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Research Article

How Soon after Blood Transfusion can the Haemoglobin Value be Estimated among Not Actively Bleeding Children?

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A B S T R A C T

Introduction: The main target of blood transfusion in children is to prevent unnecessary deaths, and ameliorate their health. After a blood transfusion, haemoglobin (Hb) estimation is necessary to assess its success. This study's objective was to assess the earliest time after blood transfusion for the estimation of the Hb value among not actively bleeding children. The ability to quickly estimate the rise in Hb value after transfusion is essential in managing outpatients and acutely ill children.

Methods: Children aged 1 month to 18 years were included in this prospective observational study conducted from January 2023 to July 2023 at the Paediatric Department of BCM Hospital, Sitapur in Uttar Pradesh, India. Three different periods of Hb measurement: pre-transfusion, 15 minutes after transfusion, and 6–8 hours after transfusion were compared using the paired Student's t-test. Two-tailed p values less than 0.05 were considered significant.

Results: During the course of the study, a total of 94 children (72 males and 22 females) were given packed red blood cell (PRBC) transfusions. Comparison between mean Hb values at 15 minutes after transfusion (mean = 10.4, SD = 1.8) and 6–8 hours after transfusion (mean = 10.4, SD = 1.9) showed statistically no significant difference (t = 0.2751, df = 93, p = 0.7838).

Conclusion: After a blood transfusion, 15 minutes is the earliest time after which haemoglobin value can be estimated among not actively bleeding children.

Keywords: Blood Transfusion, Packed Red Blood Cell, Haemoglobin

Introduction

The main target of blood transfusion in children is to save lives and ameliorate their health. Blood transfusion is a life-saving medication and many lakhs of blood units are arranged and transfused in a year in the whole world.[1–4] This is a unique intervention of patient treatment in which the main goal is to increase oxygen delivery by raising arterial oxygen concentration which is dependent on haemoglobin (Hb) levels.[5–8] After a blood transfusion, Hb estimation is necessary to assess its success. In the case of older children with severe anaemia who have received one unit of packed red blood cell (PRBC) transfusion, analysing whether they require an additional unit of PRBC transfusion to suffice their Hb level requires an estimation of after-transfusion Hb. This frequently raises a question in front of paediatricians: "What is the earliest time to estimate a child's Hb after transfusion?". The answer to this question will ensure that after knowing the post-transfusion Hb value at the earliest possible time, all necessary works like blood donor and processing of blood component for the next transfusion can be completed at the earliest. A few paediatricians have advised Hb estimation at 6–8 hours after PRBC transfusion. Others use 24 hours or the coming morning to estimate post-transfusion Hb. There are some clinical reports which show that an earlier Hb estimation can be done.[9,10] Some research related to this time factor after transfusion has been done in grown-ups, but not in children. Therefore, the purpose of this research was to determine how soon after a blood transfusion, the Hb value may be estimated in children who are not actively bleeding. Our knowledge was expanded as a result of this study, and it will be salutary for the development of specific guidelines among the children.

Methods

The subjects of this prospective observational research were 94 deliberately selected kids from 1 month to 18 years old who had been admitted to the Paediatric Department of BCM Hospital, Sitapur, Uttar Pradesh, India from January 2023 to July 2023. The ethical committee of the BCM Hospital approved the protocol before the inception of the research. All data and records related to the study subjects were kept non-public. The points and objectives of the research and its methodology, pitfalls, and advantages were discussed with the parents in an easy local dialect. Informed consent was taken from the parents in writing. Demographic parameters were acquired from the patient files of the hospital. Participants in this study were those children who had received PRBC transfusion, had normal liver and renal function along with no visible bleeding, and were at a stable clinical stage of their illness.

Age, gender, weight, and blood group were the demographic factors that were recorded for each subject. In order to determine a child's pre-transfusion Hb, a sample of blood was drawn from the child's vein just before the transfusion of PRBC. The process of PRBC transfusion was completed in four to six hours. Following that, the child's venous blood sample was drawn after 15 minutes and after 6–8 hours of completion of transfusion, and the post-transfusion Hb values were determined.

Statistical evaluation was done using version 0.17.2 of Jeffreys's Amazing Statistics Program (JASP). Continuous variables were shown as means and standard deviations, whereas categorical data were presented as frequencies and percentages. Means of Hb concentrations were compared using the paired Student's t-test. Two-tailed p value ≤ 0.05 was used as the criterion of significance.

