Journal of Pediatric Academy

Original Article

Year: 2024 Volume: 5 Issue: 3
Doi: 10.4274/jpea.2024.294
J Pediatr Acad

Retrospective Analysis of Transfusion-Related Adverse Reactions: A 15-Month Study of a Single Center's Experience

Author(s)

Şule Çalışkan Kamış, Defne Ay Tuncel, Ganiye Begül Küpeli

Affiliation(s)

University of Health Sciences Türkiye, Adana City Training and Research Hospital, Clinic of Pediatric Hematology and Oncology, Adana, Türkiye

Article Information

Article Type: Original Articles
Article Group: Pediatric Hematology

Received: 16.03.2024
Accepted: 22.07.2024
Epub: 09.09.2024
Available Online: xxxxxxxx

Cite this article as: *Çalışkan Kamış Ş, Tuncel DA, Küpeli GB. Retrospective Analysis of Transfusion-Related Adverse Reactions: A 15-Month Study of a Single Center's Experience. J Pediatr Acad.*

Abstract

The aim of this study was to evaluate transfusion-related adverse reactions (TRARs). In this study, all adverse reactions (ARs) related to blood/blood product transfusions conducted between 01.01.2022 and 31.03.2023 at the Health Sciences University Türkiye, Adana City Training and Research Hospital were evaluated. In total, 97,926 records of blood and blood component transfusions were evaluated during the study period. The distribution of blood components used was as follows: 57,066 (58.2%) red blood cell concentrates, 27,345 (28%) fresh frozen plasma, 12,282 (12.5%) pooled platelet concentrates, 564 (0.6%) apheresis platelet concentrates, and 669 (0.7%) cryoprecipitates. In total, 40 AR reports were associated with transfusions. The probability levels of the relationship degrees of reactions for these 40 cases were as follows: 2 cases; not likely (5%); 32 cases; likely (80%); 2 cases; highly likely (5%); and 4 cases, unassessable (10%). All unwanted reactions were acute, and there were no delayed reactions. No transfusion reaction (TR) leading to death occurred. Of the patients who developed reactions, 60% (n=24) were female, and 40% (n=16) were male. The ages of patients with unwanted reactions ranged from 2 to 86 years, with a median age of 33. Among the cases with unwanted reactions, 8 were children (20%) and 32 were adults (80%). In our study, the frequency of allergic TR was 8.1 per 100,000 children and 32.6 per 100,000 adults. A statistically significant difference in the distribution of blood component types among cases based on the types of unwanted reaction was observed (p=0.003).

In this retrospective evaluation of 15 months of data from a single center, 97,926 blood component transfusions were performed, and the prevalence of TRAR was 40.8 per 100,000 blood components.

Keywords: Transfusion, hemovigilance, hemolysis

Correspondence: Şule Çalışkan Kamış, University of Health Sciences Türkiye, Adana City Training and Research Hospital, Clinic of Pediatric Hematology and Oncology, Adana, Türkiye
E-mail: sulecaliskan87@yahoo.com **ORCID:** 0000-0003-0008-303X

***This article was presented as an oral presentation at the 22nd International Eastern Mediterranean Family Medicine Congress.**

Introduction

Red blood cell (RBC) transfusion is necessary to enhance a patient's oxygen-carrying capacity[1]. Transfusion reactions (TRs) are defined as adverse events associated with whole blood or its components transfusion. Their severity can range from minor to life-threatening[2]. According to the onset time, adverse reactions (ARs) of blood transfusion are classified as acute (occurring within the first 24 hours) and delayed (occurring after 24 hours). In cases of acute TR, prompt identification and immediate cessation of transfusion are critical. These reactions can typically occur immediately or within a few hours after transfusion, and their severity varies depending on the type of reaction, the patient's overall health condition, and promptness of treatment response. Occasionally, some patients may develop anaphylaxis or severe allergic reactions during or after transfusion, characterized by rapidly spreading skin rashes, respiratory distress, low blood pressure, and even shock. Acute hemolytic reactions occur as rapid and intense immune responses to blood cells. If an incorrect blood group is transfused or in cases of severe incompatibility, the patient's own blood cells can break down, leading to serious consequences, such as kidney damage and organ failure. Transfusion-related acute lung injury is a rare but serious condition characterized by acute respiratory failure and fluid accumulation shortly after transfusion, triggered by antibodies in the donor's blood reacting with the recipient's immune system. Transfusion-associated circulatory overload is associated with significant fluid overload and cardiovascular stress, particularly following high-volume transfusions, leading to septic symptoms[3,4]. Vigilance is necessary to differentiate delayed responses or reactions displaying non-specific signs and symptoms[5]. Transfusion-related ARs (TRAR) are classified according to the National Hemovigilance Guide version 2, March 2020[6]. Hemovigilance encompasses a set of monitoring procedures that involve collecting, evaluating, and preventing the recurrence of unwanted events and reactions related to the entire transfusion chain, from the collection and processing of blood and blood components to their transfusion and follow-up, aiming to gather information [7].

