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ORIGINAL ARTICLE

Incidence of Transfusion Reactions and Their Association with Blood Components

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ABSTRACT

Background: *Blood transfusion is a lifesaving intervention but may be associated with adverse reactions ranging from mild febrile or allergic events to rare, severe complications such as acute hemolytic transfusion reactions, transfusion-related acute lung injury, and transfusion-associated circulatory overload. This study aimed to determine the incidence of transfusion reactions and evaluate their association with different blood components at Tajuddin Medical College Hospital.* ***Methods & Materials:*** *This descriptive observational study was conducted over 1 year (May 2023–April 2024). All patients who developed transfusion reactions following any blood component transfusion were included. Data were collected from hospital records and analyzed using descriptive statistics and chi-square tests.* ***Results:*** *A total of 40 transfusion reactions were recorded. The mean age of patients was 41.6 ± 18.3 years; 55% were male. Packed red blood cells (PRBCs) and whole blood were most frequently associated with reactions. Febrile non-hemolytic transfusion reactions (FNHTRs) were the most common (37.5%), followed by allergic reactions (25%), while severe reactions such as AHTRs, anaphylaxis, TRALI, TACO, and delayed hemolytic reactions were less frequent. No significant association was found between blood component type and transfusion reaction type (p = 0.858). Management primarily involved stopping the transfusion and providing symptomatic treatment; pharmacologic interventions, oxygen therapy, and ICU admission were needed in a minority of cases. Most patients (95%) recovered completely, while 5% resulted in mortality.* ***Conclusion:*** *FNHTRs and allergic reactions are the most frequent transfusion reactions, predominantly associated with PRBCs and whole blood. Early recognition and timely management are essential to minimize adverse outcomes.*

Keywords: *Transfusion reaction, Febrile non-hemolytic transfusion reaction, Allergic reaction, Packed red blood cells, Whole blood, TRALI, TACO, Hemovigilance*

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INTRODUCTION

Blood transfusion is an essential, lifesaving intervention across medicine, used for hemorrhage control, treatment of severe anemia, and support of patients undergoing major surgery or chemotherapy [1]. However, transfusion carries the risk of adverse reactions ranging from mild allergic or febrile events to rare but life-threatening complications such as acute hemolytic transfusion reactions (AHTR), transfusion-related acute lung injury (TRALI), and transfusion-associated circulatory overload (TACO) [2,3]. Certain reactions were more frequently associated with specific blood components, with FNHTRs commonly linked to packed red blood cells and allergic reactions more often observed with platelet or plasma transfusions, highlighting the need for component-specific risk assessment [4].

Acute transfusion reactions (ATRs) are often under-recognized and under-reported, with incidence varying widely depending on the method of surveillance and hemovigilance practices [5]. Active surveillance studies consistently report higher ATR rates than passive reporting systems, with febrile non-hemolytic transfusion reactions (FNHTRs) and allergic reactions being the most frequently observed[5,6].

FNHTRs are primarily caused by cytokine accumulation during storage and immune reactions between donor leukocytes and recipient antibodies [7]. Leukoreduction of cellular blood products has been shown to significantly reduce FNHTR incidence in multiple settings [1,8]. Conversely, severe events such as TRALI and TACO, though rare, remain major contributors to transfusion-related morbidity and mortality [3,9].

In Bangladesh, hospital-based studies report FNHTRs and allergic reactions as the most common acute transfusion reactions, with FNHTRs frequently linked to packed red blood cells and allergic reactions to platelet transfusions [10–12].

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Serious reactions such as anaphylaxis and hypotensive episodes are less common [10,11]. These findings highlight the need for strengthened haemovigilance, preventive measures like leukoreduction, and increased clinician awareness to improve detection and reporting of transfusion-related adverse events [12].

Despite advances in transfusion safety, acute transfusion reactions remain a significant concern globally and in Bangladesh, this study was conducted at Tajuddin Medical College Hospital to determine the incidence and pattern of transfusion reactions and assess their association with different blood components over an 1 year period. Understanding the incidence and association of transfusion reactions with different blood components is essential to improve patient safety, guide clinical practices, and inform policy in hospital transfusion services.

