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# Assessment of Serum IgE Level and Blood Group Relationship in Patients with Transfusion Related Allergic Reaction Receiving Fresh Frozen Plasma

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**Abstract** **Original Research Article**

***Introduction:*** Allergic reactions are a significant concern in transfusion medicine, with varying severity from mild cutaneous symptoms to severe anaphylactic shock. This study investigates the relationship between serum IgE levels, blood groups, and allergic reactions in patients receiving fresh frozen plasma (FFP) transfusions. The aim of the study was to assess the associations between serum IgE levels, blood group antigens, and the incidence of allergic reactions in patients undergoing FFP transfusions. ***Methods:*** This cross-sectional observational study was conducted at the Department of Transfusion Medicine, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh, from March 2019 to August 2021. Fifty-five patients aged 5 to 60 years receiving FFP transfusions were included using convenient sampling. Data were collected using a pre-designed sheet and analyzed with SPSS version 26. Chi-square and Pearson's correlation tests were employed to assess associations. ***Result:*** The majority of participants were male (94.55%) and urban residents (80%). Blood group O positive was the most common (41.82%), followed by B positive (25.45%) and A positive (18.18%). Clinical symptoms included itching (56.36%) and urticarial rash (29.09%). Elevated IgE levels were found in 52.73% of participants, with 90.6% of those experiencing allergic reactions having raised IgE levels. Significant correlations were found between allergic reactions and blood groups O positive and B positive (p=0.009). ***Conclusion:*** Elevated serum IgE levels and specific blood groups (O positive, B positive) are significantly associated with allergic reactions in patients receiving FFP transfusions. Screening for IgE levels in high-risk patients and understanding blood group-specific susceptibilities can inform tailored transfusion practices to mitigate allergic reactions. Further multicenter studies are needed to validate these findings and enhance transfusion safety.

**Keywords:** Allergic reactions, Fresh frozen plasma, Serum IgE, Blood groups, Transfusion safety.



## INTRODUCTION

Blood transfusion, a cornerstone of modern medicine, is generally perceived as a safe and life-saving intervention when conducted with due diligence. However, inherent risks accompany this procedure, with acute transfusion reactions constituting a notable concern. These reactions encompass a spectrum of adverse events, including allergic reactions, febrile responses, transfusion-related acute lung injury (TRALI), and transfusion-associated circulatory overload (TACO) [1]. Among these, allergic reactions emerge as one of the most prevalent manifestations, underscoring the importance of understanding their mechanisms and risk factors. Despite significant advancements in transfusion safety protocols, allergic reactions persist as a challenge in clinical practice. Efforts to mitigate these risks have included strategies

such as the recruitment of voluntary non-remunerated blood donors, rigorous donor selection criteria, and the implementation of sensitive screening assays for transfusion transmissible infections (TTIs) [2–4]. However, despite these measures, the incidence of adverse reactions remains noteworthy, with reported rates ranging from 1% to 13.2% across various blood components [5]. Mild allergic reactions, characterized by cutaneous symptoms such as urticaria and itching, are relatively common and typically self-limiting. In contrast, severe allergic reactions, including anaphylactic shock, though rare, pose substantial risks to patient safety [4]. Anaphylactic reactions represent the extreme end of the hypersensitivity spectrum, often triggered by specific IgA antibodies or antigen-antibody complexes, leading to systemic mast cell degranulation [6,7]. Understanding the pathophysiology of allergic transfusion reactions is essential for developing effective preventive strategies. These reactions typically result from the interaction between donor plasma proteins and recipient IgE antibodies, leading to mast cell activation and the release of inflammatory mediators such as histamine and leukotrienes [8]. Recent insights suggest that undigested food allergens present in donor blood may also contribute to recipient anaphylactic responses, highlighting the complexity of allergic transfusion reactions [9]. Despite these advancements, comprehensive studies examining a large series of allergic transfusion reactions are lacking. In Bangladesh, a developing country grappling with social, economic, and health challenges, the burden of allergic reactions on transfusion-dependent patients is particularly significant. Patients receiving frequent plasma transfusions for conditions such as hemophilia or Von Willebrand's disease are especially vulnerable, underscoring the urgent need for research in this area [10,11]. This study aims to address this gap by investigating the relationship between serum IgE levels, blood group status, and allergic reactions in patients receiving fresh frozen plasma transfusions in Dhaka, Bangladesh.

