Research Article

Rate of Acute Complications of Blood and Blood Products Transfusion among Children at Jafar Ibn Ouf Hospital, Khartoum, Sudan,2022

Nasr Eldin Fadl Alla Abodeak[1], Yousif Mohammed Alhaj[1], Ghanem Mohammed Mahjaf[2], Mosab Nouraldein Mohammed Hamad[3]*

[1] Associate professor, Faculty of Medicine, Karary University, Sudan

[2] Sudan Medical Specialization Board, pediatrics and Child Health Council

[3] Department of Medical Microbiology, Faculty of Medical Laboratory Sciences, Shendi University, Sudan.

[4] Head of Parasitology and Medical Entomology, Faculty of Health Sciences, Elsheikh Abdallah Elbadri University, Sudan.

Corresponding author:

Mosab Nouraldein Mohammed Hamad

Head of Parasitology Department, Faculty of Health Sciences, Elsheikh Abdallah Elbadri University, Sudan.

Corresponding Email: musab.noor13@gmail.com

Abstract:

Background: Blood transfusion is the process of transferring blood or blood products into one`s circulation intravenously. transfusions are used for various medical conditions to replace lost components of the blood. early transfusions used whole blood, but modern medical practice commonly uses only components of the blood, such as red blood cells, white blood cells, plasma, clotting factors, and platelets. *Objectives*: To assess the Rate of Acute Complications of Blood and Blood products Transfusion among Children at Jaffar Ibn Ouf Hospital, Khartoum, Sudan,2021. *Methodology*: It was a cross-sectional, Observational, descriptive hospital-based study. Data were collected using a checklist including brief clinical history and examination and laboratory investigation, type of blood transfusion, and short-term complications. Data were cleaned and entered into a Microsoft Excel data sheet and were analyzed using SPSS latest version software. *Result*: A total of 130 pediatric patients participated in this study their ages ranged from 1-17 years, most of them; 56 (43.1%) were aged less than 5 years. Of most patients, 89 (68.5%) had blood transfusions based on both clinical conditions and lab results, and 24 (18.5%) patients had blood transfusions based on their clinical conditions. In most patients, 124 (95.4%) had a complete transfusion. Only 15 (11.5%) patients developed blood reactions among them 8 (53.3%) patients developed febrile non-hemolytic transfusion reaction, 6 (40%) patients developed an allergic reaction, and 1 (6.7%) patient developed transfusion-related acute lung injury. According to patients' outcomes; most of them 123 (94.6%) were discharged, and 2 (1.5%) cases of death. *Conclusion*: The main limitation of this study was that it was conducted in only one hospital, and the results may differ in other hospitals. Although our hospital serves a large geographical catchment area with numerous referrals, we do not know if current data accurately reflect the overall transfusion pattern in other similar health facilities or the country as a whole due to a lack of local comparable data. A multicenter survey is advised because it can provide more data and more solid conclusions.

Keywords: Complications, Blood Transfusion, Products, Acute, Children, Khartoum, Sudan

Background:

Blood is a vital human tissue and a precious health resource, required to be adequately available, safe, correctly and rationally used, and timely administered [1]. Blood transfusion is an essential component of modern healthcare systems and when used appropriately, it saves lives, improves health conditions, and enhances patient outcomes. However, improper or unnecessary use can increase the risk of serious, acute, and delayed adverse complications, and in underprivileged settings, it places further strain on already limited health resources [2,3].

In recognition of its critical role in patient management over a wide variety of medical conditions, blood and blood products are currently incorporated into the World Health Organization (WHO) model list of essential medicines [4].

Access to safe and adequate blood supply remains a public health challenge in many countries, particularly in low-resource settings (poor economics). In high-income countries, the average donation rate is 32.1/1000 population in comparison to 4.6/1000 population in low-income countries, where about 80% of the world's population lives and has access to only 20% of the world's safe blood supply [5,6]. A significant disparity also exists on regional levels, the Eastern Mediterranean and African Region are reported to have the lowest supply of blood, with an annual donation rate of 0.7/1000 population [7].

This variation indicates a serious inequality and is far below the proposed WHO estimates of 10 to 20 whole blood donations per 1000 population. However, a recent estimate suggested that the WHO target is even inadequate to fulfill blood requirements in the vast majority of low-income countries and the donation rates need to be increased several-fold [8].

