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Transfusion of Blood Products in Children Receiving Chemotherapy for Childhood Cancers in a Nigerian Tertiary Healthcare Centre

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Transfusion of blood remains an integral component in the supportive care of children with cancers. It is generally safe, and should be used liberally when necessary and available. In resource-poor settings however, the availability and use of blood and its products is generally limited. This study is aimed at reviewing the use of the various blood components amongst children receiving care in a paediatric cancer unit of a tertiary hospital, in Southern Nigeria.
Methods: A retrospective study on blood and blood product usage, in hospitalized paediatric cancer patients younger than 18 years old, over a two-year period, spanning from January 2022 to December 2023. Data were retrieved, entered into an excel sheet and analyzed. Results are presented using tables and figures.

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Results: Of the 32 children treated for various cancers, 29 (90.63%), received at least one unit of blood transfusion before, during or in-between cycles of treatment. Nephroblastoma was the most frequent cancer treated. Patients less than 5 years of age were the most transfused group. Fresh whole blood was the most transfused component. Leucopenia, was the commonest indication for transfusion in these patients.
Conclusion: Most of the children admitted for cancers received blood transfusion at least once before, or in-between cycles of chemotherapy and/or surgery. The most common indications for transfusion of blood in order of decreasing frequency were leucopenia, anaemia and thromocytopenia respectively.

Keywords: Children; cancers; blood; transfusion.

1. INTRODUCTION

Childhood cancers and other noncommunicable diseases are increasingly important causes of morbidity and death worldwide, especially in Low and Middle-Income Countries (LMIC) [1]. Improvement in childhood cancer outcomes especially in these countries such as Nigeria require proper functioning health systems capable of early diagnosis and effective treatment of affected children [1,2]. Transfusion of blood and its products remains an essential component in the supportive care of children with cancers. It is generally safe, and should be used liberally when necessary and available [3-6]. Many reports from low-income countries have established that appropriate blood and blood products remain insufficient and limited in healthcare facilities of many sub-Saharan African settings and is unavailable for use when needed most [3-7].

This study is aimed at reviewing the transfusion usage of the various blood components for childhood cancer patients in the Paediatric Oncology unit of a tertiary hospital, in Southern Nigeria.

2. METHODS

A descriptive retrospective study reviewing the medical records of children less than 18 years of age, with cancers who received one or more units of blood or a blood product in the course of treatment for various cancers in the paediatric medical ward over a two-year period from January 2022 to December 2023 at the University of Uyo Teaching Hospital, Uyo, Akwa Ibom State, Southern Nigeria.

Information on the age, gender, cancer type diagnosis, as well as the blood component transfused were retrieved for each patient. The transfused blood in these children were obtained from related donors and few from non-related donors, but all were processed at the hospital's blood bank. Each unit of blood or blood product was screened for HIV, Syphilis, Hepatitis B and C. The haematological laboratory data reviewed was the complete blood count.

The decision to transfuse each child was based on the level of the various blood count parameters in addition to the clinical status of the patient and primary disease being managed. Transfusion episodes were considered as all blood transfusions a child received within one chemotherapy cycle period. Data retrieved was inputed to an excel sheet, and analyzed with the Microsoft Excel package. Variables were expressed in percentages, tables and figures. Descriptive statistics was also used.

3. RESULTS

The total number of paediatric medical admissions in the study period, was 1031, and of these, 32 (3.1%) were children managed by the Paediatric Oncology unit for various cancers. The ages of these children ranged between 9 months to 16 years, with a median of 8 years. The Male:Female ratio was 0.8:1. Children older than five years, constituted more than two-thirds (71.9%) of the paediatric cancer admissions (Table 1).

Table 2 shows the range of various cancers confirmed on admission. The most frequently encountered cancer was nephroblastoma (10), which constituted 31.25% of the total paediatric cancer admissions. The transfusion history of the 32 children diagnosed with various cancers were evaluated. This showed that 29 (90.63%) of the 32 children needed a blood transfusion at one time or the other between treatment cycles with chemotherapy and/or surgery. They each received a minimum of one blood transfusion in

the course of their admission at various cycles of drug treatment, with a maximum of five transfusions within a treatment cycle, the latter especially seen in children managed for acute lymphoblastic leukaemia.