Results

During the course of the study, a total of 94 children (72 males and 22 females) were given PRBC transfusions. The average age of the children who took part in the research was 3.5 ± 4.2 years (1 month to 17 years being the range). Most children (56 out of 94, 59.6%) were between the ages of 1 month and 2 years. The weights of the children ranged from 2.3 kg to 53 kg, 12.5 ± 9.9 kg being the mean ± SD value (Table 1). The majority had blood type B (28, 29.8%). Children with blood type A were 24 (25.5%) in number. As many as 24 (25.5%) children in the study had blood type O, and the remainder 18 (19.2%) had blood group AB (Figure 1). The research demonstrated the need for all blood types. There was no one blood group that was in high demand.

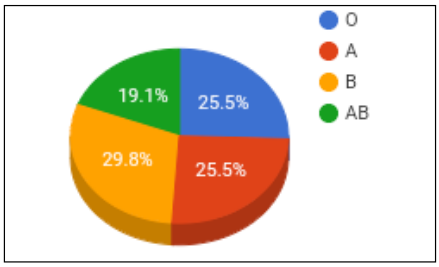

Figure 1.Distribution of Blood Types among the Participants

Before transfusion, the patient's haemoglobin levels ranged from 3.0 gm/dl to 8.8 gm/dl (with an average of 6.9 gm/dl and a standard deviation of 1.3). Fifteen minutes after transfusion, the haemoglobin levels ranged from 5.0 gm/dl to 14.6 gm/dl (with a mean of 10.4 gm/dl and a standard deviation of 1.8) and six to eight hours after transfusion, the levels ranged from 5.3 gm/dl to 15.5 gm/dl (with a mean of 10.4 gm/dl and a standard deviation of 1.9) (Figure 2).

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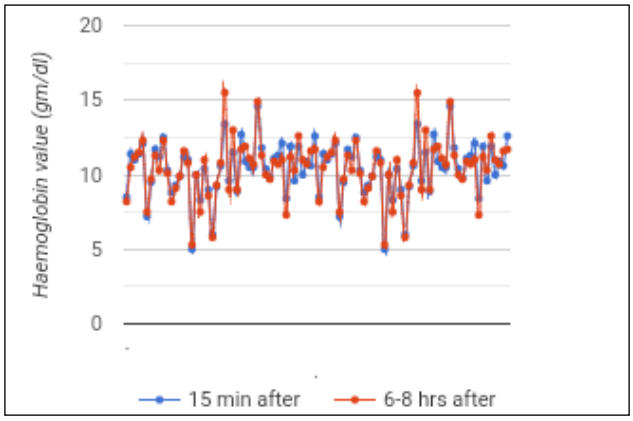

Figure 2.Haemoglobin Values of the Participants (15 Minutes and 6–8 Hours after Blood Transfusion)

Table 1.Demographic and Laboratory Parameters

Variables	Values
Age (years) (mean ± SD)	3.5 ± 4.2
Gender (male:female)	3.3:1
Weight (kg) (mean ± SD)	12.5 ± 9.9
Pre-transfusion Hb value (gm/dl) (mean ± SD)	6.9 ± 1.3
Hb value 15 min after transfusion (gm/dl) (mean ± SD)	10.4 ± 1.8
Hb value 6–8 hours after transfusion (gm/dl) (mean ± SD)	10.4 ± 1.9

A comparison of the mean haemoglobin values pre-transfusion with those taken 15 minutes after transfusion showed a statistically significant difference (t = 28.50, df = 93, p < 0.0001). The haemoglobin value taken 15 minutes after transfusion (mean = 10.4, SD = 1.8) was significantly higher than the value pre-transfusion (mean = 6.9, SD = 1.3) (Table 2).

Table 2.Comparison of Mean Haemoglobin Values Pre-transfusion and 15 Minutes after Transfusion

Hb Values (Mean ± SD)	Pre-transfusion	15 Minutes after Transfusion	t Value	df	p Value
	6.9 ± 1.3	10.4 ± 1.8	28.50	93	< 0.0001

A comparison of the mean haemoglobin values pre-transfusion with those taken 6–8 hours after transfusion showed a substantial difference in terms of statistics (t = 25.27, df = 93, p < 0.0001). The mean of the haemoglobin values taken 6–8 hours after transfusion (mean = 10.4, SD = 1.9) was significantly higher than the value prior to transfusion (mean = 6.9, SD = 1.3) (Table 3).

Table 3.Comparison of Mean Haemoglobin Values Pre-transfusion and 6–8 Hours after Transfusion

Hb Values (Mean ± SD)	Pre-transfusion	6–8 Hours after Transfusion	t Value	df	p Value
	6.9 ± 1.3	10.4 ± 1.9	25.27	93	< 0.0001

A comparison between the means of the haemoglobin values taken 15 minutes after transfusion and those taken 6–8 hours after transfusion showed statistically no substantial variation (t = 0.2751, df = 93, p = 0.7838). The haemoglobin values taken 15 minutes after transfusion (mean = 10.4, SD = 1.8) had statistically no significant difference with those taken 6–8 hours after transfusion (mean = 10.4, SD = 1.9) (Table 4).

