



WASTAGE OF BLOOD COMPONENTS IN THALASSEMIA PATIENTS IN A RURAL TERTIARY CARE HOSPITAL: A RETROSPECTIVE STUDY

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ABSTRACT

Background: Thalassemia is one of the most challenging hematological disorders. Packed Red Blood Cell (pRBC) transfusion is one of the globally accepted symptomatic treatment modality for this disease although it has numerous complications. Wastage of pRBC is crucial in the functioning of blood bank. To reduce the blood wastage new small packet of blood may be introduced.



Objectives: To find out the total frequency and volume of pRBC transfusions in a Thalassemia Unit and also to study the amount of pRBC wastage following transfusions to a thalassemic patient of an age group of 6 months to 12 years with respect to weight, age and sex.

Method: The retrospective observational study was carried out among the thalassemic patients admitted for blood transfusion in tertiary care center for a period of three months. Data regarding the blood transfusion were collected retrospectively and analyzed with respect to body weight, age and sex. The wastage of pRBC and donor exposure were considered.

Results: Wastage of blood in regular packet (250 ml) and Pedi-pack (125ml) were 141.04 ± 21.14 ml and 47.29 ± 42.78 ml respectively in the age group of below five years. In case of age group 10 years and above, the wastage of blood of the said packets were 76.33 ± 68.77 ml and 51.33 ± 26.03 ml respectively. Thus, using the Pedi-pack the wastage of blood particularly in the age group below five years were nearly less by about 100 ml.

Conclusion: In order to reduce the pRBC wastage in a Thalassemia unit, preparation of small blood packets (Pedi-pack), provision of satellite packs should be implemented. Assigned red cell units can be used to limit donor exposure.

Keywords: pRBC (Packed Red Blood Cell), Pedi-pack, Thalassemia, Transfusion, Blood Component

DOI Number: 10.48047/NQ.2022.20.21.NQ99045

Neuro Quantology 2022; 20(21): 367-375

INTRODUCTION

Thalassemia is a heterogeneous group of single gene disorders that are prevalent in certain parts of the world and are inherited in an autosomal recessive manner. It is one of the most challenging diseases being faced by the mankind which has no permanent solution for cure. β -thalassemia is a hereditary red blood cell (RBC) disorder caused by mutations in the β -globin gene¹. These mutations lead to oxidative stress and premature death of erythroblasts resulting in ineffective erythropoiesis and erythroid expansion in the bone marrow²⁻³. Comorbidities include splenomegaly, bone deformities and ulceration in leg. This disease is associated with impaired erythropoiesis, anemia and iron overload¹.

Every year approximately 100,000 children are born with thalassemia major globally, out of which 10,000 are born in India¹. It is estimated that there are about 65,000 - 67,000 beta-thalassemia patients in India and approximately 30 million carriers of beta-thalassemia with a mean prevalence of 3.3%¹.

Once a child is diagnosed with thalassemia homozygous disorders, lifelong treatment is required which includes routine filtered packed red cell (pRBC) transfusion, chelation therapy for iron overload and management of different complications due to iron overload and

transfusion. According to World Health Organization, it has been estimated that an annual average consumption of 27 units of blood and drugs are needed to manage each patient recommended by standard guidelines⁶. Stem cell transplantation as a curative treatment is out of reach for majority of children. As per standard guideline pRBC at 10ml/kg body weight was given to the thalassemic patient. The remaining amount of pRBC from each pack was discarded. Blood and its products are most valuable resource in every healthcare institution. Judicial use of these limited resources is necessary and important to maintain sufficient supply. It is a global challenge to manage the increasing demand for blood and blood products⁵. In order to solve these difficulties, we therefore, intend to study wastage of blood component (pRBC) in thalassemic patients.

The present study was undertaken to find out the total frequency and volume of transfusions in a thalassemia patient for a period of three months in a thalassemic unit of a tertiary care center and also to measure total amount of blood component (pRBC) wastage following transfusions with respect to weight, age and sex.

MATERIALS AND METHODS

It was a hospital based retrospective study conducted in the Thalassemia unit of Department



of Pediatrics, Midnapore Medical College, Paschim Medinipur for a period of 3 months (1st March 2022 to 30th May 2022). Those children aged between 6 months to 12 years with a previous diagnosis of thalassemia admitted with complain of anaemia.