In Africa which is consisting of heterogeneous countries with different levels of development, the demand for blood transfusion is on the rise as a result of increased accessibility to more advanced medical and surgical procedures, expansion of the aging population, and in children, there is a high prevalence of transfusion-dependent β-thalassemia and sickle cell disease [9].

Besides the efforts for strengthening the infrastructure and testing for transfusion transmissible infections, regular documented clinical review plays a vital role in monitoring and evaluation of clinical transfusion practices, optimization of blood use, and consistent adherence to guidelines and standard operating procedures [10].

Children are the main users of blood, and in resource-limited settings, they account for a high proportion of blood usage (16–67%), compared to about 5% reported in developed countries [11,12]. Moreover, pediatric transfusion has unique aspects and is different from adults about transfusion decisions, indications, doses, and frequency

of adverse reactions, and this should be taken into consideration when evaluating clinical blood transfusion in this age group **[13,14].**

Data on usage and pattern of blood transfusion is critical to promote rational use and this might help to conserve this scarce resource, especially in low-income settings where the gap between need and demand exists and blood requirement is highly unmet **[15].**

Materials and methods:

Study design:

It was a cross-sectional, Observational, descriptive hospital-based study.

Study population:

All Children aged from 1 day to 18 years were admitted to Jafar Ibn Ouf Hospital and received a blood transfusion during the study period.

Study area:

The study was conducted in the Jafar Ibn Ouf hospital. pediatric tertiary teaching hospital located in Khartoum, the capital of Sudan -was established in 1977. It is the biggest referral hospital for children in Sudan, it is a 200-bed capacity and receives patients for tertiary level care from all hospitals and health centers of different states of the country and nearby countries in the region. It is a tertiary hospital offering different medical specialties and services, recognized by the Sudan Board for Medical Specialization and Federal Ministry of Health for the training of registrars the pediatric subspecialty

includes; Neonatology, Neurology, Nephrology, Respiratory Hematology, gastroenterology, HDU, PICU department. in addition to the nutritional rehabilitation unit, vaccination unit, records, statistic unit, radiology department, histopathology department, and a well-equipped lab.

Study duration:

The period study was conducted from September 2021 to Jan 2022 covering the patient's data from September 2020 to September 2021.

Sampling techniques:

As this is a cross-sectional study, the formula for sample size calculation:

N = z2pq/e2. Where N = required sample size, z = the confidence level, taken as 1.98, p = anticipated percentage (frequency of occurrence of an event), taken as 0.92, q (frequency of non-occurrence of an event) = 1-p = 0.08, and e = absolute precision required, taken as 0.05; $(1.98)2(0.92)(0.08)/ (0.05)2$ = 123.0967 The formula yields a sample size of 123 cases. A simple stratified technique was applied to select a representative study sample, secondary data will be used. The sample was proportional to the size of the patients distributed in the hospital.

Sample procedure:

In the first stage - selected cases have an equal chance of being selected. In the second stage - take permission from parents or caregivers to collect data by using a questionnaire, the data will collect by the principal investigators and training nurse,

and the permission will be through a phone call if the patient was discharged. In the third stage (final) data was obtained from the records including the laboratory results and the practice of the staff.

Study tools:

By interviewer-administered questionnaire: A specially designed questionnaire was prepared for this purpose and was filled by the principal investigator and trained registrars of the pediatrics specialty. Investigation records were seen by the researcher after the permission of the parents/guardians of the child.

Data collection tools:

Data were collected using a checklist including brief clinical history and examination and laboratory investigation, type of blood transfusion, and short-term complications.

Study variables:

Independent variable's age, gender, residence, Family history, chronic disease, and anthropometric measurement, Dependent variables' symptom, examination, investigation, transfusion type, and short-term complications.

Data analysis:

Data were cleaned and entered into a Microsoft Excel data sheet and were analyzed using SPSS latest version software. Categorical data will be represented in the form of frequencies and proportions. Chi-square was used as a test of significance for qualitative data. continuous data were represented as mean and standard deviation. Graphical representation of data: MS Excel and MS word was used to obtain various types of graphs such as bar diagram. *P. value* (Probability that the result is true) of <0.05 was considered statistically significant after assuming all the rules of statistical tests and level of confidence. Data were represented after analysis in form of uni-variable tables, cross tabulation (bi-variable tables), figures, and narrative illustration.