## METHODS

The cross-sectional observational study was conducted at the Department of Transfusion Medicine, Bangabandhu Sheikh Mujib Medical University (BSMMU) in Dhaka, Bangladesh, spanning from March 2019 to August 2021. The study population consisted of patients aged between 5 to 60 years attending the Day Care Transfusion Unit for fresh frozen plasma transfusion, selected through convenient sampling based on predefined inclusion and exclusion criteria. A total of 55 eligible participants were included in the study, meeting criteria such as age within the specified range and recent receipt of fresh frozen plasma transfusion. Inclusion criteria encompassed patients without atopic history, allergies to specific substances, or current anti-allergic medication usage, while exclusion criteria encompassed patients with such medical histories or those unwilling to provide informed consent. Data collection utilized a pre-designed data sheet, with subsequent compilation onto a master chart for analysis. Statistical analysis was performed using the Statistical Package for Social Science (SPSS) version 26, with results expressed as numbers and percentages for qualitative data and mean with standard deviation for quantitative data. Categorical data were compared between groups using the Chi-square ($\chi 2$) test, while Pearson's correlation coefficient (r value) test measured correlations between quantitative variables. Significance was set at p-value <0.05. Ethical considerations included obtaining informed written consent from participants or their legal guardians, approval from the Institutional Review Board of BSMMU, assurance of confidentiality for all collected information, and the absence of financial burden to participants. Participants retained the right to withdraw from the study at any point without repercussion. Access to patient information was restricted to investigators, regulatory authorities, and the Institutional Review Board to maintain confidentiality throughout data analysis and publication.

## RESULTS

**Table 1: Distribution of baseline demographic characteristics of the participants (N=55)**

| Variables | Frequency | Percentage |
|---|---|---|
| **Age** | | |
| <10 | 5 | 9.09% |
| 11-20 | 25 | 45.45% |
| 21-30 | 17 | 30.91% |
| 31-40 | 7 | 12.73% |
| 41-50 | 1 | 1.82% |
| **Sex** | | |
| Male | 52 | 94.55% |
| Female | 3 | 5.45% |
| **Residence** | | |

| | | |
|---|---|---|
| Urban | 44 | 80.00% |
| Rural | 11 | 20.00% |

The study included a total of 55 participants, with their baseline demographic characteristics detailed in Table 1. The age distribution of the participants showed that 9.09% were under 10 years old, 45.45% were between 11 and 20 years old, 30.91% were between 21 and 30 years old, 12.73% were between 31 and 40 years old, and 1.82% were between 41 and 50 years old. The majority of participants were male, comprising 94.55% of the sample, while females represented 5.45%. In terms of residence, 80.00% of the participants were from urban areas, and 20.00% were from rural areas.

**Table 2: Distribution of blood group among the participants (N=55)**

| Blood group | Frequency | Percentage |
|---|---|---|
| O+ve | 23 | 41.82% |
| O-ve | 0 | 0.00% |
| A+ve | 10 | 18.18% |
| A-ve | 0 | 0.00% |
| B+ve | 14 | 25.45% |
| B-ve | 2 | 3.64% |
| AB+ve | 6 | 10.91% |
| AB-ve | 0 | 0.00% |

Among the 55 participants, the distribution of blood groups is summarized in Table 2. The most common blood group was O positive, found in 41.82% of the participants. This was followed by B positive, present in 25.45% of the participants, and A positive, observed in 18.18%. The AB positive blood group was identified in 10.91% of participants, while B negative was noted in 3.64%. No participants had O negative, A negative, or AB negative blood types.

**Table 3: Distribution of clinical symptoms among the participants (N=55)**

| Clinical Symptoms | Frequency | Percentage |
|---|---|---|
| Itching | 31 | 56.36% |
| Urticarial rash | 16 | 29.09% |
| Vomiting | 4 | 7.27% |
| Hypotension | 4 | 7.27% |
| Cough | 3 | 5.45% |
| Tachycardia | 2 | 3.64% |
| Respiratory distress | 2 | 3.64% |
| Angioedema | 1 | 1.82% |

The clinical symptoms observed among the 55 participants are detailed in Table 3. The most common symptom was itching, reported by 56.36% of the participants. Urticarial rash was the second most frequent symptom, affecting 29.09% of the participants. Both vomiting and hypotension were observed in 7.27% of the participants each. Cough was reported by 5.45% of the participants, while tachycardia and respiratory distress were each noted in 3.64% of the participants. Angioedema was the least common symptom, occurring in 1.82% of the participants.

