Frequency of Anemia and Blood Transfusion in Critically Ill Patients

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Received date: June 14, 2017; Accepted date: September 10, 2017; Published date: September 18, 2017

Abstract

Background: Anemia in adults is defined as, hemoglobin of <13.5 g/dl in males and <12 g/dl in females, with a hematocrit of <41% and <36% in males and females respectively. Most patients admitted to critical care units become anemic within the first 3 days of ICU stay due to a number of reasons, and almost half of the patients receive blood transfusion and the number of transfusion increases proportionately with the duration of stay of patient in critical care unit.

Objective: To determine the frequency of blood transfusion due to anemia in critically ill patients.

Subject and Method: This cross-sectional study was conducted at Medical ICU of Liaquat National hospital Karachi from 26th July 2016 to 25th January 2017. Total 196 patients from critical care unit were included. The data collection technique applied is non-probability consecutive sampling. Demographic data along with co morbidities recorded and value of hemoglobin is recorded on daily basis.

Results: Out of 196 patients 65.8% were anemic at the time of admission in ICU with mean hemoglobin of 10.85 ± 1.14 mg/dl. 84.7% of patients developed anemia during their ICU stay and their mean hemoglobin was 9.51±1.65 mg/dl. 13.8% patients were transfused packed red blood cells, 9.7% were transfused once, while only single patient was given 4PRBCs. The mean pre-transfusion hemoglobin was 7.57 ± 0.60 mg/dl.

Conclusion: Anemia is very frequent and multifactorial in critically ill patients. The study has helped to gauge the burden of blood transfusion in critically ill patients. It has highlighted the fact that blood transfusion has become an important component in the critical care units for the management of worsening anemia during ICU stay.

Keywords: Anemia; Hemoglobin; Hematocrit; Transfusion

Introduction

Anemia in adults is defined as hematocrit of <41% and hemoglobin of <13.5 g/dl in males and hematocrit of <36% and hemoglobin of <12 g/dl in females [1]. Among the many causes of anemia in critically ill, some of the most important are production of endogenous erythropoietin and immune associated functional iron deficiency [2]. Iron status is rapidly altered in critically ill patients, especially in septic patients [3]. These alterations persist during the course of disease and are associated with decreased erythropoiesis [3]. The bone marrow is still capable of incorporating iron and responds to treatment with recombinant human erythropoietin (rh-epo) [4]. 60% of patients admitted to ICU are anemic and 20 to 30% have first Hemoglobin <90 g/l [5]. After 7 days 80% of ICU patients have an Hemoglobin <90 g/l [5]. On average, hemoglobin concentrations decreased by 0.66 g/dl/day for the first 3 days and by 0.12 g/dl/day thereafter [6]. Almost 50% of patients admitted to ICU receive red blood cell transfusion during their ICU stay [7]. In those patients with an ICU length of stay of >1 week, proportion of patients transfused increases to 85% [8].

Anemia is a very common problem in critically ill patients being managed in intensive care units (ICU) setups [9]. Many factors contribute to anemia in critically ill patients, including sepsis [10], overt or occult blood loss, and frequent phlebotomies for blood sampling, functional iron deficiency that is immune associated [11] as well as decreased production of erythropoietin. As anemia is generally not well tolerated by critically ill patients [12] therefore PRBC transfusions are being used to augment oxygen delivery to tissues and to avoid the deleterious effects of tissue hypoxia [13]. Therefore, PRBC transfusions remain a cornerstone of critical care practice [14] but there is still a point of concern to look for risk versus benefit in blood transfusion and anemia tolerance in individual patients on clinical basis. Studies have suggested that anemia increases the risk of death after surgery in patients with cardiac disease and in critically ill patients [15].

Critically ill patients are thought to be at an increased risk for the immunosuppressive [16,17] and microcirculatory [18,19] complications of PRBC transfusions.
Material and Methods

This cross-sectional study was conducted in Medical ICU of the Liaquat National Hospital Karachi, Pakistan, from 26th July 2016 to 25th January 2017 (6 months duration), using Non-probability consecutive sampling. 196 patients were included in the study. The sample size was calculated by using WHO software taking P=50% [7], d=7% and 95% confidence interval. All patients of both genders and age 20-70 years, admitted and managed in ICU settings after being diagnosed as sepsis, coronary artery disease, malignancy and chronic liver disease were included in the study. All those patients with active or major bleeding (trauma, variceal bleed, any surgery, bleeding or clotting disorder), patients with Hemoglobin <9 g/l at the time of admission were excluded from the study. All those patients admitted in Medical ICU of LNH who fulfilled the inclusion criteria were included in the study. An approval from the ethical committee of LNH was taken prior to conducting the study. The purpose, procedure and risk benefits ratio of the study were explained and informed consent was taken from patient or attendant. Patient’s demographics and comorbidities were recorded. Patients were labeled as anemic if hemoglobin <12 g/dl and hematocrit <36% in females and hemoglobin <13.5 g/dl and hematocrit <41% in males. Patient’s hemoglobin and hematocrit were recorded on daily basis during ICU stay. Total numbers of units transfused were recorded. Outcome variables were measured in terms of anemia and blood transfusion due to anemia.

