Journal of Blood Medicine

Dovepress
open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Blood Transfusion Complications and Associated Factors Among Blood-Transfused Adult Patients at Debre Markos Comprehensive Specialized Hospital, Ethiopia: A Cross Sectional Study

Yalew Muche[1], Yemataw Gelaw[2], Aytenew Atnaf[1], Zegeye Getaneh[2]

[1]Department of Medical Laboratory Sciences, College of Medicine and Health Sciences, Debre Markos University, Debre Markos, Ethiopia; [2]Department of Hematology & Immunohematology, School of Biomedical and Laboratory Sciences, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia

Correspondence: Yalew Muche, Department of Medical Laboratory Sciences, College of Medicine and Health Sciences, Debre Markos University, PO. BOX 269, Debre Markos, Ethiopia, Tel +251927615910, Email enathager08@gmail.com

Background: Blood transfusion is the infusion of whole blood or its components into the veins of the patient to improve tissue oxygenation and maintain hemostasis. Besides its clinical use, it can pose a risk of transfusion complications with different factors.

Purpose: The aim of this study was to assess blood transfusion complications, and associated factors among transfused adult patients at Debre Markos Comprehensive Specialized Hospital, North West Ethiopia, 2022.

Materials and Methods: An institution-based cross-sectional study design was conducted on a total of 182 patients from March 20 to June 15, 2022. Patients were enrolled in the study using consecutive sampling method. The socio-demographic and clinical data were collected using a structured questionnaire and data extraction sheet, respectively. About 3 ml of anti-coagulated blood and 30 ml of urine samples were collected to assess transfusion complications. CBC and Coombs test were performed from blood and urinalysis from urine, respectively. Chi-square, Fisher's exact test, and binary logistic regression were done using SPSS version 25. P-values less than 0.05 are declared as statistically significant.

Results: An acute transfusion reaction (ATR) was encountered in 12 (6.6%) patients. It was 4.13, 7.78 and 3.96 times more likely to occur among patients with a previous history of transfusion, abortion, and transfused blood stored for more than 20 days compared to their counterparts, respectively. In addition, the odds of developing ATR increase by 2.07 as the number of transfused blood units increases by 1 unit.

Conclusion: The incidence of acute transfusion reactions was high. During transfusion, clinicians should closely monitor patients who had history of transfusion, abortion, transfused old blood and more than 1 unit.

Keywords: acute transfusion reactions, adults, transfusion outcome

Introduction

Blood transfusion is a common lifesaving therapy in modern medicine for a variety of diseases to improve tissue oxygenation and maintain hemostasis.[1,2] Blood transfusion can be whole blood, packed red blood cells (PRBCs), platelets (PLT), plasma, or plasma derivatives.[3]

Blood transfused patient may develop a transfusion reaction (TR), defined as unintended patient outcomes due to blood product transfusion.[4] The two types of transfusion reactions (TR) are acute transfusion reactions (ATR) and delayed transfusion reactions (DTR). Acute transfusion reactions occur during the transfusion and for up to 24 hr after the transfusion is stopped.[5,6] These include acute hemolytic transfusion reaction (AHTR), febrile non-hemolytic transfusion reaction (FNHTR), anaphylactic and simple allergic. Transfusion-related acute lung injury (TRALI), and transfusion associated circulatory overload (TACO) are other ATRs.[4] An ATR is assessed using clinical findings

Received: 10 March 2023
Accepted: 26 May 2023
Published: 8 June 2023

(physical examinations and vital signs), and laboratory investigation includes ABO and RhD group, re-cross match, complete blood count (CBC), direct anti-globulin test (DAT), and hemoglobinuria.[3]

In sub-Saharan Africa, whole blood is widely used for treatment and transfusions beyond their indications, and there is a lack of different pre-transfusion testing reagents that trigger TR.[4] Whole-blood transfusion is also widely used in Ethiopia,[7–11] with a component preparation rate of 16.5%.[12] Moreover, in high-income countries, the most frequently transfused patient group is over 65 years of age and accounts for up to 76% of all transfusions. In low- and middle-income countries, pregnancy-related complications, childhood malaria, and trauma-related injuries are common indications.[12–16]

The burden of ATR also varies in different countries. In Europe and other continents, the prevalence is between 0.23% and 3.6%.[1,4,17,18] The lowest prevalence is reported in the United States of America (USA) (0.23%), while the highest is found in Bangladesh (3.6%).[19,20] However, the prevalence of ATR ranges from 2.6% to 5.2%[8,21,22] in some African countries, whereas in Ethiopia it is not well studied.

Transfusion reaction prevalence is affected by different factors including sex and age,[19] pre-hematological abnormalities in CBC results,[23] clinical severity of disease, storage time of transfused blood, and history of transfusion. Furthermore, factors influencing blood transfusion outcome or complications include abortion history, vital signs, transfused blood component, and the number of transfused units.[8,24] To summarize, there was variation in blood component transfusion and ATR across the world. In Ethiopia, there is no hemovigilance system, and whole blood is the most commonly transfused blood.

