

## THE ANEMIA EMERGENCE AND BLOOD TRANSFUSION POSSIBILITY FOLLOWING PHLEBOTOMY IN CRITICAL CARE UNITS OF EDUCATIONAL HOSPITALS

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### ARTICLE INFO

#### Received:

03<sup>th</sup> Jun 2017

#### Accepted:

29<sup>th</sup> Nov 2017

#### Available online:

14<sup>th</sup> Dec 2017

**Keywords:** *Anemia, Phlebotomy, Blood transfusions, Critical care units*

### ABSTRACT

**Introduction and Objective:** anemia is inter alia the common findings in the critical care units. Although numerous factors lead to anemia in CCUs, but, since repeated phlebotomies for performing laboratory tests are factors contributing to the anemia emergence, the aim of this study was to determine the anemia emergence and the possibility to perform blood transfusions following phlebotomy in CCUs of educational hospitals of Urmia University of Medical Sciences.

**Method:** the present study has been conducted based on prospective observations in critical care units of educational hospitals of Urmia University of Medical Sciences. In the present study, first of all, the patients qualifying the entry to the examinations including a period of one week stay in the hospital were selected to undergo further tests. The entire information pertaining to the patients' admission time, their demographic information and admission prognostications as well as the background ailments and the other relevant information like hemoglobin count at the admission time, the patients' daily hemoglobin rates and patient's reception of any transfusion and the patients' daily phlebotomy volume of blood were recorded in three work shifts. The results were analyzed through taking advantage of statistical tests like frequency distribution, central indices and independent t-test in SPSS software.

**Results:** Out of the 100 patient participants of the present study, 54 patients were males and 46 patients were females. Some 64% of the patients had been admitted to anemia critical care units and almost 97% of the patients had been found with anemia after a 30-day stay in the hospital. Some 57% of the patients had received blood during their stays in the CCUs. The average volume of the patients' daily phlebotomy in the blood-receiving group was  $9.53 \pm 1.28$  ml and it was  $7.7 \pm 2.30$  ml in the patients with no blood transfusion. The difference was reported statistically significant ( $P < 0.001$ ). The highest rate of phlebotomy rate (60%) was in night shift and the highest rate of requested phlebotomy (55.50%) was applied in biochemistry examinations.

**Discussion and Conclusion:** a high percentage of the patients had anemia upon their admission to CCU; moreover, over 90% of the patients expressed anemia symptoms after a long-term stay. Repeated blood sampling for performing the laboratory examinations were pinpointed amongst the important factors that had led to anemia in the CCUs. Thus, in line with reducing this risky trend in the CCUs, the patients had to be monitored more carefully in terms of the real rates of the tests (repeated blood sampling) and treatment parallel to compensating the symptoms resulting from anemia.

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**To Cite This Article:** Sayyedah Roghayeh Hosseini, Rahim Baghaei, Seyfolah Rezaei, (2017), "The Anemia Emergence and Blood Transfusion Possibility Following Phlebotomy in Critical Care Units of Educational hospitals", *Pharmacophore*, **8(6S)**, e-1173567.

### Introduction

Anemia is one common finding in the critical care units [1]. A prevalence rate ranging from 95% to 98% has been reported for the disease in CCUs [1, 2]. The World Health Organization defines anemia as the reduction in hemoglobin counts below the normal levels (hemoglobin below 12g/dl for women and below 13g/dl for the men) [3]. The studies carried out in this regard signify that the patients with anemia are prone to more symptoms and difficulties like heart failure, re-infarction, cardiogenic shocks and brain strokes; moreover, these patients are known to have a higher rate of mortality [4, 5]. There are

