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SHORT COMMUNICATION

Trends and Incidence of Transfusion Reactions: a Single-Center 5-Year Retrospective Analysis

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SUMMARY

Background: **Transfusion reactions, including allergic and febrile non-hemolytic responses, remain a safety concern despite advancements in donor screening and leukocyte reduction. Understanding the incidence and contributing factors of these reactions is essential for enhancing transfusion practices and patient safety.**
Methods: **This study retrospectively analyzed transfusion reactions at our institution from January 2019 to August 2024. Data from hemovigilance records were reviewed to identify the incidence, types, and severity of reactions.**
Results: **An overall reaction rate of 0.28% was observed, with itching/urticaria, chills, and fever as the most common types. These findings align with global reports, indicating the effectiveness of the implemented preventive strategies in minimizing severe reactions.**
Conclusions: **This study highlights the importance of individualized patient protocols and continuous monitoring to reduce transfusion risks. Preventive strategies, such as leukocyte reduction, premedication for high-risk patients, and vigilant observation during transfusions, have proven effective in limiting reaction severity. By providing insights into transfusion reaction patterns, this analysis supports efforts to enhance patient safety and optimize transfusion practices through targeted quality improvements.**
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KEYWORDS

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INTRODUCTION

Blood transfusions serve as essential therapeutic interventions across various medical specialties, supporting acute trauma management, chronic hematologic care, and the treatment of oncologic disorders. They provide critical support in replenishing blood volume, improving oxygen delivery, and managing coagulopathy in various clinical scenarios. Transfusions are integral to both emergency medicine and the long-term care of patients with conditions like anemia, thrombocytopenia, and clotting factor deficiencies. Transfusions, while offering significant therapeutic benefits, can also cause

adverse effects. These adverse effects, known as transfusion reactions, occur in response to the transfusion of blood or its components [1,2].

Advances in donor screening, blood collection, and product storage have significantly reduced the risks associated with transfusion; however, transfusion reactions continue to occur, sometimes with severe consequences. Transfusion reactions are described as negative events in connection with the transfusion of whole blood or its components, including red blood cells (RBCs), platelets, plasma, granulocytes, and others [3]. Transfusion reaction prevalence and types vary significantly worldwide, influenced by differences in transfusion protocols, patient demographics, and healthcare infrastructure. The incidence of transfusion reactions varies widely across institutions due to differing reporting standards but is estimated to occur in about 0.1% to 3% of all transfusion events [4,5].

Allergic reactions and febrile non-hemolytic transfusion reactions (FNHTRs) are the two most frequently occurring types of transfusion reactions [6]. Rare but severe reactions, such as anaphylaxis and acute hemolytic transfusion reactions, are of particular concern due to their rapid onset and potentially fatal consequences [7]. The risk of these severe reactions has been mitigated to some extent by rigorous screening of blood donors, improved storage and handling protocols, and the implementation of leukocyte reduction and pathogen inactivation techniques [8]. However, even with these advancements, transfusion reactions remain a significant risk, and continuous efforts are needed to improve transfusion safety.

This study retrospectively evaluated the incidence and causes of transfusion reactions at our institution between January 2019 and August 2024. We aimed to identify key factors contributing to these reactions and propose potential strategies to mitigate their incidence, thereby improving overall patient safety.

MATERIALS AND METHODS

Study design and setting

Throughout the study period, 145,286 transfusions were administered, including, involving leukocyte-reduced packed red blood cells, platelets, plasma, and cryoprecipitate. We retrospectively reviewed the transfusion incident reports of all patients who experienced transfusion reactions. Between January 2019 and August 2024, a total of 145,286 transfusions were performed.

Data collection and sources

Transfusion reaction data were sourced from institutional hemovigilance records, with incidents documented in fully anonymized and aggregated formats to maintain patient confidentiality. Each entry in the database provided the type and quantity of blood products transfused, the classification of transfusion reactions, and the timing of the reaction relative to transfusion administration. The data used in this study were limited to information on transfusion events and reaction types, without any individual-level identifiers such as patient age, gender, or medical history. This approach ensured a focus solely on reaction patterns and incidence rates associated with different blood product types, allowing for comprehensive analysis without compromising patient confidentiality.

RESULTS

Incidence of transfusion reactions

Between January 2019 and August 2024, a total of 145,286 blood transfusions were administered at our institution. Out of these, 414 transfusion reactions were reported, resulting in an overall reaction incidence rate of 0.28% (2.8 reactions per 1,000 transfusions).