Despite the fact that Ethiopia had a transfusion service for many years, there is still an unfilled gap in the evidence on major indications for blood transfusion complication and associated factors of patient outcomes information. As a result, the purpose of this study was to assess blood transfusion complications and associated factors of ATR in adult transfused patients at Debre Markos Comprehensive Specialized Hospital, Ethiopia (DMCSH) in North West Ethiopia.

Materials and Methods

Study Design, Setting and Period

An institutional-based cross-sectional study was conducted from March 20 to June 15, 2022. The study was conducted at DMCSH, Debre Markos, East Gojjam zone, Amhara regional state, Ethiopia. Debre Markos is located 299 km away from Addis Ababa, the capital city of Ethiopia, in the North West direction and 265 km away from Bahir Dar, the Amhara regional city. The city has a longitude of 37.734398, a latitude of 10.3296345, elevation of 2411m/7910feet. According to 2012 census the population of the city is 262,497.[25] The hospital gives services to an estimation of 5 million people from the catchment area and as a referral from other general and primary hospitals. The Hospital has one mini blood bank to distribute blood products to different wards. In this hospital, blood is transfused in surgical, Gynecological/Obstetrics, emergency, and inpatient (medical) wards. The hospital gets blood for transfusion from Debre Markos Blood Bank.[26] All blood transfused adult patients at DMCSH were the source population.

Population

Blood transfused adult patients who fulfilled the eligibility criteria at DMCSH during the study period were study populations. In this study, patients who took anesthetic drug were excluded from the study.

Sample Size and Sampling Technique

A total of 182 adult patients were enrolled in the study. All adult patients who received blood and met eligibility requirements were enrolled in the study by consecutive manner.

Data Collection Methods

Socio-Demographic and Clinical Data Collection

Socio-demographic data were collected from voluntary participants using a pretested, structured questionnaire. Clinical data were collected through interviews and patient card reviews and extracted onto a data extraction sheet. General

physical and clinical examinations such as body temperature, blood pressure, pulse rate, respiratory rate, and oxygen saturation percentage were measured as baseline data after resting for at least 5 min.

During the transfusion, vital signs were initially recorded at intervals of 15 min, 30 min, and 1 hr during the transfusion. They were then recorded again at 4 hr after the transfusion had ended. Patients were physically evaluated, and their vital signs were monitored at the same time to look for indicators of a TR. The following symptoms were recorded: headache, palpitations, mild dyspnea, urticaria, nausea, tachycardia, restlessness, vomiting, and dyspnea.

After the transfusion, the monitoring was kept up for 24 hr at 4-hr intervals. Data from the patient chart and/or the laboratory registration logbook were also used to record the blood donation date, the blood group of the transfused blood and the quantity of units transfused. Patients were suspected of having ATR, and laboratory tests were performed when one or more vital signs deviated from baseline values and when signs and symptoms were noticed.

Sample Collection and Laboratory Analysis

Sample Collection

Blood and urine samples were collected from each volunteer patient before and after transfusion. Those samples were used to investigate the post-transfusion outcome and ATR for suspected cases. Seventy percent alcohol was used to clean the skin and waited until it dried. About three milliliters (mL) of blood specimens were collected from each patient and added to tri-potassium ethylene di-amine tetraacetic acid (K3-EDTA) test tube. The collected blood sample was checked for proper labeling, hemolysis, and clotting pre-analytically. It was then properly mixed to prevent clotting, and it was used for CBC testing, ABO and Rh regrouping, rechecking-cross-matching, and DAT testing. About 30mL of urine was collected in a clean urine cup container for urine analysis (UA), which is typically used to determine hemoglobinuria levels.

Laboratory Analysis

For each laboratory test, standard operating procedures were strictly followed. Pre-transfusion CBC (Hb, RBC, WBC, and PLT), and UA results were used as a baseline. These data were obtained from either on a patient chart or requested for those who lack it on their chart. The baseline CBC was performed from a specimen collected for cross-match for those who did not have it on their chart and CBC was analyzed before performing cross-match. Pre- and post-transfusion samples were performed with a similar instrument to avoid instrumental variation. For patients suspected of ATR either clinically or using the screening of urine samples, firstly the labels of transfused blood units and the patient's identity were checked. Additionally, the pre-transfusion of patients' samples was regrouped for ABO and Rh blood types. Then, donor blood samples were rechecked for blood groups, cross-matched, on the other side, the recipient's post-transfusion blood sample was tested for CBC, blood grouping, and screened for in vivo sensitization of RBCs (DAT).

