

Original Article



# Evaluation of Blood Transfusion-Related Reactions of Blood Recipients in Hamadan Besat Hospital Patients during 2020-2022

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## Abstract

**Background:** Blood transfusion has some complications known as transfusion-related reactions. Accurate identification and recording of these reactions is more important for their management and prevention. This study aimed to evaluate blood transfusion-related reactions in blood recipients in patients in Hamadan Besat hospital during 2020-2022.

**Methods:** In this cross-sectional study, the data of 400 patients who had complications after receiving blood and blood components were collected in terms of hemolytic and non-hemolytic blood transfusion reactions. Data were collected from patients' medical records and standard blood transfusion checklists and analyzed by SPSS version 26 software using the chi-square test and Fisher's exact test.

**Results:** Red blood cell (RBC), 70.25%, random donor platelet (RDP), 10.3%, and fresh frozen plasma (FFP), 9.5%, were the most transfused blood components. Blood transfusion reactions were allergic reactions (53.5%), febrile non-hemolytic transfusion reaction (FNHTR) (24%), dyspnea (10.25%), hemolytic reactions (HR) (4.5%), hypotension (4.25%), transfusion-associated cardiovascular overload (TACO) (1.75%), and other reactions (2.75%). A significant relationship was also observed between receiving components containing RBC, including whole blood (WBO), RBC concentrate, and leukoreduced RBC, and the incidence of FNHTR ( $P=0.001$ ).

**Conclusion:** Based on the findings of the present study, allergic reaction and FNHTR were the most common complications after blood transfusions. Blood transfusion-related reactions could be predicted, managed, and possibly prevented by considering the relationship between the type of reaction and the type of transfused blood components.

**Keywords:** Blood component, Hemolytic reaction, Febrile non-hemolytic transfusion reaction, Allergic reaction



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## Introduction

Blood transfusion is one of the most critical medical interventions. Physicians, nurses, laboratory staff, and some other health workers are involved in the blood transfusion cycle (1). Different types of blood components are divided into two main categories: cellular components and plasma components. Red blood cell (RBC) concentrates, leukoreduced RBC, and platelet concentrates, as the cellular components, are transfused to anemic and thrombocytopenic patients. Fresh frozen plasma (FFP) and cryoprecipitate have the highest consumption in coagulopathy conditions (2-4). Patients

with a history of liver, lung, renal, cardiovascular, and hypertension diseases might need blood transfusion which might lead to some complications.

Any reaction occurring during a blood transfusion or some minutes after it is known as a blood transfusion-related reaction except when there is some proof to reject it (2). These reactions are classified into acute/ primary or delayed reactions. Acute reactions occur within the first 24 hours of blood transfusion. On the other hand, hemolytic and non-hemolytic reactions are another category of these reactions (5,6). Allergic reactions, febrile non-hemolytic transfusion reaction (FNHTR), infection, back pain, and



dyspnea are examples of the non-hemolytic reactions (2-4), with FNHTR and allergic reactions being the most prevalent hemolytic reactions (2,5,6).

FNHTR constitutes about 60% of all blood transfusion reactions. This reaction happens by interactions between recipient antibodies and donor leukocyte antigens or platelet and results in a fever of about 38°C in the recipient (1,5-7). FNHTR present at 1 °C increases the body temperature, and allergic reactions appear in the form of increased body temperature, itching, and hives (4,5,7). Allergic reactions mediated by IgE, basophil, and mast cells are another prevalent blood transfusion-related reaction (2-4).

ABO incompatibility and other blood group system antibody-mediated hemolysis are known as hemolytic transfusion reactions (HTRs) (2,5,6). HTRs might appear as acute or delayed reactions (1,2,4,7). Delayed blood transfusion-related reactions such as infection and iron overload appear some days, months, or even years after transfusion. These reactions generally occur in multi-transfused patients (1,5,8).

The severity of the reactions may not be estimated only based on clinical signs due to the similarity of initial signs/ symptoms of life-threatening HR and mild FNHTR ones. Acute HTR and transfusion-related acute lung injury (TRALI) are the most important blood transfusion reactions that must be diagnosed and treated as soon as possible (8,9).

