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Original Article

Increment in hemoglobin and hematocrit levels after blood transfusion in a tertiary care hospital

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ABSTRACT

Background: Blood transfusion is considered to be the first line of therapy for all types of anemia. One unit of blood transfusion is known to increase the hemoglobin level by 1g/dl and hematocrit by 3%. This study aims to analyze the mean increment in hemoglobin and hematocrit levels after 1-unit of blood transfusion in a tertiary care hospital.

Materials and Methods: A retrospective study was done. 133 patients with 1-unit of blood transfusion (whole blood or packed red blood cells) having pre and post-transfusion hemoglobin and hematocrit values were enrolled in the study.

Results: Patients of all diagnoses, who received blood transfusion were enrolled, with the highest proportion (27.1%) in the age group 18-35 years. Male predominance was seen (57.1%) and a majority of the patients were on hemodialysis (57.9%). The most common blood group was B positive (30%) and 90.9% were Rh positive. 48 patients were transfused with whole blood and 85 were transfused with packed red blood cells. The mean increment in hemoglobin and hematocrit levels were 0.75 ± 2.21 and 2.47 ± 6.84 respectively. A significant increment in post-transfusion parameters was seen compared with pre-transfusion parameters ($p < 0.001$).

Conclusions: A mean increment in hemoglobin and hematocrit level was seen in patients after transfusion. However, the value of the increment is low in our study as compared to the literature. This may be due to varied reasons, ranging from a history of chronic disease, acute bleeding, the volume of other fluids administered, and the characteristics of the donor.

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INTRODUCTION

Transfusion of blood is a lifesaving intervention and millions of units of blood are transfused yearly worldwide to improve the health condition and save lives in anemic patients and patients incurring blood loss due to varied reasons.[1] WHO defines anemia as a hemoglobin level of less than 13g/dl in males and less than 12g/dl. [2] However, recent guidelines by various societies including the American Association of Blood Banks have supported the level of 7-8g/dl of hemoglobin as a threshold for blood transfusion in an otherwise stable anemic patient to curb irrational use

of blood transfusion.[3]

A wide variety of blood products can be transfused based on the medical requirement of different individuals. Whole blood and packed red blood cells are most commonly transfused in patients that are anemic or have active bleeding. Whole blood is a fluid assortment of blood cells along with plasma, whereas packed red blood cells are derived from whole blood after the separation of plasma. It is known that one unit of blood increases the level of hemoglobin by 1g/dl and hematocrit by 3%.[4]

Hemoglobin concentration equilibration after transfusion takes about 24 hours, but some studies have shown that earlier measurements reflect steady-state value in persons who have not bled recently.[5]

The aim of this study was to analyze the mean increment in hemoglobin and hematocrit levels within 24 hours of whole blood or packed red cell transfusion in patients, of all diagnoses in a tertiary care hospital. After the transfusion, hemoglobin, and hematocrit monitoring is essential to assess the success of a transfusion for better patient outcomes.

MATERIALS AND METHODS

A retrospective study was done from 1st January 2022 to 1st April 2022 at the Blood Bank, Department of Pathology and Laboratory Medicine, Patan Academy of Health Sciences, Nepal. The study population included patients of all diagnoses, transfused with 1-unit of blood (whole blood or packed red blood cells) with full records of hemoglobin and hematocrit levels before and after transfusion. The post-transfusion hemoglobin and hematocrit levels were observed within 24 hours of transfusion. Recipients with incomplete records and having more than one unit blood transfusion at a time were excluded from the study.

A complete blood count was performed by Sysmex XN-550 and baseline characteristics of the study population were retrieved from the computerized database. Whole blood was collected in 350 ml bags and stored at 2-8 degree Celsius for a maximum duration of 35 days. Packed red blood cells were received from other centers and stored at the same temperature as above. The volume of packed cells per unit was also 350ml.

The data were collected and entered into Microsoft Excel. Analysis was done using Statistical Package for the Social Sciences version 20.0. Mean and standard deviation were calculated and paired t-test was applied for analysis. A p-value of <0.05 was considered significant.

RESULTS

A total of 133 study subjects were included in this study after meeting the inclusion criteria. From a total of 133 transfused patients, 76 (57.1%) were males and 57 (42.9%) were females. The age ranged between 7 months to 91 years, with the highest proportion (27.1%) being in the age group 18–35 years. The majority of the recipients were blood group B positive (30%). 121 (90.9%) of all the subjects were Rh positive (Table 1).

