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Research Article

EVALUATION OF INCOMPATIBLE CROSSMATCHES AT A TERTIARY CARE HOSPITAL IN CHENNAI-A RETROSPECTIVE STUDY

SHOGANRAJ S[1], SRI DEVI M[2], SREEDEVI R[3], CHITRA M[4]*

[1]Department of Transfusion Medicine, Kilpauk Medical College Hospital, Chennai, Tamil Nadu, India. [2]Department of Transfusion Medicine, Stanley Medical College Hospital, Chennai, Tamil Nadu, India. [3]Department of Transfusion Medicine, Tamil Nadu Government Multi Superspecialty Hospital, Chennai, Tamil Nadu, India. [4]Department of Transfusion Medicine, Kalaignar Centenary Superspecialty Hospital, Chennai, Tamil Nadu, India.

***Corresponding author: Chitra M, Email: drchitra81@gmail.com**

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ABSTRACT

Objectives: The primary goal in blood transfusion is that the transfused blood unit be compatible with the patient during crossmatching. This compatibility testing is performed before every administration of blood component. This cross-matching test helps to detect the presence of antibodies in the recipient against antigens over red blood cells of donor. The aim of this study was to evaluate the incidence and causes of in compatible crossmatches in patients by tube agglutination method.

Methods: This was a retrospective cross-sectional study conducted by analyzing incompatible crossmatches encountered during routine compatibility testing between January and December 2021 at the Department of Transfusion Medicine, Government Kilpauk Medical College and Hospital, Chennai, Tamil Nadu, India. The analysis was done in March and April 2022. All crossmatches were done by tube agglutination technique. Data were entered in Microsoft Excel and analyzed. Descriptive statistics were given in summary statistics.

Results: Out of the total of 12943 crossmatches performed, 0.3% (n=39/12943) were incompatible. About 76.9% (n=30/39) were seen in females while 69.2% (n=27/39) were seen in the age group 20–60 years. About 35.9% (n=14/39) of the incompatible crossmatches were due to autoimmune hemolytic anemia (AIHA). A root cause analysis protocol was formulated to resolve the incompatibility and ensure safe transfusion.

Conclusion: AIHA was the most common cause of incompatible crossmatch. The root cause analysis protocol involves a thorough evaluation of the patient's clinical condition, underlying pathology, and errors during technical procedure to identify the cause of incompatibility. Protocols should be developed in each blood center and a logical stepwise approach will enable the provision of safe transfusion.

Keywords: Autoimmune hemolytic anemia, Compatibility, Crossmatch, Root cause analysis.

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INTRODUCTION

Blood transfusion is the most frequent procedure performed during hospital admissions, and many transfusions are administered in the perioperative period, often on a time-sensitive basis. Pre-transfusion testing is a multistep process aimed at avoiding potentially fatal hemolytic transfusion reactions. The process begins on the clinical ward with the identification of the intended recipient and collection of a properly labeled blood sample. When the sample and requisition are received in the transfusion laboratory, blood bank personnel review the recipient's transfusion history, perform the necessary testing, and if ordered, crossmatch erythrocytes [1].

One of the essential goals in crossmatch testing is that the transfused red blood cells (RBC) must be compatible with the patient, to provide maximum therapeutic support and minimal red cell destruction. In the Southern part of India, a major crossmatch between the recipient's serum and donor red cells by anti-human globulin antisera is the most common practice in most of the blood centers. These tests are carried out either by the conventional tube techniques or by the semi-automated column agglutination technology. This is due to the constraints related to trained workforce and the availability of regular supply of reagents and other logistics [2].

The crossmatching of the donor blood component with that of the recipient determines the compatibility of the same with recipient [3]. This crossmatch has to be performed before every administration of blood components. The crossmatch test helps in detecting the presence of antibodies in the recipient against the RBC of the donor. In case of incompatible blood transfusion, these antibodies attach to the donor RBC after transfusion which may lead to hemolysis and can lead even to death.

The clinical and serologic evaluation, which allows for the transfusion of the most compatible (or "best matched") blood, requires a joint effort between the clinician and the transfusion medicine physician. The aim of the present study was to evaluate the incidence and causes of incompatible cross matches by tube agglutination method and to formulate root cause analysis to help ensure safe transfusion.

METHODS

This was a retrospective cross-sectional study conducted by analyzing incompatible crossmatches encountered during routine compatibility testing between January and December 2021 at the Department of Transfusion Medicine, Government Kilpauk Medical College and Hospital, Chennai, Tamilnadu, India. The analysis was done over two months (March and April 2022). When incompatible crossmatch was encountered, the test was repeated with the same donor unit along with one additional group-specific donor blood unit. This repeat test was done to rule out possibility of technical errors such as contamination, direct antiglobulin test (DAT) positive donor unit, or wrong blood in

the tube (WBIT), as well as clerical errors. If incompatibility persisted, initial workup with DAT, Indirect antiglobulin test (IAT), and auto control were performed (Fig. 1). If any of these tests turned positive, the samples were sent to the regional testing center – immunohematology reference laboratory at Rajiv Gandhi Government General Hospital, Chennai, for further advanced immunohematology workup. If alloantibody(s)/autoantibody(s) were detected, antigen-negative red cell unit or a best-matched unit was issued, after consulting the treating physician. Data were entered in Microsoft Excel and analyzed. Descriptive statistics were given in summary statistics.