Different rates of blood transfusion-related reactions were reported in published studies (8,10-14). The type and number of transfused blood components influence these reaction incidences (15,16). Acute allergic reactions often occur during platelet concentrate transfusion, while non-acute ones happen after RBC component transfusion (16). Severe reactions might be observed in the transfusion of four or more blood component units (14,15). Blood transfusion reactions require substantial cost, and they can be managed and reduced by an accurate identification and reporting system known as the haemovigilance system (1,8).

The demand for blood transfusion increases during the period of the outbreak of the COVID-19. However, despite the importance of the subject, there were few studies in terms of blood transfusion reactions in this period. Hence, based on the literature review, this study was designed and implemented to evaluate the blood transfusion-related reactions in Hamadan. In other words, this study was conducted to evaluate blood transfusion-related reactions in blood recipients among Hamadan Besat hospital patients during 2020-2022.

## Materials and Methods

In this cross-sectional retrospective study, the data of blood recipient inpatients that showed blood transfusion reactions during 2020-2022 were assayed. The data were extracted from medical records documented in the nursing office, quality assurance department, and

Haemovigilance department in the special form format. These standard blood transfusion reaction reporting forms were provided for medical centers and hospitals by the Iranian blood transfusion organization. The desired data, including sex, age, history of disease, the history of blood transfusion, the type of transfused blood components, the number of transfused blood components, and the type of blood transfusion reactions were gathered from medical records. To easily analyze the data, the history of blood transfusion was divided into two time periods: the recent three months and more than the recent three months. According to the objectives of the study, the number of transfused blood components was estimated not for each inpatient. Including criteria included hospitalization, receiving blood components, and having blood transfusion reactions. Excluding criteria were incomplete records, having no reaction, and/ or having non-transfusion-related reactions. The data were entered into SPSS version 26 software. Then, chi-square and exact Fisher statistical tests were used to analyze data, and a  $P$  value  $>0.05$  was considered a significant level.

## Results

Blood transfusion reactions were reported in 400 blood component recipients in this period. The age mean and standard deviation of these people were  $45.97 \pm 23.47$  years, with 69% and 31% of the study population being female and male, respectively. History of cardiovascular diseases (31.5%), renal diseases (27.4%), lung diseases (21.5%), allergic diseases (14.1%), hypertension (11%), and liver diseases (11%) were recorded for the inpatients who received blood components. The history of blood transfusion in patients was as follows: 58.6% had a blood transfusion history (43.1% within more than 3 months and 15.5% within recent 3 months), and 41.4% did not have any blood transfusion history.

According to Table 1, RBC concentrate (70.25%), random donor platelet (RDP: 10.3%), and FFP (9.5%) were the most transfused blood components, respectively. leukoreduced RBC (7.6%), cryoprecipitate (0.75%), single donor platelet (SDP: 0.75%), and whole blood (WB: 0.75%) were other transfused blood components.

As shown in Table 2, among blood recipients the most prevalent reactions were allergic reactions (53.5%), FNHTR (24%), and dyspnea (10.25%). Other reported blood transfusion-related reactions were HR (4.5%), hypotension (4.25%), transfusion-associated cardiovascular overload (TACO: 1.75%), and other reactions (2.75%), respectively, as depicted in Table 2. Furthermore, ABO-associated hemolytic reaction was reported in two cases (0.5%).

FNHTR and allergic reaction were more prevalent in patients with recent three months blood transfusion history, but according to Chi-square and exact Fisher test results, there was no significant relationship between those mentioned reactions and recent three months ( $P$  value = 0.09) or more than three months ( $P$  value = 0.075)

**Table 1.** Frequency of Transfused Blood Components in Blood Recipients

Blood Components	Number	%
RBC	281	70.25
RDP	41	10.3
FFP	38	9.5
Leukoreduced RBC	31	7.6
Cryoprecipitate	3	0.75
SDP	3	0.75
WB	3	0.75

Note. RBC: Red blood cell; RDP: Random donor platelet; FFP: Fresh frozen plasma; SDP: Single donor platelet; WB: Whole blood.