METHODS & MATERIALS

Study Design and Setting

This was a hospital-based descriptive observational study conducted at Tajuddin Medical College Hospital over a period of 1 year, from May 2023 to April 2024. The study aimed to determine the incidence of transfusion reactions and assess their association with different blood components.

Study Population

All patients who developed transfusion reactions following the administration of any blood component during the study period were included. Patients with incomplete medical records or uncertain diagnosis of transfusion reaction were excluded.

Sample Size

A total of 40 cases of transfusion reactions were documented and included in the analysis.

Data Collection

Data were collected from hospital transfusion records, patient medical charts, and blood bank registers. Information obtained included patient demographics (age, sex), type of blood component transfused, indication for transfusion, type of transfusion reaction, onset time, clinical manifestations, laboratory findings, and management outcome.

Classification of Transfusion Reactions

Transfusion reactions were classified according to standard definitions provided by the World Health Organization (WHO) and the American Association of Blood Banks (AABB), into:

- Acute hemolytic transfusion reaction (AHTR)
- Febrile non-hemolytic transfusion reaction (FNHTR)
- Allergic reaction
- Anaphylactic reaction
- Transfusion-related acute lung injury (TRALI)
- Transfusion-associated circulatory overload (TACO)
- Delayed hemolytic transfusion reaction (DHTR)

Data Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 25. Descriptive statistics were presented as frequencies and percentages for categorical variables and mean ± standard deviation for continuous variables. The association between types of blood components and transfusion reactions was assessed using the Chi-square test or Fisher's exact test, as appropriate. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board of Tajuddin Medical College Hospital. Patient confidentiality was maintained by anonymizing all data.

RESULTS

Table I shows a total of 40 transfusion reactions were recorded at Tajuddin Medical College Hospital between May 2023 and April 2024. The mean age of patients was 41.6 ± 18.3 years, ranging from 7 to 78 years.

Table – I: Distribution of Transfusion Reactions by Patient Demographics (*n* = 40)

Variable	Categories	Frequency (n)	Percentage (%)
Age group (years)	<20	5	12.5
	20–39	14	35.0
	40–59	13	32.5
	≥60	8	20.0
Sex	Male	22	55.0
	Female	18	45.0

Table II presents the distribution of transfusion reactions according to the type of blood component among 40 transfusion events. The highest proportion of reactions occurred with packed red blood cells (PRBCs), accounting for 37.5% of cases, followed by whole blood transfusions at 25%. Platelet concentrate was associated with 17.5% of reactions, while fresh frozen plasma (FFP) and cryoprecipitate caused fewer reactions, representing 12.5% and 7.5%, respectively.

Table – II: Distribution of Transfusion Reactions by Type of Blood Component (*n* = 40)

Blood Component	Frequency (n)	Percentage (%)
Whole Blood	10	25.0
Packed Red Blood Cells (PRBC)	15	37.5
Platelet Concentrate	7	17.5
Fresh Frozen Plasma (FFP)	5	12.5
Cryoprecipitate	3	7.5

Table III shows the distribution of transfusion reactions according to their clinical type among 40 transfusion events. The most common reaction was febrile non-hemolytic transfusion reaction (FNHTR), accounting for 37.5% of cases, followed by allergic reactions at 25%. Less frequent but more severe reactions included acute hemolytic transfusion reactions (AHTR, 10%), anaphylactic reactions (7.5%), transfusion-related acute lung injury (TRALI, 7.5%), and transfusion-associated circulatory overload (TACO, 5%).

