

Transfusion Reaction Occurrence Based on Types of Blood Components in Airlangga University General Hospital

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ABSTRACT

Blood transfusion reactions are a common occurrence, but they can be minimized through proper screening and monitoring procedures. By understanding the types of blood components that are most likely to cause reactions, healthcare providers can take steps to reduce the risk of adverse events. This thesis describes the Transfusion Reactions that Occur Based on Types of Blood Components at Airlangga University General Hospital. This is a retrospective observational study using secondary data from medical records of blood transfusion recipients at Airlangga University General Hospital. The goal is to analyze blood transfusion reactions that occurred between January 2022 and June 2023. All medical records of blood transfusion recipients during this period were included in the study. The study found a significant gender disparity in transfusion reactions, with females being more likely to experience reactions than males. The most common transfusion reactions were febrile non-hemolytic transfusion reactions (FNHTR) and allergic reactions. There are 51 patients who show febrile non-hemolytic and 17 Patients with allergic reactions. These reactions can occur in individuals of all ages but are most prevalent in adults aged 19-60. Packed red cells (PRCs) were the most common blood component involved in reactions. In conclusion, most transfusion reactions are mild and do not require further treatment. Patients should be informed about the potential risks of blood transfusions before undergoing the procedure.

Keywords: transfusion component; transfusion reaction; quality of life.

INTRODUCTION

The demand for blood and blood products has been steadily increasing globally due to advances in healthcare, an aging population, and the growing need for complex medical procedures such as surgeries, cancer treatments, and trauma care. In India alone, the clinical demand for blood was estimated at approximately 14.6 million units annually, translating to about 36 donations per 1,000 eligible individuals [9]. Similarly, in the United States, an estimated 15 million units of blood are transfused annually to support medical procedures, emergency interventions, and the treatment of chronic diseases [8]. These figures highlight the crucial role that blood transfusions play in modern healthcare systems.

Blood transfusions involve the administration of whole blood or its specific components, such as packed red cells (PRCs), platelets, plasma, or cryoprecipitate, to patients with varying medical needs. Advances in blood banking and transfusion medicine have shifted the focus from whole-blood transfusions to component-based transfusions, allowing for the targeted treatment of specific deficiencies in patients. For instance, patients with anemia often receive packed red cells, while those

with clotting disorders may require plasma or cryoprecipitate [11]. While blood transfusions have undoubtedly saved countless lives, they are not without risk. One of the most prominent concerns in transfusion medicine is the occurrence of transfusion reactions, which can range from mild allergic reactions to life-threatening conditions such as acute hemolytic reactions or transfusion-related acute lung injury (TRALI) [5].

Transfusion reactions are classified as either immune-mediated or non-immune-mediated. Immune-mediated reactions occur when the recipient's immune system reacts to foreign antigens in the donor blood, which can result in febrile non-hemolytic transfusion reactions (FNHTRs), allergic reactions, and more severe outcomes such as acute hemolytic transfusion reactions (AHTRs) [5]. Non-immune-mediated reactions, on the other hand, are caused by factors unrelated to immune incompatibility, such as bacterial contamination, improper storage of blood products, or physical injury to red blood cells [13]. The most frequently observed reactions are febrile non-hemolytic transfusion reactions (FNHTR), which account for a substantial proportion of transfusion-related complications [10].

Febrile non-hemolytic transfusion reactions (FNHTRs) are characterized by an increase in body temperature during or shortly after a transfusion. This reaction is thought to be caused by cytokines released from white blood cells in the stored blood product, as well as the recipient's antibodies reacting with donor leukocytes [10]. FNHTRs are considered mild but can cause significant discomfort for patients and may lead to interruptions in critical transfusion therapy. Another common reaction is the allergic transfusion reaction (ATR), often triggered by plasma proteins in donor blood, resulting in symptoms like hives, itching, and in rare cases, anaphylaxis [12]. Allergic reactions are more frequently observed in patients receiving plasma or platelet transfusions.

