A Prospective Study on Anemia and Blood Transfusion in Critically ill Patients

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A Prospective Study on Anemia and Blood Transfusion in Critically ill Patients

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Abstract

Objective: To quantify the incidence of anemia and red blood cell (RBC) transfusion practice in critically ill patients and to examine the relationship of anemia and RBC transfusion in clinical outcomes.

Design: The cohort study included 100 critically ill patients from King Abd El Aziz University Hospital, Saudi Arabia in 2010. Complete blood count was done detecting types and causes of anemia, and accordingly patients were divided into two groups - those who received blood transfusion versus those who did not. Anemic patients were identified, when having Hemoglobin (Hb) less than 14g/dl in males and Hb less than 12g/dl in females. The study contained 23% Saudi patients and 77% non-Saudi patients. There were 53% enrolled males and 47% females with an average age of 59.74 + 2.03 years. The data was analyzed based on the overall and the blood transfusion basis (50/50)

Results: The study enrolled 100 patients, 50% of whom had blood transfusion. 82% of the patients in the ICU had anemia, mainly Normocytic Normochromic. There is an association between blood transfusion and mortality in critically ill patients, as 66% of patients, who had transfusion, died.

Conclusion: Although critically ill patients with anemia have an increased risk of death, especially in the case of blood transfusion (66% of patients who received a transfusion died), however each of them must be assessed individually.

Introduction

Anemia is a common problem among critically ill patients that the majority of them need blood transfusion during their stay in the intensive care unit (ICU). However, the decision to transfuse is not always clearly defined and in the recent years, this issue has seen considerable debate and controversy.[1]

Two decades ago, a hematocrit between 0.20 and 0.25 was considered an urgent indication for transfusion, but at the turn of this century, maintaining a hematocrit at this level is considered to be "best-practice medicine".[2]

Although the definition and grading of anemia varies among different organizations, most of them agree that a hemoglobin level below 6.5 g/dl indicates severe or life-threatening anemia.[3]

Anemia of critical illness, a commonly encountered clinical situation, is hematologically similar to that of chronic anemia, except that its onset is generally sudden. The etiology is usually multifactorial, occurring as a consequence of direct inhibitory effects of inflammatory cytokines, erythropoietin deficiency, blunted erythropoietic response, blood loss, nutritional deficiencies, and renal insufficiency. Although anemia is not well tolerated by critically ill patients, aggressive treatment of anemia can be just as detrimental as no treatment. [3] It can also be due to reduced erythropoiesis, or increased red cell destruction.[1]

The possible relationship between blood transfusion and poor outcome has led many to review their transfusion practices. There are two main reasons to give a blood transfusion in a critically ill patient:

1. To increase tissue oxygenation: The hemoglobin level is, with the cardiac output and the PaO2, an essential determinant of oxygen transport. Nevertheless, increasing hemoglobin levels via transfusion will not necessarily increase tissue oxygenation. Indeed, increasing the number of red blood cells can increase blood viscosity, which in turn can decrease cardiac output, and hence, limit oxygen delivery. In addition, a reduction in the hematocrit can have beneficial effects on the microcirculation, with oxygen extraction capacities being greater when the hematocrit is reduced whether under physiological conditions[4] or during sepsis.[5] It should also be stressed that blood transfusion rarely increases oxygen uptake, except under extreme conditions, where oxygen uptake is directly dependent on oxygen delivery, essentially in circulatory shock associated with hyperlactatemia[6,7,8] or in severe anemia with hemoglobin levels generally less than 6 g/dl. Hebert and Chin-Yee[9] identified 14 studies, in which the impact of blood transfusion on oxygen kinetics was assessed, and noted that only five reported an increase in VO2 following transfusion.