Ethical considerations:

Approval from Khartoum state ministry of the health research department, and hospitals. The research purpose and objectives will be explained to participants in clear simple words. Participant has the right to voluntary informed consent. Participant has the right to withdraw at any time without any deprivation. Participant has the right to no harm (privacy and confidentiality by using a coded questionnaire). Participant has the right to benefit from the researcher's knowledge and skills. The questionnaire was filled out by the researcher during the study period. Precautions from COVID 19 by wearing a face mask (both researchers, the participants, their caregiver, and the medical counselor). washing hands and using disposable gloves for each participant was taken.

Results:

It was a cross-sectional, observational, descriptive hospital-based study conducted at Jafar Ibn Ouf Hospital 2021. A total of

130 pediatric patients participated in this study their ages ranged from 1-17 years, most of them; 56 (43.1%) were aged less than 5 years, 41 (31.5%) were aged from 5-10 years, and 33 (25.4%) were aged from 11-17 years. The majority of the studied patients 85 (65.4%) were males, and 45 (34.6%) were females. About 55 (42.3%) patients were diagnosed with sickle cell anemia, 21 (16.2%) patients were diagnosed with aplastic anemia, 14 (10.8%) patients were diagnosed with thalassemia, and 11 (8.5%) patients were diagnosed with anemia for investigation **(Table 1).** According to indications; 54 (41.5%) cases of anemia heart failure, 21 (16.2%) cases of routine transfusion, 18 (13.8%) cases of exchange transfusion, and 11 (8.5%) cases of top-up transfusion **(Table 2).** The majority of the patients 86 (66.2%) had a blood group O+ve, 19 (14.6%) had a blood group A+ve, and 13 (10%) had a blood group B+ve **(Table 3).** In most patients, 89 (68.5%) had blood transfusion based on both clinical condition and lab results, 24 (18.5%) patients had blood transfusion based on clinical condition, and 7 (5.4%) patients had blood transfusion based on lab results. Furthermore, 78 (60%) patients had PRBC transfusion the mean volume was

242±140 ml, 21 (16.2%) patients had a whole blood transfusion the mean volume was 271±133 ml, 15 (11.5%) patients had exchange transfusion the mean volume was 298±136 ml, and 6 (4.6%) patients had platelet transfusion the mean volume was307±55 ml **(Table4).** In most patients, 124 (95.4%) had a complete transfusion. The average duration of blood transfusion in hours was 3.35±1.133 hours **(Table5).** While the time spent from admission to transfusion in hours was 2.24±3.299 hours **(Table 6).** However, 121 (93.1%) patients had clear instructions. Only 15 (11.5%) patients developed blood reactions, among them 8 (53.3%) patients developed febrile non-hemolytic transfusion reaction, 6 (40%) patients developed an allergic reaction, and 1 (6.7%) patient developed transfusion-related acute lung injury **(Table7).** According to patients' outcomes; most of them 123 (94.6%) were discharged, and 2 (1.5%) cases of death. There was a significant association between patients' outcome and type of blood reaction P-value < 0.05, however, there was no significant association between an allergic reaction and patients' outcome *P. value = 0.84* **(Table 8).**

Table-1: The diagnosis among the studied patients (N=130) at Jafar Ibn Ouf Hospital 2021.

Diagnosis	Frequency	Percent %
Sickle cell anemia	55	(42.3%)
Thalassemia	14	(10.8%)
Aplastic anemia	21	(16.2%)
Anemia for investigation	11	(8.5%)
Others	82	(66.9%)

Table-2: The indications among the studied patients (N=130).

Indications	Frequency (*Percent*)
Anemia heart failure	54 (41.5%)
Routine transfusion	21 (16.2%)
Top up transfusion	11 (8.5%)
Exchange transfusion	18 (13.8%)
Others	33 (25.4%)

Table-3: The distribution of the studied patients according to their blood group (N=130).

