The Effect of Body Mass Index on Postoperative Bleeding and Blood Transfusion in Patients with Coronary Bypass Surgery

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Abstract

Objectives: The use of blood and blood products, which is a major complication, significantly increases the duration of stay in intensive care and hospitalization, as well as hospital costs on open heart surgery. In our study, we aimed to investigate the relationship between postoperative early bleeding, blood and blood product use in coronary artery bypass grafting (CABG) surgery under cardiopulmonary bypass (CPB).

Methods: In this study, 843 patients who underwent consecutive CABG operation between May 2012 and March 2014 were included. The patients were classified into three categories according to their body mass index (BMI); weak group (BMI ≤19 kg/m²), normal weight group (BMI 20-29 kg/m²) and obese group (BMI ≥30 kg/m²). Preoperatively; age, gender, height, weight, diabetes mellitus (DM), hypertension, hyperlipidemia, chronic obstructive pulmonary disease (COPD), preoperative myocardial infarction, left ventricular ejection fraction (LVEF), mean hemoglobin and platelet values. Intraoperatively; cross clamp time, cardiopulmonary bypass time, total duration of the operation, amount of cardioplegia given, number of grafts used in coronary bypass. Postoperatively; the total amount of blood used, drainage amount, given vasopressor treatment, given positive inotropic support, intraaortic balloon pump usage, intubation duration, intensive care stay, hospital stay, bleeding-related re-exploration and mortality of all patients were examined.

Results: It was observed that more blood transfusions performed in patients with low and normal weight compared to the obese group (11.22±2.85 ml/kg, p=0.011). Also in patients with low and normal weight compared to the obese group more blood loss was observed (7.12±1.87 ml/kg, p=0.017).

Conclusion: In our study, in accordance with the general opinion of previous studies, we found that patients with high BMI had lower postoperative blood loss and blood use than patients with low BMI.

Keywords: Body mass index, blood transfusion, coronary bypass surgery


Obesity is becoming a worldwide burden. By 2025, the percentage of obesity is expected to be over 18% in males and 21% in females; severe obesity will be more than 6% in males and 9% in females.[1] Obesity increases annually at an average of 0.4-0.5 kg m-2 BMI worldwide.[2] Bleeding after open heart surgery is a major complication, and blood loss and transfusion amounts are an important...
Severe postoperative bleeding after cardiac surgery can cause some complications such as stroke, acute kidney injury, perioperative myocardial infarction and mortality. The use of blood and blood products, which is a major complication, significantly increases the duration of stay in intensive care and hospitalization, as well as hospital costs. Therefore, studies have been carried out aimed at different strategies for using blood and blood products and reducing postoperative bleeding in patients undergoing open heart surgery.

In our study, we aimed to investigate the relationship between postoperative early bleeding, blood and blood product use in coronary artery bypass grafting (CABG) surgery under cardiopulmonary bypass (CPB).

Methods

In the study, 843 patients who underwent consecutive CABG operation between May 2002 and March 2014 at the Private Akay Hospital Cardiovascular Surgery Clinic were included.

The patients were classified into three categories according to their body mass index; weak group (BMI ≤19 kg/m²), normal weight group (BMI 20-29 kg/m²) and obese group (BMI ≥30 kg/m²).

Patients with chronic kidney failure, peripheral vascular disease, chronic liver disease, patients underwent emergency surgery, reoperations, patients with chronic malnutrition, patients underwent additional surgery for the CABG operation, patients received antiaggregant within 5 days before the operation and patients with a prior history of bleeding diathesis and the cases with comorbidity which is enhancing the risk of bleeding were excluded.

Demographic data, preoperative risk factors, postoperative complications, laboratory findings, observed mortality and morbidity records of the patients were obtained retrospectively from patient files and hospital database.

Preoperatively; age, gender, height, weight, diabetes mellitus (DM), hypertension, hyperlipidemia, chronic obstructive pulmonary disease (COPD), preoperative myocardial infarction, left ventricular ejection fraction (LVEF), mean hemoglobin and platelet values,

Intraoperatively; cross clamp time, cardiopulmonary bypass time, total duration of the operation, amount of cardioplegia given, number of grafts used in coronary bypass, Postoperatively; the total amount of blood used, drainage amount, given vasopressor treatment, given positive inotropic support, inaarotic balloon pump usage, intubation duration, intensive care stay, hospital stay, bleeding-related re-exploration and mortality of all patients were examined.

Operative Technique

The operation was performed by median sternotomy in all CABG operated cases.