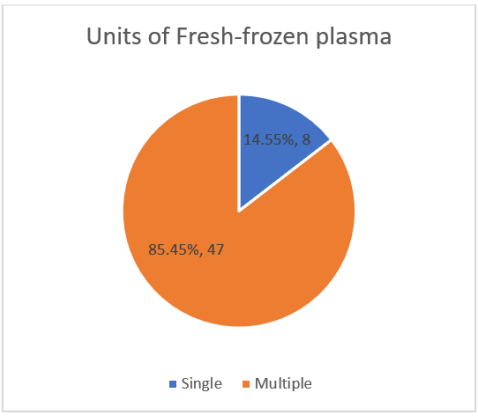


**Figure 1: Distribution of the study patients by unit of fresh frozen plasma transfusion (N=55)**

Out of the 55 participants, 14.55% received a single unit of fresh frozen plasma, while a significant majority, 85.45%, received multiple units.

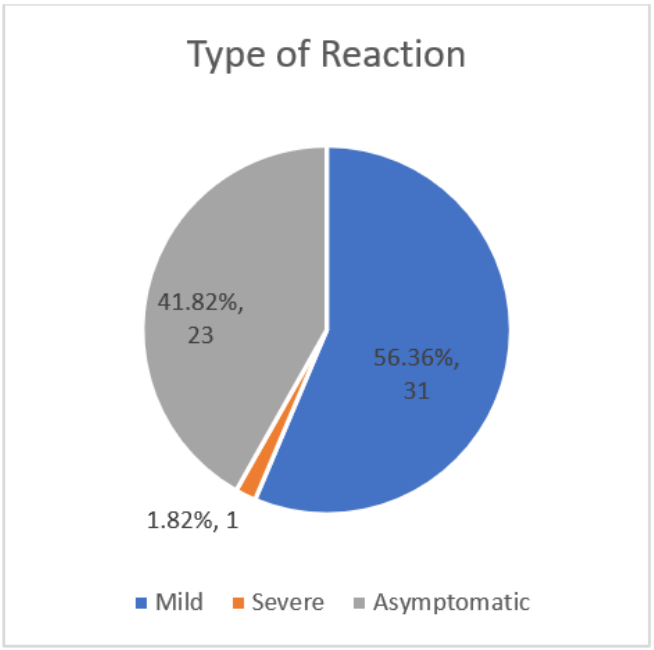


**Figure 2: Distribution of the study patients by allergic reaction type (N=55)**

The majority of participants, 56.36%, experienced mild allergic reactions. Severe allergic reactions were rare, occurring in only 1.82% of the participants. Meanwhile, 41.82% of the participants were asymptomatic, showing no allergic reactions following the transfusion of fresh frozen plasma.