2. To avoid myocardial ischemia: During anemia, the increased cardiac output (due to decreased viscosity and adrenergic stimulation) augments myocardial
oxygen demands, and patients with acute myocardial instability tolerate anemia poorly.[10]

Anemia, because of its associated morbidity and mortality, is of a clinical importance in critically ill patients. Among patients who have normal hemoglobin levels on admission to an intensive care unit (ICU), nearly all become anemic during the course of their ICU stay.[11,12]

The whole transfusion issue has become a hot area of debate in the last five years; triggered by the study by Hebert et al[13] noting that a more restrictive transfusion protocol (transfusions given when the hemoglobin concentration drops below 7.0 g/dl and hemoglobin concentrations maintain at 7.0-9.0 g/dl) was at least as effective and possibly more than a more conservative approach (transfusions given when the hemoglobin concentration fall below 10.0 g/dl and hemoglobin concentrations maintain at 10.0-12.0 g/dl).[1]

Study Objectives:
To assess the prevalence of anemia and study the association of blood transfusion and mortality in critically ill patients.

Methodology

It is a cohort study; it recruited 100 critically ill patients divided into 2 group, 50 of whom received blood transfusion versus the remaining 50, who did not. Enrolled patients were evaluated to detect the association of anemia in critically ill patients and the incidence of mortality with blood transfusion. The data was analyzed based on overall and blood transfusion.

Statistical Methodology
Frequency statistics (number, percent) were mainly calculated for all the measurements. Comparability was assessed using chi-square test for categorical variables, like sex, etc. and t-test for continuous variables, like Hb levels.

Results

Out of the 100 patients, 82% (82 patients) were anemic with Hb average of 10.06 + 0.28, 48 of whom had blood transfusion. There was a very high significance between the patients who had blood transfusion and those who did not. (P value=0.000)

Discussion

A study shows that nearly half the patients admitted to an ICU have Hb levels less than 10 g/l, while another study showed that two-thirds of patients admitted to an ICU have Hb levels less than 10 g/l [2] and this was close to another study that showed that 29% of the patients had a hemoglobin concentration of less than 10 g/dl. [1]

The mortality rate of patients who received a transfusion versus who did not was 66% versus 34% showing a similar very high significant rate (P-value 0.001), similar as another study that included 3534 patients from 146 Western European ICUs.[2]

Sepsis was the most common clinical setting associated with anemia for 72% of the patients followed by Chronic Renal Failure in 56% of the patients. Another study, also, showed that sepsis was the most common association with anemia followed by chronic renal failure. [2]

The complications of blood transfusion include volume overload, febrile reactions and fatal hemolytic reactions, which may all contribute to increased mortality rate.[15,16,17,18,19,]

In our study, anemic patients had a shorter duration of stay in the ICU (7.3 days) compared to normal patients (8.5 days), this result was contradicting to another study that showed that anemic patients had a longer ICU stay (P-value < 0.001).[1]

The relationship of anemia and red blood cell transfusion with clinical outcomes, in anemia and blood transfusion in the critically ill study, was examined before.[2] They found that as the number of red blood cell units transfused increased, the longer ICU & hospital stay increased, in addition to increased mortality rate. [3]

Conclusion

In the recent years, we have seen conflicting reports for the association of blood transfusion with different outcomes,[1] leading to no universally accepted treatment guidelines for managing anemia, in addition to different practices performed among clinicians, hospitals, regions, and countries. [20] Thus, each patient must be individually assessed and the decision to transfuse the patient should be based on many parameters including clinical condition, age, pre-existing and current disease processes, oxygenation parameters with indexes of tissue hypoxia available, as well as the traditional hemoglobin values. [1]

References
20. Shander A. Anemia in the critically ill. Department of Anesthesiology, Critical Care Medicine, Pain Management and Hyperbaric Medicine, Englewood Hospital and Medical Center, NJ 07631, USA.
Patients’ Demographics:
The study cohort of 100 patients, 50% of whom had blood transfusion, while the other 50% did not.

The study contained 23% Saudi patients, 13% of whom had blood transfusion, while the remaining 10% did not; and 77% non-Saudi patients, 37% of whom had a transfusion and the remaining 40% did not. There were 53% enrolled males and 47% females with average age of 59.74 ± 2.03 years.