Studies have also shown that certain patient characteristics, such as gender, age, and blood type, may influence the risk of transfusion reactions. Multiple studies report that women, especially those with a history of pregnancy, are at a higher risk of developing immune-mediated reactions due to exposure to foreign antigens [2]. Additionally, the type of blood product transfused plays a significant role in the likelihood of reactions. For instance, packed red cells (PRCs) are associated with the highest number of reactions due to their widespread use and the presence of leukocytes and cytokines that accumulate during storage [5]. While the use of leukoreduced blood products has been shown to reduce the risk of FNHTR, many healthcare facilities continue to use non-leukoreduced products due to cost constraints [13].

Given the potentially serious health consequences of transfusion reactions, it is imperative for healthcare providers to identify patients at risk and implement appropriate preventive measures. Such measures include leukoreduction (filtering white blood cells from donor blood), improving donor screening procedures, and using advanced storage technologies to reduce cytokine buildup in blood products [3]. Healthcare providers must also counsel patients on the risks and benefits of transfusion, particularly in vulnerable populations such as infants, the elderly, and those with specific immune conditions.

This study aims to examine the prevalence and characteristics of transfusion reactions at Airlangga University General Hospital. Specifically, it seeks to identify the blood components most frequently associated with transfusion reactions and analyze the types of reactions experienced by patients. The findings will provide valuable insights into the hospital's transfusion safety profile and may inform the development of evidence-based policies to reduce transfusion-related complications. By identifying patterns related to gender, age, and blood type, this study aims to support the development of targeted interventions, such as improved leukoreduction protocols or patient-specific risk assessments, to enhance patient safety and reduce the burden of transfusion-related morbidity.

METHOD

A retrospective observational study was conducted using secondary data from the medical records of blood transfusion recipients at Airlangga University General Hospital. The study period covered January 2022 to June 2023. The inclusion criteria were all blood transfusion recipients with recorded transfusion reactions during this timeframe. Patients with incomplete medical records were excluded from the study.

Data collection involved extracting information on patient demographics (age, sex, and blood type), the type of blood component received (whole blood, packed red cells, plasma, or platelets), and the type of transfusion reaction observed. Data were processed and analyzed using descriptive statistics. The frequency and percentage of transfusion reactions by gender, age, blood type, and type of transfused blood component were calculated and visualized using tables and charts.

RESULT

The study identified 68 transfusion reactions out of a total of 7,319 blood transfusions during the study period. The key findings are summarized as follows:

(1) Patient Demographics:

- Gender Distribution: 76.5% of patients who experienced transfusion reactions were female, while 23.5% were male.

TABLE 1: Gender Distribution and Frequency.

Gender	Frequency	Percentage (%)
Male	16	23.5%
Female	52	76.5%

- Age Distribution: Patients' ages ranged from 2 months to 82 years, with an average age of 45 years.

TABLE 2: Age Distribution.

	Minimum	Maximum	Mean
Age Diagnose	2 month	82	45

(2) Blood Type and Component Analysis

- Blood Type: The most common blood type among patients with transfusion reactions was blood type O (41.2%), followed by blood type A (30.9%), and blood type B (27.9%). No reactions were observed in patients with blood type AB.

TABLE 3: ABO Blood Group Distribution and Frequency.

ABO Blood Group	Frequency	Percentage(%)
A	21	30.9
B	19	27.9
AB	0	0
O	28	41.2

- Blood Component: Packed red cells (PRCs) were the most frequently associated with transfusion reactions, accounting for 77.9% of cases, followed by plasma (10.3%), whole blood (8.9%), and platelets (2.9%).

TABLE 4: Blood Transfusion Type Distribution and Frequencies.

Blood Transfusion Type	Frequency	Percentage (%)
PRC	53	77,9
Whole Blood	6	8,9
Plasma Component	7	10,3
Platelets Component	2	2,9
White Blood Component	0	0

(3) Types of Transfusion Reactions:

- Febrile Non-Hemolytic Transfusion Reactions (FNHTR): The most prevalent reaction, occurs in 75% of cases (51 out of 68 patients). This type of reaction was more common in female patients and predominantly occurred in individuals aged 19-60.
- Allergic Reactions: Occurred in 25% of cases (17 out of 68 patients). Allergic reactions were more common in female patients, with blood type O being the most represented.
- Other Reactions: No cases of acute hemolytic reactions, delayed hemolytic reactions, transfusion-related acute lung injury (TRALI), transfusion-associated circulatory overload (TACO), or transfusion-associated graft-versus-host disease (TA-GvHD) were reported during the study period.