CBC analysis of the K_3-EDTA anti-coagulated blood was carried out automatically by a mindray BC-3000 plus (Mindray, China) three differential hematological analyzer machine at DMCSH. The tests were performed within 2 hr of sample collection. The remaining sample was kept for blood type regrouping, cross match rechecking, and DAT when TRs were suspected. Patient blood ABO, and Rh type were re-grouped using commercially prepared antisera (anti-A, anti-B and anti-D). The slide method was applied to determine ABO and Rh blood groups. If a transfusion reaction was suspected, patient plasma and donor red cells were mixed for compatibility test under saline and anti-globulin conditions. The DAT was performed for all study participants who were suspected of ATR. It was tested by mixing washed patient RBCs directly with the anti-globulin serum for the detection of in vivo sensitization of patient RBCs. Urine dipstick was performed for screening of transfusion reaction followed by microscopic examination to rule out hematuria.

Data Analysis and Interpretation

Data were entered, cleaned using Epidata version 3.1, and exported to statistical package for the social sciences (SPSS) version 25 software for analysis. The result was presented in texts, tables, and figures as numbers and percentages. To determine the average distribution of data, the median with interquartile range and mean with standard deviation were calculated for the participants' age and Hb. The strength of the association was assessed by binary logistic regression. Variables with p-values less than or equal to 0.25 from the output of bi-variable were transferred to multivariable binary

logistic regression. Finally, the odds ratio, 95% confidence interval, and p-value were used to express the strength of the association. P-value of <0.05 is declared statistically significant.

Results

Demographic Characteristics of Study Participants

A total of 182 participants were enrolled in the study. Night-nine (54.4%) of the total participants were male. Majority of the study participants 110 (60.4%) were in the age range of 18–35 years, while aged 36–45 years were 29 (15.9%) participants. Females had a median (interquartile range) age of 32 (11) years, while males had a median (interquartile range) age of 30 (23) years. Most of the study participants (81.9%) were rural residents.

Clinical Characteristics of the Participants

Of the total study participants, 95 (52.3%) were transfused in the emergency department, followed by surgical department 33 (18.1%), medical ward 30 (16.5%), gynecology/obstetrics 15 (8.2%), and the least transfusion was done in intensive care unit 9 (4.9%). Out of the total number of transfused patients, 95 (52.2%) were stable based on pre-transfusion clinical assessment. Forty-six (25.3%) participants had previous transfusion histories. Of the total female participants, 66 (79.5%) had a history of pregnancy; among females who had pregnancy history, 13 (19.7%) had an abortion history.

One hundred five and 55 patients were transfused by the orders of general practitioners and specialist doctors, respectively. In this study, 350 mL citrate phosphate dextrose adenine-1 (CPDA-1) preserved whole blood was the only blood transfused during the study period. The mean (standard deviation) of the blood storage time was 17.36 (7.74) days. One hundred twenty five (68.7%) participants were transfused with blood that had a storage time of up to 20 days, and 141 (77.5%) were transfused more than 1 unit of blood (Table 1).

Primary Diagnosis of Transfusion

In the current study, acute anemia (57), chronic anemia (95), and hematological abnormalities (17) are the common reasons for whole-blood transfusion (Table 2).

Acute Transfusion Reaction

One hundred eighty-two patients were assessed for ATR. Fifty-four patients who took anesthetic drugs were excluded because it may mask ATR. The overall incidence of ATR was 12 (6.6%) with 95% confidence interval (95% CI: 3.3–10.7%). Among these ATRs, allergic reactions had the highest proportion, followed by FNHTR with a proportion of 50% and 33.33%, respectively. In addition, alloimmunization and TRALI were encountered with equal proportion of 8.33% (Table 3).

Table 1 Clinical Characteristics of Blood Transfused Adult Patients at DMCSH from March 20 to June 15, 2022

Clinical Variables		Frequency	
		N	%
Transfusion ward	Emergency	95	52.2
	Gynecology/ obstetrics	15	8.2
	Medical inpatient	30	16.5
	Intensive care unit	9	4.9
	Surgical	33	18.1
Pre transfusion clinical status	Stable	95	52.2
	Not stable	87	47.8
Age of blood (days)	≤ 20	125	68.7
	>20	57	31.3
Amount of blood transfused (units)	=1	41	22.5
	>1	141	77.5

Table 2 Indications of Blood Transfusion for Adult Patients at DMCSH from March 20 to June 15, 2022

Indication =182	Underline Disease	Frequency	
		N	%
Chronic anemia	GI bleeding	9	4.9
	Infection	40	22.0
	Metabolic disorder	8	4.4
	Organ associated	28	15.4
	Others	10	5.5
Acute anemia	Gynecological and obstetrics cases	13	7.1
	Trauma, other surgical cases	44	24.2
Hematological	Malignancy	8	4.4
	Bi and pan cytopenia	9	4.9
Anemia	Undefined	10	5.5

Notes: Infection; HIV, HBV, malaria, and Tuberculosis. Metabolic disorder; Diabetes Mellitus, hypertension, and malnutrition. Maternal and gynecological related; retained placenta, uterine atony, myoma, gestational thromboplastin disease (GTD), vaginal bleeding, eclampsia, and abortion. Other surgical-related diseases; Peptic ulcer disease (PUD), hyperthyroidism and ascites; Organ-related; chronic kidney disease, chronic liver disease, and acute kidney disease; Hematological malignancy; (Acute Lymphoid Leukemia) ALL, Chronic Myeloid Leukemia (CML), Acute Myeloid Leukemia (AML); Hematological Cytopenia; bicytopenia, and pancytopenia. Others include asthma, epistaxis, and gangrene.