Table (1) shows the sample characteristics:

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Blood Transfusion</th>
<th>No Blood Transfusion</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>53% (53)</td>
<td>26% (26)</td>
<td>27% (27)</td>
<td>0.842</td>
</tr>
<tr>
<td>Females</td>
<td>47% (47)</td>
<td>24% (24)</td>
<td>23% (23)</td>
<td></td>
</tr>
<tr>
<td><strong>Age:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SE</td>
<td>59.74 ± 2.03</td>
<td>56.72 ± 2.89 years</td>
<td>62.76 ± 2.82 years</td>
<td>0.138</td>
</tr>
<tr>
<td>Range</td>
<td>14 – 97 years</td>
<td>14 – 90 years</td>
<td>21 – 97 years</td>
<td></td>
</tr>
<tr>
<td><strong>Nationality:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saudi</td>
<td>23% (23)</td>
<td>13% (13)</td>
<td>10% (10)</td>
<td>0.476</td>
</tr>
<tr>
<td>Non Saudi</td>
<td>77% (77)</td>
<td>37% (37)</td>
<td>40% (40)</td>
<td></td>
</tr>
</tbody>
</table>
Table (2) shows the level of Hemoglobin:

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Blood Transfusion</th>
<th>No Blood Transfusion</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anemic:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>82% (82)</td>
<td>96% (48)</td>
<td>68% (34)</td>
<td>0.000</td>
</tr>
<tr>
<td>No</td>
<td>18% (18)</td>
<td>4% (2)</td>
<td>32% (16)</td>
<td></td>
</tr>
<tr>
<td><strong>Hb range:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SE</td>
<td>10.06 ± 0.28</td>
<td>8.82 ± 0.31</td>
<td>11.3 ± 0.39</td>
<td>0.000</td>
</tr>
<tr>
<td>Range</td>
<td>4.9 – 16.1</td>
<td>4.9 – 14</td>
<td>5.4 – 16.1</td>
<td></td>
</tr>
</tbody>
</table>
The predominant peripheral smear picture was of Normocytic normochromic type (68%). The others were microcytic hypochromic with 25% showing a leukemoid reaction. There was no significance between patients who received blood transfusion and those who did not.

Figure 1: The predominant peripheral smear picture was Normocytic Normochromic
Sepsis was the most common clinical setting associated with anemia in 72% of the patients followed by Chronic Renal Failure in 56% of the patients. The others being gastrointestinal bleeding, hemolysis and internal hemorrhage. The blood transfusion group, also, had the same most common clinical setting associated with anemia as sepsis, which was 76% of the cases followed by Chronis renal failure in 62%. There was no significance between patients who received blood transfusion and those who did not.

Figure 2: Causes of anemia identified in the study
The mortality rate of the 100 patients studied was 50% (50 patients), 66% (33 patients) of whom were given blood transfusion, while the other 34% (17 patients) had no blood transfusion showing a very high significant rate (P-value 0.001).

The mortality rate, in those who were transfused at Hb< 7 g/l, was 80% compared to 40% of the mortality rate, in those who were transfused at Hb>10 g/l (P-value 0.015).

The duration of stay in the ICU for patients who got blood transfusion was 10.94 + 1.5 compared to 4.1 + 0.79 in patients who had no blood transfusion having a very high significant rate (P-value 0.000).

The range of blood units received by patients was 3.32 + 0.3.

Table (3) shows the mortality and morbidity rates:

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Blood Transfusion</th>
<th>No Blood Transfusion</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>50% (50)</td>
<td>66% (33)</td>
<td>34% (17)</td>
<td>0.001</td>
</tr>
<tr>
<td>No</td>
<td>50% (50)</td>
<td>34% (17)</td>
<td>66% (33)</td>
<td></td>
</tr>
<tr>
<td>Duration of ICU Stay:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SE</td>
<td>7.52 ± 0.91</td>
<td>10.94 ± 1.5</td>
<td>4.1 ± 0.79</td>
<td>0.000</td>
</tr>
<tr>
<td>Range</td>
<td>1 – 54 days</td>
<td>1 – 54 days</td>
<td>1 – 32 days</td>
<td></td>
</tr>
</tbody>
</table>
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