

The preoperative characteristics and demographics of patients are shown in Table 1. Intraoperative and postoperative patients characteristics are listed in Table 2. The low BMI group (mean = 17 ± 0.5 kg/m^2) contained 2.1% (n = 24) of the patients. The healthy weight BMI group (mean BMI = 22.4 ± 1.4 kg/m^2) included 57.8% (n = 648) of the patients. The overweight/high BMI accounted for 11.4% (n = 128) of patients and had mean BMIs of 27.5 ± 1.5 kg/m^2, and obese/very high BMI groups accounted for 28.6% (n = 320) of patients and had mean BMIs of 33 ± 2.7 kg/m^2. Postoperative complications and operative mortality are shown in Table 2.

Table 1: Preoperative patient's characteristics

Variables	**BMI (≤18.5)**	**BMI (>18.5-≤24.9)**	**BMI (25-≤29.9)**	**BMI (≥30)**	***p*-value**
Age (years)	50±7	60±8.7	60±7.7	56±8.5	0.067
Sex (male/female)	1.2/3.8	6.4/30	28.7/30.8	63.7/35.4	0.020
Ejection fraction	53±2	46±9.7	45±10	44±8.4	0.767
Chronic obstructive pulmonary disease (%)	8.3	7.5	9.3	12.5	0.044
Hypertension (%)	33.8	39.5	27.8	35	0.662
Smoking (%)	29.1	14.9	16.4	11.8	0.044
Opium use (%)	28.5	20	14.8	11.8	0.049
Diabetes (%)	7.0	18.5	25.5	35	0.083
Left main disease	1.1	3.4	4.6	4.1	0.907
Peripheral vascular disease	5.9% (65)	7% (77)	5.5% (60)	6.8% (74)	0.055
Preoperative renal failure (creatinine >1.5 mg/dl)	5.5% (60)	4.6% (50)	7.4% (82)	5% (55)	0.067
Hypercholestrolemia	23% (253)	25% (275)	22% (247)	27% (297)	0.055

Table 2: Intraoperative and post-operative complications

Variables	Underweight (≤18.5)	Normal weight (>18.5-≤24.9)	overweight (25-≤29.9)	obese (≥30)	*p*-value
Post-operative renal failure (%)	1.3	1.7	1.5	1.1	0.885
Number of grafts	3±0.5	3.1±0.7	3.2±0.8	3.2±0.7	0.328
Time in intensive care unit (day)	2.6±0.5*	3.2±1.8	2.8±0.7	2.7±.05	0.039
Ventilation time (hours)	14±6.6	12±5.4	11±6.1	11±5.8*	0.045
Mortality (%)	4.1*	1.8	1.5	2.5	0.037
Post-operative myocardial infarction (%)	0	1.8	2.3	2.8	0.911
Atrial fibrillation (%)	4.1	12.3	10.9	12.5	0.453
Reintubation (%)	0	5.4	4.6	6.25	0.065
Post-operative bleeding (%)	8.3*	7.4	8.5*	5.9	0.011
Intra-aortic balloon pump usage (%)	0	0.92	0.78	0.93	0.643
Transfusion volume (unit)	0.6±1.1*	1.7±1.8*	1.6±1.7	1.2±1.3	0.033
Post-operative PCO_2 (number)	37±2.6	36.7±5.5	35.4±4.8	37±5.9	0.516
Post-operative creatine phosphokinase myocardial band (unit)	21±2.5	25±13	15±8.9*	30±18.7*	0.021
Post-operative PO_2 (number)	93±6.8	90±3.7	89±4.7	88±6.8	0.062
Post-operative stroke (%)	0.0	0.7	0.7	0.6	0.765
Post-operative respiratory infection infection (%)	5	6.7	4.6*	6.8*	0.038
Post-operative fever (%)	8.3	8	7.8*	11*	0.000
Bronchodilator drugs using (%)	8.3	6.4	6.2*	13.1*	0.001
Dehiscence (%)	0	2	1.5	2.5	0.786
Post-operative cough (%)	6	8.25	11	12	0.345

*Post hock hockey analysis : showed significant difference between groups

A multivariate logistic regression analysis was used for the following hospital outcome variables: AF, IABP, stroke, mortality and reintubation. Linear regression analysis was used for assessing ICU stay and ventilation time [Tables 3, 4, 5 and 6].