**Table 2.** Frequency of Blood Transfusion Related Reactions in Blood Recipients

Reaction	Number	%
Allergic	214	53.5
FNHTR	96	24
Dyspnea	41	10.25
HR	18	4.5
Hypotension	17	4.25
TACO	7	1.75
Other reaction	7	2.75

Note. FNHTR: Febrile non-hemolytic transfusion reaction; HR: Hemolytic reaction; TACO: Transfusion-associated cardiovascular overload.

blood transfusion history. On the other hand, the relationship between disease history and type of reactions, FNHTR ( $P$  value = 0.06), allergic ( $P$  value = 0.09), dyspnea ( $P$  value = 0.068) hypotension ( $P$  value = 0.085), TACO ( $P$  value = 0.1) was not significant.

The impact of blood component type on FNHTR was detected using Chi-square and exact Fisher tests. There was a significant relationship between receiving RBC-containing blood components such as RBC concentrate, leukocytreduced RBC, and WB ( $P$  value = 0.001) and FNHTR incidence. It means that the transfusion of RBC-containing blood components led to more FNHTR reaction (Table 3); however, the transfusion of SDP, RDP ( $P$  value = 0.065), FFP, and cryoprecipitate ( $P$  value = 0.321) had no significant relationship with FNHTR (Table 3).

Regarding allergic reaction and the type of blood components, a greater number of RBC-containing components were transfused to patients with this reaction compared to other components (Table 4). However, no significant relationship was observed between receiving-WB, RBCs, leukoreduced RBCs, as well as other components and the incidence of allergic reaction ( $P$  value = 0.211, 0.081, 0.054), as illustrated in Table 4.

**Discussion**

In the current study, the prevalence of blood transfusion-related reactions was the allergic reaction (53.5%), FNHTR (24%), dyspnea (10.25%), hemolytic reaction (4.5%), hypotension (4.25%), and TACO (1.75%), respectively. Blood transfusion has greatly improved the survival rate of critically ill patients. However, due to the foreign

**Table 3.** Frequency of FNHTR According to Type of Transfused Blood Components and Their Relationship

			FNHTR		Total	P Value
			Yes	No		
Type of components	FFP & Cryoprecipitate	Number	0	41	41	0.321 <sup>a</sup>
		%	0	100	100	
	SDP & RDP	Number	21	23	44	0.065 <sup>b</sup>
		%	47.7	52.3	100	
	WB & RBC & leukoreduced RBC	Number	76	239	315	0.001 <sup>b</sup>
		%	24.2	75.8	100	
Total	Number	96	304	400		
	%	24	76	100		

Note. FNHTR: Febrile non-hemolytic transfusion reaction; FFP: Fresh frozen plasma; SDP: Single donor platelet; RDP: Random donor platelet; RBC: Red blood cell; WB: Whole blood.

<sup>a</sup> Exact Fisher test; <sup>b</sup> Chi-square test.

**Table 4.** Frequency of Allergic Reaction According to Transfused Blood Components and Their Relationship

			Allergic Reaction		Total	P Value
			Yes	No		
Type of components	FFP & Cryo	Number	34	7	41	0.221*
		%	82.9	17.1	100	
	SDP & RDP	Number	24	20	44	0.081*
		%	55.5	45.5	100	
	WB & RBC & leukoreduced RBC	Number	156	159	315	0.054*
		%	49	51	100	
Total	Number	214	186	400		
	%	53.5	46.5	100		

Note. FFP: Fresh frozen plasma; SDP: Single donor platelet; RDP: Random donor platelet; WB: Whole blood; RBC: Red blood cell.

\* Chi-square test.

antigenicity of blood components and the degeneration of blood during storage, it is easy to cause non-hemolytic fever reactions, chills, and allergies (4). Furthermore, although blood safety made significant progress, there are still potential risks in the transfusion of blood and blood components (2,8).