Blood group	Rhesus type	Frequency (*Percent*)
A	-ve	1 (0.8)
A	+ve	19 (14.6%)
B	-ve	2 (1.5%)
B	+ve	13 (10%)
O	-ve	5 (3.8%)
O	+ve	86 (66.2%)
AB	-ve	0 (0%)
AB	+ve	4 (3.1%)

Table-4: The type & volume in (ml) of blood transfusion performed among the studied patients (N=130).

Type of transfusion	Frequency(*Percent*)	Mean volume ±SD	Minimum	Maximum
Exchange transfusion	15 (11.5%)	298±136	80	571
Factor IX	2 (1.5%)	200±0	200	200
FFP	4 (3.1%)	285±186	60	510
FFP+PLt transfusion	4 (3.1%)	221±164	75	400
Platelet transfusion	6 (4.6%)	307±55	200	360
PRBC transfusion	78 (60%)	242±140	40	600
Whole Blood transfusion	21 (16.2%)	271±133	50	504
Total	**130 (100%)**	**256±136**	**40**	**600**

Table-5: The duration of blood transfusion in hours among the studied patients (N=130).

Duration of blood transfusion in hours					
Type of transfusion	Mean	N	Std. Deviation	Minimum	Maximum
Exchange transfusion	2.73	15	.704	1	4
Factor IX	2.50	2	2.121	1	4
FFP	1.75	4	1.500	1	4
FFP + platelet Transfusion	2.25	4	.500	2	3
Platelet transfusion	2.67	6	1.211	1	4
PRBC Transfusion	3.65	78	1.067	1	8
whole blood transfusion	3.48	21	.981	1	4
Total	**3.35**	**130**	**1.133**	**1**	**8**

Table-6: The time spent from admission to transfusion in hours among the studied patients (N=130).

Time spent from admission to transfusion in hours					
Type of transfusion	**Mean**	**N**	**Std. Deviation**	**Minimum**	**Maximum**
Exchange transfusion	1.40	15	.828	1	4
Factor IX	2.00	2	1.414	1	3
FFP	1.00	4	.000	1	1
FFP + platelet Transfusion	2.25	4	1.258	1	4
Platelet transfusion	3.50	6	5.648	1	15
PRBC Transfusion	2.47	78	3.799	1	24
whole blood transfusion	1.86	21	2.032	1	10
Total	2.24	130	3.299	1	24

Table-7: The type of blood reaction among the studied patients (N=15).

Type of reaction	**Frequency (Percent)**
Allergic reaction	6 (40%)
Transfusion-related acute lung injury	1 (6.7%)
Febrile non-hemolytic transfusion reaction	8 (53.3%)
Total	**15 (100%)**

Table-8: The association between patients' outcome and type of blood reaction among the studied patients (N=130).

Type of reaction		**Patients' outcome**			**Total**	*P-value*
		Discharged	**Death**	**Others**		
Allergic reaction	Yes	6	0	0	6	0.84
	No	117	2	5	124	
Transfusion-relatedacute lung injury	Yes	0	1	0	1	0.001
	No	123	1	5	129	
Febrile non-hemolytic transfusion reaction	Yes	7	1	0	8	0.03
	No	116	1	5	122	

Discussion:

A total of 130 pediatric patients participated in this study their ages ranged from 1-17 years, most of them; 56 (43.1%) were aged less than 5 years. The majority of the studied patients 85 (65.4%) were males, and 45 (34.6%) were females. Al-Saqladi et al conducted a similar study and reported that the average age of transfused children was 5.63±4.63 years and 63.4% were male. Children ≤5 years comprised 50% of recipients. Single transfusion was most common (56.7%), and the studies study showed a higher frequency of blood transfusion in male children (63.4%) than females (36.6%) [**16**]. which is similar to the 63.1 percent and 36.9 percent reported by Irish et from Ghana [**17**]. Gender differences are less noticeable in developed countries. In an English multicenter study, 57 percent of transfused children were males [**18**]. It is unclear why male children required more blood transfusions; this issue has not been thoroughly researched. However, in our sample, it could be due to the over-representation of men. According to indications; 54 (41.5%) cases of anemia heart failure, 21 (16.2%) cases of routine transfusion, 18 (13.8%) cases of exchange transfusion, and 11 (8.5%) cases of top-up transfusion. Al-Saqladi et al, reported major indications were hemoglobinopathies (43.6%), and oncologic diseases (25.3%) [**16**]. This finding is comparable to reports from Venezuela (86.4%) [**19**]. Repeated transfusions may increase the risk of alloimmunization, particularly in sickle cell disease and thalassemia patients, therefore extended blood group sub-typing is strongly recommended [**20**]. Most patients received blood transfusions based on both clinical condition and lab results, with 89 (68.5 %) receiving blood transfusions based on both clinical condition and lab results, 24 (18.5 %) receiving blood transfusions based on clinical condition, and 7 (5.4 %) receiving blood transfusions based on lab results.