Table 3: The factors predict atrial fibrillation by logistic regression analysis

Variables	Univariate			Multivariable		
	OR	95% CI	*p*-value	OR	95% CI	*p*-value
Age (year)	2.04	0.78, 1.439	0.055	3.55	0.032, 9.87	0.044
Gender (%)	0.66	0.12, 2.56	0.754			
Left main disease (%)	0.36	0.07, 2.671	0.689			
Ejection fraction ≤30%	0.55	0.18, 8.03	0.750			
Hypertension (%)	1.18	0.15, 9.44	0.874			
Post-operative myocardial infarction (%)	0.24	0.01, 4.15	0.885			
Smoking (%)	0.45	0.06, 3.52	0.445			
Emergent surgery (%)	1.03	0.22, 4.77	0.975			
Preoperative renal failure (%)	0.48	0.06, 3.80	0.488			
Time in intensive care unit	0.99	0.96, 1.02	0.584			
Diabetes (%)	2.08	0.62, 6.99	0.238			
Ventilation time (%)	1.02	0.27, 3.80	0.978			
Mortality (%)	0.84	0.23, 3.13	0.797			
Opium usage (%)	0.22	0.12, 3.67	0.045	4.56	0.054, 8.99	0.000
Second BMI group	1.04	0.93, 1.17	0.490			
Reintubation	2.54	0.13, 49.59	0.395	7.24	0.134, 18.9	0.025
Transfusion volume	0.67	0.07, 8.44	0.864	6.27	0.067, 13.8	0.000
Chronic obstructive pulmonary disease (%)	1.17	0.25, 5.46	0.843			
Post-operative inotropic drug usage	0.99	0.94, 1.06	0.962			
Intra-aortic balloon pump usage	0.23	0.01, 6.31	0.387			
Post-operative stroke (%)	0.93	0.87, 0.99	0.044	0.93	0.87, 0.99	0.043
Post-operative respiratory infection	0.93	0.89, 0.98	0.005	0.93	0.89, 0.98	0.005
Low BMI group	0.97	0.95, 0.99	0.011			

Table 4: The factors predicts IABP insertion by logistic regression analysis

Variables	Univariate			Multivariable		
	OR	95% CI	*p*-value	OR	95% CI	*p*-value
Age (year)	2.14	0.81, 1.20	0.532			
Gender (%)	0.76	0.25, 2.31	0.628			
Left main disease (%)	0.46	0.06, 3.61	0.459			
Ejection fraction ≤ 30%	0.87	0.19, 4.03	0.022	0.9	0.05,2.45	0.001
Hypertension (%)	1.18	0.15, 9.44	0.874			
Smoking (%)	0.45	0.06, 3.52	0.445			
Emergent surgery (%)	1.03	0.22, 4.77	0.975			
Preoperative renal failure (%)	0.48	0.06, 3.80	0.488			
Time in intensive care unit	0.99	0.96, 1.02	0.584			
Diabetes (%)	2.08	0.62, 6.99	0.238			
Ventilation time (%)	1.02	0.27, 3.80	0.978			
Mortality (%)	0.84	0.23, 3.13	0.797			
Opium usage (%)	0.19	0.01, 3.29	0.656			
Atrial fibrillation	1.04	0.93, 1.17	0.490			
Reintubation	2.54	0.13, 49.59	0.395	16	1.45,63.2	0.044
Post-operative bleeding (%)	0.42	0.02, 7.23	0.998			
Chronic obstructive pulmonary disease (%)	1.17	0.25, 5.46	0.843			
Post-operative inotropic drug	0.56	0.64, 1.03	0.432	1.36	0.02,4.52	0.033
Second BMI group	0.23	0.01, 6.31	0.387			
Post-operative stroke (%)	0.93	0.87, 0.99	0.044	0.93	0.87,0.99	0.043
Post-operative respiratory infection	0.93	0.89, 0.98	0.005	0.93	0.89,0.98	0.005
Low BMI Group	0.97	0.95, 0.99	0.011			