DISCUSSION

The findings of this study highlight important insights into the occurrence of transfusion reactions at Airlangga University General Hospital. The analysis of gender, age, blood type, and transfused blood components revealed several significant patterns.

- (1) Gender Differences in Transfusion Reactions The study revealed that female patients accounted for 76.5% of transfusion reactions, significantly higher than the proportion of male patients (23.5%). This finding aligns with similar studies, such as those by Chakravarty-Vartak et al. (2021) and Ibrahim et al. (2020), where female patients also had a higher likelihood of experiencing transfusion reactions. This gender disparity may be attributed to biological and immunological differences, as women are more likely to have been previously sensitized to foreign antigens through pregnancies, increasing the likelihood of developing antibodies that may react to transfused blood components. The role of HLA sensitization in pregnancy, which primes the immune system, may partly explain this trend. Further research could explore whether

hormonal or genetic differences influence susceptibility to transfusion reactions.

- (2) Age Variations in Transfusion Reactions The patients' ages ranged from 2 months to 82 years, with an average age of 45 years. The age distribution in this study contrasts with findings from other studies, such as Kohorst et al. (2020), which observed a higher frequency of transfusion reactions in older patients (above 60 years). The present study's broader age range suggests that transfusion reactions are not exclusive to specific age groups and can affect all age brackets. Notably, 19–60 years was the most affected age group, possibly reflecting the hospital's active working-age population. The higher risk for children observed in other studies may be linked to their immature immune system or smaller blood volume, which may make them more susceptible to complications.
- (3) Blood Type and Reaction Occurrence Blood type O was the most common blood type associated with transfusion reactions (41.2%), followed by blood type A (30.9%) and blood type B (27.9%). No reactions were observed in blood type AB. Blood type O individuals are universal donors but not universal recipients, as they can only receive blood from type O donors. This limited compatibility might increase their risk of experiencing transfusion reactions. The absence of transfusion reactions in blood-type AB patients may be attributed to their universal recipient status, which reduces the likelihood of incompatibility [12].
- (4) Blood Component and Transfusion Reaction The most frequently implicated blood component in transfusion reactions was packed red cells (PRCs), which accounted for 77.9% of cases. This finding is consistent with global patterns, as PRCs are the most commonly used blood component in hospitals. The large volume of PRCs administered may increase the statistical likelihood of transfusion reactions. Febrile non-hemolytic transfusion reactions (FNHTR) were the most frequent reactions, comprising 75% of all cases. FNHTR is linked to the presence of leukocytes and cytokines in transfused blood products, which stimulate the recipient's immune system [5]. The high rate of FNHTR in this study may reflect the hospital's reliance on non-leukocyte-reduced blood products, as leukoreduction has been shown to reduce FNHTR incidence. Implementing pre-storage leukoreduction could significantly lower the rate of this reaction.
- (5) The severity of Transfusion Reactions Notably, no cases of severe transfusion reactions such as acute hemolytic reactions, TRALI, TACO, or TA-GvHD were observed during the study period. This absence may be attributed to rigorous screening protocols and improved transfusion practices at Airlangga University General Hospital [7]. The predominance of FNHTR and

allergic reactions, which are mild in nature, reflect similar trends observed in hemovigilance reports from other countries [1].

CONCLUSIONS

This study highlights the prevalence and characteristics of transfusion reactions at Airlangga University General Hospital. The majority of reactions were mild, with febrile non-hemolytic transfusion reactions (FNHTR) and allergic reactions being the most frequent. Packed red cells (PRCs) were the most commonly implicated blood component, reflecting the high usage of PRCs in transfusion medicine. The higher incidence of reactions among females and patients with blood type O may point to potential biological or operational factors that warrant further investigation. These findings emphasize the need for rigorous monitoring of blood transfusion recipients, especially those receiving PRCs. Hospitals should enhance risk communication with patients and staff and consider preemptive measures to mitigate allergic and febrile reactions. This study serves as a reference for improving blood transfusion protocols and enhancing patient safety at healthcare facilities.

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