# Anemia in ICU Patients

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**Summary:**

**Background**: Anemia is one of the most commonly encountered abnormal laboratory findings in intensive care unit (ICU) patients. Several mechanisms may be involved; many ICU patients will receive a blood transfusion during their ICU stay.

**Objectives**: This study was performed to characterize the occurrence of anemia, transfusion, and mortality in critically ill patients in ICU.

**Methods:** The sampling study included 80 patients from two Iraqi (Al-Kadhmia Teaching Hospital and AL-Shaheed Ghazy Al-Harrery Hospital ) ICUs, (≥17 years old). Patients were followed up for at least 28 days of ICU admission, between May 2011 to May 2013.

**Results:** A total of 80 patients were enrolled. The mean age is 42.26 ± 2.30. sixty five percent were male. The mortality rate was 43.8% (35 patients).The number of patients who received blood was 49 (61.3%), the hemoglobin concentration was lower in days 14 and 28 than day 1. For 28 days, mortality percentage is higher for patients with hemoglobin concentration between 9-10 g/dl. The mortality rate was higher in patients who received blood transfusion.

**Conclusion:** In conclusion, anemia is common in the critically ill patient, and persists throughout the ICU stay. Blood transfusion in an important way for management of this anemia, however the mortality rate was higher in patients who received blood transfusion.

**Keywords**: intensive care unit; anemia; blood transfusion

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## Introduction:

The World Health Organization (WHO) defines anemia as a hemoglobin <13 g $dl^{-1}$ (hematocrit <39%) for adult males and <12 g $dl^{-1}$ (hematocrit <36%) for adult non-pregnant females (1).Anemia is very common in the critically ill; almost 95% of patients admitted to the intensive care unit (ICU) have a hemoglobin level below normal by ICU day 3(2).More than 50% of ICU patients receive at least one unit of red blood cells (RBCs) to maintain hemoglobin and hematocrit levels at >10 mg/dL and 30%, respectively(3).The etiology of anemia in ICU is multifactorial, phlebotomy for diagnostic testing is a major source of blood loss(4), anemia may be the result of the critically ill patient's index problem (trauma or GI bleeding, for example) (5), insufficient production of red blood cells(6).Underproduction anemia is commonly referred to as the anemia of chronic inflammatory disease. It is attributable to abnormal serum erythropoietin (EPO) concentrations, with a minimal reticulocyte response to endogenous EPO because of inhibition of the EPO gene by inflammatory mediators such as interleukin-1 alpha, tumor necrosis factor-alpha, tumor growth factor-B, and interleukin-1b (7).In some anemic ICU, normal vitamin B12 levels but abnormally low folic acid concentrations. RBC size was not increased, and therefore the significance of folic acid deficiency as a factor contributing to ICU-acquired anemia remains uncertain (8).Rodriguezand colleagues reported iron deficiency in 9% of ICU patients (9).Tarpey and Lawler (10) investigated ICU patients, and found a mean blood loss per day of 66 mL.The decision to transfuse is usually based on patient factors such as volume status, acuteness of anemia, severity of symptoms, age, and presence of comorbid conditions, and particularly cardiovascular disease(11).To address the RBC transfusion needs, the Transfusion Requirements in Critical Care Investigators ( TRICC )Trial,(12)showed the effect of restrictive strategy of RBC transfusion (hemoglobin <7 mg/dL),and the liberal strategy (RBC transfusion if hemoglobin levels were <10 mg/dL). The 30-day mortality was similar in both groups, although the rates were significantly lower with the restrictive transfusion strategy among patients with Acute Physiology and Chronic Health Evaluation, and among patients <55 years of age, but not among patients with clinically significant cardiac disease.Compared to patients with higher hemoglobin levels, patients with hemoglobin levels ≤ 10 g/dL were five times as likely to experience extubation failure (13).Administration of recombinant human erythropoietin (rHuEPO) can stimulate reticulocytosis and increase circulating hemoglobin concentration in critically ill adults (14).