Each BMI group was entered in logistic regression analysis as dependent variable and other variables were considered independent variables. The regression analysis of all variables combined with each of BMI groups on AF was calculated as the following: age (OR 3.6, $p = 0.044$), reintubation (OR 7.2, $p = 0.025$), opium addiction (OR 4.6, $p = 0.000$) and transfusion volume (OR 6.3, $p = 0.000$). Both the underweight and obese groups were regressed on IABP and were found that neither of these groups was related to IABP insertion [Table 5]. Additionally, inotropic drugs use (OR 1.36, $p = 0.033$), reintubation (OR 16, $p = 0.044$) and EF (OR 0.9, $p = 0.001$) impacted the needs for IABP insertion, especially in older patients (68.4 vs. 64.4 years). Hypertension (OR 1.6, $p = 0.045$), LMD (OR 2.1, $p = 0.049$) and intubation time (OR 1.7, $p = 0.01$) were found to have a relationship with the occurrence of stroke. The following factors were found to have a significant correlation with the postoperative mortality: having a healthy weight ($p < 0.000$, OR 2.21), IABP use ($p < 0.004$, OR 1.06), POIDU ($p < 0.03$, OR 2.5), stroke ($p < 0.043$ OR 0.93), PORI ($p < 0.005$, OR 0.88) and COPD ($p < 0.041$, OR 1.70). BMI groups regressed on reintubation ($p = 0.044$, OR 12) and a low BMI ($p = 0.003$, OR 2.45), AF ($p = 0.000$, OR 16.5) and PORF ($p = 0.022$, OR 47) were found to be significant variables associated with reintubation [Table 4]. Two linear regression models were conducted with the four BMI variables looking at ICU stay time and ventilation time. The low BMI group was found to have a significant correlation with increased ICU stay time (r^2 21, $p = 0.041$). The longer ICU stay time could also be predicted by reintubation (r^2 51, $p = 0.011$) and ventilation time ($p = 0.0001$, r^2 124). The linear regression for ventilation time was also regressed on multiple variables. The low BMI group ($p = 0.021$, r^2 12) was statistically important for the prediction of a longer ventilation time. Longer ventilation time was also significantly related to older age ($p = 0.033$, r^2 17), postoperative PO_2 ($p = 0.011$, r^2 13) and COPD ($p = 0.000$, r^2 23).

Table 5: Factors predicting stroke using logistic regression analysis

Variables	Univariate			Multivariable		
	OR	**95% CI**	***p*-value**	**OR**	**95% CI**	***p*-value**
Age (year)	1.04	0.91, 1.19	0.583			
Gender (%)	0.76	0.25, 2.31	0.628			
Ejection Fraction ≤ 30%	0.87	0.19, 4.03	0.857			
Hypertension (%)	2.33	0.42, 8.21	0.874	1.6	0.049, 8.90	0.043
Post-operative myocardial infarction (%)	0.24	0.01, 4.15	0.885			
Smoking (%)	0.45	0.06, 3.52	0.445			
Emergent surgery (%)	1.03	0.22, 4.77	0.975			
Intensive care unit stay	0.99	0.96, 1.02	0.584			
Diabetes (%)	2.08	0.62, 6.99	0.238			
Ventilation time (%)	1.02	0.27, 3.80	0.978	1.7	0.063, 6.99	0.01
Mortality (%)	0.84	0.23, 3.13	0.797			
Opium usage (%)	0.19	0.01, 3.29	0.656			
Atrial fibrillation	1.04	0.93, 1.17	0.490			
Reintubation	2.54	0.13, 49.59	0.395			
Postoperative bleeding (%)	0.42	0.02, 7.23	0.998			
Chronic obstructive pulmonary disease (%)	1.17	0.25, 5.46	0.843			
Postoperative inotropic drug (%)	0.99	0.94, 1.06	0.962			
Intra-aortic balloon pump usage	0.23	0.01, 6.31	0.387			
Post-operative stroke (%)	0.93	0.87, 0.99	0.044	0.93	0.87, 0.99	0.043
Post-operative respiratory infection	0.93	0.89, 0.98	0.005	0.83	0.89, 0.98	0.005
Second BMI	0.97	0.95, 0.99	0.011			