Fresh whole blood was the most frequently transfused blood component (Fig. 1). The commonest indication for its usage was leucopenia, coupled with evidence of infection. Total leucocyte counts before transfusion ranged from 0.8 x 10^9/L to 85.7 x 10^9/L. Neutropenia varied from severe to mild, with absolute neutrophil counts ranging between 140/mm^3 and 3300/mm^3. Children five years of age and younger, were the most transfused group.

Fig. 1 also shows that red cell transfusion, given as sedimented cells was the second most transfused blood component, while platelets and fresh frozen plasma were the least used components. The latter two blood products, together with granulocyte-colony stimulating factor were needed for use in the two children who were managed for acute lymphoblastic leukaemia. The haematocrit range before transfusion ranged between 11% - 35%, with a median of 21%. Platelet values ranged between 9 x 10^9/L and 744 x 10^9/L, with the most severe thrombocytopenia seen in children diagnosed with acute lymphoblastic leukaemia.

Table 1. Age distribution of children with cancers

Age of children (Years)	N (%)
< 1	1 (3.13)
1 - < 5	8 (25.00)
5 - < 10	10 (31.25)
10 - < 15	7 (21.87)
≥ 15	6 (18.75)
Total	**32 (100)**

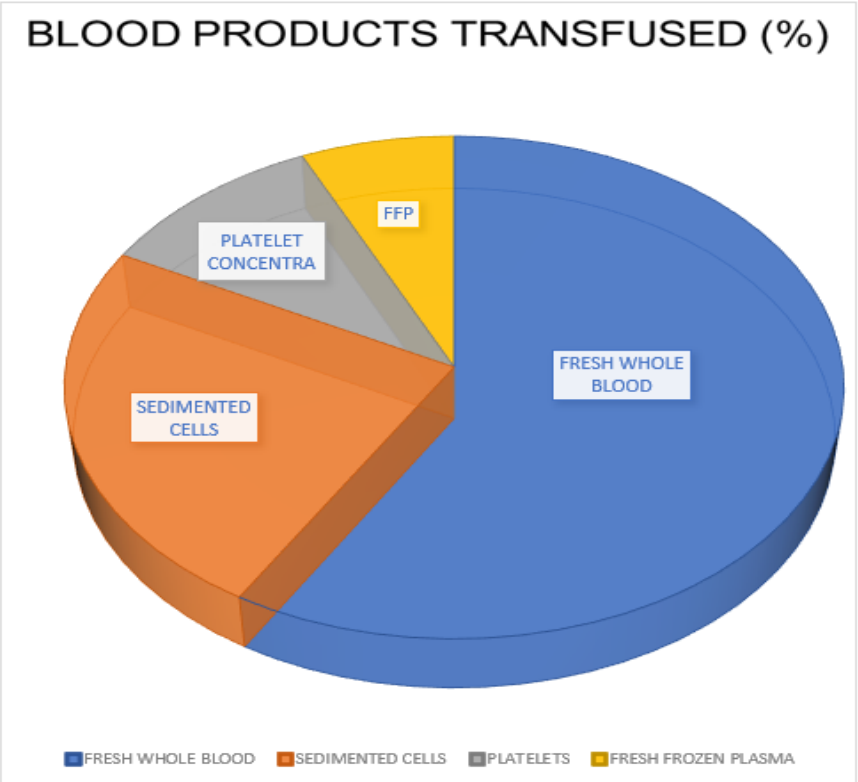

Fig. 1. Distribution of various blood components transfused

1. *Fresh Whole Blood: 17 (58.6)%*
2. *Sedimented cells: 7 (24.1%)*
3. *Platelet concentrate: 3 (10.4%)*
4. *Fresh frozen plasma (FFP): 2(6.9%)*