Confounding variables and biasness were controlled by strictly following inclusion and exclusion criteria. All the demographic data were entered into the predesigned proforma. Data was analyzed using statistical software package SPSS version 20. Mean and standard deviation were calculated for quantitative variable like age and number of blood transfusions. Frequency and percentages were calculated for categorical data like gender, comorbidity (i.e. CLD, CAD, and Malignancy), anemia (yes/no), transfusion (yes/no). Stratification was done on gender and age to see the effect of modifiers on outcome using chi square test considering P<0.05 as significant.

Results

A total of 196 patients of either gender diagnosed as sepsis, coronary artery disease, malignancy, and chronic liver disease were evaluated to determine the frequency of anemia and blood transfusion due to anemia in ICU patients. Descriptive statistics were calculated using SPSS version 21. Stratification was done and post stratification Chi square test was applied to observe the effect of modifiers on outcome. Mean difference was compare by using independent t-test. P value ≤ 0.05 was considered as significant.

The results showed that there were 102 male and 94 female patients. Mean age of patients was 54.90 ± 16.82 years. Mean hemoglobin level at admission was 12.10 ± 2.20 g/l while mean hemoglobin level at onset of anemia was 10.02 ± 2.08 g/l. Most of the patients 115(58.7%) was found with no complication/co morbid.65 (33.2%) were presenting with CKD, 5(2.6%) with CLD and 11(5.6%) with Malignancy. 129(65.8%) were found Anemia at Admission while 166(84.7%) were develop Anemia during ICU stay. 27(13.8%) patients were received blood transfusion. Demographic and Clinical characteristics are presented in Table 1. Number of transfusion received by patients is presented in Figure 1.

Significant mean difference of anemia during hospital stay was found for Hemoglobin level at admission (p=0.021) and Hemoglobin level at onset of anemia (p=0.000) while significant association was found with anemia at admission (p=0.021) and transfusion of blood (p=0.017). Detailed results of comparison and association with anemia during hospital stay are presented in Table 2.
Significant mean difference of transfusion of blood was found for Hemoglobin level at admission ($p=0.000$) and Hemoglobin level at onset of anemia ($p=0.000$) while significant association was found with anemia at admission ($p=0.006$) and anemia during ICU stay ($p=0.017$). Detailed results of comparison and association with blood transfusion are presented in Table 3.

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<tr>
<td>Age(years)$\pm$</td>
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<tr>
<td>Hemoglobin level at admission (g/dL)$\pm$</td>
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<td>Hemoglobin level at onset of anemia (g/dL)$\pm$</td>
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± Mean ± SD; Independent t-test applied; Chi Square test was applied; P-value ≤ 0.05 considered as significant; * Not Significant at 0.05 level.

Table 3: Blood transfusion with Demographic and clinical characteristics.

Our study was designed to estimate the frequency of anemia in Asian population, among those patients admitted to ICU, at the time of admission in ICU and during their ICU stay as no figures are found and no work has been done so far in an Asian country on this ground. The high frequency of anemia is multifactorial, decreased endogenous erythropoietin production; frequent phlebotomy and functional iron deficiency are the major contributing factors [2, 21,22]. Other factors involved in pathogenesis include coagulopathies, pathogen-associated hemolysis, hypoadrenalism, and nutritional deficiencies [23,24], including deficiencies of iron, B12, and folate can lead to ineffective erythropoiesis with resultant anemia [25,26].

There is an important role of decreased erythropoietin production and impaired bone marrow response to erythropoietin in the development of anemia [27]. The inflammatory cytokines such as Interleukin-1 (IL-1) and tumor necrosis factor-α (TNF-α) inhibit erythropoietin (EPO) production, while IL-1, IL-6, and TNF-α suppress erythropoiesis by direct inhibitory effects on bone marrow [28]. The inflammatory cytokines IL-6 and interferon-γ (IFN-γ) are
released in hyper-adrenergic states following severe injury and they inhibit the differentiation and proliferation of erythroid precursor cells [29].

The most common causes of Anemia of Chronic Disease are acute or chronic inflammatory conditions such as infections, cancer, autoimmune diseases, and chronic kidney disease (CKD) [30]. In anemia of chronic disease there is sequestration of iron in macrophages and iron-restricted erythropoiesis.

Its association with elevated levels of inflammatory cytokines, including IL-1, IL-6, and IFN-γ [31] induce excess hepcidin production, which in turn down regulate ferroportin, an iron export protein on the cell surface of duodenal enterocytes, macrophages, and hepatocytes [25, 32]. That is how high serum levels of hepcidin decrease intestinal iron absorption and block iron export from tissue stores, resulting in functional iron deficiency [33,34].

In our study, we found that 13.8% patients were transfused PRBC, 9.7% received only single PRBC transfusion, only single patient was threshold proposed by TRICC of 7.0 g/l, although their ICU stay or had further worsening of anemia with mean hemoglobin recorded as 10.02 mg/dl, and the minimal value of 7.57 ± 0.60 mg/dl. Our transfusion trigger of 7.6 mg/dl approaches the ISSN:2155-9864 released in hyper-adrenergic states following severe injury and they inhibit the differentiation and proliferation of erythroid precursor cells [29].

To conclude; Anemia is very frequent and multifactorial in critically ill patients. The study emphasizes the fact that the practice of frequent blood transfusion has been changed drastically over the last decade, yet it is found to be an important component of management in critically ill patients.

References
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