Extracorporeal circuit was consisted of atmospheric type venous reservoir, roller pump (Sorin Stockert S3 heart lung machine, sorin group Inc. Milan, Italy), heat exchanger, membrane oxygenator (Capiox SX18; Terumo Inc., Tokyo, Japan), arterial filter (Quart arterial filter; Maquet Cardio-pulmonary AG, Hirrlingen, Germany).

The tube diameter of the perfusion set for both the arterial and venous side (two tubes) was 5/16 inches (7.9 mm). The circuit (uncoated) was prepared with approximately 1000 ml sodium acetate Ringer’s solution, 0.25 g/kg mannitol (20%), 20 meq bicarbonate and 5000 IU heparin.

For CPB, standard cannulation (with two stage cannula) of the ascending aorta and right atrium was performed. After cardiac arrest was achieved with antegrade-retrograde cold crystalloid cardioplegia and topical hypothermia, the continuation of the arrest was achieved with intermittent retrograde cold blood cardioplegia.

CPB management; Operations were completed under moderate hypothermia (28 °C), using alpha-stat pH management, with targeted mean arterial blood pressure between 50 and 80 mmHg and pump flow rates of 2.4 l/min/m².

In all 843 patients who underwent CAGB, anastomosis was performed on the left anterior descending artery (LAD) using the left internal mamarian artery (LIMA). The saphenous vein graft removed from the leg was also used in bypasses performed to other coronary arteries. Proimal anastomoses were performed under the cross clamp. Hot blood cardioplegia was given before the cross clamp was removed. The blood in the reservoir in the CPB circuit was always returned to the patient before leaving the operating room.

Statistical Analysis

Statistical analysis was performed using the SPSS version 13.0 software (SPSS Inc., Chicago, IL, USA). Descriptive statistics were expressed in mean±standard deviation (SD), percent or number and frequency for continuous variables. Categorical variables were compared between the groups using the chi-square test. The Fisher exact test was used, if the expected contingency table cell frequency was less than 5. The Mann-Whitney U test and independent samples t-test were used to analyze significant differences between the groups for continuous variables. P value <0.05 was considered significant.
Results

There was no statistically significant difference between the mean ages and gender distribution of all three groups \( (p=0.654, p=0.347) \) (Table 1).

In terms of risk factors, it was found statistically significant that it correlated with BMI increase between DM, HT and HL values, respectively \( (p=0.001, p=0.003, p=0.027) \) (Table 1).

No statistically significant difference regarding COPD, Previous myocardial infarction, Left ventricular ejection fraction (LVEF), hemoglobin and platelet values was detected in all three groups (Table 1).

In comparison of intraoperative data of patients, no statistically significant difference was found between cross-clamp time, cardiopulmonary bypass time, operation duration time and total amount of cardioplegia \( (p=0.356, p=0.531, p=0.455, p=0.127) \) (Table 2).

Besides, the number of coronary arterial anastomoses was higher in obese patients \( (p=0.001) \) (Table 2).

It was observed that more blood transfusions performed in patients with low and normal weight compared to the obese group \( (11.22\pm2.85\text{ml/kg}, p=0.011) \) (Table 3). Also in patients with low and normal weight compared to the obese group more blood loss was observed \( (7.12\pm1.87\text{ml/kg}, p=0.017) \) (Table 3).

Discussion

In our study, we found an inverse relationship between increased BMI and the need for blood transfusion and decreased amount of blood loss in patients after CABG. In addition, as an additional finding, although there were more coronary artery anastomoses in obese patients, blood loss was less. We evaluated this finding toward that the number of anastomoses did not affect blood loss. Our results were toward that low or normal weight is an important preoperative indicator of increased chest tube drainage and perioperative bleeding.

The relationship between Body Mass Index (BMI), postoperative bleeding volume and blood transfusion remains uncertain.\(^9\)