Inclusion Criteria:

- Children aged between 6 months to 12 years admitted in Thalassemic unit of pediatric ward with anaemia.
- Previously diagnosed case of thalassemia aged between 6 months to 12 years.
- Gave consent by parent or local guardian of thalassemic patients aged 6 months to 12 years needs blood transfusion.

Exclusion Criteria:

- Those thalassemic patients whose parents did not give consent were excluded.

All details regarding weight, age, sex, blood group, Rh factors, date of transfusion, date of expiry of blood product (pRBC) and amount of blood transfusion were recorded in a predesigned proforma. In the Blood bank, there are four types of blood components mainly pRBC, Fresh frozen plasma (FFP), Whole Blood (WB) and Random Donor Plasma (RDP) with packet sizes of 250 ml, 180-220 ml, 320-360 ml, and 50 ml respectively of which pRBC is utilized at the rate of 10ml/kg over 4 hours from the supplied 250ml pack. The remaining amount of each pack of pRBC is discarded. The blood bank in the institute does not have any provision either to supply a small size pack or to prepare a satellite pack (pRBC=125ml) of different blood component for thalassemia patients. As per guidelines

remaining blood component should not be preserved for further utilization to avoid complication. Therefore, in any blood component transfusion like pRBC a huge amount of unused blood component is discarded even in a situation of blood crisis. So, unwillingly, we have to discard that huge amount of unused pRBC into dustbin as per bio-hazard management.

Statistical analysis was performed using SPSS software. For continuous variables, data was presented as the mean ± standard deviation. ANOVA was computed to study the age difference in wastage of blood. The categorical variables were compared using the Chi-squared test to evaluate statistical significance. Statistical significance was considered at $p < 0.05$.

RESULTS

A total 151 previously diagnosed case of thalassemia children (Girls 83 and boys 68) got admission in Thalassemia unit of Department of Pediatrics, Midnapore Medical College, Paschim Medinipur District for a period of 3 months for blood transfusion were included in the study (Table 1). The mean age of the participants was 6.85 ± 3.17 years. This study showed that the blood required for transfusion was 163.51 ± 54.72 ml. The wastage of blood in using regular pack (250 ml) was 101.39 ± 50.92 ml while in Pedi-pack (125 ml) it was 59.17 ± 36.22 ml. While calculating the ratio of blood wastage in the regular pack and Pedi-pack these were $1:0.77 \pm 0.59$ and $1:0.39 \pm 0.27$ respectively.

Table 1. Descriptive statistics of the demographic and blood parameters

| Parameters | Mean±Sd/n(%) |
|--------------------|--------------|
| Age (years) | 6.85±3.17 |
| <5 | 48 (31.79) |
| 5 – 9 | 58 (38.41) |
| ≥10 | 45 (29.80) |
| Sex | |
| Girls | 83 (54.97) |
| Boys | 68 (45.03) |
| Weight (kg) | 16.35±5.47 |
| Blood group | |



| | |
|--|--------------|
| A | 34 (22.52) |
| AB | 6 (3.97) |
| B | 49 (32.45) |
| O | 62 (41.06) |
| Rh factor | |
| Rh ⁻ | 4 (2.65) |
| Rh ⁺ | 147 (97.35) |
| Blood volume (ml) | |
| Transfusion | 163.51±54.72 |
| Wastage in regular packet | 101.39±50.92 |
| Wastage in Pedi-pack | 59.17±36.22 |
| Transfusion Wastage Ratio in regular packet | 1:0.77 |
| Transfusion Wastage Ratio in Pedi-pack | 1:0.39 |

The study indicated that age was an important determining factor for blood wastage. As blood transfusion is related with the weight of the children, thus in lower age more blood is wastage.

Table 2. Effect of age on the blood volume transfused and wastage

| Age (years) | n | Blood volume (ml) | | |
|--------------|----|--------------------|---------------------------|----------------------|
| | | Transfusion | Wastage in Regular Packet | Wastage in Pedi-pack |
| <5 | 48 | 108.96±21.14 | 141.04±21.14 | 47.29±42.78 |
| 5–9 | 58 | 161.98±28.31 | 88.02±28.31 | 75.09±31.56 |
| ≥10 | 45 | 223.67±41.72 | 76.33±68.77 | 51.33±26.03 |
| ANOVA | | F=157.966; P<0.001 | F=30.728;P<0.001 | F=10.388;P<0.001 |

The wastage of blood in regular packet and Pedi-pack were 141.04±21.14ml and 47.29±42.78ml respectively in the age group of below five years and 76.33±68.77ml and 51.33±26.03ml respectively in 10 years and above (Table 2). Thus, using the Pedi-pack the wastage of blood particularly in the age group below five years

were nearly 100 ml less than using the regular packet.

