Hemoglobin Level Decrease after Open Heart Surgery in A Tertiary Hospital in Indonesia

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Introduction

Cardiovascular disease is the number one cause of death in the world. Estimated that 17.9 million people died of cardiovascular disease in 2016, representing 31% of all deaths in the world.1 With heart disease as the number one killer in the world, there are a lot of treatments carried out to prevent death. One of them is open-heart surgery.2 Open heart surgery is usually conducted by connecting the heart to the cardiopulmonary bypass (CPB) machine.3 The most common open-heart surgeries are coronary artery bypass graft (CABG) surgery and heart valve surgery.4,5

The use of CPB machines will cause hemodilution. Hemodilution occurs due to the process of mixing the blood of patients with priming fluid in the extracorporeal circuit.6 Hemodilution will cause a decrease in hemoglobin (Hb) levels.7 Besides hemodilution, hemolysis can also cause a decrease in hemoglobin levels. Hemolysis is the damage of the red blood cell membrane integrity, causing the hemoglobin released and its levels fall.8 Hemolysis during open-heart surgery might also be caused by the use of CPB machines.9 Several things can cause hemolysis; the first cause is trauma due to CPB engine pumps caused by high shear stress. The second cause is an augmented or assisted venous return (AVD). The third cause is the arterial cannula.10-12 Excessive decreased in hemoglobin levels can cause serious complications such as dyspnea, hypotension, tachycardia, and loss of consciousness.13

The aim of the study was to explore the decrease of hemoglobin levels after open-heart surgery. It is expected that the result might give information for clinicians to monitor the level of hemoglobin to prevent complications and to facilitate early treatment is necessary.

Abstract

Background: Open heart surgery is usually performed by connecting the heart to a cardiopulmonary bypass (CPB) machine. The use of the CPB machine may decrease the hemoglobin level and a very low hemoglobin level could cause serious complications. This study aimed to explore the decrease in hemoglobin level after open heart surgery.

Methods: A cross-sectional retrospective descriptive study was conducted on medical records of patients underwent coronary artery bypass graft (CABG) surgery and heart valve surgery in a tertiary hospital in Indonesia in 2018. The total sampling method was deployed to all medical records of patients underwent CABG surgery (n=25) and patients underwent heart valve surgery (n=3).

Results: The decrease in hemoglobin level among young-adult female patients after heart valve surgery was 6.8 g/dl. The average decrease in mid-adult male and female patients after CABG surgery were 6 g/dl and 5.8 g/dl, respectively, and, after the heart valve surgery, the levels were 8.5 g/dl and 5.4 g/dl, respectively. The average decrease in Hb level among late-adult male and female patients after CABG surgery was 6.1 g/dl and 5.4 g/dl, respectively.

Conclusions: Hemoglobin level decreases after an open heart surgery. Therefore, observation on the hemoglobin level to prevent complications and to facilitate early treatment is necessary.

Keywords: Coronary artery bypass graft surgery, heart valve surgery, hemoglobin
prevent the decrease of Hb levels during open-heart surgery.

**Methods**

This study was a retrospective descriptive study with a cross-sectional design, conducted from June to November 2019 using secondary data from the medical record database in Dr. Hasan Sadikin General Hospital, Bandung. All data of the patients aged ≥18 years old who underwent CABG and heart valve surgery in 2018 were collected. Only data with complete medical records were included. The exclusion criteria were incomplete data on Hb values before and after CABG or heart valve surgery. Those who had low Hb levels before CABG and heart valve surgery were also excluded. The normal Hb value of adult men was 13.5–18 g/dl and of adult women was 12–15 g/dl.14 Data collection was carried out after obtaining ethical approval number 955/UN6.KEP/EC/2019 issued by the Research Ethics Committee of Universitas Padjajaran, and Research Licensing Letter issued by the Research Ethics Committee of Dr. Hasan Sadikin General Hospital Bandung (No. LB.02.01/X.2.2.1/1781/2019). The selected data was analyzed and presented in a table to illustrate the decrease of hemoglobin levels.