In line with these results, Baradaran et al reported FNHTR and allergic reaction as the most prevalent reactions in blood recipients with 53.16% and 34.5%, respectively (10). Amiri et al surveyed the type and frequency of blood transfusion reactions in hospitalized patients in Hamadan. Their results indicated that 54.1% of these reactions is FNHTR, and 23.3% is an allergic reaction (11). Baradaran evaluated the blood transfusion reactions in traumatic patients referred to the emergency department, but in the current study, all inpatients who received blood components were considered the study population. Sharma et al reported higher rates of allergic reaction, 68.5% in blood component recipients in India. They realized that the number of blood bags results in more undesirable reactions in patients (17). Moreover, 75% of allergic reactions were non-acute platelet concentrate transfusion-related, and the rest were acute

ones that occurred after RBC-containing components. The transfusion process must be stopped when the reaction is observed (16). In contrast to our results, FNHTR was reported as the most prevalent reaction in some studies (12,18,19). Shimmer and colleagues' results indicated that FNHTR occurs more than allergic reactions in patients who underwent surgery (18). Bodaghkhan et al also recorded about 68% rate for FNHTR which is higher than that for allergic reactions (19). Different types of transfused blood components, number of transfused units, history of transfusion, and history of diseases might justify the reasons for different results (13,15).

Moreover, the rate of blood transfusion reactions was higher in women than in men. Although no difference rate is reported by different studies in terms of sex or partial higher reaction rate in men (18-20), lower hemoglobin limits and greater need for blood transfusion due to physiological conditions of women might be the reasons for these findings.

In addition, 33% of blood recipients had a disease history, but it did not impact the type of reactions. Having a history of disease increases the possibility of hospitalization and blood transfusion, resulting in more transfusion-related reactions (2,4,6). Mohebi et al showed that the majority of patients receiving blood components have a disease history, including cardiac and liver diseases (21), but Amini Dashti and colleagues' study demonstrated that disease history as well as other demographic parameters such as age and sex do not influence the type and rate of blood transfusion reactions (20).

Blood transfusion-related reactions were more prevalent in patients with transfusion history. The history of transfusion leads to previous exposure to the different antigens and increases the rate and severity of blood transfusion reaction (8,10,16,18). Amiri et al and Refaai & Blumberg reported higher reaction rates in the recent three months' recipients (11,22). In other words, having a transfusion history increases the frequency of reactions. Multi-transfused patients and multiparous women were more susceptible to blood transfusion reactions due to former exposure to antigens and blood components (11,13,21,22). The number of transfused units could impact the frequency or even type of reaction, and the transfusion of more than two blood units leads to an increased rate of reactions, especially in terms of allergic reactions (11,13,15). The current study did not evaluate the relationship between the number of transfused units or the number of transfusion times and the type of reactions.

RBC concentrate and RDP were the most transfused components, while SDP and cryoprecipitate were the least ones. Mohebbifar et al and Beuno et al have also demonstrated higher RBC- and RDP-transfused units in their research (14,21), but FFP was reported as the least transfused component by Mohebbifar et al (21). Due to the high prevalence of anemia and thrombocytopenia in inpatients, the usage of RBC concentrates and RDP is higher than that of other blood components (8,14,21). On

the other hand, blood component consumption/ order patterns might vary according to medical protocols and/ or physician orders.

According to the results of the current study, there was a significant relationship between the transfusion of RBC-containing components and FNHTR, but the transfusion of platelet or plasma components did not impact the FNHTR rate. Furthermore, the type of blood components did not affect allergic reaction incidence. Kasim et al indicated that the transfusion of RBC concentrates leads to more non-acute transfusion and FNHTR reactions and reported RDP as the main cause of acute allergic reactions (16). Another study reported a higher occurrence of allergic reactions after the transfusion of platelet components (23).

### Conclusion

In sum, allergic reactions and FNHTR were the most prevalent reactions in the blood recipients. Despite all applied strategies for reducing unwanted blood transfusion reactions, their occurrence is inevitable. Updating blood transfusion procedures, using proper filters during transfusion, the root cause analysis of events, staff training, and implementation of an improved haemovigilance system could be useful in reducing blood transfusion reactions (11, 13). Conducting studies on larger sample sizes, surveying non-reacting blood recipients, and designing proper control groups can be considered in future studies.

### Authors' Contribution

**Conceptualization:** Fatemeh Amiri.

**Data curation:** Fatemeh Amiri, Mahta Razaghi.

**Formal analysis:** Fatemeh Amiri.

**Funding acquisition:** Fatemeh Amiri.

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**Methodology:** Mohammad Rezaei .

**Project administration:** Fatemeh Amiri.

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### Competing Interests

None declared.

### Ethical Approval

This study was approved by the Hamadan University of Medical Sciences with Ethic Code: IR.UMSHA.REC.1401.007.

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