The ANOVA did not show any significant changes of amount of transfusion or wastage of blood in different blood group (Table 3).

Table 3. Effect of blood group on the blood volume transfused and wastage

| Blood group | n | Blood volume (ml) | | |
|-------------|---|-------------------|--------------------|----------------------|
| | | Transfusion | Wastage in regular | Wastage in Pedi-pack |



| | | | packet | |
|--------------|----|-----------------|-----------------|-----------------|
| A | 34 | 167.94±61.07 | 104.12±49.52 | 52.65±38.04 |
| AB | 6 | 166.67±26.58 | 83.33±26.58 | 83.33±26.58 |
| B | 49 | 159.29±62.36 | 111.12±60.35 | 60.10±35.10 |
| O | 62 | 164.11±46.91 | 93.95±44.22 | 59.68±36.53 |
| ANOVA | | F=0.178; P>0.05 | F=1.331; P>0.05 | F=1.279; P>0.05 |

This study showed that more than 150ml of blood loss/packet was observed in 13.25% of cases in regular pack and this was mainly observed in age group below five years and ≥10 years (Table 4). The volume (101-150 ml) of wastage of blood was 33.11% in regular pack and it was predominant in the children of below five years (77.08%). It is well known that amount of blood to be transfused is based on the weight of the children, thus while using the standard packet size there is a chance of more amount of

wastage in the age group of less than five years. In the case of 10 years and above, there is a chance of requirement of more than one packet, thus the 2nd packet of blood is not fully utilized and the wastage happened. To reduce this while introducing the Pedi-pack the wastage of the blood may be drastically reduced. The blood wastage more than 100 ml in regular pack and Pedi-pack were 46.36% and 12.58% respectively. This study indicated that Blood group B was in the mostly wastage blood group (Table 5).

Table 4. Relationship between age and blood wastage

| Blood Wastage (ml) | Age (Years) | | | Total n=151 | χ ² test |
|-----------------------|------------------|---------------------|-------------------|----------------|-------------------------------------|
| | <5 years n=48 | 5 - 9 years n=58 | ≥10 years n=45 | | |
| Regular packet | | | | | |
| ≤50 ml | 0 (0.00) | 10 (17.24) | 23 (51.11) | 33 (21.85) | χ ² =116.491; P<0.001 |
| 51-100 | 0 (0.00) | 35 (60.34) | 13 (28.89) | 48 (31.79) | |
| 101-150 | 37 (77.08) | 13 (22.41) | 0 (0.00) | 50 (33.11) | |
| >150 | 11 (22.92) | 0 (0.00) | 9 (20.00) | 20 (13.25) | |
| Pedi-pack | | | | | |
| ≤50 ml | 33 (68.75) | 16 (27.59) | 23 (51.11) | 72 (47.68) | χ ² =41.741; P<0.001 |
| 51-100 | 3 (6.25) | 35 (60.34) | 22 (48.89) | 60 (39.74) | |
| 101-125 | 12 (25.00) | 7 (12.07) | 0 (0.00) | 19 (12.58) | |

Table 5. Relationship between blood group and blood wastage

| Blood Wastage (ml) | Blood Group | | | | Total n=151 | χ ² test |
|-----------------------|-------------|-----------|------------|------------|----------------|-----------------------------------|
| | A n=34 | AB n=6 | B n=49 | O n=62 | | |
| Regular packet | | | | | | |
| ≤50 ml | 9 (26.47) | 0 (0.00) | 7 (14.29) | 17 (27.42) | 33 (21.85) | χ ² =20.857; P<0.05 |
| 51-100 | 7 (20.59) | 5 (83.33) | 18 (36.73) | 18 (29.03) | 48 (31.79) | |
| 101-150 | 15 (44.12) | 1 (16.67) | 12 (24.49) | 22 (35.48) | 50 (33.11) | |
| >150 | 3 (8.82) | 0 (0.00) | 12 (24.49) | 5 (8.06) | 20 (13.25) | |
| Pedi-pack | | | | | | |
| ≤50 ml | 20 (58.82) | 0 (0.00) | 20 (40.82) | 32 (51.61) | 72 (47.68) | χ ² =12.134; |



| | | | | | | |
|---------|------------|-----------|------------|------------|------------|---------|
| 51-100 | 10 (29.41) | 5 (83.33) | 25 (51.02) | 20 (32.26) | 60 (39.74) | P=0.059 |
| 101-125 | 4 (11.76) | 1 (16.67) | 4 (8.16) | 10 (16.13) | 19 (12.58) | |