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Table – III: Distribution of Transfusion Reactions by Clinical Type (*n* = 40)

Type of Reaction	n=40	%
Febrile Non-Hemolytic Transfusion Reaction (FNHTR)	15	37.5
Allergic Reaction	10	25.0
Anaphylactic Reaction	3	7.5
Acute Hemolytic Transfusion Reaction (AHTR)	4	10.0
Transfusion-Related Acute Lung Injury (TRALI)	3	7.5
Transfusion-Associated Circulatory Overload (TACO)	2	5.0
Delayed Hemolytic Transfusion Reaction (DHTR)	3	7.5

Table IV presents the distribution of transfusion reactions across different blood components. Among 40 transfusion events, FNHTRs were most frequently observed with PRBCs (7/15, 46.7%) and whole blood (4/15, 26.7%), while allergic reactions occurred with PRBCs (3/10, 30%), whole blood (3/10, 30%), platelets (2/10, 20%), FFP (1/10, 10%), and cryoprecipitate (1/10, 10%). Severe reactions were less common: AHTR occurred in 4 cases (10%), anaphylactic reactions in 3 cases (7.5%), TRALI in 3 cases (7.5%), and TACO in 2 cases (5%). Statistical analysis using the chi-square test indicated no significant association between the type of blood component and the type of transfusion reaction (χ^2 = 5.93, df = 24, p = 0.858), suggesting that all components had a comparable risk of causing different types of transfusion reactions in this sample.

Table – IV: Association Between Blood Component and Type of Transfusion Reaction (*n* = 40)

Blood Component	FNHTR	Allergic	Anaphylactic	AHTR	TRALI	TACO	DHTR	Total
Whole Blood	4	3	1	1	0	1	0	10
PRBC	7	3	0	2	1	0	2	15
Platelets	2	2	1	0	1	0	1	7
FFP	1	1	1	1	1	0	0	5
Cryoprecipitate	1	1	0	0	0	1	0	3
Total	15	10	3	4	3	2	3	40
Chi-square test	χ^2 = 5.93, df = 24, p = 0.858							

Table V summarizes the management strategies and immediate outcomes of 40 transfusion reactions. The majority of reactions (25/40, 62.5%) were managed by stopping the transfusion and providing symptomatic treatment. Antihistamines were administered in 10 cases (25%) and corticosteroids in 7 cases (17.5%), while oxygen therapy was required in 4 cases (10%). A small proportion of patients (3/40, 7.5%) needed ICU admission. Most patients (38/40, 95%) recovered completely, whereas 2 cases (5%) resulted in mortality.

Table – V: Management and Immediate Outcomes of Transfusion Reactions (*n* = 40)

Management/Outcome	Frequency (n)	Percentage (%)
Stopped transfusion, symptomatic treatment	25	62.5
Administration of antihistamines	10	25.0
Administration of corticosteroids	7	17.5
Oxygen therapy	4	10.0
ICU admission	3	7.5
Complete recovery	38	95.0
Mortality	2	5.0

DISCUSSION

This study identified 40 transfusion reactions at Tajuddin Medical College Hospital between May 2023 and April 2024. The mean age of patients was 41.6 ± 18.3 years, ranging from 7 to 78 years. The highest proportion of reactions occurred in the 20–39 years age group (35%), followed by 40–59 years (32.5%) (Table I). This age distribution is similar to other studies conducted in Bangladesh, where transfusion reactions were observed across a wide age range [12]. Males accounted for 55% of cases, while females represented 45% (Table I). These age and sex distributions are comparable to previous studies reporting transfusion reactions across all adult age groups with mild male predominance [13,14].

Regarding blood component type, packed red blood cells (PRBCs) were most frequently associated with transfusion reactions, accounting for 37.5% (15/40), followed by whole blood at 25% (10/40) (Table II). Platelet concentrates accounted for 17.5% (7/40), while fresh frozen plasma (FFP) and cryoprecipitate caused fewer reactions, representing 12.5% (5/40) and 7.5% (3/40), respectively (Table II). This is consistent with prior studies showing that red blood cell products are more frequently implicated in transfusion reactions due to their higher antigenic load and wider clinical use [15,16]. The findings are consistent with other studies conducted in Bangladesh, highlighting the importance of monitoring and managing transfusion reactions to ensure patient safety [10,12].