Table 2. Frequency distribution of the various childhood cancers seen

Type of Cancer	N (%)
Nephroblastoma	10 (31.3)
Rhabdomyosarcoma	6 (18.8)
Non-Hodgkin's Lymphoma	2 (6.3)
Acute Lymphoblastic Leukaemia	2 (6.3)
Ovarian Tumour	2 (6.3)
Neuroblastoma	1 (3.1)
Retinoblastoma	1 (3.1)
Brain Tumour	1 (3.1)
Hodgkin's Lymphoma	1 (3.1)
Osteosarcoma	1 (3.1)
Ewing's Sarcoma	1 (3.1)
Synovial Sarcoma	1 (3.1)
Colon Carcinoma	1 (3.1)
Nasopharyngeal carcinoma	1 (3.1)
Pancreatoblastoma	1 (3.1)
Total	**32 (100.0)**

4. DISCUSSION

Paediatric cancer is an emerging health concern for the global community. Blood transfusions are crucial for children with cancers for several reasons, as their treatment often leads to significant changes in their blood counts. Transfusion of blood components remains a life-saving supportive practice in the care of these children with haematologic and oncologic diseases. Some studies have documented, that paediatric oncology patients account for approximately 25% or greater of all inpatient paediatric transfusions in clinical practice, while others indicate a lower percentage [8-10]. Disease outcomes and long term survival in paediatric patients with cancers have improved significantly over the years due to advent of increasingly effective myelosuppressive chemotherapy regimens. Furthermore, the availability and effective usage of blood and its products have played a pivotal role in the delivery of supportive care that facilitates successful use and administration of these myelosuppressive regimens. Unfortunately, many centers in Nigeria and other sub-Saharan countries, still grapple with the challenge of unavailability of blood and blood components [3,7,11].

In this present study, children above five years of age, constituted more than two-thirds of the paediatric cancer admissions. This is in contrast with erstwhile studies from same study center, that reported younger-aged children as presenting more with childhood cancers [12,13]. It is also in contrast with other studies across many Nigerian centers that reported younger children under 5 years [11,14-17]. This present finding, could be attributed to the observation, that apart from nephroblastoma which had the highest presenting frequency, a wide distribution of childhood cancers in this study center within the stated period were those commoner in older children and adolescents like carcinomas, germ cell tumours and sarcomas. Other authors' reports seem to reflect more of the embryonal tumour types which commonly present earlier in life [11,14-16].

Nephroblastoma as aforementioned, was the most frequent childhood cancer managed in the study period, and has remained the top-ranking cancer admission documented in the present study center for the past eight years [12,13]. Various studies on childhood cancers from different regions and centers in Nigeria and other countries have interestingly, observed differing trends of predominant childhood cancers seen [11-16]. There was no significant gender predilection in present study, which varies with documentation from northern Nigeria15 and other regions that noted a male preponderance of the childhood cancers [11,16].

A high frequency of children with cancers in this study received blood transfusion at least once or more, during their course of treatment. Studies from various countries within and outside Africa, have also noted that the transfusion of a blood component is almost always necessary in the course of management of childhood cancers [5,8,9,11,18-22] Children with cancer usually require blood or blood product support

throughout their course of treatment. This may be due to the adverse effects of chemotherapy or radiotherapy on the blood cell lines, or as a result of surgery, and often as a consequence of the disease process itself [5].

Of the available blood products, fresh whole blood was the most frequently used component in the course of treatment. The commonest indication for its usage was leucopenia, coupled with evidence of infection. A report from Enugu, [9] South-East Nigeria, also noted that children with malignancies and sepsis (infection) had the topmost indications for transfusion of blood, and mostly fresh whole blood used. Other researchers documented other blood products, like red cell concentrate or sedimented cells as more frequently used [6-8]. In many sub-Saharan African (sSA) countries, whole blood is said to be more commonly available from blood transfusion services than red cell concentrates[6]. This is still applauding however, the significant progress many countries have made in the implementation of component preparation, despite unique issues faced. Such challenges as quality assurance, low donation, high demand, cost-limitations to component preparation and leucocyte-reduction [3,5-8,11,22].