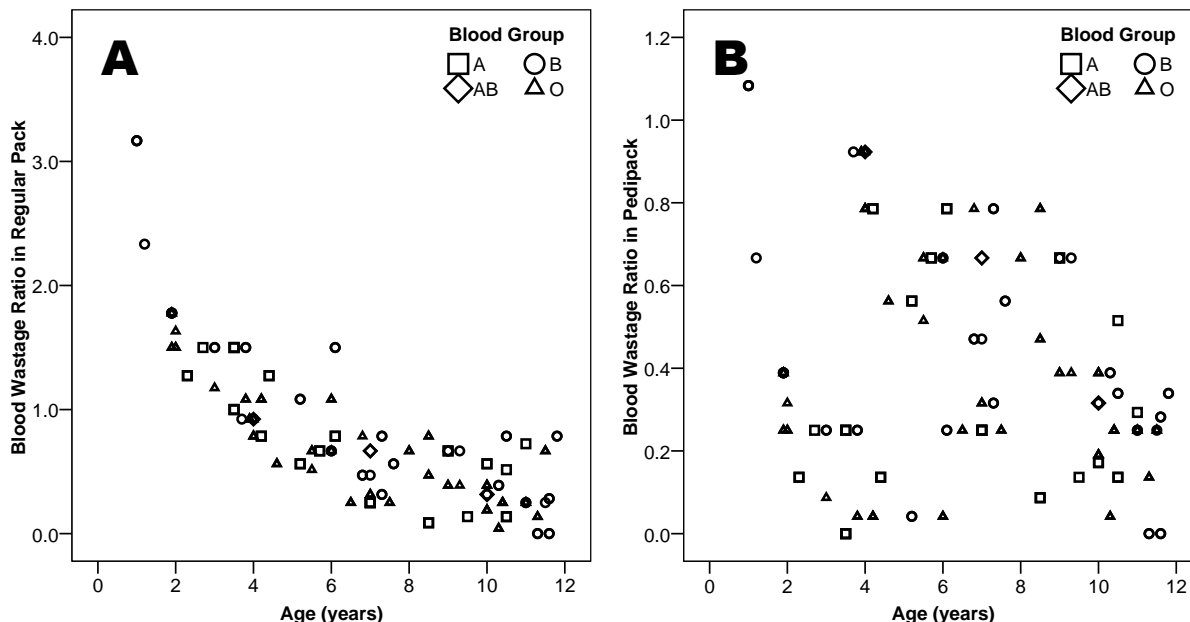


Figure 1. Distribution blood wastage ratio in respect to age in varied blood group of regular pack (A) and Peditack (B).

Distribution blood wastage ratio in respect to age in varied blood group of regular pack and Peditack is presented in Figure 1. There is no sexual dimorphism observed in the blood wastage in the regular packet (Boys: 108.38 ± 51.10 ml; Girls: 95.66 ± 50.35 ml; $t=1.534$; $P>0.05$) and Peditack (Boys: 60.58 ± 33.81 ml; Girls: 58.01 ± 38.25 ml; $t=0.434$; $P>0.05$) as a whole (Figure 2). But in case of age group less than five years much amount of blood wastage was observed in boys (149.04 ± 20.49 ml) than the girls (131.59 ± 18.09 ml) in statistically significant level ($t=3.941$;

$P<0.001$). The cause behind the sexual dimorphism is that the body weight of the thalassemic boys (10.10 ± 2.05 kg) were significantly lighter ($t=3.099$; $P<0.001$) than the girls (11.84 ± 1.81 kg) that causes more amount of wastage of blood from the standard packet. The low weight among the boys were reflected in the mean WAZ, that is presented in Figure 3. This study also documented that boys were more prone to become underweight (69.23%) in comparison to thalassemic girls (45.45%).