numerous factors resulting in anemia in CCUs [6, 7]. In a study that was carried out in 2003 by Walsh et al, three major causes of anemia in CCU patients were determined: losing too much blood, reduction in the longevity of the red blood cells and disruptions in erythropoietin production [8]. Chronic illnesses are the primary reason behind the reduction in red blood cells' life and the disruption in erythropoietin [9]. The majority of the patients hospitalized in CCUs are most often found with chronic ailments. The chronic illnesses are known to lead to the activation of monocytes and T-cells thereby to increase the cytokine, interferon, tumor necrosis factor and interleukin levels. The abovementioned inflammatory factors decrease iron absorption and erythropoiesis which are the underlying causes of reduction in erythropoietin production hence the reduction in the red blood globules [9]. Moreover, inter alia the substantial reasons giving rise to anemia in patients in bad health situations is their losing of blood due to gastrointestinal bleedings and phlebotomy [10]. Also, the placement of invasive catheters for monitoring purposes like main artery catheter and venous catheter can lead to the loss of blood in the patients. Furthermore, these patients are at risk of bleeding due to their peptic ulcers and repeated phlebotomy is also amongst the factors that can result in the loss of blood in such patients [11]. Blood stream monitoring, acid and base status evaluations, oxygen delivery examinations, the coagulation tests and investigation of the organs' performances are inter alia the necessary cases for assessing the patients' statuses and therefore there is a need for repeated phlebotomies [1, 3, 13 and 14] and the amount of blood taken in every phlebotomy ranges in volume from 13 ml to 50 ml on a daily basis. It has to be reminded that the reduction in phlebotomy contributes to the reduction in blood transfusion [13]. In the study conducted by Vincent et al on 1136 patients hospitalized in CCU, the blood samples were to be taken from the patients 4 to 6 times a day during which a total of 41.1 ml blood had to be taken everyday [3]. In another study where the blood volume taken from the patients were subjected to examinations under mechanical ventilation, the mean volume of the blood taken in phlebotomy interventions was 16 ml per every twenty four hours and a total of over 500 ml blood was taken from 4 patients during their hospital stays for laboratory tests [14]. Anemia is amongst the cases that necessitates blood transfusion in CCUs [13]. The transfusion blood volume in CCUs is rather higher than the other units in such a manner that in a study performed by Entezary et al, about 40% of the hospital injections were carried out in CCUs [15]. The results obtained in a study undertaken by Chant et al indicated that only 17% of the blood transfusions in long hospital stays in CCUs are accounted for by the bleeding cases and 40% pertain to the reduction in patients' hemoglobin and anemia and the patients receive higher blood levels with the lengthening of hospital stays [13]. Blood transfusion, though saving the patients under some conditions they cause increase in the mortality and morbidity rates of the patients in some of the cases [16-24]. Thus, according to the prevalence rates reported for anemia and considering its symptoms and, on the other hand, taking into consideration the blood transfusion and its problems, the current research paper intends to meanwhile determining the prevalence and occurrence rates of anemia in patients hospitalized in CCUs of educational hospitals of Urmia University of Medical Sciences investigate the daily phlebotomies and their effects on patients' development of anemia.

**Study Method:**

The current research paper is a prospective observation in which the patients from CCUs belonging to two educational hospitals of Urmia University of Medical Sciences have been selected as the study subjects. The entire patients having been hospitalized for more than a week in CCUs and were above 18 years of age and were hospitalized for a type of chronic diseases comprised the study population. The patients who had bleeding symptoms for any reason and/or the ones needing dialysis were excluded. A total number of 100 qualified patients were studied for a 6-month period. The entire admission time information including the demographic characteristics and the admission diagnoses and the historical diseases were all collected from the patients' files and the other required information like hemoglobin count at the time of admission, the daily hemoglobin counts and transfusion and daily phlebotomy volume were recorded in three work shifts and then separated based on the type of the requested laboratory tests to hematology, biochemistry, serology and hormone examinations. The information were recorded till the 31<sup>st</sup> day of the patients' stays or till their dismissal or their death and the patients were divided to two groups, named with blood transfusion and without blood transfusion, so as to evaluate the effect of the phlebotomy on the anemia occurrence. In the current study, the female patients with hemoglobin counts below 12g/dl for and the male patients with hemoglobin counts below 13g/dl were considered anemic. SPSS software was applied to analyze the results of the above study.

**Results:**

Out of the patients who had been hospitalized for more than one week, 100 patients were qualified for entry to the present study about 63% of whom were from critical care unit of Imam Khomeini and 37% were from critical care unit of Taleghani hospital in Urmia. 54 patients (54%) were male and 46 (46%) were female. The patients' average age was 64.24 years. Out of the total number of the patients, 57 patients (57%) had received blood during their hospital stays and the rest had not received any blood. Amongst the patients who had received blood, about 69% had received more than one unit of blood. There was no significant difference between the two groups in terms of gender distribution, disease diagnosis and historical illnesses (table 1) and this is suggestive of the homogeneity of the data between the two groups.