Transfusion of blood and its products tend to be safe, but a child with cancer is immune suppressed with a consequent increased risk for transfusion reactions.4 These reactions such as fever, pruritus, erythema, shortness of breath, rigors among others, vary from mild to life-threatening and could be immediate or delayed [4]. The standard recommendation of blood use to patients with cancer is a modification of the component of packed red cells or platelet concentrate of which the leukocyte component has been reduced and irradiated [4,20]. Cellular blood components including viable lymphocytes also need to be irradiated in children with cancer. The gamma irradiation prevents T-lymphocytes from proliferating and reduces the risk of transfusion-associated graft-versus-host disease (TA-GVHD) [5]. This is unavailable presently in the study center and many centers across Nigeria [11,20].

The second most frequently used blood product in these children, was the red cell concentrate (transfused as sedimented cells). It was used in children with haematocrit less than 30%, also considering their clinical status and primary disease, to build up their haemoglobin concentration before commencement of treatment, either chemotherapy or surgery. This is a standard operating procedure maintained in the paediatric haematology unit of the study center. Anaemia frequently occurs in children with cancers, due to the suppression or dysfunction of erythropoiesis secondary to the underlying disease, as well as a consequence of bleeding which can also occur in these children [5]. National audits of paediatric red blood cell transfusions in the United Kingdom reported that more than half of paediatric transfusions were given to haematology/oncology patients [5].

Platelet concentrate was also available, though sparingly in present study. The difficulties in getting multiple donors for the pooling of platelets constituted a barrier to easy availability. The use of fresh whole blood was sometimes used as a substitute, for the prescription of platelets where availability of platelets would constitute a delay in treatment- prophylactic or therapeutic. This reaffirms the importance and need for greater advocacy/implementation of blood component availability for use in many resource-poor settings [5-8]. The unavailability of cold centrifuges in many Nigerian centers caring for children with cancers, also constitutes a barrier to availability of platelets [11]. It is however, available in this study center. In other studies, children with malignancies were top ranked in the need and use of platelet concentrates, and they were transfused mostly as prophylaxis or sometimes therapeutically to increase low platelet counts and decrease the risk of bleeding [6,20,21].

Thrombocytopenia occurs frequently in many children diagnosed with various cancers, at one time or the other in the course of their illness. It could result from bone marrow infiltration by the tumour cells, or could be chemotherapy induced or associated with other morbidities such as sepsis or disseminated intravascular coagulopathy [5]. Dosing recommendation is 10 to 15 mL/kg of ideal body weight. Leucoreduction and irradiation are also recommended for platelet transfusions in paediatric cancer patients [5,20]. This is unavailable presently in study centre.

Fresh Frozen Plasma (FFP) is transfused to correct multiple coagulation factor deficiencies in patients with active bleeding (therapeutic transfusions) or to prevent bleeding before invasive procedures (prophylactic transfusions). Dosing recommendation is 10 to 20 mL/kg [5,20]. Patients with cancer may be at risk for abnormalities of haemostasis due to the tumor

pathology, evolution of the disease as well as treatment effects [20,21]. In present study, it was used in children with severe myelosuppression, overwhelming infection and bleeding from multiple sites. While FFP transfusion has its benefits, it also has some risks that should be weighed against its perceived benefit [5]. Its usage in the few children as indicated, gave satisfactory transfusion outcome.

5. CONCLUSION

Transfusion of at least one component of blood or more, was seen to be necessary for almost every child admitted for the treatment of childhood cancers. Fresh whole blood was the most used component in this study center. This makes it imperative that blood and its products should always be available, safe and accessible in every center caring for children with cancers, to optimize their care, outcome of treatment and survival. We recommend increased advocacy for voluntary non-renumeration blood donations from the local communities, strengthening of health systems by policy makers with improved resource allocation, to support availability and safe use of all blood products.

6. LIMITATIONS OF THE STUDY

The study being retrospective in nature, had the challenge of incomplete data records from few children who were managed within the study period. Also, adverse reactions from transfusion of blood/blood products was not explored.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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