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## Patients and Methods:

*Design:* This study included 80 patients, was conducted from May 2011 to May 2013. For the medical – surgical ICU patients in the Al-Kadhmia Teaching Hospital and AL Shaheed Ghazy Al

Harrery Hospital. Patients requiring mechanical ventilation or intense physiologic support or monitoring were admitted to the ICU. Patients were enrolled for at least 28 days of ICU admission. Inclusion criteria included: age of ≥17 years admission to a medical, surgical ICU patients. Exclusion criteria included: less than 17 years of age, who remained in the ICU for less than 28 days, with confirmed primary hematologic disease.

*Data Collection*

Data collected included: patient demographics; admitting diagnostic categories (medical, elective surgery, emergency surgery);hemoglobin levels at day 1, day 14, day 28, history of blood transfusion, and the outcome(improvement or death).

*Statistical analysis*

Statistical analysis was performed with the SPSS 19.0 statistical package for social sciences and also Excel 2010. Descriptive statistics for the numerical data were formulated as mean and standard deviation (SD) and standard error (SE).Numerical data were analyzed using Analysis of Variance (ANOVA) test for comparison among groups. While, categorical data were formulated as count and percentage. Chi-square test used to describe the association of these data. The level of statistical significant difference is bellow or equal to 0.05.

**Results:**

Over the 2-year study period, 80 patients who stay in the ICU for 28 days. Their age was between 17-78 years, Mean 42.26 ± 2.30Table 1 showed the characteristics of patients admitted to ICU 28 (35%) female, and 52 (65%) male. The mortality rate was 43.8% (35 patients).The number of patients who received blood was 49 (61.3%), while those did not received blood was 31 (38.8%).In table2 the Admission Diagnostic Categories (ADC) of the patients: the elective surgery 10 (12.5%), emergency surgery 10 (12.5%), medical29 (36.3%), trauma 31 (38.8%).Table 3 showed the hemoglobin concentration outcome in medical and surgical patients in day 1, days 14 and day 28, the hemoglobin concentration was lower in days 14 and 28 than day 1, with statistically significance difference (p value <0.001), especially in surgical patients. However there is no statistically significance difference for each group of causes in separation (p-value > 0.05). Table 4 showed the logistic Regression for 30 days mortality, in which the percent is higher for patients with hemoglobin concentration between9-10g/dl, with statistically significance difference. The mortality rate was higher in patients who received blood transfusion, with statistically significance difference (p-value 0.010).

**Table 1: Characteristics of patients admitted to ICU**

| | | Count | % | Chi-Square | df | P value |
|---|---|---|---|---|---|---|
| Number of patients | | 80 | 100 | | | |
| Gender type | Female | 28 | 35.0% | | | |
| | Male | 52 | 65.0% | | | |
| ICU mortality | No | 45 | 56.3% | 1.25 | 1 | $0.264^{NS}$ |
| | Yes | 35 | 43.8% | | | |
| Received blood | No | 31 | 38.8% | 4.05 | 1 | 0.044* |
| | Yes | 49 | 61.3% | | | |

NS= not significant difference.
* = significant difference.

**Table2 Admission Diagnostic Categories (ADC)**

| | | Count | % |
|---|---|---|---|
| Causes of admission | Elective surgery | 10 | 12.5% |
| | Emergency surgery | 10 | 12.5% |
| | Medical | 29 | 36.3% |
| | Trauma | 31 | 38.8% |

**Table 3 Hemoglobin concentration outcome in medical and surgical patients**

| | Day 1 | Day 14 | Day 28 | P value |
|---|---|---|---|---|
| Elective surgery | 11.24±2.14 | 9.73±1.71 | 9.58±0.94 | $>0.05^{NS}$ |
| Emergency surgery | 11.24±2.48 | 8.87±1.59 | 9.92±1.39 | $>0.05^{NS}$ |
| Medical | 11.36±2.73 | 9.87±2.20 | 10.33±1.88 | $>0.05^{NS}$ |
| Trauma | 11.19±2.44 | 9.42±1.66 | 10.02±1.66 | $>0.05^{NS}$ |
| Total | 11.26±2.48 | 9.58±1.87 | 10.04±1.64 | <0.001** |

NS= not significant difference.
**= highly significant difference.