The present study aimed to determine the frequency of TRAR among patients receiving blood transfusions in our tertiary care hospital and contribute to the national hemovigilance data.

Highlights

- Frequency of transfusion-related adverse reactions (TRARs): TRARs are very rare. In this retrospective study conducted at a single center and based on 15 months of data, 97,926 blood component transfusions were performed, and the prevalence of TRARs was 40.8 per 100,000 blood components.
- Hemovigilance: Hemovigilance encompasses the reporting, monitoring, and analysis of adverse events with the inclusive goal of improving donor and patient safety throughout the transfusion process. The current study aimed to determine the frequency of TRARs in patients undergoing blood transfusion at our tertiary care hospital and contribute to national hemovigilance data.
- Evaluation of blood component types by adverse reaction types: In our study, statistically significant differences were found in the distribution of blood component types among cases according to the types of adverse reactions (p=0.003).

Material and Method

In this study, all ARs related to blood/blood product transfusions conducted at the Health Sciences University Türkiye, Adana Faculty of Medicine, Adana City Training and Research Hospital between January 01, 2022, and March 31, 2023, were evaluated. Transfusion monitoring forms specific to patients, suspected adverse reaction forms related to transfusion, investigation and treatment forms, rapid notification forms, and verification forms standardized in the NHG were retrospectively examined from the hospital's hemovigilance unit archive and Hospital Information Management System.

All TR reported to the hemovigilance unit were classified according to the degree of evidence-based relationship degree[6]. The severity of TRAR was graded according to the form specified in the NGH version 2, March 2020[6].

This study was approved by the Adana City Training and Research Hospital Clinical Research Ethics Committee (decision no: 2426, date: 06.04.2023).

Statistical Analysis

The statistical analysis of the study was conducted using the Statistical Package for the Social Sciences version 26 (IBM Corp., Armonk, NY, USA) software. The demographic data of the patients were presented using descriptive statistics. Categorical measurements were presented as counts and percentages, whereas numerical measurements were presented as means and standard deviations (or medians and interquartile ranges where necessary). The chi-square test was used to compare categorical measurements between groups, and the chi-square test for multiple proportions was employed for multi-category comparisons. A statistical significance level (p) of 0.05 was considered statistically significant in all analyses.

Results

In total, 97,926 records of blood and blood component transfusions were evaluated during the study period. The distribution of blood components used was as follows: 57,066 (58.2%) RBC concentrates, 27,345 (28%) fresh frozen plasma (FFP), 12,282 (12.5%) pooled platelet concentrates, 564 (0.6%) apheresis platelet concentrates, and 669 (0.7%) cryoprecipitates. In total, 40 TRARs were reported. The probability levels of the

relationship degrees (imputability) for the reactions of these 40 cases were as follows: 2 cases; not likely (5%); 32 cases; likely (80%); 2 cases; highly likely (5%); and 4 cases, unassessable (10%). All unwanted reactions were acute, and there were no delayed reactions. No TR leading to death occurred.

Among the patients who developed reactions, 60% (n=24) were female, and 40% (n=16) were male. The ages of patients with unwanted reactions ranged from 2 to 86 years, with a median age of 33. Among the cases with unwanted reactions, 8 were children (20%) and 32 were adults (80%). In our study, the frequency of allergic TR was 8.1 per 100,000 children and 32.6 per 100,000 adults. Among these patients, 16 were blood group A Rh-positive (40%), 1 was A Rh-negative (2.5%), 7 were B Rh-positive (17.5%), 14 were O Rh-positive (35%), and 2 were AB Rh-positive (5%). The most common symptom observed was itching, with a rate of 37.5% (n=15). The second most frequently observed symptom was fever, at a rate of 15% (n=6). Redness, shortness of breath, and rash were observed at a rate of 12.5% each (n1=5, n2=5, n3=5). Other observed symptoms included hypotension, headache, nausea, and tachycardia at a rate of 2.5% (n1=1, n2=1, n3=1, n4=1).

When unwanted reactions were evaluated, “mild allergic reaction” was observed in 26 patients (65%). “Febrile non-hemolytic transfusion reaction” (FNHTR) was observed in 6 patients (15%). “Acute undefined transfusion reaction” was observed in 3 patients (7.5%). “Transfusion-associated shortness of breath” was observed in 2 patients (5%), and “anaphylactic reaction” was observed in 2 patients (5%). Unwanted reactions related to transfusion were associated with 18 cases (45%) of RBC Suspension, 20 cases (50%) FFP, and 2 cases (5%) of pooled platelet suspension.