Table 3 Acute Transfusion Reaction Proportion Among Blood Transfused Adult Patients at DMCSH from March 20 to June 15, 2022

Transfusion Reaction (n=182)	No=170	Incidence of ATR		Proportion of ATR %
	Yes=12	N	%	
ATR =12 (6.6%)	Allo-immunization	1	0.55	8.34
	Allergic	6	3.30	50.00
	FNHTR	4	2.20	33.33
	TRALI	1	0.55	8.33
	Total	12	6.60	100.00

Abbreviations: FNHTR, febrile non-hemolytic transfusion reaction; TRALI, transfusion related acute lung injury.

Factors Associated with the Development of ATR

The proportion of ATR was higher in females (8.6%), patients who lived in an urban area (18.2%). In the bivariable binary logistic regression analysis, ATR was associated with urban residence (COR = 5.26, 95% CI: 1.58–17.53), transfusion history (COR = 4.67, 95% CI: 1.4–15.52), abortion history (COR = 9.11, 95% CI: 2.31–40.75), storage time (COR = 4.89, 95% CI: 1.41–17.01), and transfused whole blood increased by 1 unit (COR = 2.42, 95% CI: 1.44–4.06).

Transfusion history (AOR = 4.13, 95% CI: 1.07–15.99), abortion history (AOR = 7.78, 95% CI: 1.75–18.68), storage time of transfused blood for more than 20 days (AOR = 3.96, 95% CI: 1.03–15.2), and transfused blood increased by 1 unit (AOR = 2.07, 95% CI: 1.21–3.55) were significantly associated with ATR in multivariable logistic regression analysis (Table 4).

Discussion

In the current study, we have evaluated acute transfusion complications and associated factors among 182 adult patients who were transfused blood.

An ATR is an unintended outcome related to blood product transfusion that happens during transfusion and 24 hr after cessation of transfusion.[5,6] In this study, the incidence of ATR was encountered in 12 patients (6.6%) (95% CI: 3.3–10.7%). This result was in line with previous studies conducted in Bahir Dar, Ethiopia (5.2%),[8] Bangladesh (3.6%),[19]

Table 4 Bivariable and Multivariable Binary Logistic Regression Analysis of Associated Factors of ATRs Among Adult Transfused Patients at DMCSH

Variables		ATR No (%)		COR	AOR (95% CI)	p-value
		Yes	No			
Gender (n=182)	Male	5 (5.1)	94 (94.9)	Ref		
	Female	7 (8.4)	76 (91.6)	1.71 (0.52–5.61)		0.374
Residence (n=182)	Urban	6 (18.2)	27 (81.8)	5.29 (1.58–17.53)	3.87 (1.00–14.88)	0.051
	Rural	6 (4.0)	143 (96.0)	Ref	Ref	
Age years (n=182)	18–35	4 (3.6)	106 (96.4)	Ref	Ref	
	36–45	2 (6.9)	27 (93.1)	1.94 (0.34–11.81)	2.18 (0.33–14.49)	0.420
	≥46	6 (13.9)	37 (86.1)	4.26 (1.14–15.93)	3.62 (0.80–16.37)	0.095
Transfusion history (n=182)	Yes	7 (15.2)	39 (84.8)	4.67 (1.40–15.52)	4.13 (1.07–15.99)	0.040*
	No	5 (3.7)	131 (94.3)	Ref	Ref	
Pregnancy (83)	Yes	5 (7.6)	61 (92.4)	0.62 (0.11–3.44)		0.582
	No	2 (11.8)	15 (88.2)	Ref		
Abortion history (n=66)	Yes	4 (30.8)	9 (69.2)	9.11 (2.31–11.75)	7.78 (1.75–18.68)	0.015*
	No	1 (1.9)	52 (98.1)	Ref	Ref	
Storage time (days) (n=182)	≤20	4 (3.2)	121 (96.8)	Ref	Ref	
	>20	8 (14.0)	49 (86.0)	4.89 (1.41–17.01)	3.96 (1.03–15.2)	0.045*
Transfused units (=182)				2.42 (1.44–4.06)	2.07 (1.21–3.55)	0.008*
Qualifications (n=182)	Specialist	3 (5.5)	52 (94.5)	1.21 (0.12–12.32)		0.871
	General practitioner	8 (7.6)	97 (92.4)	1.73 (0.21–14.60)		0.614
	Nurses/midwifery	1 (4.6)	21 (95.4)	Ref		

Note: *Significantly associated factors.
Abbreviations: Ref, Reference categorical variables; COR, crud odd ratio; AOR, adjusted odd ratio; CI, confidence interval; ATR, Acute Transfusion Reaction; No, number.