Table 1: Demographic and blood group-wise distribution of the study population

Variable Frequency (n)		Male		Female		Total (N)	
		%	Frequency (n)	%	Frequency (n)	%	
Age group in years	<17	3	2.3	5	3.8	8	6.1
	18-35	18	13.5	18	13.5	36	27
	36-45	12	9	12	9	24	18
	46-65	21	15.8	13	9.8	34	25.6
	>65	22	16.6	9	6.7	31	23.3
	Total (n)	76	57.2	57	42.8	133	100
ABO blood group	A+	15	11.3	21	15.8	36	27.1
	A-	3	2.25	3	2.25	6	4.5
	B+	31	23.3	9	6.7	40	30
	B-	1	0.8	0	0	1	0.8
	AB+	5	3.75	5	3.75	10	7.5
	AB-	0	0	0	0	0	0
	O+	20	15	18	13.6	38	28.6
	O-	1	0.75	1	0.75	2	1.5
Total (n)		**76**	**57.2**	**57**	**42.8**	**133**	**100**

Out of 133 subjects, 85 (63.9%) were transfused with packed red blood cells, and the remaining 48 (36.1%) were transfused with whole blood. The most frequent indication for blood transfusion in this study was patients undergoing hemodialysis (57.9%).

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The mean increment in levels of hemoglobin and hematocrit based on the type of blood component transfused in both genders was also analyzed (Table 2).

Table 2: Mean increment in post-transfusion parameters according to the type of blood component transfused and gender

Type of blood component	Parameters	Male	Female
Whole blood	Hemoglobin (g/dl)	1.01 ±1.93	1.4± 2.91
	Hematocrit (%)	3.05± 6.18	5.06± 8.47
Packed red cells	Hemoglobin (g/dl)	0.27± 2.08	0.82± 2.17
	Hematocrit (%)	0.61± 6.19	3.04± 6.91

However, in our study, there was no statistical significance in the increment of both the parameters post-transfusion based on the type of blood component transfused.

The overall mean increment in hemoglobin level after blood transfusion was 0.75g/dl ±2.21 and the mean increment in hematocrit levels after transfusion was 2.47% ±6.84. A significant increment in post-transfusion parameters (hemoglobin and hematocrit) was seen compared with pre-transfusion parameters (Table 3).

Table 3: Comparison between pre and post-transfusion hemoglobin and hematocrit level among the study population (n=133)

		Mean	t	p-value
Hemoglobin	**Pretransfusion**	7.34 (1.8)		
	Posttransfusion	8.09(1.8)	0. 3.9	<0.001
Hematocrit	**Pretransfusion**	23.44 (5.9)		
	Posttransfusion	25.91(5.9)	0.4.1	<0.001

DISCUSSION

The study included recipients of all age groups and diagnoses. Among the 133 subjects that were enrolled in this study, 76 were males (57.1%) and 42.9% were females. The majority of the subjects were among the age group of 18-35 years (27.1%). These findings are similar to a study conducted in Ethiopia where similar male preponderance was noted (53.2%) with the highest proportion of subjects being in the same age group as our study (43.5%).[6] The similarity in the age group can be attributed to the similar socioeconomic condition and disease patterns of both countries. A study done on the epidemiological trends in patients requiring chronic renal therapy in Switzerland showed that the mean age increased from 48 ± 14 to 64 ± 15 years.[7] This is probably due to better medical facilities which have improved the overall prognosis and survival rates of patients with chronic renal disease.

ABO and Rh genes and phenotypes vary across races and geographical boundaries. Few studies of ABO and Rh blood group prevalence amongst the Nepalese population have been carried out, and the majority of these only deal with individual communities are confined to a particular region of the country.90.9% of the patients in our study were Rh-positive and the most common blood group was B positive (30%). A multicentric study done in India concluded that the most common blood group is O positive followed by B positive with an Rh positivity of 94.61%.[8] Another study done in Iraq showed that most of the patients undergoing hemodialysis belonged to blood group O followed by blood group B. [9] The similarity can be attributed to the high frequency of hemodialysis patients receiving a blood transfusion in our study (57.9%).

Most of the recipients of blood transfusion were patients on hemodialysis (57.9%) followed by patients admitted in medical, surgical, and gynecology wards. Our, hospital is a tertiary care center providing service to patients of all diagnoses. Among the many specialties offered at the hospital, the Hemodialysis unit is one most visited departments offering chronic renal transfusion services to patients. Therefore, due to anemia or chronic disease, many of these patients have to undergo blood transfusions during their procedure.

48 of the recipients were transfused with whole blood and 85 were transfused with packed red blood cells in the present study. Patients that presented with Hemoglobin levels <7g/dl were transfused with packed red blood cells. Similar studies were carried out in Indonesia[4] and Bangladesh[1] where whole blood and packed red blood cells were transfused in anemic patients. However, no statistical significance was calculated based on the type of blood component transfused. In this study, the mean increment of hemoglobin and hematocrit levels after whole blood transfusion was 1.16± 2.32 and 3.80 ± 7.1 respectively. The mean hemoglobin and hematocrit increment post-packed red cell transfusion was 0.52 ± 2.13 and 1.72 ± 6.6 respectively. Based on these values, the mean increment in both the parameters based on the type of blood component transfused was calculated. However, the values were not statistically significant (p value>0.05).

