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Evaluation of Incompatible Crossmatch at a Tertiary Care Blood Center

Dr Tejal Ahuja[1], Dr. Nidhi Bhatnagar[2], Dr. Mamta Shah[3], Dr. Sangeeta Shah[4], Dr. Tarak Patel[5], Dr. Rajvi Vora[6]

[1]Resident Doctor, MD IHBT, Dept. of IHBT, B. J. Medical College, Ahmedabad, Gujarat, India
tejal23992[at]gmail.com
[2]Professor & Head, Dept. of IHBT, B. J. Medical College, Ahmedabad, Gujarat, India
bhatnagarnidhi[at]ymail.com
[3]Assistant Professor, Dept. of IHBT, B. J. Medical College, Ahmedabad, Gujarat, India
mamtacshah[at]gmail.com
[4]Assistant Professor, Dept. of IHBT, B. J. Medical College, Ahmedabad, Gujarat, India
sangitadar[at]yahoo.com
[5]Assistant Professor, Dept. of IHBT, B. J. Medical College, Ahmedabad, Gujarat, India
drtarakp[at]yahoo.com
[6]Resident Doctor, MD IHBT, Dept. of IHBT, B. J. Medical College, Ahmedabad, Gujarat, India

Postal Address: Department of IHBT, B2 Blood Bank, Civil Hospital, Asarwa, Ahmedabad, Gujarat, India

Name of Corresponding Author: **Dr Tejal Ahuja**

Abstract: ***Introduction: Crossmatching is one of the basic tests of pretransfusion testing. Resolving problems in crossmatch should be carried out after proper planning and following departmental guidelines and SOPs (Standard Operating Procedures). The transfused RBCs will have acceptable Survival Rate, and there will be no significant destruction of recipient's own RBCs. The aim of this study is to evaluate the incidence and causes of incompatible cross matches in patients. Material and Method: A total of 270 incompatible cross matches were reviewed out of total 85, 400 cross matches performed by column agglutination technique in a period of 1 year. A root cause analysis protocol was formulated to resolve the incompatibility, which would help to ensure safe transfusion to patients. Results: The overall incidence of incompatible cross matches was found to be 0.31%. The major cause for incompatibility was autoimmune hemolytic anemia (AIHA) (48%). Other causes of incompatibility were multiple transfusion (15%), Infections (10%), Hemolytic disease of newborn (10%), Presence of Allo-Antibody (10%) and DAT (Direct Agglutination Test) positive Donors (5%), Clerical error (2%). Incompatibility rate was higher in females (61%). Conclusion: The commonest Cause of Incompatibility was AIHA. Incompatible Crossmatch poses a challenge in the field of transfusion medicine. Root cause analysis is a systemic method for identifying all the contributing factors to a problem, so that the corrective action can be taken. A logical stepwise approach will enable the provision of safe transfusion.***

Keywords: Antibody screening, Antibody Identification, Column Agglutination Technique (CAT), Direct Antiglobulin Test (DAT), Incompatibile cross- match

1. Introduction

One of the essential goals in crossmatching of red cells is that the transfused blood must be compatible with patient's blood to provide maximum therapeutic support and minimal red cell destruction. Crossmatching is one of the basic tests of pretransfusion testing. Whenever problems are encountered during crossmatching, that should be resolved properly and immediately. Problems in crossmatching should be resolved by following guidelines and departmental SOPs, so that unnecessary delay can be avoided for transfusion. If transfusion can be postponed, the resolution of the problems is desirable before issuance of blood even though compatible units are available [1]. Sometime due to nonspecific reactions, which are not harmful to patient but interference with compatibility testing may occur. Once these problems have been resolved, units which appeared incompatible may be shown to be suitable for transfusion; however, it is essential that problem should be completely resolved before blood transfusion when nonspecific agglutination present [2]. The clinical and serological evaluation, which allows transfusion of most compatible (or "least incompatible") blood, requires a joint effort between the clinician and the transfusion medicine specialist [3].

2. Material and Methods

The current study was aprospective study was conducted in Tertiary care teaching hospital blood center in western India during one year of period from January 2020 to December 2020. An Average annual blood collection is over 40, 000 units. The center supplies an overall annual average of 1, 00, 000 units of blood components.

270 incompatible cross matches were evaluated from 85, 400 cross-matches performed by column agglutination technology in patients, who required blood transfusion. Detailed clinical history including previous blood transfusion and previous pregnancy was taken. Some Other serological investigations were also done for analysis of incompatibility like Direct Anti-globulin Test (DAT), Indirect Anti-globulin Test (IAT), antibody screening and identification.

Specimen: Clotted (plain) and anti coagulated (EDTA) Blood Samples of patient and anti coagulated blood samples from segment of donor unit.

Following serological tests were performed.