Sweden (7.9%),[27] Tzu-Chi Hospital, Taiwan (3.5%),[24] Belgaum (4.4),[28] Kano, and North-Western Nigeria (3.6%).[29] The result of this study was higher than studies conducted in Iran (0.95),[18] India (0.96%),[1] Namibia (0.2%),[21] Bangalore, India (0.5%),[17] and Democratic Republic of Congo 2.6.[22] One of the reasons may be that component transfusion was practiced in the areas mentioned later, especially in Iran, where leukocyte filtration was practiced. In contrast, only whole blood is used in the current study, which has triggering factors for TR.[30] The other reason may be that most studies were done based on the report of national hemovigilance, which may decrease the incidence rate. India has an incidence rate of 1 in 1412 in the uploaded and 1 in 743 without consideration of uploaded.[31]

In our study, allergic reactions (50%) and FNHTR (33.33%) were the two most common types of ATRs, which is consistent with studies conducted in Bahir Dar, Ethiopia (65% and 30%),[8] Iran (49.2%, 37.2%),[18] and Bangladesh (40.5%, 36.4%),[19] respectively. This study's proportion of FNHTR was higher than in India (22.8%),[1] and the Democratic Republic of the Congo (19.2%),[22] but lower than in Kano, North-Western Nigeria (90%).[29]

Recipient immunoglobulin E or non-IgE antibodies to proteins or other allergenic soluble substances in the donor plasma cause the allergic reaction. Due to the infused antigens, such as WBC, which increase the recipient's in vivo cytokine production, a febrile non-hemolytic transfusion reaction developed. The infusion of donor cytokines generated in storage may also affect the start of allergic responses and FNHTR in transfusion recipients.[32] Histamine, lipids, complement fragments, and cytokines are examples of potential biological response modifiers. These substances arise during storage in RBC or PLT products or are both linked to TR. There is no clinical proof that cytokines cause ATR since their levels are low in products made from preserved erythrocytes.[33]

In this study, AHTR was encountered in one patient with a proportion of (8.6%) from the total of ATR. This is comparable to the study conducted in Iran 6.8%[18] and Bangladesh (9.4%).[19] This patient's cross-match result was compatible in the saline technique but incompatible in IAT, suggesting that AHTR is caused by incompatible blood transfusion.[34] Furthermore, TRALI was observed only in one patient, accounting for 8.6% of the total ATR. This patient was presented with respiratory distress and bilateral infiltration in x-ray result. This might be due to the infusion of

plasma containing antibodies against the patient's WBCs. Lung edema and neutrophil buildup are brought on by complement activation and cytokine stimulation.[35]

In the current study, patients who had previous transfusion histories were 4.13 times more likely to develop ATR than its counterpart. The reason may be due to the immune system's sensitization and production of antibodies to certain blood cell antigens (RBC, WBC, and PLT) after the previous transfusion. This sensitized immune system may cause the development of HTR or FNHTR in a subsequent blood transfusion.[36,37] According to the American Society of Hematology, alloimmunization to sickle cell disease and thalassemia causes hyper-hemolysis in subsequent transfusions.[38] It also causes immune modulation and leads to immune suppression, which increases the risk of pneumonia and sepsis.[39] The formation of alloantibodies can directly increase the morbidity and mortality of transfusion-dependent patients by increasing the probability of HTR.[40] Previous transfusion was found to be significantly associated with TR, similar to studies done in Bahir Dar, Ethiopia[8] and Kano, north west, Nigeria.[29]

Additionally, as transfused blood increased by 1 unit, the odds of developing ATR increased by 2.07, which was similar to the study conducted in Bahir Dar, Ethiopia.[8] Repeated or multi-unit blood transfusions can result in the production of alloantibodies against one or more red cell antigens, which complicates the subsequent transfusions.[36,37] In multiple (many units of transfusion) biochemicals, cytokines, and antibodies complexity happens leading to TR. Endothelial vasculature may induce recipient neutrophil priming and production of reactive oxygen species (ROS). These changes may produce depletion of available nitric oxide, with subsequent endothelial dysfunction predisposing to morbidity and mortality in the transfused patients.[41] In addition, there might be an incompatibility between the previously transfused blood and the new blood, which leads to the patient developing ATR. Multiple units of transfusion are associated with FNHTR and allergic reactions.[32]