Literature suggests an increase of 1 g/dL of hemoglobin per unit of blood transfused. Also, a common assumption among clinicians is that the transfusion of one unit of blood will result in a 3% increase in the hematocrit or 1 g/dL of hemoglobin.[1] In our study the Mean±SD of hemoglobin level before and after transfusion was 7.34 ± 1.8 and 8.10 ± 1.8 respectively. The Mean ± SD of hematocrit level was 23.44± 5.97and 25.92 ±5.92 respectively. A mean increase of hemoglobin and hematocrit was seen, being 0.75± 2.21 and 2.47 ± 6.84 respectively. A statistically significant increment was seen in both the parameters post-transfusion with a p-value

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<0.001. A study done in a tertiary care setting in India also showed a similar mean increase in hemoglobin level post-transfusion.[10] This value is lower than the expected increase in hemoglobin level after a unit of blood transfusion. This discrepancy could be due to different reasons, including the age and sex of the donor[11], hemoglobin content in the unit, weight of the patient, and the cause of anemia. We included anemic patients of all diagnoses, including the ones having active bleeding too. This could be another additional reason for a lower increment in post-transfusion parameters than expected.

CONCLUSIONS

Anemia is a global health issue and blood transfusion is a lifesaving procedure. 1-unit red blood transfusion is known to increase the hemoglobin by 1g/dl and hematocrit by 3%. Our study aimed to study the increment of both these parameters in the patients at our tertiary care center. A mean hemoglobin increment of 0.75 ± 2.21 and a mean hematocrit increment of 2.47 ± 6.84 was seen. This value is lower than expected, which may be due to the inclusion of patients of all diagnoses, including patients with active bleeding and patients with chronic diseases.

Limitations

This was a single-center study with a limited study population. The post-transfusion parameters within 24 hours of transfusion were included in the study. Measurement of parameters at specific timings post-transfusion may help clinicians manage the patient better. Other factors which were not assessed could have had an impact on the outcomes, including the volume of other fluids administered both intravenously and oral route along with donor characteristics, age, and sex.

Conflict of Interest: None

REFERENCES

1. Hoque MM, Adnan SD, Karim S. Equilibration and increase of hemoglobin concentration after one unit whole blood transfusion among patients not actively bleeding. J Dhaka Med Coll. 2014; 23(2) : 161-6. Website
2. McEvoy MT, Shander A. Anemia, bleeding, and blood transfusion in the intensive care unit: Causes, risks, costs, and new strategies. American Journal of Critical Care; 22. Epub ahead of print 1 November 2013. Crossref
3. Burns CD. Anemia and red blood cell transfusion in the adult non-bleeding patient. Annals of Blood; 7. Epub ahead of print 1 March 2022. Crossref
4. Linda R, Ninda D, Klinik MP. Differences in changes of hemoglobin between 6-12 hours and 12-14 hours after transfusion clinical pathology and medical laboratory. 2018. Cited on 10th March 2022) Available from: Website
5. Elizalde JI, Clemente J, Marín JL, et al. Early changes in hemoglobin and hematocrit levels after packed red cell transfusion in patients with acute anemia. Transfusion. 1997;37(6):573-6. Crossref
6. Tewabe H, Mitiku A, Worku H. Assessment of Blood Transfusion Utilization and Patient Outcomes at Yekatit-12 Hospital, Addis Ababa, Ethiopia. J Blood Med. 2022;13:171-80. Crossref
7. Lehmann PR, Ambühl M, Corleto D, et al. Epidemiologic trends in chronic renal replacement therapy over forty years: A Swiss dialysis experience. BMC Nephrol; 13. Epub ahead of print 2012. Crossref
8. Agrawal A, Tiwari AK, Mehta N, Bhattacharya P, Wankhede R, Tulsiani S, Kamath S. ABO and Rh (D) group distribution and gene frequency; the first multicentric study in India. Asian J Transfus Sci. 2014;8(2):121-5. Crossref
9. Hassoon WA, Melconian AK, Al-Safar JM. Study the Relationship between Hemodialysis (HD) Patients and Their ABO Blood Grouping as Well as Screening of Hemodialysis Access-related Bacterial Infections. Current Research Journal of Biological Sciences 2013; 5: 291–5. Website
10. Tiwari A, Ratan A, Arora D, et al. Audit of clinical use of red blood cells in a tertiary care setting: An algorithmic approach! Global Journal of Transfusion Medicine 2017; 2: 109. Website
11. Roubinian NH, Plimier C, et al. Effect of donor, component, and recipient characteristics on hemoglobin increments following red blood cell transfusion. Blood. 2019 ;134(13):1003-13. Crossref