Distribution of transfusion reactions by blood product type

Table 1 presents the distribution of blood products transfused during the study period. The majority of transfusions involved leukocyte-reduced red blood cells (53.52%, 77,757 units) and fresh frozen plasma (27.10%, 39,378 units). Other blood products included cryoprecipitate (11.37%, 16,518 units), leukocyte-reduced platelet pheresis (4.27%, 6,205 units), and platelet pheresis (3.31%, 4,807 units). Less frequently used products comprised platelets (0.37%, 532 units), washed red cells (0.02%, 36 units), whole blood (0.02%, 33 units), and frozen plasma (0.01%, 20 units).

Types of transfusion reactions

The most common transfusion reaction observed was itching or urticaria, accounting for 25.4% of all reactions (105 cases). Chills were the second most frequent, representing 18.6% (77 cases), followed closely by fever (> 1°C) in 17.4% (72 cases). Other notable reactions included whole-body skin rash (14.5%, 60 cases) and a category of “other reactions” that collectively accounted for 18.6% (77 cases). These reactions included gastrointestinal symptoms, cardiovascular symptoms, and isolated incidents such as decreased urine output, sudden back pain, post-transfusion shock, edema, and sudden respiratory failure. Rare but severe reactions were documented at lower frequencies. Nausea/vomiting constituted 1.4% of reactions, while chest pain accounted for 0.97%, and headache 0.48%. The low incidence of these severe reactions highlights the effectiveness of the institution's leukocyte reduction protocols and preventive measures, particularly in high-risk patients. Figure 1 shows the distribution of these transfusion reaction types, illustrating the relative frequencies of both common and rare reactions over the study period.

Table 1. Distribution of blood products transfused from 2019 to 2024

Blood Product	Units Transfused
Whole Blood	33
Red Cells, Washed	36
Red Cells, Leukocyte Reduced	77,757
Cryoprecipitate	16,518
Platelets	532
Platelet Pheresis	4,807
Leukocyte Reduced Platelet Pheresis	6,205
Fresh Frozen Plasma	39,378
Frozen Plasma	20

DISCUSSION

The transfusion reaction rate is an essential indicator of patient safety and the quality of blood transfusion practices within healthcare settings. In our study, the overall transfusion reaction rate was calculated to be 0.28%. This rate aligns with findings reported in the existing literature, in which the reported transfusion reaction rates typically range from 0.2% to 3%, depending on various factors such as the patient population, type of blood products used, and institutional protocols for monitoring and reporting adverse events [9]. Effective transfusion practices, such as rigorous donor screening, proper blood product storage, and adherence to transfusion guidelines, can help lower the reaction rate. However, even a low rate of transfusion reactions emphasizes the importance of continuous monitoring, staff education, and quality improvement measures to further reduce these risks and enhance patient care. Recently, Saha H et al. retrospectively analyzed adverse transfusion reactions (ATR) at a multi-organ transplant center in South India from April 2011 to April 2018, finding an overall ATR incidence of 0.14%, with allergic reactions being the most common, primarily in male patients and those undergoing liver transplantation [10]. However, ATR was not observed in our study; instead, the most commonly reported reactions were itching/urticaria. Mardani A et al. analyzed 20,062 transfusion reactions (TRs) reported in Iran between 2014 and 2018, revealing an overall TR frequency of 0.14%, with the most common reactions being allergic and febrile nonhemolytic, highlighting the importance of comprehensive hemovigilance practices to improve transfusion safety [11]. Our transfusion reaction rate of 0.28% aligns with similar studies, such as Mardani et al., who reported a lower rate of 0.14%. The higher proportion of allergic reactions (25.4%) observed in our cohort may be due to differences in blood product utilization or the specific demographics of our patient population. Another study demonstrated that 380,658 blood transfusions between 2007 and 2012 reported a transfusion reaction rate of 0.05%, with allergic reactions being the most common, emphasizing the need for increased awareness and proper hemovigilance to improve transfusion safety [12]. Additionally, a 7-year retrospective study in Western Norway found that non-hemolytic ATRs occurred at a rate of 1.28 per 1,000 blood products, with mild allergic reactions being the most common. The study also highlighted associations between erythrocyte suspension transfusions in elderly patients and febrile non-hemolytic transfusion reactions, as well as between fresh frozen plasma transfusions and mild allergic reactions [13]. Furthermore, Yeh SP et al. demonstrated that, following the implementation of the online transfusion reaction reporting system in Taiwan, the reported incidence of transfusion reactions significantly increased from 0.21% to 0.61% per unit of blood [14]. The most common transfusion reactions observed were chills, allergic reactions, and febrile non-hemolytic transfusion reactions (FNHTRs).