Table 6: Factors predict mortality by logistic regression analysis

Variables	Univariate			Multivariable		
	OR	95% CI	*p*-value	OR	95% CI	*p*-value
Age (years)	1.04	0.91, 1.19	0.583			
Post-operative inotropic drug usage	0.76	0.25, 2.31	0.050	2.5	0.087, 10.23	0.003
Left main disease (%)	0.46	0.06, 3.61	0.459			
Ejection fraction ≤ 30%	0.87	0.19, 4.03	0.857			
Chronic obstructive pulmonary disease	1.18	0.15, 9.44	0.874	1.70	0.098, 3.087	0.004
Smoking (%)	0.45	0.06, 3.52	0.445			
Intra-aortic balloon pump usage	1.03	0.22, 4.77	0.041	1.06	0.11, 6.21	0.004
Preoperative renal failure (%)	0.48	0.06, 3.80	0.488			
Intensive care unit stay	0.99	0.96, 1.02	0.584			
Diabetes (%)	2.08	0.62, 6.99	0.238			
Ventilation time (%)	1.02	0.27, 3.80	0.978			
Low BMI	0.84	0.23, 3.13	0.045	2.21	0.78, 6.31	0.000
Opium use (%)	0.19	0.01, 3.29	0.656			
Atrial fibrillation	1.04	0.93, 1.17	0.490			
Reintubation	2.54	0.13, 49.59	0.395			
Post-operative bleeding (%)	0.42	0.02, 7.23	0.998			
Post-operative stroke (%)	0.93	0.87, 0.99	0.044	0.93	0.87, 0.99	0.043
Post-operative respiratory infection	0.93	0.89, 0.98	0.005	0.93	0.89, 0.98	0.005

DISCUSSION

Despite considerable debate about the efficacy of OPCAB, our knowledge about the effect of BMI is limited (6-9). The results of our study demonstrated a major effect of BMI on some in-hospital outcomes such as intubation time, reintubation time, ICU stay time, ARF, re-exploration for postoperative bleeding, COPD, fever, atelectasis and mortality in OPCAB method. Postoperative complications such as AF, IABP use and stroke seem not to be affected by BMI in off-pump coronary artery bypass grafting of patients. Moreover, a tendency for increased 30-day mortality in favor of OPCAB patients could be observed with decreasing BMI. In a study by Keeling et al., a higher mortality rate in patients with low BMI following OPCAB surgery was found, which was similar with our results (9). Bhamidipati et al. and Prapas et al. evaluated the effect of BMI on morbidity and mortality rates in patients with OPCAB surgery and found no significant relation between BMI and these factors (10,11). Engelman et al. (2) showed that low BMI was an important predictor of poor outcomes, while being overweight or obese did not predict an increase in the rate of mortality, which was supported by another study (12,13).

The issue of high BMI and its impact on early morbidity and mortality after OPCAB surgery remains a controversial issue. The term ‘obesity paradox’ explains a protective role of high BMI in patients with coronary artery disease, because of better early and long-term outcomes compared to patients with a low BMI (14-15). However, our findings revealed a statistically significant inclination for increased in-hospital mortality with decreasing BMI values (15). Our study revealed that BMI had no impact on postoperative AF. However, AF was associated with older age, reintubation, transfusion volume and opium addiction. Both the underweight and obese patient groups were associated with high rates of IABP insertion. There is a logical explanation for this event, since having a low or high BMI may be associated with high incidence of reintubation, which then indirectly may be associated with increased use of IABP. Reintubation may be associated with hemodynamic instability and increased a need for IABP usage. Schwann et al. revealed that IABP insertion had a statistically significant relationship BMI and post CABG clinical outcomes when compared to the normal weight BMI group (16). They attributed this result to a bias caused by the low number of operated patients in this group. Uni-varable and multivariable logistic regression analyses revealed no relationship between BMI group and postoperative stroke. However, hypertension, LMD and intubation time were significantly related to postoperative stroke (17). Linear regression analysis revealed that the low BMI group was significantly associated with prolonged intubation time.