A statistically significant difference in the distribution of blood component types among cases based on the types of unwanted reaction was observed (p=0.003) (**Table 1**).

Table 1. *Evaluation of blood component types according to unwanted reaction types*

Transfusion reactions	Blood products			p-value
	Red blood cell suspension	Fresh frozen plasma	Platelet suspension	
	n (%)	n (%)	n (%)	
Mild allergic reaction	4 (%22.22)	20 (%100)	2 (%100)	0.003
Febrile nonhematologic transfusion reaction	6 (%33.33)	0	0	
Hypertensive transfusion reaction	1 (%5.56)	0	0	
Acute undefined transfusion reaction	3 (%16.67)	0	0	
Transfusion-related dyspnea	2 (%11.11)	0	0	
Anaphylactic reaction	2 (%11.11)	0	0	
Total	18 (%100)	20 (%100)	2 (%100)	

Discussion

Hemovigilance encompasses the reporting, monitoring, and analysis of adverse events with the inclusive goal of improving donor and patient safety throughout the process of transfusion from vein to vein[7]. In this study, conducted at a single center and retrospectively evaluating 15 months of data, a total of 97,926 blood component transfusions were performed, and the prevalence of TRAR was 40.8 per 100,000 blood components. Although blood transfusion is a life-saving treatment method, TRAR is associated with common complications that rarely result in death[8]. When the literature is reviewed, it provides significant insights into the frequency, diversity, and impact of TRs. Large-scale epidemiological studies have indicated that the most common ARs post-transfusion are febrile non-hemolytic TRs (FNHTR) and mild allergic reactions. FNHTR is characterized by symptoms such as high fever and chills, typically resulting from immune responses. Allergic reactions may present with mild symptoms like itching, redness, hives, or localized angioedema, and may occasionally escalate to serious conditions, such as anaphylaxis[9,10].

Despite the high safety of blood transfusion, adverse effects can still occur. Generally, unwanted reactions occur in approximately 1% of transfusions[11]. Allergic TR is mostly characterized by mild clinical symptoms, such as itching, redness, urticaria, or localized angioedema. Anaphylactic reactions, on the other hand, are severe allergic reactions accompanied by bronchospasm and hypotension[12]. In our study, when unwanted reactions were evaluated, “mild allergic reaction” was observed in 26 patients (65%). The second most frequent allergic reaction is FNHTR. These reactions are defined by the U.S. Centers for Disease Control and Prevention defined as an increase in body temperature to 38°C or higher, an increase of ≥1°C within 4 hours of transfusion, or the occurrence of chills and shivering[13]. In our study, “febrile non-hemolytic reaction” was observed in 6 patients (15%). Literature reports also highlight the occurrence of rare yet life-threatening reactions, such as acute hemolytic reactions. These reactions can occur due to factors like mismatched blood transfusions or pre-existing antibodies to transfused blood products, which significantly impact the patient’s health. Hemovigilance programs play a crucial role in the early identification and management of such serious reactions[14,15].

Hericks et al.[16] reported a case of acute hemolytic reaction in a neonate likely caused by transfusion of an FFP product containing autoantibodies. In our study, ARs were observed in 20 out of 40 patients receiving FFP who developed unwanted reactions. A comparison of TR rates between children and adults in a tertiary care institution in the United States was published by Oakley et al.[17] in 2015. During the 2-year study period, the incidence of allergic TR was 2.7 per 1000 individuals in children and 1.1 per 1000 adults[17]. Kracalik et al.[18] reported 18,308 TRARs among 8.34 million transfused blood components (220 per 100,000) from 2013 to 2018 in 201 facilities. In our study, the frequency of allergic TR was 8.1 per 100,000 children and 32.6 per 100,000 adults. Advancements in the management and

prevention of TRs play a pivotal role in clinical practice and the formulation of transfusion policies. Recent research continuously enhances the knowledge and practices related to transfusion safety, thereby ensuring optimal patient outcomes from this critical medical intervention. In this context, hemovigilance is central to enhancing transfusion safety and minimizing potential risks[19,20].

Furthermore, our study found a statistically significant difference in the distribution of blood component types among cases based on the types of unwanted reaction (p=0.003).

Conclusion

The present study aimed to determine the frequency of TRAR among patients receiving blood transfusions in our tertiary care hospital and contribute to the national hemovigilance data. In this retrospective evaluation of 15 months of data from a single center, 97,926 blood component transfusions were performed, and the prevalence of TRAR was 40.8 per 100,000 blood components.