**Results**

In total, data were collected from CABG surgery patients (n=25) and heart valve surgery patients (n=3). The characteristic of the patients was shown in Table 1. There were no young adult patients who underwent CABG surgery, and there were no late adult patients who underwent heart valve surgery. The majority of CABG surgery patients were in the late adult group (64%) and male patients (88%) whereas, the majority of heart valve surgery patients were in the middle adult group (66.7%) and female patients (66.7%). The decrease of hemoglobin levels after

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**Table 1 Characteristics of Patients Underwent Open Heart Surgery**

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>CABG Surgery (n=25)</th>
<th>Heart Valve Surgery (n=3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Young Adult (18–35 years old)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Middle Adult (36–55 years old)</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Late Adult (&gt;55 years old)</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>3</td>
</tr>
</tbody>
</table>

Note: CABG= Coronary Artery Bypass Graft

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**Table 2 Decrease of Hemoglobin Levels After Open Heart Surgery Based on Age Groups and Gender**

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>Gender</th>
<th>CABG</th>
<th>Heart Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Preoperative</td>
<td>Postoperative</td>
</tr>
<tr>
<td>Young Adult</td>
<td>Male</td>
<td>15.2</td>
<td>9.2</td>
</tr>
<tr>
<td>(18–35 years old)</td>
<td>Female</td>
<td>13.3</td>
<td>7.5</td>
</tr>
<tr>
<td>Middle Adult</td>
<td>Male</td>
<td>14.9</td>
<td>8.8</td>
</tr>
<tr>
<td>(35–55 years old)</td>
<td>Female</td>
<td>12.9</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Note: CABG, Coronary Artery Bypass Graft
Table 3 Packed Red Blood Cell Transfusion Given After Open Heart Surgery Based on Age Groups and Gender

<table>
<thead>
<tr>
<th></th>
<th>Young Adult (18–35 years old)</th>
<th>Middle Adult (35–55 years old)</th>
<th>Late Adult (&gt;55 years old)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>PRBC (ml)</td>
<td>-</td>
<td>-</td>
<td>490.5</td>
</tr>
<tr>
<td>CABG</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Heart Valve</td>
<td>-</td>
<td>385</td>
<td>525</td>
</tr>
</tbody>
</table>

Note: CABG= Coronary Artery Bypass Graft; PRBC= Packed Red Blood Cell

Discussion

The result of this study showed that patients of CABG surgery were predominantly male (88%), conform the other study showing that men have a higher risk of coronary heart disease than women. Men have a higher risk of coronary heart disease because men smoke more and have higher alcohol consumption than women. Men also have a higher risk of heart valve disease than women. However, our study shows that there is a trend that female was more prevalent than men, although the numbers of patients are very limited.

Furthermore, the age of patients who underwent of CABG surgery in this study are predominantly (64%) the late adult group (>55 years old). This data is similar to data from the Ministry of Health Republic of Indonesia. As for patients with heart valve surgery in this study, the middle adult group (36–55 years old) was predominant (66.7%).

In this study, the average decrease of hemoglobin levels in male and female patients of the middle adult group after CABG surgery is 6 g/dl and 5.8 g/dl, and after heart valve surgery is 8.5 g/dl and 5.4 g/dl respectively. Furthermore, the average decrease of hemoglobin levels in male and female patients of late adult group after CABG surgery is 6.1 g/dl and 5.4 g/dl. The decrease of hemoglobin is almost 50% of the baseline of hemoglobin before surgery. The decrease of hemoglobin levels in male patients is greater than female patients after CABG surgery and after heart valve surgery. The result of this study is similar to a study that examined the decrease of hemoglobin levels after cardiac surgery in Dhaka, Bangladesh. The monitoring of the hemoglobin in that study was taken on the 1st, 3rd, and 7th post-operative days. Interestingly, the decrease of hemoglobin levels can be caused by hemolysis and hemodilution due to the use of CPB machines.

Further study is needed to find out the factors that cause the difference in the decrease of hemoglobin levels.

In this study, all patients have received PRBC transfusion after CABG surgery and heart valve surgery. The purpose of PRBC transfusion is to prevent tissue hypoxia related to anemia. As a standard procedure, PRBC transfusion will be given after heart surgery when hemoglobin levels reach the transfusion threshold ≤7 g/dl. In this study, all patients received PRBC transfusion even though some of the decreases in hemoglobin levels have not yet reached the threshold of PRBC transfusion. Further research is needed to find out the factors that influence this result.

There are some limitations to this study. The hemoglobin monitoring has been only
conducted in the same day after the surgery. Hemoglobin level needs to be monitored regularly. Furthermore, the complete medical records before and after open-heart surgery needs to be well recorded. More patients’ data analysis needs to be performed to have a good view on the hemoglobin decrease after open heart surgery.

In conclusion, the hemoglobin level is decreased after open heart surgery. Therefore, it is necessary to observe the decrease in hemoglobin levels for prevention and treatment if the decrease exceeds normal.

References