In terms of clinical type, febrile non-hemolytic transfusion reactions (FNHTRs) were the most commonly observed in 37.5%, followed by allergic reactions in 25%. A study at a tertiary care center reported that FNHTRs accounted for 51.6% of reactions, while allergic reactions comprised 35.8% [10]. Severe reactions, including acute hemolytic transfusion reactions (AHTRs), anaphylactic reactions, transfusion-related acute lung injury (TRALI), transfusion-associated circulatory overload (TACO), and delayed hemolytic transfusion reactions (DHTRs), were less frequent in this study (Table III). These findings are consistent with global data, which indicate that

FNHTRs are generally the predominant transfusion reaction, while severe reactions are comparatively rare [17,18].

Regarding the type of blood component, our study found that FNHTRs were most frequently observed with packed red blood cells (PRBCs) and whole blood, while allergic reactions occurred with PRBCs, whole blood, platelets, fresh frozen plasma (FFP), and cryoprecipitate. Statistical analysis indicated no significant association between the type of blood component and the type of transfusion reaction ($p = 0.858$), suggesting that all components had a comparable risk of causing different types of transfusion reactions in this sample. These observations are similar to other studies, although larger sample sizes may yield more precise associations [19]. A study from a tertiary care center in Bangladesh [10] also reported that the frequency of transfusion reactions was significantly higher with PRBC transfusion (50%). Another study from Ethiopia, where FNHTRs and allergic reactions were the predominant transfusion reactions, our study also observed that these milder reactions were the most common, with severe reactions being relatively rare [20] Sembai et al., found that certain blood components, particularly packed red blood cells (PRBCs), were more commonly associated with moderate to severe transfusion reactions [21].

The majority (62.5%) were managed by stopping the transfusion and providing symptomatic treatment, reflecting standard practice recommendations for acute transfusion reactions [5, 22]. Antihistamines were administered in 25%, corticosteroids in 17.5%. Antihistamines and corticosteroids were administered in a proportion of cases to address allergic manifestations and inflammatory responses, which aligns with international guidelines suggesting pharmacologic intervention for moderate to severe reactions [23]. Oxygen therapy was required in in 10% patients, primarily for those with respiratory complications such as TRALI or TACO, while ICU admission (7.5%) was necessary in a few severe cases. Similar patterns have been observed in other studies, where severe reactions are uncommon but may require intensive care support [24,25]. Most patients recovered completely, while 5% resulted in mortality. These outcomes align with prior studies highlighting that early recognition, appropriate supportive care, and preventive measures are critical for minimizing morbidity and mortality associated with transfusion reactions [26–28].

Overall, this study confirms that transfusion reactions can occur with any blood component, with PRBCs and whole blood more frequently implicated. FNHTRs and allergic reactions remain the most common, whereas severe reactions are less frequent but require immediate intervention. Vigilant monitoring, hemovigilance, and timely management are critical to minimize adverse outcomes.

CONCLUSION

This study at Tajuddin Medical College Hospital demonstrates that transfusion reactions occur across all age groups and both sexes, with a slightly higher frequency among adults and males. Packed red blood cells (PRBCs) and whole blood were the blood components most commonly associated with transfusion reactions. Febrile non-hemolytic transfusion reactions (FNHTRs) and allergic reactions were the predominant clinical types, while severe reactions such as acute hemolytic transfusion reactions (AHTRs), anaphylaxis, TRALI, TACO, and delayed hemolytic reactions were relatively rare. No significant association was found between the type of blood component and the type of transfusion reaction.

Most reactions were effectively managed by stopping the transfusion and providing symptomatic care, with pharmacologic interventions, oxygen therapy, and ICU admission required in a minority of cases. The majority of patients recovered completely, highlighting the importance of early recognition and prompt management. These findings underscore the need for continuous hemovigilance, careful selection of blood components, and adherence to standardized management protocols to ensure patient safety and minimize adverse outcomes in transfusion practice.

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