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EFFECT OF TRANSFUSING BLOOD VOLUME ON HAEMOGLOBIN INCREMENT IN NOT ACTIVELY BLEEDING CHILDREN

Paediatrics

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ABSTRACT

Introduction: A substantial number of paediatric patients need blood transfusion as an essential component of their therapy. There is limited research done among Indian children regarding haemoglobin increment after packed red blood cell transfusion. This study presents an effort to determine more precisely the effect of transfusing packed red blood cell volume on haemoglobin increment in not actively bleeding children. **Methods:** A retrospective observational research was carried out on 62 children (1 month to 16 years old) with no active bleeding who received a packed red blood cell transfusion at the paediatric department of BCM Hospital Sitapur (UP) in India from October 2022 to March 2023. Comparisons were made between the patient's haemoglobin levels before and after the transfusion. **Results:** After transfusing packed red blood cell at a rate of 14.2 ± 3.3 ml/kg, the total increase in haemoglobin level was found to be 4.0 ± 1.2 gm/dl. **Conclusion:** According to the findings of this research, the level of haemoglobin increased by 1.4 gm/dl after receiving transfusion of 5 ml/kg of packed red blood cell.

KEYWORDS

blood transfusion; packed red blood cell; haemoglobin

INTRODUCTION

Many children need blood transfusion as an essential component of their therapy.[1] In rural India, it is very difficult for paediatricians to explain the parents about the need of blood transfusion to their children. Paediatricians have to face many questions. Few of them are how much blood volume is required for their children? What will be the increment in haemoglobin level after one time of blood transfusion? Because, paediatric blood packs are not available everywhere, it is very difficult to explain the parents that one or two paediatric blood packs are required to suffice haemoglobin requirement of their children. It is a widely held belief among pediatricians that the transfusion of 5 ml/kg of packed red blood cell (PRBC) would increase the patient's haemoglobin level by about 1 g/dl.[2] However, there are only few studies conducted determining amount of haemoglobin increment after transfusing PRBC in Indian children. As a result, the purpose of this research is to assess, in a more accurate manner, the influence of PRBC transfusion volume on haemoglobin increment in children who are not actively bleeding. Our knowledge was expanded as a result of this study, and it will be beneficial for the development of specific guidelines of PRBC transfusion among the Indian children.

METHODS

This retrospective observational research was carried out on children who had been hospitalized to the paediatric department of BCM Hospital Sitapur, Uttar Pradesh, India from October 2022 to March 2023. The age of the youngsters varied from one month to sixteen years. Participants in this study were required to have normal kidney function, normal liver function, no active bleeding, and in a stable clinical stage of their disease. Participants also needed to receive a packed red blood cell transfusion.

Age, gender, weight, and blood group were the demographic factors that were recorded for each subject. The computation that was used to establish the amount of PRBC volume to be transfused was based on the child's weight. In order to determine the patient's haemoglobin level, a sample of blood was drawn from the patient's vein soon before the PRBC transfusion. The process of PRBC transfusion was completed in four to six hours. Following that, patient's venous blood sample was drawn from within 6 to 8 hours of the completion of PRBC transfusion, and the haemoglobin concentration of the patient was determined.

In order to investigate whether or not there was a link between the amount of haemoglobin prior and following the transfusion, Paired t-tests was carried out. In order to assess the possibility that there was a link between the volume of PRBC transfused and the rise in haemoglobin, Pearson's correlation coefficient was calculated.

RESULTS

During the course of study, a total of 62 children, 44 of whom were male and 18 of whom were female, were given PRBC transfusions. The average age of the children who participated in the research was one and a half years. (2 months - 8 years being the range). Most children [(29 out of 62) (46.8%)], were in the age group of 6 months to 1 year. The weight of the children ranged from 2.5 kg to 24 kg, 8.9 kg being the mean. Majority had blood type O [24 (38.7%)]. Blood type A were 16 (25.8%). As many as 14 (22.6%) of study children had blood type B, and the remaining 8 (12.9%) had blood group AB. In this study, it showed the demand of all blood types. There was no dominant demand for one type of blood group.

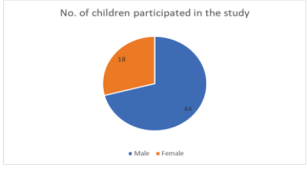

Figure 1 Graphical Representation Of No. Of Children Participated

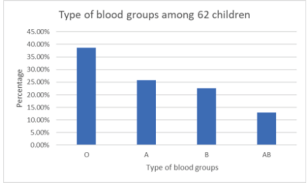

Figure 2 Graphical Representation Of Type Of Blood Groups Among 62 Children

PRBC transfusion volume ranged from 6 to 21.6 ml/kg, with the mean volume being 14.2 ml/kg, the standard deviation being 3.3. Before transfusion, patient's haemoglobin levels ranged from 3.4 to 9 gm/dl (with an average of 6.6 gm/dl and a standard deviation of 1.3). After transfusion, haemoglobin levels varied from 7.3 to 14.9 gm/dl (with a mean of 10.7 gm/dl and a standard deviation of 1.7).