### Table 1. Baseline demographic and clinical characteristics of patients

<table>
<thead>
<tr>
<th>Variable</th>
<th>Underweight (BMI ≤19 kg/m²)</th>
<th>Normal weight (BMI 20–29 kg/m²)</th>
<th>Obese (BMI ≥30 kg/m²)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>62.55±8.45</td>
<td>61.87±9.12</td>
<td>60.93±10.34</td>
<td>0.654</td>
</tr>
<tr>
<td>Sex (female)(n/%)</td>
<td>28/36.84</td>
<td>157/38.48</td>
<td>133/37.04</td>
<td>0.347</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>40</td>
<td>247</td>
<td>287</td>
<td>0.001</td>
</tr>
<tr>
<td>Hypertension</td>
<td>22</td>
<td>203</td>
<td>265</td>
<td>0.003</td>
</tr>
<tr>
<td>Hiperlipidemia</td>
<td>34</td>
<td>214</td>
<td>147</td>
<td>0.027</td>
</tr>
<tr>
<td>COPD</td>
<td>17</td>
<td>231</td>
<td>246</td>
<td>0.462</td>
</tr>
<tr>
<td>Previous myocardial infarction</td>
<td>27</td>
<td>186</td>
<td>278</td>
<td>0.735</td>
</tr>
<tr>
<td>LVEF (mean±SD)</td>
<td>50.3±7.9</td>
<td>46.7±8.4</td>
<td>48.3±9.2</td>
<td>0.159</td>
</tr>
<tr>
<td>Hemoglobin (gr/dl, mean±SD)</td>
<td>13.4±1.6</td>
<td>13.7±1.8</td>
<td>14.1±1.6</td>
<td>0.347</td>
</tr>
<tr>
<td>Platelet (109/L)</td>
<td>204.4±62.3</td>
<td>204.95±61.53</td>
<td>211.7±65.6</td>
<td>0.563</td>
</tr>
</tbody>
</table>

COPD: Cronic Obstructive Pulmonary Disease; LVEF: Left Ventricule Ejection Fraction.

### Table 2. Intraoperative data of patients

<table>
<thead>
<tr>
<th>Variable</th>
<th>Underweight (BMI ≤19 kg/m²)</th>
<th>Normal weight (BMI 20–29 kg/m²)</th>
<th>Obese (BMI ≥30 kg/m²)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross-clamp time (min)</td>
<td>83.2±23.5</td>
<td>78.3±36.2</td>
<td>85.2±28.8</td>
<td>0.356</td>
</tr>
<tr>
<td>Cardiopulmonary bypass time (min)</td>
<td>102.5±22.3</td>
<td>98.3±25.7</td>
<td>108.3±32.7</td>
<td>0.531</td>
</tr>
<tr>
<td>Operation duration (min)</td>
<td>187.3±32.1</td>
<td>196.5±29.8</td>
<td>227.7±49.6</td>
<td>0.455</td>
</tr>
<tr>
<td>Total amount of cardioplegia (mL)</td>
<td>1570±420</td>
<td>1530±390</td>
<td>1660±450</td>
<td>0.127</td>
</tr>
<tr>
<td>Number of anastomosis (n/%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤2</td>
<td>35/46.05</td>
<td>227/55.63</td>
<td>120/43.43</td>
<td>0.017</td>
</tr>
<tr>
<td>≥3</td>
<td>41/53.95</td>
<td>181/44.37</td>
<td>239/66.57</td>
<td>0.001</td>
</tr>
</tbody>
</table>
There are studies indicating that the transfusion rate and amount and total blood loss are reduced in obese individuals and there is a linear correlation between BMI and postoperative bleeding volume.[10]

On the other hand, there have been studies showing that the risk of postoperative bleeding complications does not differ between obese and non-obese patients.[11]

In some studies evaluating risk factors and re-explorations due to bleeding in obese patients underwent CABG, similar results were obtained with our study, including reduced re-exploration among obese patients.[12]

In a research, which supports our study, conducted by Mertens and his friends, it has been demonstrated that adipocytes produce plasminogen activator inhibitor-1, which probably explains why we have less perioperative bleeding and less blood transfusion in our obese patient group underwnt CABG.[13]

Likewise, it has been suggested that the connecting link between BMI and postoperative bleeding volume and transfusions may be related to procoagulant status. There are studies toward that obese patients have higher plasma clotting factor II (FVII), thrombin and thrombin-antithrombin (TAT) complexes and tissue factor procoagulant activity (TF).[14]

There are also studies showing that obesity is associated with increased platelet activation.[15]

In our study, in accordance with the general opinion of previous studies, we found that patients with high BMI had lower postoperative blood loss and blood use than patients with low BMI. There were some limitations in our study. First of all, the fact that our study is retrospective and single-centered, is the main one. However, we think that the sample size reduces the negativity caused by this limitation.

More clinical studies are needed to find out the underlying reasons why high BMI reduces blood loss and blood use. However, regardless of the reason for less blood loss and blood use in patients with high BMI, looking at with an eye of a surgeon, we think that BMI is a very important biomarker that should be kept in mind in terms of reducing the postoperative mortality and morbidity of the patient.

Disclosures

Ethics Committee Approval: The Ethics Committee of Lokman Hekim University provided the ethics committee approval for this study (25.12.2019/2019039).

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.


References