**Table 4 Logistic Regression for 30 days mortality**

| | | Mortality | | | | P value |
|---|---|---|---|---|---|---|
| | | Yes | | No | | |
| | | Count | % | Count | % | |
| Hb level g/dl | <8 | 4 | 11.42 % | 2 | 4.44% | 0.026 * |
| | 8-9 | 3 | 8.57% | 3 | 6.67% | |
| | 9-10 | 18 | 51.42 % | 12 | 26.67 % | |
| | >10 | 10 | 28.57 % | 28 | 62.22 % | |
| Transfusion | Yes | 27 | 77.14 % | 22 | 48.89 % | 0.010 * |
| | No | 8 | 22.86 % | 23 | 51.11 % | |

* = significant difference.

**Discussion**

This prospective study for 80 patients, male more than female in two ICUs of two Iraqi hospitals. In this study anemia was common, and the patients who received blood during the 28 day course of admission were 61.3% with statistically significance difference (p –value 0.044), this percentage was lower than that of Aryehet al (15), who approximately 50% will receive allogeneic blood transfusions, and of Taylor et al (16) which ranged from 37% to 44% of patients admitted to ICUs were transfused. This result is lower than the rate found in a study by Corwin et al (17), in which 85% of patients with length of stay longer than 1 week received a blood transfusion.

Causes of an admission in this study were medical and surgical, trauma is higher incidence (38.8%), then the medical, then the surgical(elective and emergency).While in Jean et al (18) the higher incidence was for the elective surgery then to medical then to emergency and to trauma.In this study the mean hemoglobin level at baseline was 11.0± 2.48 g/dL, the mean hemoglobin level is lower in these critically ill patients in day 14 and day 28, (9.58±1.87, 10.04±1.64 respectively) with or without blood transfusion. This result is in agreement with that of Howard et al (19) in which the mean hemoglobin level at baseline was 11.0 _ 2.4 g/ dL , hemoglobin level decreased throughout the duration of the study. And also with that of Jean et al (18), who showed that the mean hemoglobin level at baseline was 11.3g/dL,and a convergence of hemoglobin levels over time, irrespective of the admitting hemoglobin level. However there is no statistically significance difference for each group of causes in separation, this may due to the limited number of each group.The mortality rate in this study was 43.8%, this was higher than that of Jean et al (18), in which the 28-day overall mortality was 20.2%.The ICU mortality rates were significantly higher in those patients who received transfusion(61.3%vs. 38.8%respectively;*P* 0.044),this result is in agreement with that of Corwin et al (19) in which the28-day overall mortality were significantly higher in those patients who received transfusion(29% vs. 14.9%,respectively; $P < .001$). The mortality rate was significantly higher in those patients with low hemoglobin level (9-10 g/dL), this result is in disagreement with that of Corwin et al (19) in which the increase in the ICU mortality rates in patients who received transfusion were independent of severity of illness or hemoglobin level. The explanation of increase the mortality rate in those patients with low hemoglobin level that that patient may need more blood transfusion, and the deleterious effects of RBC transfusion, the likely contributing factor to mortality in the critically ill population is related to immunosuppression as opposed to allergic reaction or infectious transmission (20). Some studies have found an association between allogeneic RBC transfusion and an increased incidence of nosocomial infections such as pneumonia, wound infections and intra-abdominal sepsis (21, 22).

The American Association of Blood Banking has recommended titrating transfusion requirements to parameters of severity of illness rather than arbitrarily defined hemoglobin levels (23). This recommendation is in agreement with the more recent recommendations of the American Society of Anesthesiologists Task Force, (24) and the Canadian Guidelines which suggest "There is no single value of hemoglobin concentration that justifies or requires transfusion.Measures to decrease the anemia in ICU is by changing from 3 mL arterial blood gases syringes to 1 mL syringes, reducing the amount of discarded blood and by using the smallest available blood collection bottles, this would represent a reduction from52.4 mL to 29.8 mL of blood taken per patient per day or158 mL less per patient per week (25).

**Conclusion:**

In conclusion, anemia is common in the critically ill patient, and persists throughout the ICU stay. Blood transfusion in an important way for management of this anemia, however blood transfusion is associated with higher mortality rate. So other way for the management, and measures to decrease the occurs of anemia in ICU is recommended

**Authors Contributions:**

*Dr.Haider Noori Dawood: Design ,collection of sample, interpritation of data, drafting of manuscription and critical version.*

*Dr.Amar Kasim Muhamad: Collection of sample, interpritation of data.*

*Dr. Zeyad Kareem: Collection of sample.*

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