Table 4.Comparison of Mean Haemoglobin Values 15 Minutes and 6–8 Hours after Transfusion

Hb Values (Mean ± SD)	15 Minutes after Trans-fusion	6–8 Hours -after Trans-fusion	t Value	df	p Value
	10.4 ± 1.8	10.4 ± 1.9	0.2751	93	0.7838

Discussion

In this single-centre, prospective observational study, we discovered that the Hb value obtained 15 minutes after blood transfusion (mean = 10.4, SD = 1.8) had no statistically significant difference with that obtained 6–8 hours after transfusion (mean = 10.4, SD = 1.9). After a blood transfusion, 15 minutes was found to be the earliest time after which the Hb value can be estimated among not actively bleeding children. However, there is insufficient data available from clinical studies in children that show the earliest time after transfusion.

Wiesen et al. did a study in 1994 on 39 adult cases. They estimated the Hb values after completion of a 2-unit PRBC transfusion at 15 minutes, 1 hour, 2 hours, and 24 hours. At these post-transfusion times, there were no discernible variations in the mean Hb levels (p = 0.82).[9]

Thirty-two adult individuals who recently had an acute bleeding episode were given a 2-unit PRBC transfusion in the 1997 trial by Elizalde et al. There were no discernible variations in the post-transfusion Hb levels estimated at 15 minutes, 30 minutes, 1 hour, 2 hours, and 24 hours (p = 0.4) after transfusion.[10]

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Linda and Ninda did a retrospective study on 98 adult cases at the University Islam Indonesia. They concluded that there was a 10%–30% increase in Hb concentration 6–12 hours after receiving PRBC transfusion. In contrast, Hb rose by 15%–37% from the baseline 12–24 hours after transfusion. Every specified after-transfusion time had the same Hb levels ($p = 0.76$; $p > 0.05$). At 6–12 hours and 12–24 hours after transfusion, the Hb readings were the same.[11]

A cross-sectional study was conducted on 100 adult patients by Hoque et al. at Dhaka Medical College in Bangladesh. After 6 hours of blood transfusion, there was an average rise of 0.39 gm/dl in Hb levels, and after 24 hours, the increase was 1.14 gm/dl. The mean Hb levels were statistically different at 6 and 24 hours after transfusion.[12]

Audu et al. performed prospective observational research on a cohort of 47 anaemic newborns who were stable at the National Hospital in Abuja. Prior to the transfusion, as well as 1, 6, 12, 24, and 48 hours post-transfusion (PT), the packed cell volume (PCV) values were measured. The PT PCV measured after 1 hour (48.5% ± 5.5%) was found to be comparable to the PT PCV measured after 6 hours (47.8% ± 5.6%) with a p value of 0.516. However, both of these measurements exhibited statistically significant differences when compared to the PT PCVs measured after 12 hours (46.8% ± 5.9%), 24 hours (45.9 ± 5.8%), and 48 hours (45.4% ± 6.2%). According to the data, there was no statistically significant variation in PT PCV after 12 hours as compared to that after 24 and 48 hours ($p = 0.237$ and 0.063, respectively). The researchers reached the conclusion that in young babies who are stable and not experiencing haemorrhage or haemolysis, the expected time for haematocrit equilibration and subsequent PT PCV is around 12 hours after the administration of PRBC.[13]

Blood transfusions are associated with many side effects, but they have been associated with various benefits too. If anaemia is not being corrected, it results in increased death rates.[14–17]

The limitations of our study are that it is single-centred research with a tiny sample size of children and a uniform research population. Combined studies at multiple centres are required to be done in future, which will enhance the scientific knowledge of researchers and paediatricians.

Conclusion

Haemoglobin readings were statistically not significantly different after 15 minutes of transfusion as compared to those taken 6–8 hours after transfusion. After a blood transfusion, 15 minutes is the earliest time after which the haemoglobin value can be estimated among not actively bleeding children.