Ethical Approval: This study was approved by the Adana City Training and Research Hospital Clinical Research Ethics Committee (decision no: 2426, date: 06.04.2023).

Informed Consent: Because the study was designed retrospectively no written informed consent form was obtained from the patients.

Author Contributions: Çalışkan Kamış Ş: Literature Search, Writing.; Tuncel DA: Data Collection or Processing.; Küpeli GB: Concept, Design, Data Collection or Processing, Analysis or Interpretation.

Conflict of Interest: The authors declare no conflicts of interest.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Tanhehco YC. Red Blood Cell Transfusion. *Clin Lab Med*. 2021;41:611-619. *[Crossref]*
2. Suddock JT, Crookston KP. Transfusion Reactions. 2023 Aug 8. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan. *[Crossref]*
3. Goel R, Tobian AAR, Shaz BH. Noninfectious transfusion-associated adverse events and their mitigation strategies. *Blood.* 2019 Apr 25;133:1831-1839. *[Crossref]*
4. Ackfeld T, Schmutz T, Guechi Y et al. Blood Transfusion Reactions-A Comprehensive Review of the Literature including a Swiss Perspective. *J Clin Med.* 2022 May 19;11:2859. *[Crossref]*
5. Wang Y, Rao Q, Li X. Adverse transfusion reactions and what we can do. *Expert Rev Hematol.* 2022;15:711-726. *[Crossref]*
6. Ertuğrul Örüç N, Yenicesu İ, Öztürk A, Kodaloğlu Temur Ü. Ulusal Hemovijilans Rehberi. Sağlık Bakanlığı Sağlık Hizmetleri Genel Müdürlüğü Kan ve Kan Ürünleri Dairesi Başkanlığı, 2020. *[Crossref]*
7. de Vries RR, Faber JC, Strengers PF, et al. Haemovigilance: an effective tool for improving transfusion practice. *Vox Sang.* 2011;100:60-67. *[Crossref]*
8. Pektaş G, Çetin D. Transfüzyon İlişkili İstenmeyen Reaksiyonların 7 Yıllık Retrospektif Analizi: Tek Merkez Deneyimi. *Abant Medical Journal.* 2021;10:47-54. *[Crossref]*
9. Savage WJ, Tobian AA, Savage JH et al. Scratching the surface of allergic transfusion reactions. *Transfusion.* 2013 Jun;53:1361-71. *[Crossref]*
10. Andrys B, Korybalska K. Analysis of the frequency of post transfusion adverse reactions and their association with blood components supplied by the Regional Blood Transfusion Center in Poznań (2011–2018). *Journal of Transfusion Medicine.* 2022;15:196-209. *[Crossref]*
11. Clebone A. Transfusion reactions and cognitive aids. *Curr Opin Anaesthesiol.* 2019;32:242-246. *[Crossref]*
12. Delaney M, Wendel S, Bercovitz RS, et al. Transfusion reactions: prevention, diagnosis, and treatment. *Lancet*. 2016;388:2825-2836. *[Crossref]*
13. Scott RD. The Direct medical costs of healthcare-associated infections in U.S. hospitals and the benefits of prevention, 2009. *[Crossref]*
14. Strobel E. Hemolytic Transfusion Reactions. *Transfus Med Hemother.* 2008;35:346-353. *[Crossref]*
15. Hong H, Duque M. A., Al Mana A. F. et al. Noninfectious transfusion-associated adverse events. *Annals of Blood.* 2022;7. *[Crossref]*
16. Henricks LM, Huisman EJ, Lopriore E, et al. Acute haemolytic transfusion reaction after transfusion of fresh frozen plasma in a neonate-Preventable by using solvent/detergent-treated pooled plasma? *Transfus Med*. 2023;33:174-178. *[Crossref]*
17. Oakley FD, Woods M, Arnold S, et al. Transfusion reactions in pediatric compared with adult patients: a look at rate, reaction type, and associated products. *Transfusion*. 2015;55:563-570. *[Crossref]*
18. Kracalik I, Mowla S, Basavaraju SV, et al. Transfusion-related adverse reactions: Data from the National Healthcare Safety Network Hemovigilance Module - United States, 2013-2018. *Transfusion*. 2021;61:1424-1434. *[Crossref]*
19. De Jonge L. L., Wiersum-Osselton J. C., Bokhorst A. G. et al. Haemovigilance: current practices and future developments. *Annals of Blood.* 2022;7,6918. *[Crossref]*
20. Rogers TS, Fung MK, Harm SK. Recent Advances in Preventing Adverse Reactions to Transfusion. *F1000Res.* 2015 Dec 17;4:F1000 Faculty Rev-1469. *[Crossref]*