Furthermore, 78 (60%) patients received PRBC transfusions with a mean volume of 242140 ml, 21 (16.2%) patients received whole blood transfusions with a mean volume of 271133 ml, 15 (11.5%) patients received exchange transfusions with a mean volume of 298136 ml, and 6 (4.6%) patients received platelet transfusions with a mean volume of 30755 ml. The majority of the patients 86 (66.2%) had a blood group O+ve, 19 (14.6%) had a blood group A+ve, and 13 (10%) had a blood group B+ve. Only 15 (11.5%) patients developed blood reactions, among them 8 (53.3%) patients developed febrile non-hemolytic transfusion reaction, 6 (40%) patients developed an allergic reaction, and 1 (6.7%) patient developed transfusion-related acute lung injury. In the study of Al-Saqladi et al, the prevalence of the ABO/Rhesus D blood groups in the study population were: O positive 55.4%, A positive 22.8%, A negative 7.4%, B positive 7.4%, O negative 4%, AB positive 2%, AB negative (1%). All blood group types were requested in this study except blood group B negative. In total, 88% were Rhesus D positive, and (12%) were Rhesus D negative. The most requested group was O positive (57.5%), followed by A positive (21.9%), and the least requested blood type was AB negative (0.6%). one-quarter of patients had profound anemia with pre-transfusion Hb levels less than 5 g/dL, while 64.7% between 5 and 10 g/dL, and 10.3% more than >10 g/dL. In hemoglobinopathies, malaria, visceral leishmaniasis, and impaired erythropoiesis, the mean pre-transfusion Hb values were generally low, while in malignancies and bleeding disorders the mean pre-transfusion Hb levels were decreased but not that much [**16**]. In most patients, 89 (68.5%) had blood transfusion based on both clinical condition and lab results, 24 (18.5%) patients had blood transfusion based on clinical condition, and 7 (5.4%) patients

had blood transfusion based on lab results. Furthermore, 78 (60%) patients had PRBC transfusion the mean volume was 242±140 ml, 21 (16.2%) patients had a whole blood transfusion the mean volume was 271±133 ml, 15 (11.5%) patients had exchange transfusion the mean volume was 298±136 ml, and 6 (4.6%) patients had platelet transfusion the mean volume was307±55 ml. Regarding the blood product involved in transfusion reactions, in Al-Saqladi et al, study RBCs were the most frequently reported product (66.7%); this might be attributed to the higher use of this component mainly for children with chronic hemolytic anemias. This result is comparable to 53.8% in the UK [20], and 82.8% in India **[21]**, but in contrast to a Brazilian study which found 50.9% of transfusion reactions in platelet transfusions **[22].**

Conclusion:

The results of this study revealed that most of the patients were aged less than 5 years. The majority of the studied patients were males. Most patients were diagnosed with sickle cell anemia. Most patients received blood transfusions based on both clinical conditions and lab results. Only 11.5% of patients developed blood reactions and most of these patients developed febrile non-hemolytic transfusion reactions.

Sources of Funding:

Conflict of Interest:

The author has declared that no competing interests exist.

References:

[1] Goodnough LT, Panigrahi AK. Blood transfusion therapy. Med Clin North Am. 2017;101(2):431–447. doi:10.1016/j.mcna.2016.09.012.

[2] Moncharmont P. Adverse transfusion reactions in transfused children. Transfus Clin Biol. 2019;26(4):329–335. doi:10.1016/j.tracli.2019.08. 002.

[3] Klein HG. Should blood be an essential medicine? N Engl J Med. 2013;368(3):199–201. doi:10.1056/NEJMp1213134.