RESULTS

In this retrospective study on analysis of incompatible cross-matches, a total of 12943 cross matches were performed during the study period, out of which 0.3% (n=39/12943) were found incompatible. Incompatible crossmatches were more common in females (76.9%, n=30/39) and were seen most in the 20–60 years age group (69.2%, n=27/39) (Fig. 2). DAT was positive in 38.46% (n=15/39) samples. Autoimmune hemolytic anemia (AIHA) was the most common cause (35.89%, n=14/39) for incompatible crossmatch (Fig. 3). In one of the sample, donor RBCs were DAT positive.

In the six samples with positive IAT, antibody screening and identification were performed. Anti-D was the most common alloantibody (33.33%, n=2/6) (Table 1). Alloantibodies were more common in multi-transfused patients (due to renal failure and hematological disorders) and multiparous females. Naturally occurring Anti-A1 was found in one patient, reactive at room temperature. In patients whom antibody was identified, antigen negative and RBC units were transfused. Root cause analysis tool was formulated and used for analysis as per Fig. 4.

DISCUSSION

Elements of pre-transfusion testing include reviewing sample acceptability, determining ABO group and Rh D type, screening for RBC antibodies, identifying the specificity of unexpected antibodies when detected, selecting donor red cell units that are appropriate for the recipient's ABO and Rh D types and unexpected antibody status and thus completing the compatibility testing. Correct ABO testing is key to avoiding ABO- incompatible transfusions, whereas correct Rh D typing is key to avoiding unnecessary exposure of Rh D-negative girls and women of child-bearing potential to Rh D-positive RBCs. Antibody detection identifies clinically significant antibodies and should include 37°C incubation. Cross-matching allows the detection of both ABO incompatibility as well as unexpected clinically significant antibodies, in the case of all immunized patients [4].

Incompatibility in crossmatching during pre-transfusion testing is not uncommon. There is hardly any evidence-based study on the frequency of incompatible cross-matched red cells and how to approach these cases, for better transfusion practice, from the southern part of India till now [2]. When blood is ordered for transfusion, the transfusion service typically performs a series of tests on the patient's red cells and plasma. There are three major clinical situations that may lead to difficulty in providing crossmatch compatible blood: (i) Alloantibodies, due to previous transfusions or pregnancy, (ii) Autoantibodies reacting with common RBC antigens in AIHA and some forms of drug-induced immune hemolytic anemia, or (iii) ABO grouping discrepancies.

Table 1: Alloantibody specificity in patients who were indirect antiglobulin test positive

Specificity of alloantibody	No. of patients
Anti-D	2
Anti-M	1
Anti-S	1
Anti-Leb	1
Anti-Fya	1

In the present study, the majority of incompatible crossmatches were found in females (76.9%), which was comparable to the