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Conflict of Interest: None declared

References

1. Napolitano LM, Kurek S, Luchette FA, Corwin HL, Barie PS, Tisherman SA, Hebert PC, Anderson GL, Bard MR, Bromberg W, Chiu WC, Cipolle MD, Clancy KD, Diebel L, Hoff WS, Hughes KM, Munshi I, Nayduch D, Sandhu R, Yelon JA; American College of Critical Care Medicine of the Society of Critical Care Medicine; Eastern Association for the Surgery of Trauma Practice Management Workgroup. Clinical practice guideline: red blood cell transfusion in adult trauma and critical care. Crit Care Med. 2009 Dec;37(12):3124-57. [PubMed] [Google Scholar]
2. Chassé M, English SW, McIntyre L, Knoll G, Shehata N, Forster A, Wilson K, van Walraven C, Tinmouth A, Fergusson DA. Effect of blood donor characteristics on transfusion outcomes: a protocol for systematic review and meta-analysis. Syst Rev. 2014 Mar 20;3:28. [PubMed] [Google Scholar]
3. Surgenor DM, Wallace EL, Hao SH, Chapman RH. Collection and transfusion of blood in the United States, 1982-1988. N Engl J Med. 1990 Jun 7;322(23):1646-51. [PubMed] [Google Scholar]
4. Wallace EL, Surgenor DM, Hao HS, An J, Chapman RH, Churchill WH. Collection and transfusion of blood and blood components in the United States, 1989. Transfusion. 1993 Feb;33(2):139-44. [PubMed] [Google Scholar]
5. Raat NJ, Ince C. Oxygenating the microcirculation: the perspective from blood transfusion and blood storage. Vox Sang. 2007 Jul;93(1):12-8. [PubMed] [Google Scholar]
6. Vincent JL, Piagnerelli M. Transfusion in the intensive care unit. Crit Care Med. 2006 May;34(5 Suppl):S96-101. [PubMed] [Google Scholar]
7. Tinmouth A, Fergusson D, Yee IC, Hébert PC; ABLE Investigators; Canadian Critical Care Trials Group. Clinical consequences of red cell storage in the critically ill. Transfusion. 2006 Nov;46(11):2014-27. [PubMed] [Google Scholar]
8. Lelubre C, Vincent JL. Red blood cell transfusion in the critically ill patient. Ann Intensive Care. 2011 Oct 4;1:43. [PubMed] [Google Scholar]

ISSN: 2394-6539
DOI: https://doi.org/10.24321/2394.6539.202304

9. Wiesen AR, Hospenthal DR, Byrd JC, Glass KL, Howard RS, Diehl LF. Equilibration of hemoglobin concentration after transfusion in medical inpatients not actively bleeding. Ann Intern Med. 1994 Aug 15;121(4):278-30. [PubMed] [Google Scholar]
10. Elizalde JI, Clemente J, Marín JL, Panés J, Aragón B, Mas A, Piqué JM, Terés J. Early changes in hemoglobin and hematocrit levels after packed red cell transfusion in patients with acute anemia. Transfusion. 1997 Jun;37(6):573-6. [PubMed] [Google Scholar]
11. Linda R, Ninda D. Differences in changes of hemoglobin between 6-12 hours and 12-14 hours after transfusion. Indones J Clin Pathol Med Lab. 2018 Sep 30;24(2):108-11. [Google Scholar]
12. Hoque MM, Adnan SD, Karim S, Al Mamun MA, Nandy S, Faruki MA, Mahmud K, Islam K. Equilibration and increase of hemoglobin concentration after one unit whole blood transfusion among patients not actively bleeding. J Dhaka Med Coll. 2014 Oct;23(2):161-6. [Google Scholar]
13. Audu LI, Otuneye AT, Mairami AB, Mshelia LJ, Nwatah VE. Posttransfusion haematocrit equilibration: timing posttransfusion haematocrit check in neonates at the National Hospital, Abuja, Nigeria. Int J Pediatr. 2015;2015:175867. [PubMed] [Google Scholar]
14. Carson JL, Duff A, Poses RM, Berlin JA, Spence RK, Trout R, Noveck H, Strom BL. Effect of anaemia and cardiovascular disease on surgical mortality and morbidity. Lancet. 1996 Oct 19;348(9034):1055-60. [PubMed] [Google Scholar]
15. Mudumbai SC, Cronkite R, Hu KU, Wagner T, Hayashi K, Ozanne GM, Davies MF, Heidenreich P, Bertaccini E. Association of admission hematocrit with 6-month and 1-year mortality in intensive care unit patients. Transfusion. 2011 Oct;51(10):2148-59. [PubMed] [Google Scholar]
16. Sakr Y, Lobo S, Knuepfer S, Esser E, Bauer M, Settmacher U, Barz D, Reinhart K. Anemia and blood transfusion in a surgical intensive care unit. Crit Care. 2010;14(3):R92. [PubMed] [Google Scholar]
17. Vincent JL. Indications for blood transfusions: too complex to base on a single number? Ann Intern Med. 2012 Jul 3;157(1):71-2. [PubMed] [Google Scholar]

ISSN: 2394-6539
DOI: https://doi.org/10.24321/2394.6539.202304