To minimize transfusion reaction risks, our institution has implemented a series of preventive strategies, including leukocyte reduction protocols and patient monitoring. We introduced leukocyte-reduced red cells in October 2017 and leukocyte-reduced platelets in October 2022. This practice significantly decreases the incidence of FNHTRs, primarily caused by leukocytes in transfused blood products. By reducing the number of white blood cells in these units, we have minimized immune-mediated reactions, particularly in patients who undergo frequent transfusions or are at higher risk due to underlying conditions. Additionally, we have also established monitoring protocols for high-risk patients (e.g., those with a history of allergic reactions or multiple transfusions), ensuring that these patients are closely observed during and after transfusions. Premedication, such as the use of antihistamines and antipyretics, is considered on a case-by-case basis, particularly for patients with known sensitivities. These preventive measures have contributed to the low incidence of severe transfusion reactions observed in our study, and we continue to evaluate and improve these protocols to enhance patient safety.

The overall transfusion reaction rate in our hospital was 0.28%, comparable to previously reported rates in the literature, ranging from 0.05% to 3%. Itching/urticaria and Chills were the most common reactions. These findings underscore the need for individualized transfusion practices, especially for patients with pre-existing conditions or those requiring repeated transfusions. This retrospective analysis offers valuable insights into transfusion reaction rates and contributing factors at our institution from 2019 to 2024. While the overall rate was low, identifying key contributing factors such as pre-existing conditions, storage duration of blood products, and transfusion rates offers actionable pathways for improving transfusion safety. These findings contribute to the broader understanding of transfusion reactions and

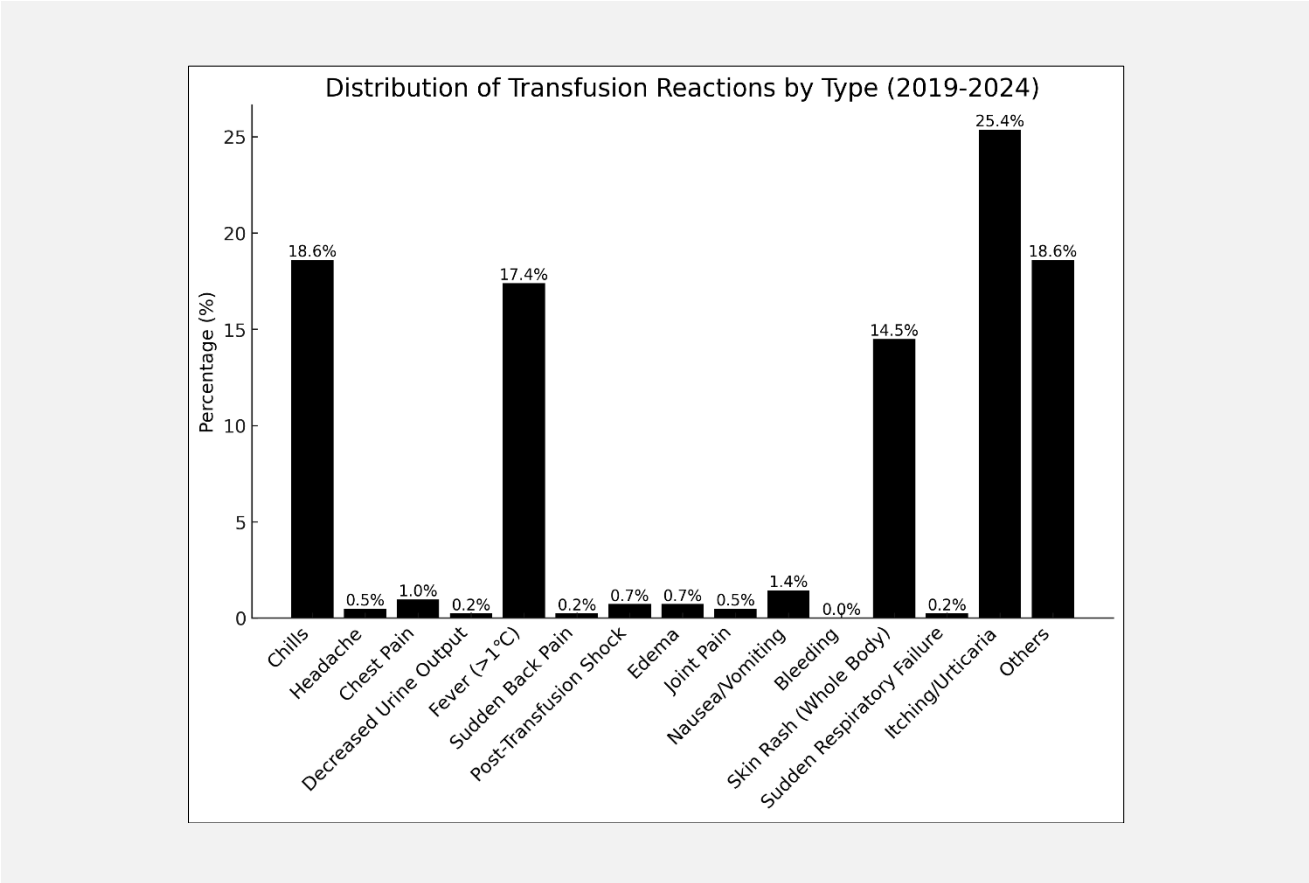

Figure 1. Distribution of transfusion reactions by type (2019 - 2024).