Table 1: patients' demographic characteristics separated for both of the groups with and without blood transfusion

Variable	Without blood transfusion (n=43)	With blood transfusion (n=57)	Total
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Gender			
Male	24 (55.8%)	30 (52.6%)*	54 (54%)
Female	19 (44.2%)	27 (47.4%)*	46 (46%)
Age (years ± standard deviation)	15.16±63.49	17.84±64.81*	16.70±64.24
Admission diagnosis (number[%])			
Respiration	14(32.6%)	15(26.3%)*	29(29%)
Heart	4(9.3%)	9(15.8%)*	13(13%)
Nerves	21(48.8%)	19(33.3%)*	40(40%)
Gastrointestinal	0	3(5.3%)*	3(3%)
Other	4(9.3%)	11(19.3%)*	15(15%)
Background diseases (%)			
Coronary artery disease	6(14%)	3(5.3%)*	9(9%)
Heart failure	5(11.6%)	6(10.5%)*	11(11%)
Cerebral stroke	4(9.3%)	4(7%)*	8(8%)
Diabetes	4(9.3%)	14(24.6%)*	18(18%)
Respiratory closure	4(9.3%)	3(5.3%)*	7(7%)
Hypertension	6(14%)	9(15.8%)*	15(15%)
With no disease history	14(32.6%)	16(28.1%)*	30(30%)
*P-value<0.67			

About 64% of the patients had been anemic at the time of admission to the anemia care units in such a manner that after the first week of hospitalization in 72% of the patients had gone below 12g/dl in women and below 13g/dl in men and about 97% of the patients had been found with anemia after 30 days of hospitalization (table 2). Both of the male and female groups had been found inflicted with anemia during their stays and there was not observed any significant difference between the two gender groups in terms of anemia occurrence.

Table 2: anemia occurrence during stays in CCUs based on normal hemoglobin rates in both of the gender groups

Variable	Males (number[%])	Females (number[%])	Total	p-value
Anemia at admission	33(61.1%)	28(60.9%)	61(61%)	<0.98
Anemia in week one	41(75.9%)	31(67.4%)	72(72%)	<0.34
Anemia in week two	36(92.3%)	33(97.1%)	69(94.5%)	<0.37
Anemia in week three	24(88.9%)	21(95.5%)	45(91.8%)	<0.40
Anemia in week four	16(94.1%)	19(100%)	35(97.2%)	<0.28

The patients' average hemoglobin level at their admission to CCU was 11.38±2.1 g/dl which reached to 9.02±1.26 g/dl during the week four of their stays (P<0.001). The admission time hemoglobin level in the group with transfusion was equal to 10.56 g/dl and it was 12.48 g/dl in the group with no blood transfusion which is indicative of a significant difference between the two groups. The hemoglobin level was also found decreased in both of the groups and these are also found statistically significant (P<0.001) (Table 3).

Table 3: the mean scores of the studied variables in the patients separated based on the groups

Variable	Group with blood transfusion (mean[standard deviation])	Group without blood transfusion (mean[standard deviation])	Total (mean[standard deviation])
Hemoglobin at the admission (g/dl)	05.2±56.10	64.1±48.12*	2.01±11.38
First week Hemoglobin average (g/dl)	1.52±10.01	1.48±12.13*	1.83±10.92
Second week Hemoglobin average (g/dl)	1.09±9.47	0.98±10.99*	1.27±9.97

Third week Hemoglobin average (g/dl)	1.22±9.08	1.22±10.78*	1.45±9.63
Fourth week Hemoglobin average (g/dl)	1.01±8.37	1.40±10.50*	1.26±9.02
*P<0.001			

Phlebotomy data analyses in both of the patient groups with and without blood transfusion (table 4) indicated that the average phlebotomy average of the patients during their overall stays was equal to 155.74±53.62 ml and an amount of 9.17±1.95 ml blood was taken from the patients on a daily basis. The average daily phlebotomy volume of the group with blood transfusion was 9.53±1.82 and it was 7.70±2.03 ml for the group without blood transfusion. During the four-week stay of the patients in CCU, the phlebotomy volume of the patients with blood transfusion was found more than the group without blood transfusion and this difference is statistically significant. Also, the results obtained from the repeated measures indicated that the phlebotomy blood volume difference during the four-week stays of the patients in both with and without blood transfusion groups is statistically significant (P=0.00) (Diagram 1).

The average phlebotomy volumes reported for the patients in morning, afternoon and night shifts have been 40.92±22.8 ml, 18.66±10.70 ml and 94.83±37.58 ml, respectively and this is suggestive of the idea that 60% of the phlebotomy blood volume has been collected in night shifts, 28% in morning shifts and 12% in afternoon shifts (Table 5) and the most frequent requests for blood sampling have been made for performing biochemical examinations (55.50%) followed by hematology tests (33%) (Table 6).