Moreover, in pre-transfusion Hb, as Hb increased by 1 g/dl, the odds of patient improvement increased by 69%. When Hb is low, the patient is more likely to receive many units, resulting in complex formation and decreased patient compliance. Studies indicate a negative correlation between pre-transfusion Hb and transfusion complications in Thailand.[42] Patients' low pre-transfusion hematocrit and the dose of PRBCs administered were risk factors, but not factors in survival.[39,43]

Patients who had a history of abortion were 7.78 times more likely to develop ATR. During an abortion, fetal antigens may enter maternal circulation, leading to sensitization. When transfusion takes place, the immune system produces antibodies, which cause AHTR or FNHTR.[44] The finding is similar to the study in Bahir Dar, Ethiopia.[8]

In this study, patients who had received blood stored for more than 20 days had a risk of developing ATR by 3.96 times than its counter. This is similar to a study conducted in Kano, North-Western Nigeria.[29] The effect of young versus old blood on patient outcomes is still controversial. Red blood cell storage induces progressive biochemical, biomechanical, and immunological changes that affect RBC viability, survival, oxygen delivery capacity, and the recipient's response to transfusion.[41] ICU patients, cardiac surgery patients and trauma patients with prolonged storage of transfused blood may have a higher mortality rate.[45] In contrast, the age of transfused PRBC units was not identified as a risk factor for TR.[39,43] Despite this, in the United States, mortality after massive blood transfusion was no worse in patients transfused with PRBC stored for long periods of time.[46]

Limitations of the Study

Because whole blood is the only blood transfused in the study area, this study used only whole-blood transfusion, which may overestimate the prevalence of transfusion reactions. Antibody screening, identification, and organ function tests were not assessed for those who developed AHTR.

Conclusion and Recommendations

We concluded that the incidence of ATR was higher than the 2014 WHO report in African countries.[12] Patients with a history of transfusion, abortion, blood transfusion older than 20 days, or more than 1 transfusion were associated with developing ATR.

We recommend that clinicians should closely monitor and consider transfused patients who have a history of previous transfusions and abortions. Regardless of these factors, they should strictly adhere to transfused patients who have old blood transfused, or more than 1 unit transfused. Laboratory personnel should implement a crossmatch of at least saline

and IAT to handle TRs due to incompatibility. Additionally, for those suspected of having TRs, antibody screening and identification should be performed. We recommend that researchers look into multi-center cohort studies to see if there are any explanatory factors, outcomes, or ATR subtypes.

Abbreviations

AHG, Anti-Human Globulin; AHTR, Acute Hemolytic Transfusion Reactions; ATR, Acute Transfusion Reaction; CBC, Complete Blood Count; DAT, Direct Anti-Globulin Test; DMCSH, Debre Markos Comprehensive Specialized Hospital; FFP, Fresh Frozen Plasma; FNHTR, Febrile Non-Hemolytic Transfusion Reaction; ICU, Intensive Care Unit; TACO, Transfusion Associated Circulatory Overload; TRALI, Transfusion Related Acute Lung Injury; WHO, World Health Organization.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable requests.

Ethical Approval and Informed Consent

This research was carried out in accordance with the Helsinki Declaration. Ethical approval was obtained from the School of Biomedical and Laboratory Sciences, Research Ethical Review Committee, College of Medicine and Health Sciences, University of Gondar (Reference number SBMLS/189/2014). Before recruitment, the aim, potential benefits, and risks of the study were explained to participants or their attendants. The written informed consent or assent was taken from volunteer participants or attendants, respectively. Furthermore, whenever a TRs or abnormal laboratory results occurred, the patient was linked to responsible health professionals to manage the problem.

Acknowledgments

We want to acknowledge DMCSH staff who helped during data collection. We also thank the study participants for their voluntary participation in the study.

Author Contributions

All authors made a significant contribution to the study reported whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation or all the areas: took part in drafting, revising, critically reviewing the article: gave final approval of the version to be published: have agreed on the journal to which the article to which the article has been submitted and agreed to accountable for all aspects of the work.

Funding

No funded organization.

Disclosure

The authors declare no conflicts of interest in this work.

References

1. Krishnamurthy AV, Mathialagan J, Raghavan AV, Srinivasan S. Analysis of patterns of adverse transfusion reactions and management: a novel initiative toward hemovigilance in a teaching hospital of South India. *J Lab Physicians*. 2020;12:133–140.
2. The American Red Cross. *A Compendium of Transfusion Practice Guidelines*, Vol. 4. The American Red Cross; 2021:3–8
3. World Health Organization. *Clinical Transfusion Practice: Guidelines for Medical Interns*, Vol. 2. World Health Organization; 2020:26–33
4. Adewoyin AS, Oyewale OA. Complications of allogeneic blood transfusion: current approach to diagnosis and management. *Int Blood Res Rev*. 2015;3(4):135–151. doi:10.9734/IBRR/2015/17874
5. Jolee T, Suddock KP. Transfusion reactions. In: *NCBI Book Shelf. A Service of the National Library of Medicine, National Institutes of Health*. Stat Pearls Publishing; 2021.
6. sharma S, Sharma P, Lisa N. Transfusion of blood and blood products: indications and complications. *Am Acad Fam Physicians*. 2011;83 (6):719–724.