In our study, patients who required prolonged intubation time tended to be older and had a lower postoperative PO_2. In similar studies, older age and postoperative atelectasis were associated with prolonged intubation. Respiratory muscle weakness and its consequent complications such as pulmonary infection were believed to cause this prolonged intubation time. No other authors have challenged this relationship (24). Re-exploration for bleeding was different between BMI groups, and its incidence was higher in those patients who were in the under and overweight groups. The higher postoperative bleeding rate in the underweight group is explained by malnutrition and its coagulation deficiency consequences. The increased bleeding in the overweight group could be explained by missing of the small artery bleeding site in the harvested fatty left internal mammary artery (LIMA). In another study, re-exploration for postoperative bleeding was common in the obese group (19,20).

We found that the normal weight group had the longest ICU stay time. However, a study by Kuczmarski et al. did not support our finding (21). This finding was not explained by any specific factor such as respiratory muscle dysfunction, which was found in the under and overweight BMI groups. We attributed this finding to the increased number of cases in this group, which was an important limitation of our study. In a similar study, increased stay time was associated with the obese BMI group. The authors found that increased postoperative respiratory complication in this group was related to the prolonged stay time. A higher BMI is typically associated with a reduction in forced expiratory volume in one second (FEV_1), forced vital capacity (FVC), total lung and functional residual capacity and expiratory reserve volume, as in our study (22). However, there was a conflict in result of our study, which was explained by the patients exposure to biomass and others natural fuels.

The prevalence of COPD was greatest in the obese group, but this group had the least prevalence of smoking. However, there was a history of exposure to non-cigarette smoking, such as biomass, wood, animal dung and bakeries. A history of COPD is usually missed in asymptomatic non-smokers patients with history of indoor biomass smoke inhalation. These non-smokers with COPD have an abnormal respiratory parameter index (23). Fever in the first 24 hours of postoperative period is related to atelectasis, which is more common in obese patients with high BMI. Postoperative care is more prominent in the high BMI group, especially in the obese group. This precise postoperative care reduces the incidence of atelectasis in this group, and other studies supported our result (24). We believe that the higher incidence of renal failure in the normal weight group can be explained by a higher incidence of low ejection fraction in this group. A similar study reaffirmed our results and found that acute renal failure was related to low cardiac output syndrome in the postoperative period. However, ARF was more common in the underweight group in an another study; the authors explained that this association was the effect of some trace element deficiency in renal function in these malnourished patients (25). Patients with renal failure tended to be older and had high preoperative serum creatinine level. Based on our results, the risk of mortality after OPCAB is increased in the low BMI group. A systematic review of cohort studies also found that the low BMI group was associated with the greatest risk for mortality after an on-pump CABG (26). This similarity in mortality between the two CABG methods (on pump vs. off pump) in the low BMI group has different mechanisms. In the on-pump group, both respiratory muscle weakness and increased levels of the postoperative serum level of inflammatory cytokines caused subsequent lung dysfunction. In logistic regression analysis, the low BMI group was also associated with reintubation, and this may be explained by the occurrence of postoperative respiratory complication in these patients (27). Despite the small number of patients in the fourth group, we noted that the ICU stay time in the obese patients was not significantly longer than other groups. However, stay time was prolonged in the normal weight group. In other studies, ICU stay was prolonged in the obesity group, and this was explained by increased postoperative respiratory complications (28). Life-threatening postoperative morbidity was more likely in patients with COPD due to emphysema and respiratory failure. In our study, spirometry profile was mostly compromised in the obese group and the prevalence of COPD in this group was higher than in other groups. Furthermore, our study only included a limited number of patients in the low BMI and very high BMI groups, even though these two extremes seem to be a controversial issue in the medical literature.

In conclusion, the low BMI group was significantly associated with reintubation, prolonged intubation time and ICU stay time following OPCAB surgery. High BMI caused postoperative atelectasia and fever. Surgeons and anesthesiologists must be aware of these differences in order to be able to provide appropriate premedication, proper general anesthesia and adequate perioperative managements for patients with an abnormal physique.

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