Table 4: phlebotomy volume in the studied individuals based on the groups

Quantitative variable	Total	Without blood transfusion	With blood transfusion	p-value
First week phlebotomy volume (ml)	67.86±17.50	62.95±17.09	17.03±71.65	0.01
Second week phlebotomy volume (ml)	49.15±85.31	40.60±10.41	16.19±52.20	0.001
Third week phlebotomy volume (ml)	45.44±15.75	40.82±12.86	47.24±16.56	0.01
Fourth week phlebotomy volume (ml)	48.16±24.33	36.33±11.43	51.60±16.09	0.05
Total phlebotomy volume during the overall stay period (ml)	155.53±74.62	53.45±177.128	42.56±170.37	0.000
Daily phlebotomy volume average (ml)	9.1±17.95	7.2±70.03	9.53±1.82	0.03

Diagram (1): the patients' phlebotomy volume average during the four-week stay

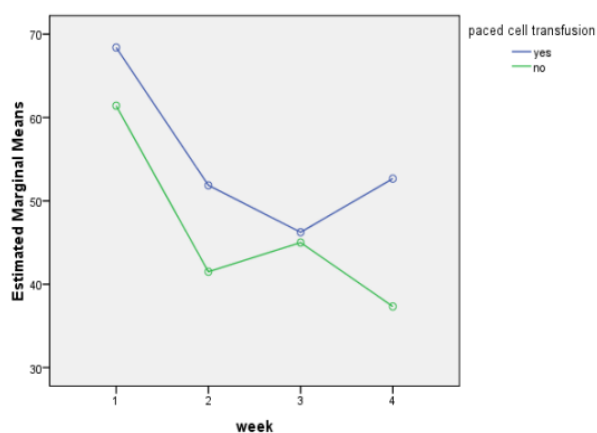


Table 5: phlebotomy blood volume average based on the three work shifts

Variable	Phlebotomy volume average (ml-liliter ± standard deviation[%])
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Morning shift	4.22±92.8 (28%)
Afternoon shift	18.10±66.70 (12%)
Night shift	94.37±83.85 (60%)

Table 6: phlebotomic volume mean based on the type of the requested examination

Variable	Phlebotomic volume mean (milliliter ± standard deviation [%])
Hematology blood volume	60.22±86.35 (33%)
Biochemical blood volume	54.33±87.60 (55.55%)
Serology/immunology blood volume	77.4± 23.8(7.50%)
Hormonic blood volume	7.2±32.4 (4%)

In the current research paper, the average hemoglobin level at the admission time was 11.37±2.1 g/dl and about 64% of the patients were found anemic at the admission. The abovementioned findings are consistent with the results obtained in the other researches [3, 13 and 26]. In the study conducted by Vincent et al in 2002 on 145 CCUs in Western Europe, the average hemoglobin level of the admission time was 11.3 g/dl and 63% of the patients were found with hemoglobin levels below 12 g/dl. There was found a significant relationship between the hospital stays in CCUs and the elapse of time with hemoglobin reduction and passage of time in such a manner that after 30 days of hospital stays, about 100% of the patients had a hemoglobin level below 12g/dl and this is in compliance with the other researches [1, 13].

Critical care unit is inter alia the units in which a high percentage of blood transfusion takes place [15] and a high percentage of the patients hospitalized in CCUs normally undergo blood transfusions [26]. In our study, as well, about 57% of the patients received blood and this is a high percentage for a study in which the blood transfusions to the acute and/or dialysis patients are eliminated and it is also higher than the studies in which 20% to 40% transfusion rates have been reported for the patients with short stays [3, 27]. Some of the studies have reported transfusion rates equal to 70% to 85% in the CCUs [1, 26]. In the study performed by Thomas et al, the amount of blood transfusion for the entire patients was 40% and this value was increased to 70% for the patients who had been hospitalized for a period over one week. In our study, the average hemoglobin level for blood transfusion has been higher than the other studies [13, 28].

The findings of the current research paper indicated that the blood volume taken for the laboratory examinations is effective on anemia diagnosis and subsequently blood transfusion and this is proved statistically significant. The average daily blood volume obtained in the studied patients of the current research paper was lower than some of the other studies [1, 3] and it was closer to some others [2, 13, 14]. The reason behind low daily phlebotomic volume in the current research paper might have been the idea that the other studies took higher blood volumes for performing the experiments. The phlebotomic blood volume used in laboratory tests is inter alia the factors that can result in anemia and subsequent blood transfusion in CCUs and the majority of the studies found phlebotomic volumes taken for laboratory examinations effective on anemia occurrence [1, 3, 13]. But, in the study that was conducted by Bedayez et al, no significant relationship was found between the patients' phlebotomic blood volume and blood transfusion [2].

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