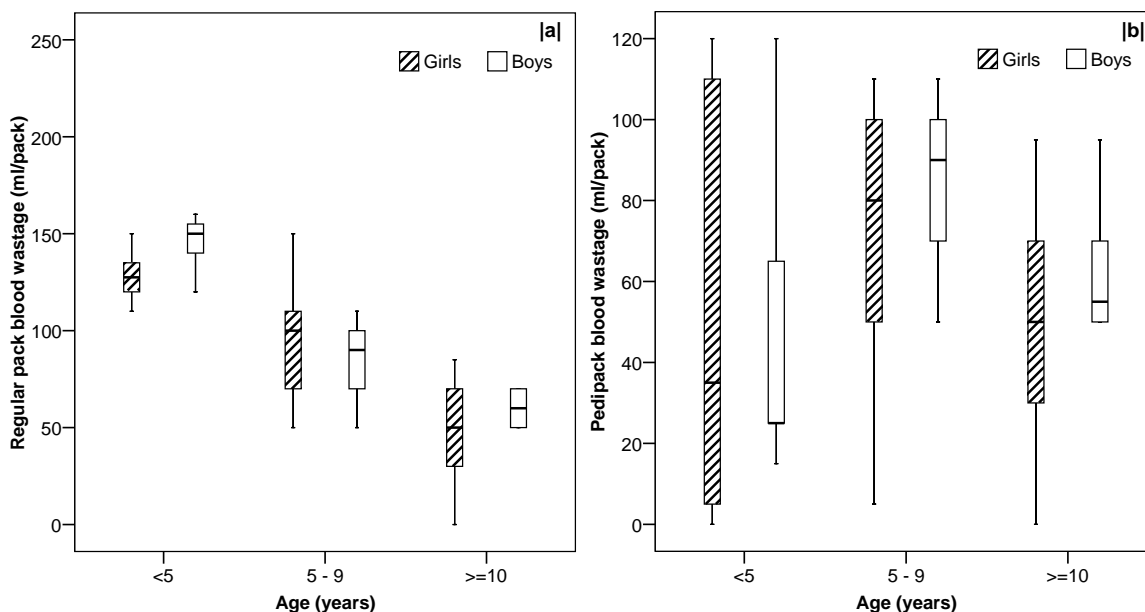


Figure 2. Impact of age and sex on the blood wastage of (a) regular packet and (b) Pedi-pack.

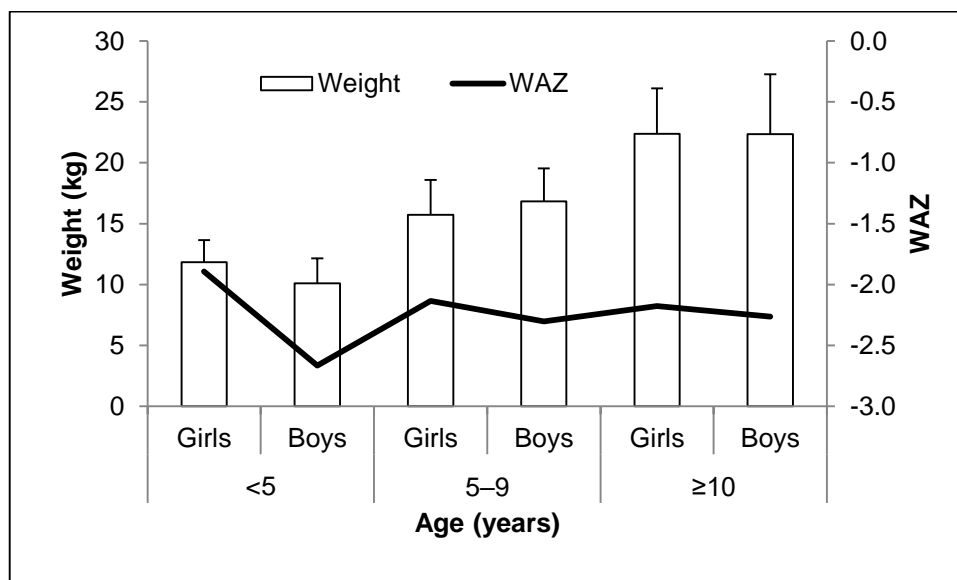


Figure 3. Impact of age on the weight and WAZ of the children.