This bar chart presents the percentage distribution of various transfusion reactions recorded between 2019 and 2024. The most commonly observed reactions are itching/urticaria (25.4%), followed by chills (18.6%) and fever (> 1°C, 17.4%). Less frequent reactions, such as chest pain, headache, sudden back pain, and post-transfusion shock, each constitute a small proportion of the overall cases. Additionally, minor reactions like decreased urine output and edema collectively account for less than 1% of the total distribution

may stimulate further research into strategies for improving transfusion safety.

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Declaration of Interest:
None.

References:

1. Ning S, Solh Z, Arnold DM, Morin PA. Premedication for the prevention of nonhemolytic transfusion reactions: a systematic review and meta-analysis. Transfusion 2019, 59(12):3609-16. (PMID: 31670424)

2. Kar YD, Yildirgan DO, Aygun B, Erdogmus D, Altinkaynak K. Retrospective evaluation of acute transfusion reactions in a tertiary hospital in Erzurum, Turkey. North Clin Istanb 2021;8(3):261-8. (PMID: 34222807)

3. Goel R, Tobian AAR, Shaz BH. Noninfectious transfusion-associated adverse events and their mitigation strategies. Blood 2019; 133(17):1831-9. (PMID: 30808635)

4. Karafin MS, Bruhn R, Westlake M, et al. Demographic and epidemiologic characterization of transfusion recipients from four US regions: evidence from the REDS-III recipient database. Transfusion 2017;57(12):2903-13. (PMID: 29067705)

5. Nitsche E, Dressler J, Henschler R. Systematic Workup of Transfusion Reactions Reveals Passive Co-Reporting of Handling Errors. J Blood Med 2023;14:435-43. (PMID: 37576590)

6. Marti-Carvajal AJ, Sola I, Gonzalez LE, Leon de Gonzalez G, Rodriguez-Malagon N: Pharmacological interventions for the prevention of allergic and febrile non-haemolytic transfusion reactions. Cochrane Database Syst Rev 2010;2010(6):CD007539. (PMID: 20556779)

7. Soutar R, McSporran W, Tomlinson T, Booth C, Grey S. Guideline on the investigation and management of acute transfusion reactions. Br J Haematol 2023;201(5):832-44. (PMID: 37211954)

8. Paglino JC, Pomper GJ, Fisch GS, Champion MH, Snyder EL. Reduction of febrile but not allergic reactions to RBCs and platelets after conversion to universal prestorage leukoreduction. Transfusion 2004;44(1):16-24. (PMID: 14692962)

9. Delaney M, Wendel S, Bercovitz RS, et al. Transfusion reactions: prevention, diagnosis, and treatment. Lancet 2016;388(10061): 2825-36. (PMID: 27083327)

10. Saha S, Krishna D, Prasath R, Sachan D. Incidence and Analysis of 7 Years Adverse Transfusion Reaction: A Retrospective Analysis. Indian J Hematol Blood Transfus 2020;36(1):149-55. (PMID: 32158098)

11. Mardani A, Balali MR. Transfusion reactions: A retrospective analysis of the Iranian national haemovigilance system (INHS) data. Transfus Apher Sci 2020;59(4):102767. (PMID: 32280036)

12. Kumar P, Thapliyal R, Coshic P, Chatterjee K. Retrospective evaluation of adverse transfusion reactions following blood product transfusion from a tertiary care hospital: A preliminary step towards hemovigilance. Asian J Transfus Sci 2013;7(2):109-15. (PMID: 24014939)

13. Erikstein BS, Alnaes MB, Apelseth TO. Blood transfusion-associated anaphylaxis in perioperative- and non-perioperative patients in Western Norway 2002-2021. Blood Transfus. Epub 2024 May 15. (PMID: 38814882)

14. Yeh SP, Chang CW, Chen JC, et al. A well-designed online transfusion reaction reporting system improves the estimation of transfusion reaction incidence and quality of care in transfusion practice. Am J Clin Pathol 2011;136(6):842-7. (PMID: 22095368)