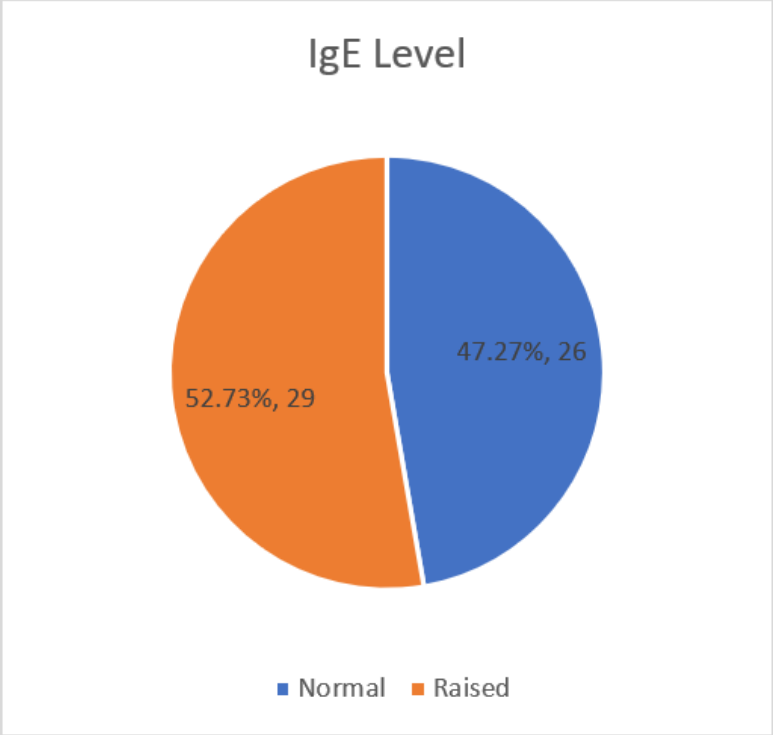


**Figure 3: Distribution of the study patients by IgE level (N=55)**

Among the 55 participants, 47.27% had normal IgE levels, while 52.73% exhibited raised IgE levels.

**Table 4: Association of allergic reaction with IgE level (n=55)**

| IgE level | Allergic Reaction Present (n=32) n (%) | Allergic Reaction Absent (n=23) n (%) | p-value |
|---|---|---|---|
| Normal | 3 (9.4%) | 23 (100.0%) | **<0.01** |
| Raised | 29 (90.6%) | 0 (0.0%) | |
| Mean ±SD | 521.4±434.6 | 67.8±33.2 | |

The association between IgE levels and the presence of allergic reactions among the 55 study participants is summarized in Table 4. Of the participants with normal IgE levels, only 9.4% experienced an allergic reaction, whereas 100% of those without allergic reactions had normal IgE levels. Conversely, among participants with raised IgE levels, 90.6% experienced allergic reactions, and none were without allergic reactions. The mean IgE level in participants with allergic reactions was significantly higher (521.4±434.6) compared to those without allergic reactions (67.8±33.2). This association was statistically significant, with a p-value of <0.01, indicating a strong correlation between elevated IgE levels and the occurrence of allergic reactions in patients receiving fresh frozen plasma transfusions.

**Table 5: Association of allergic reaction with blood groups (n=55)**

| Blood group | Allergic Reaction Present (n=32) n (%) | Allergic Reaction Absent (n=23) n (%) | p-value |
|---|---|---|---|
| O+ve | 14(43.8%) | 9(39.1%) | **0.009** |
| O-ve | 0 (0.0%) | 0 (0.0%) | |
| B+ve | 10(31.3%) | 4(17.4%) | |
| B-ve | 2(6.3%) | 0(0.0%) | |
| A+ve | 1(3.1%) | 9(39.1%) | |
| A-ve | 0 (0.0%) | 0 (0.0%) | |
| AB+ve | 5(15.6%) | 1(4.3%) | |
| AB-ve | 0 (0.0%) | 0 (0.0%) | |

The association between blood groups and the presence of allergic reactions among the 55 participants is detailed in Table 5. Among those with allergic reactions, the distribution was as follows: 43.8% had O positive, 31.3% had B positive, 6.3% had B negative, 3.1% had A positive, and 15.6% had AB positive blood groups. No allergic reactions were reported in participants with O negative, A negative, or AB negative blood groups. Conversely, among participants without allergic reactions, the distribution was: 39.1% had O positive, 17.4% had B positive, 39.1% had A positive, and 4.3% had AB positive blood groups, with no occurrences in O negative, A negative, B negative, or AB negative groups. The association between blood group and the presence of allergic reactions was statistically significant, with a p-value of 0.009, indicating a notable correlation between specific blood groups and the likelihood of experiencing allergic reactions in patients receiving fresh frozen plasma transfusions.