DISCUSSION

Thalassemia is the most common genetic disorder on a worldwide basis. Blood transfusion therapy and iron chelation are the cornerstone in management of thalassemia. In the Blood Bank four types of blood components mainly pRBC, FFP, WB and RDP with packet sizes of 250 ml, 180-220 ml, 320-360 ml and 50 ml respectively were generally available. Indications to commence and recommendations to guide regular transfusions are unambiguous for

patients with β -thalassemia major and are clearly laid down in the management guidelines of the Thalassemia International Federation⁷. These guidelines recommend regular transfusions every 2 to 5 weeks to maintain pretransfusion hemoglobin levels between 9.0 and 10.5 g/dl in patients with transfusion-dependent β -thalassemia. The goals of transfusion therapy are correction of anemia, suppression of erythropoiesis and inhibition of gastrointestinal iron absorption, which occurs in non-transfused



patients as a consequence of increased, although ineffective, erythropoiesis. The decision to start transfusion in patients with confirmed diagnosis of thalassemia should be based on the presence of severe anemia (Hb < 7 g/dl for more than two weeks, excluding other contributory causes such as infections). However, also in patients with Hb > 7 g/dl, other factors should be considered, including facial changes, poor growth, evidence of bony expansion and increasing splenomegaly. When possible, the decision to start regular transfusions should not be delayed until after the second third year, due to the risk of developing multiple red cell antibodies and subsequent difficulty in finding suitable blood donors. Several different transfusional regimens have been proposed over the years, but the most widely accepted aims at a pre-transfusional Hb level of 9 to 10 g/dl and a post-transfusion level of 13 to 14 g/dl. This prevents growth impairment, organ damage and bone deformities, allowing normal activity and quality of life⁸⁻⁹. The frequency of transfusion is usually every two to four weeks. Shorter intervals might further reduce the overall blood requirement, but are incompatible with an acceptable quality of life. The amount of blood to be transfused depends on several factors including weight of the patient, target increase in Hb level and hematocrit of blood unit. Appropriate graphs and formulae to calculate the amount of blood to be transfused are available⁸. In general, the amount of transfused RBC should not exceed 15 to 20 ml/kg/day, infused at a maximum rate of 5 ml/kg/hour, to avoid a fast increase in blood volume. So, the blood component at 10-20 ml/kg was utilized. The remaining amount of each pack of the blood component is discarded. The Blood Bank in the Institute does not have any provision either to supply a small size pack or to prepare a satellite pack of different blood component for Thalassaemic children. Hospital blood bank should maintain adequate supply of blood to meet the demands from patients. Each and every drop of blood is precious. Wastage of blood is highly undesirable. In the present study, it is shown that increasing the age of the thalassaemic patients the wastages of pRBC decreasing pattern. Similar

finding shows in the study of Casaleet al¹⁰. Annual transfusion requirements of patients in our cohort were greater than the values reported by other centers; recently, Casale et al reported that the average blood consumption by regularly transfused patients with β -thalassaemia as 188 ml/kg/year¹¹. Therefore, requirement of blood transfusions is increasing. So, most of the blood banks face shortage of blood components at a given point of time. Shortage and wastage of the blood are both crucial in the proper functioning of a blood bank. The cause behind the sexual dimorphism is that the body weight of the thalassaemic boys (10.10±2.05 kg) were significantly lower (P<0.001) than the girls (11.84±1.81 kg) that causes more amount of wastage of blood from the standard packet. The low weight among the boys were reflected in the mean WAZ, that is presented in Figure 3. This study also documented that boys were more prone to become underweight (69.23%) in comparison to thalassaemic girls (45.45%). Wastage of blood components in the Pediatrics unit and related issues are not well researched in the Indian/Asian context¹².

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CONCLUSION

The mean wastage of blood loss following transfusion was significantly high among pediatric thalassaemic patients. As patients weight increases wastage of blood component decreases. So, preparation of small pack as Pedi-pack. Therefore, saving of rare blood groups pRBC by preparing small Pedi-pack (125ml) is more rewarding because patients of rare blood groups have a fixed monthly need of pRBC. There is a need to develop sufficient facilities to keep the unused blood components in Pediatrics unit as well as in blood bank. Aliquots of that unit can be utilized for further transfusions until it is depleted or expires.

Conflict of interest

There are no conflicts to declare.

Informed consent

This was a retrospective study so Institutional review board granted a waiver of consent.

Source of funding

Self-financed.



ACKNOWLEDGEMENT

We sincerely thank to Prof. Panchanan Kundu, Principal, Midnapore Medical College, Midnapore, W.B., for constant encouragement throughout the study and Sick Neonatal Care Unit, MMC, for providing data. We also grateful to Mrs. Ancey Joseph, Statistician TDMC, and Dr. Jazeela Mohamed Siddique, PGT, Com. Medicine, TDMC, Alappuzha, Kerala, India.

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