7. Tufa F, Kiya T, Maleko G, et al. Assessment of recipients' characteristics, transfusion appropriateness, and utilization pattern of blood and blood products in Jimma Medical Center, Jimma, Ethiopia. *PLoS One*. 2021;16(4):e0250623. doi:10.1371/journal.pone.0250623
8. Gelaw Y, Woldu B, Melku M. Proportion of acute transfusion reaction and associated factors among adult transfused patients at felege hiwot compressive referral hospital, Bahir Dar, Northwest Ethiopia: a cross-sectional study. *J Blood Med*. 2020;11:227–234. doi:10.2147/JBM.S250653
9. Mahteme Bekele M, Yisak EH, Gebreselassie HA, et al. A cross-sectional study to analyze blood and blood component transfusion practice at tertiary care hospital of Ethiopia. *Clin Audit*. 2021;13:29–35. doi:10.2147/CA.S326707
10. Tamene M, Tsegaye A, Birhanu A, et al. Assessment of transfusion utilization and patient outcomes at the largest referral and university hospital in Addis Ababa, Ethiopia. *ISBT Sci Ser*. 2016;11(1):7–13. doi:10.1111/voxs.12234
11. Tewabe H, Mitiku A, Worku H. Assessment of blood transfusion utilization and patient outcomes at Yekatit-12 Hospital, Addis Ababa, Ethiopia. *J Blood Med*. 2022;13:171. doi:10.2147/JBM.S355178
12. World Health Organization. *Status of Blood Safety in the Who African Region*. Brazzaville: World Health Organization; 2014.
13. Qin Caroline X, Yesantharao Lekha V, Merkel Kevin R, et al. Blood utilization and clinical outcomes in ECMO patients. *Anesth Analg*. 2020;131 (3):901. doi:10.1213/ANE.0000000000004807
14. Unal D, Senayli Y, Polat R, et al. Peri-operative blood transfusion in elective major surgery: incidence, indications and outcome - an observational multicentre study. *Blood Transfus*. 2020;18(4):261–279. doi:10.2450/2020.0011-20
15. World Health Organization. *Global Status Report on Blood Safety and Availability*. Geneva: World Health Organization; 2017.
16. Yaddanapudi S, Yaddanapudi L. Indications for blood and blood product transfusion. *Indian J Anaesth*. 2014;58(5):38–42. doi:10.4103/0019-5049.144648
17. Shweta P. Surveillance of transfusion related adverse reactions in a tertiary care centre in Bangalore: a 4-year hemovigilance initiative. *Indian J Hematol Blood Transfus*. 2020;36(4):733–739. doi:10.1007/s12288-020-01312-w
18. Mehrdad P, Mohammad Erfan Z, Atefeh Nasir K, et al. Descriptions of acute transfusion reactions in the teaching hospitals of Kermanshah University of Medical Sciences, Iran. *Int J Hematol Oncol Stem Cell Res*. 2013;7(2):11.
19. Miah SS, Doha MA, Islam A, et al. The first data of hemovigilance: appraised from a single center in Bangladesh. *Glob J Transfus Med*. 2021;2 (2):18–23.
20. Harvey AR, Basavaraju SV, Chung KW, Kuehnert MJ. Transfusion-related adverse reactions reported to the National Healthcare Safety Network Hemovigilance Module, United States, 2010 to 2012. *Transfusion*. 2015;55(4):709–718. doi:10.1111/trf.12918
21. Meza BP, Lohrke B, Rea W. Estimation of the prevalence and rate of acute transfusion reactions occurring in Windhoek, Namibia. *Blood Transfus*. 2014;12(3):352. doi:10.2450/2013.0143-13
22. Musumari PM, Mbikayi SM, Srithanaviboonchai K, Techasrivichien T, Tangmunkongvorakul A, Tshilolo L. Symptoms of acute transfusion reactions at a general referral hospital in Kinshasa, Democratic Republic of Congo: a cross-sectional study. *BMJ open*. 2021;11(7):e045081. doi:10.1136/bmjopen-2020-045081
23. Alter HJ, Klein HG. The hazards of blood transfusion in historical perspective. *blood*. 2008;112(7):2617–2626. doi:10.1182/blood-2008-07-077370
24. Yao C-Y, Chien J-H, Chuang H-Y, Ho T-F. Associated factors with acute transfusion reaction from hospital online reporting events: a retrospective cohort study. *J Patient Saf*. 2020;16:e303–e309. doi:10.1097/PTS.0000000000000527
25. CSA. *Central Statistical Agency of the Federal Democratic Republic of Ethiopia*. Vol. 2. Addis Ababa: CSA; 2012.
26. Health informatics. Debre markos comprehensive specialized hospital administrative information; 2021.