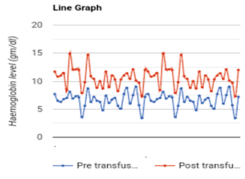

Figure 3 Graphical Representation Of Haemoglobin Level Before And After Transfusion

Following transfusion of PRBC at a rate of 14.2 ± 3.3 ml/kg, the increase in haemoglobin level was 4.0 ± 1.2 gm/dL. The standard

deviation for the amount of time spent delivering transfusions was 0.8 hours, with the average amount of time spent was 4.8 hours.

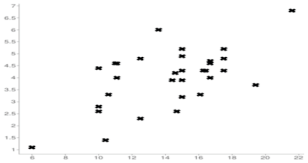

Figure 4 Scattered Plot Of Volume Of Transfusion (ml/kg)_x Axis Versus Rise In Haemoglobin (gm/dl)_y Axis

The two-tailed P value was discovered to be less than 0.0001 which indicates that the results are extremely significant statistically. This was established by doing an analysis of rise in haemoglobin levels that occurred after transfusion. With a Pearson correlation coefficient of 0.59, it was shown that an increase in haemoglobin level was substantially linked with the volume of PRBC that was transfused.

DISCUSSION

In this single center, retrospective observational study, we discovered that the average increase in haemoglobin level in children who did not have active bleeding was 4 gm/dl after receiving an average transfusion volume of 14.2 ml/kg of PRBC. The common assumption is that the transfusion of 5 ml/kg of PRBC will result in a rise in haemoglobin level by 1 gm/dl; but, in this study we found this haemoglobin rise by 1.4 gm/dl. There are not enough data available from clinical studies that compare the rise in haemoglobin level before and after a child received PRBC transfusion.

In the prospective observational research on children in Nepal who were not actively bleeding, Shrestha et al., depicted the total rise in haemoglobin level after receiving transfusion of PRBC with haematocrit 57.0 ± 4.8% at the rate of 14.2 ± 5.8 ml/kg was 2.9 ± 1.4 gm/dl.[3]

Chegondi et al. who did a retrospective study to assess the haemoglobin threshold for packed red blood cell transfusion in children admitted to a paediatric intensive care unit concluded that the mean (±SD) pre- transfusion haemoglobin was 7.3 gm/dl (±1.20) and the mean post- transfusion haemoglobin was 9.83 gm/dl (±1.97) after transfusing an average of 11.52 ml/kg (± 9.94) of PRBC.[4] The patients were divided into the following categories so that the research could be carried out: acute blood loss, haematologic, unstable and stable groups. On subgroup analysis of patients, the mean rise of haemoglobin was similar for equal volume of blood transfused.

In a retrospective research carried out at Bristol Royal Hospital for Children, Giancarlo Liumbruno and his colleagues came to the realization that a blood transfusion of 10 ml/kg of red cell with haematocrit of 60% boosts the haemoglobin level by about 2 g/dl.[2]

The Investigators, Patrik Davies and colleagues came to the conclusion that the equation, weight (kg) x rise in haemoglobin (g/dl) x 3/ (haematocrit level of RBCs), could be applied to estimate the volume of blood required for transfusion.[5] According to the equation, the haematocrit level of the blood that was donated is the most important element in determining the haemoglobin level after transfusion, assuming that there are no other variables that might be contributing to the increase in haemoglobin level. Since it is possible that the haematocrit of the PRBC can vary from 50% to 80% dependent on the preservative used for storage of blood, the post-transfusion haemoglobin may differ even after transfusing the same volume of blood if they have various haematocrit levels.

We did not study the effect of donor blood haematocrit on haemoglobin increment. This is the limitation of our study.

CONCLUSION

According to the results of our study, a patient's haemoglobin level would increase by 4 gm/dl after receiving transfusion of PRBC at a rate of 14.2 ml/kg. The common assumption is that the transfusion of 5 ml/kg of PRBC would increase the level of haemoglobin by 1 gm/dl; but, we found this haemoglobin increment after transfusion of 5 ml/kg of PRBC by 1.4 gm/dl.

Thus, with the help of this study, in Indian settings, paediatricians can be able to answer the parents'queries, " how much blood volume is required for their children? What will be the increment in haemoglobin level after one time of blood transfusion?"

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