[4] World Health Organization. World Health Organization Model List of Essential Medicines: 21st List 2019. Geneva: World Health Organization; 2019.

[5] World Health Organization. Global Status Report on Blood Safety and Availability 2016. Geneva: World Health Organization; 2017.

[6] Custer B, Zou S, Glynn SA, et al. Addressing gaps in international blood availability and transfusion safety in low- and middle-income countries: a NHLBI workshop. Transfusion. 2018;58(5):1307–1317. doi:10.1111/trf.14598

[7] World Health Organization. The Regional Status Report on Blood Safety and Availability, 2016. Cairo: EMRO; 2017.

[8] Roberts N, James S, Delaney M, Fitzmaurice C. The global need and availability of blood products: a modelling study. Lancet Haematol. 2019;6(12):e606–e615. doi:10.1016/S2352- 3026(19)30200-5.

[9] Haddad A, Benajiba M, Hmida S, et al. How to manage transfusion systems in developing countries: the experience of Eastern and Southern Mediterranean countries. Transfus Med. 2020;30(1):7–15. doi:10.1111/tme.12663.

[10] Roberts DJ, Field S, Delaney M, Bates I. Problems and approaches for blood transfusion in the developing countries. Hematol Oncol Clin North Am. 2016;30(2):477–495. doi:10.10 16/j.hoc.2015.11.011.

[11] Hassell OBI, Maitland K. Blood transfusion in resource-limited settings. In: Hunter's Tropical Medicine. 9th ed. London: Magill – Maguire – Ryan - Solomon; 2012:162–167.

[12] McCormick M, Delaney M. Transfusion support: considerations in pediatric populations. Semin Hematol. 2020;57:65–72. doi:10.1053/j.seminhematol.2020.07.003.

[13] Goel R, Cushing MM, Tobian AA. Pediatric patient blood management programs: not just transfusing little adults. Transfus Med Rev. 2016;30(4):235–241. doi:10.1016/j.tmrv.2016.07.004

[14] Rai PKS, Agrawal A. Unique aspects of red blood cell transfusion in pediatric patients. Int J Clinl Transfus Med. 2016;4:43–54.

[15] Burnouf T. Blood products: unmet needs for essential medicines. Lancet Haematol. 2019;6(12):e598–e599. doi:10.1016/S2352-3026 (19)30217-016.

[16] Al-Saqladi AW, Albanna TA. A Study of Blood Transfusion in Pediatric Patients at a Teaching Hospital, Aden, Yemen. International Journal of Clinical Transfusion Medicine. 2021;9:1.

[17] Orish VN, Ilechie A, Combey T, Onyeabor OS, Okorie C, Sanyaolu AO. Evaluation of blood transfusions in anemic children in effia Nkwanta Regional Hospital, Sekondi-Takoradi, Ghana. The American Journal of Tropical Medicine and Hygiene. 2016 Mar 2;94(3):691.

[18] Morley SL, Hudson CL, Llewelyn CA, Wells AW, Johnson AL, Williamson LM, EASTR Study Group. Transfusion in children: epidemiology and 10 year survival of transfusion recipients. Transfusion Medicine. 2016 Apr;26(2):111-7.

[19] Martí-Carvajal AJ, Muñoz-Navarro SR, Martí-Peña AJ, del Carmen Matheus-Fernández E, Medina-Laurentín MC. Appropriate Use of Blood Products in Pediatric Patients in a Venezuelan General University Hospital: cross-sectional study. Salus. 2005;9(1):20-30.

[20] Pedrosa AK, Pinto FJ, Lins LD, Deus GM. Blood transfusion reactions in children: associated factors. Jornal de pediatria. 2013 Aug;89(4):400-6.

[21] Ghataliya KJ, Kapadia JD, Desai MK, Mehariya KM, Rathod GH, Bhatnagar N, Gajjar MD. Transfusion-related adverse reactions in pediatric and surgical patients at a tertiary care teaching hospital in India. Asian Journal of Transfusion Science. 2017 Jul;11(2):180.

[22] Berg A, Courtney R, Krishnamurti L, Triulzi DJ, Yazer MH. Is intensive monitoring during the first transfusion in pediatric patients necessary?. Hematology. 2014 Jul 1;19(5):304-8.