# DISCUSSION

The present study aimed to assess the relationship between serum IgE levels, blood groups, and the occurrence of allergic reactions in patients receiving fresh frozen plasma (FFP) transfusions. The findings revealed significant associations between elevated IgE levels and allergic reactions, as well as correlations between specific blood groups and the likelihood of experiencing such reactions. The demographic distribution showed a predominance of younger patients, with the majority being male (94.55%) and urban residents (80%). This demographic skew suggests that certain demographic factors, such as age and sex, influence the incidence of transfusion-related reactions. This is contradictory to the findings of Savage *et al.*, whose study found no significant association between patient age and allergic transfusion reactions [12]. The blood group distribution among participants highlighted that O positive was the most common (41.82%), followed by B positive (25.45%) and A positive (18.18%). Interestingly, the study found that participants with O positive and B positive blood groups were more prone to allergic reactions. Specifically, allergic reactions were present in 43.8% of O positive and 31.3% of B positive patients. These findings are consistent with research by other authors, which indicated that individuals with certain blood groups, particularly O positive, may have a higher propensity for allergic transfusion reactions due to the presence of specific antigens that interact with donor plasma components [9,13]. Clinical symptoms of allergic reactions, such as itching and urticarial rash, were prevalent among the participants, with itching being the most common symptom (56.36%), followed by urticarial rash (29.09%). This observation is in line with previous studies which reported that cutaneous manifestations are the most frequent signs of allergic transfusion reactions [14,15]. The occurrence of severe reactions, though rare (1.82%), underscores the need for vigilant monitoring during transfusions, as emphasized by a study of Menendez and Edwards, and a review article by Savage, who noted the critical importance of early detection and intervention to prevent severe outcomes [16,17]. The analysis of IgE levels revealed that a significant proportion of participants with allergic reactions had elevated IgE levels. Raised IgE levels were observed in 52.73% of participants, and 90.6% of those with allergic reactions had elevated IgE levels. This finding supports the hypothesis that IgE-mediated hypersensitivity plays a crucial role in allergic transfusion reactions. Similar conclusions were drawn by a study of Platts-Mills, who found that raised IgE levels were significantly associated with allergic reactions in transfusion recipients [18]. The mean IgE level was markedly higher in participants with allergic reactions (521.4±434.6 IU/mL) compared to those without (67.8±33.2 IU/mL), suggesting that elevated IgE levels could serve as a predictive marker for transfusion-related allergic reactions. The statistical association between blood groups and allergic reactions was significant, with O positive and B positive blood groups showing higher susceptibility. This pattern is corroborated by a study conducted by Poole and Daniels, which demonstrated that blood group antigens could influence the immune response during transfusions, potentially leading to a higher incidence of allergic reactions in certain blood groups [19]. A study Leikola *et al.*, [7] discussed the first reported case of an anaphylactic transfusion reaction related to anti-IgA, indicating that patients with specific antibody profiles are at greater risk [20]. The findings of this study underscore the importance of considering both IgE levels and blood group antigens when assessing the risk of allergic transfusion reactions. Given the significant correlation between raised IgE levels and allergic reactions, screening for IgE levels in high-risk patients could be a valuable preventive measure. Moreover, the identification of blood group-specific susceptibilities could inform tailored transfusion practices to mitigate the risk of allergic reactions.

### *Limitations of The Study*

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

# CONCLUSION

This study aimed to elucidate the relationship between serum IgE levels, blood groups, and the occurrence of allergic reactions in patients receiving fresh frozen plasma (FFP) transfusions. The findings revealed significant associations between elevated IgE levels and allergic reactions, and highlighted correlations between specific blood groups and the likelihood of experiencing such reactions. The demographic analysis showed a predominance of younger, male, and urban patients, suggesting

demographic factors influence the incidence of transfusion-related reactions. Notably, participants with O positive and B positive blood groups were more susceptible to allergic reactions. Clinical symptoms such as itching and urticarial rash were prevalent, underscoring the need for vigilant monitoring during transfusions. Elevated IgE levels were significantly associated with allergic reactions, suggesting that IgE-mediated hypersensitivity plays a crucial role. These findings underscore the importance of considering both IgE levels and blood group antigens when assessing the risk of allergic transfusion reactions. Screening for IgE levels in high-risk patients could serve as a valuable preventive measure, while understanding blood group-specific susceptibilities can inform tailored transfusion practices to mitigate the risk of allergic reactions. Future research should focus on larger, multicenter studies to validate these findings and explore the underlying mechanisms, ultimately enhancing transfusion safety and patient outcomes.

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***Conflict of interest:*** None declared

***Ethical approval:*** The study was approved by the Institutional Ethics Committee

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