27. Thurn L, Wikman A, Westgren M, Lindqvist PG. Incidence and risk factors of transfusion reactions in postpartum blood transfusions. *Blood Adv*. 2019;3(15):2298–2306. doi:10.1182/bloodadvances.2019000074
28. Madhushree D, Metgud MC, Patil K. Retrospective analysis of all patients undergoing blood transfusion in obstetrics at a Tertiary Care Hospital, Belgaum: a cross-sectional study. *Indian J Health Sci Biomed Res*. 2018;11(2):116. doi:10.4103/kleuhsj.kleuhsj_233_17
29. Gwaram BA, Borodo MM, Dutse AI, A K-G. Pattern of acute blood transfusion reactions in Kano, North-Western Nigeria. *Niger J Basic Clin Sci*. 2012;9(1):27–32. doi:10.4103/0331-8540.102110
30. Vasudev R, Sawhney V, Dogra M, Raina TR. Transfusion-related adverse reactions: from institutional hemovigilance effort to National Hemovigilance program. *Asian J Transfus Sci*. 2016;10(1):31–36. doi:10.4103/0973-6247.175391
31. Dhiman Y, Raturi M, Kala M, Kusum A. Significance of mandating a dedicated hemovigilance nurse and objectification of 'imputability' levels. Experience from a hospital-based blood centre in India. *Transfusion clinique et biologique*. 2023;30(1):96–102. doi:10.1016/j.tracli.2022.09.066
32. Pomper GJ. Febrile, allergic, and nonimmune transfusion reactions. *Rossi's Princ Transfus Med*. 2009;2009:826–846.
33. Heddle NM. Pathophysiology of febrile nonhemolytic transfusion reactions. *Curr Opin Hematol*. 1999;6(6):420–426. doi:10.1097/00062752-199911000-00012
34. Webb C, Norris A, Hands K. An acute transfusion reaction. *Clin Med*. 2018;18(1):95–97. doi:10.7861/clinmedicine.18-1-95
35. Fung YL, Silliman CC. The role of neutrophils in the pathogenesis of transfusion-related acute lung injury. *Transfus Med Rev*. 2009;23(4):266–283. doi:10.1016/j.tmrv.2009.06.001
36. Bhuva DK, Vachhani JH. Red cell alloimmunization in repeatedly transfused patients. *Asian J Transfus Sci*. 2017;11(2):115–120. doi:10.4103/0973-6247.214347
37. Bowman Z, Fei N. Single versus double-unit transfusion: safety and efficacy for patients with hematologic malignancies. *Eur J Haematol*. 2019;102 (5):383–388. doi:10.1111/ejh.13211
38. Chou S, Alsawas M, Fasano R, et al. American Society of Hematology 2020 guidelines for sickle cell disease: transfusion support. *Blood Adv*. 2020;4(2):327–355. doi:10.1182/bloodadvances.2019001143
39. Blajchman MA. Immunomodulation and blood transfusion. *Am J Ther*. 2002;9(5):389–395. doi:10.1097/00045391-200209000-00005
40. Chonat S, Quarmyne M-O, Bennett CM, et al. Contribution of alternative complement pathway to delayed hemolytic transfusion reaction in sickle cell disease. *Haematologica*. 2018;103(10):e483. doi:10.3324/haematol.2018.194670
41. Obrador R, Musulin S, Hansen B. Red blood cell storage lesion. *J Vet Emerg Crit Care*. 2015;25(2):187–199. doi:10.1111/vec.12252
42. Wanchaitanawong W, Tantiworawit A, Piriyakhuntorn P, et al. The association between pre-transfusion hemoglobin levels and thalassemia complications. *Hematology*. 2021;26(1):1–8. doi:10.1080/16078454.2020.1856513
43. Holowaychuk MK, Leader JL, Monteith G. Risk factors for transfusion-associated complications and nonsurvival in dogs receiving packed red blood cell transfusions: 211 cases (2008–2011). *J Am Vet Med Assoc*. 2014;244(4):431–437. doi:10.2460/javma.244.4.431

44. Tormey CA, Hendrickson JE. Transfusion-related red blood cell alloantibodies: induction and consequences. *Blood*. 2019;133(17):1821–1830. doi:10.1182/blood-2018-08-833962
45. Ng MS, Ng AS, Chan J, Tung JP, Fraser JF. Effects of packed red blood cell storage duration on post-transfusion clinical outcomes: a meta-analysis and systematic review. *Intensive Care Med*. 2015;41(12):2087–2097. doi:10.1007/s00134-015-4078-5
46. Bautista A, Wright TB, Meany J, et al. Red cell storage duration does not affect outcome after massive blood transfusion in trauma and nontrauma patients: a retrospective analysis of 305 patients. *Hindawi*. 2017;2017:3718615.