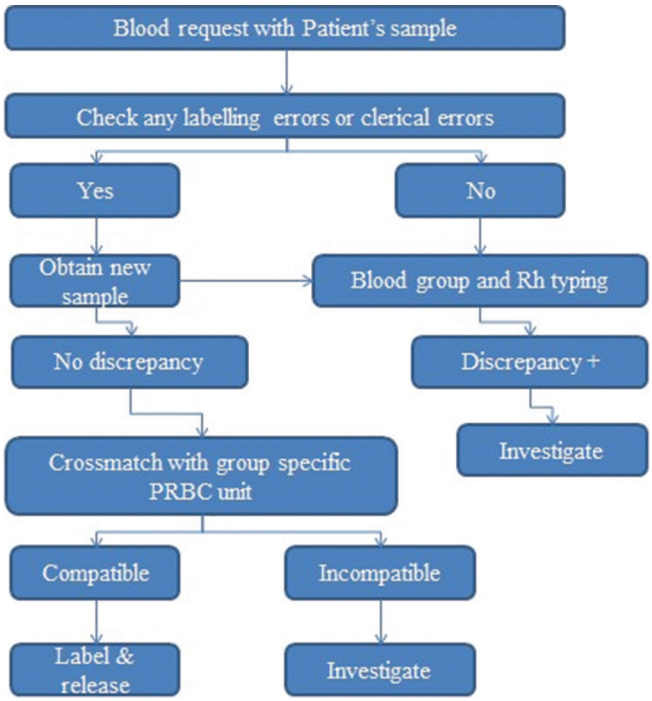

Fig. 1: Traditional approach to incompatible crossmatch

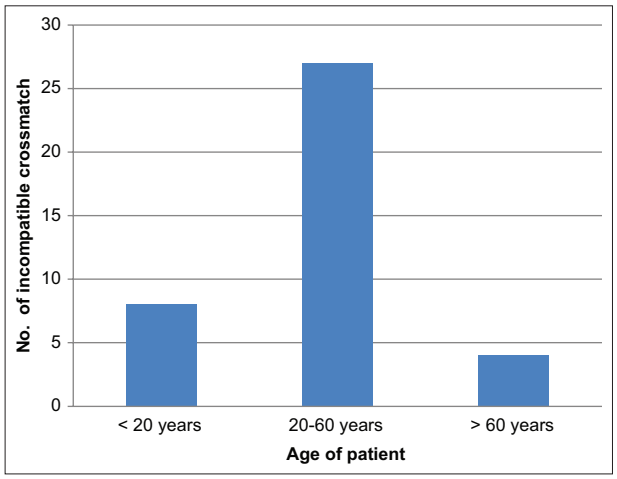

Fig. 2: Age distribution of patients among incompatible crossmatches

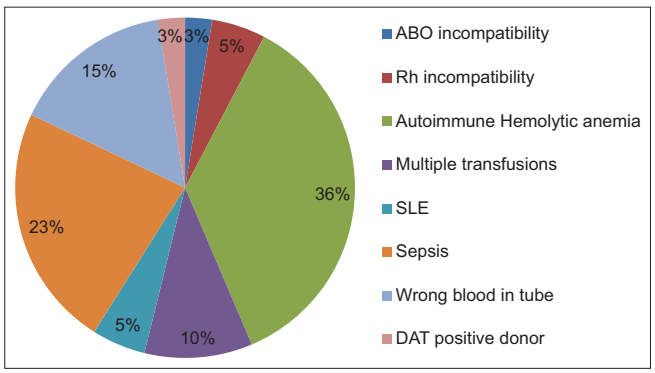

Fig. 3: Causes for incompatible crossmatch during compatibility testing

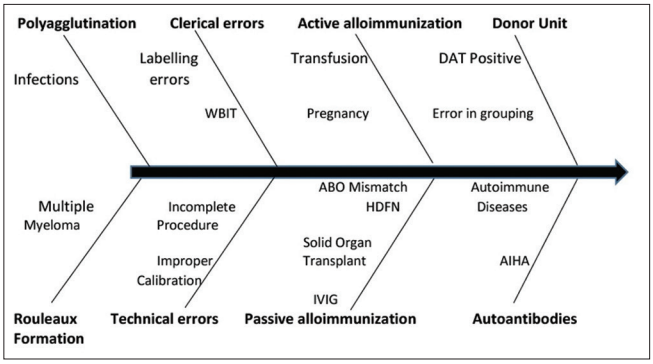

Fig. 4: Root cause analysis tool for analyzing incompatible crossmatch

study by Bhatt *et al*. in the Western part of India and Bhattacharya *et al*. in the eastern part of India [2,5]. AIHA (35.9%) was the most prevalent cause of incompatible crossmatch, which was similar to the study conducted by Bhatt *et al*. (40%), whereas in contrast to the study conducted by Bhattacharya *et al*. and Vidushi *et al*. where Alloantibody (38% and 31%, respectively) was the most prevalent cause of incompatible crossmatch [2,5,6]. Multi-transfused patients and pregnant females are at risk of forming alloantibodies to red cell antigens which can cause delayed hemolytic transfusion reaction and problems in finding compatible donor units and in the case of pregnant females, it can cause hemolytic disease of fetus and newborn. The rate of alloimmunization can be decreased by providing phenotype-matched blood. Blood to be transfused should always be matched at least with ABO, Rh, and Kell system [7].

In the present study, one of the incompatible crossmatch was due to DAT positive donor unit. In recent days, there is an emphasis on use of type and screen/electronic crossmatch instead of type and crossmatch, during pre-transfusion testing. These can miss DAT-positive donor units unless DAT screening of donors is included in pre-transfusion testing. Similar cases of incompatible crossmatch due to DAT-positive donors were reported by Puri *et al*. and Vidushi *et al*. [6,8]. However, DAT positivity has been reported in 0.008% of donors [9]. Mostly, blood donors with a positive DAT result appear to be perfectly healthy and have no obvious signs of hemolytic anemia. However, a careful evaluation may show evidence of increased red cell destruction.

In our institute, there is an established protocol of documenting the blood group twice before issuing blood unit to patient. This has helped avoid mishaps in cases of WBIT or any clerical error and preventing mismatch blood transfusion reaction.

CONCLUSION

AIHA was the most common cause of incompatible crossmatch in the present study. The root cause analysis protocol involves a thorough evaluation of the patient's clinical condition, underlying pathology, and errors during technical procedures to identify the cause of incompatibility. Protocols should be developed in each blood center and a logical stepwise approach will enable the provision of safe transfusion.

AUTHOR'S CONTRIBUTION

SS: Conceptualized the study and collected data. MS: Critically analyzed and approved the final draft. SR: Edited manuscript and analyzed data. MC: Analyzed data and prepared manuscript.

CONFLICTS OF INTEREST

None declared.

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