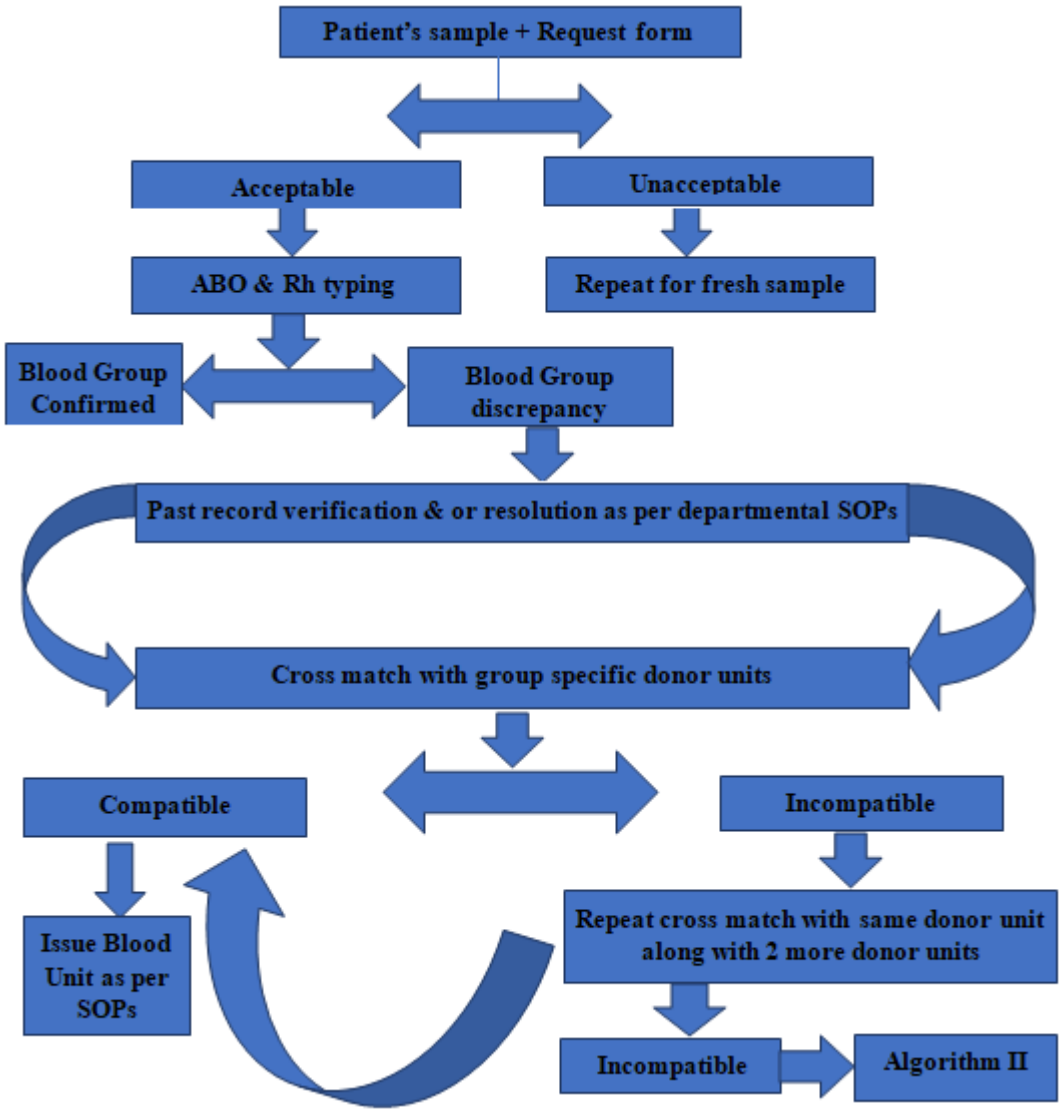
- Patient's ABO and Rh typing by polyspecific gel card containing Anti IgG + C3d technique.
- Donor's ABO and Rh typing by polyspecific gel card containing Anti IgG + C3d technique.
- Cross-match by column agglutination technique in AHG phase.
- Direct anti-globulin test by column agglutination technique in AHG phase.
- Indirect anti-globulin test by column agglutination technique in AHG phase.
- Antibody screening with 3 cell panel by column agglutination technique in AHG phase.
- Antibody identification with 11 cell panel by column agglutination technique in AHG phase.

Evaluation of an incompatible cross-match sample

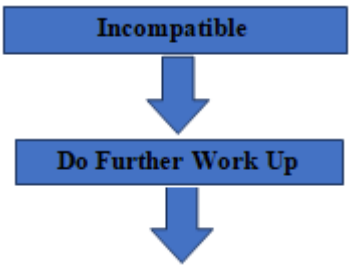
In case of any incompatible major cross-match results, a repeat cross-match with the same donor along with two additional group specific donor units was performed. This repetition was done to rule out any possibility of technical errors (contamination, Direct Anti-globulin Test [DAT], positive donor unit, mis-grouping, etc.) as well as clerical/transcriptional errors. If in Repeat 3 cross-match it is incompatible, further evaluation of recipient's sample was done.

An initial workup of recipient's sample was done by DAT, IAT, auto-control, antibody screening and identification [4]. Any reaction with a strength 2+ or above was considered to be strong and below there were weakly reactive. DAT and IAT done by column agglutination technique in AHG phase. Antibody screening with 3 cell panel by column agglutination technique in AHG phase. Antibody identification with 11 cell panel by column agglutination technique in AHG phase. A detail of clinical history of the patient along with history of medications and relevant history suggestive of alloimmunization / sensitization was recorded. The Algorithm to evaluate an incompatible cross-match was shown in Figure 1.

3. Algorithm to Evaluate an Incompatible Cross-Match



4. Algorithm for Work Up of Incompatibility



1. First Check Clerical Error, If it present Solved out it.
2. Asked about Clinical History of Patient.
3. See Any drug History Present or Not.
4. See other Blood Investigation Reports.
5. Do 3 Cell and 11 Cell Panel to identify specific Allo-Antibody

5. Results

During the study period from 1st Jan 2020 to 31st Dec 2020 total number of cross matches done was 85, 400. Out of these, 270 incompatible cross matches were found in 76 patients.

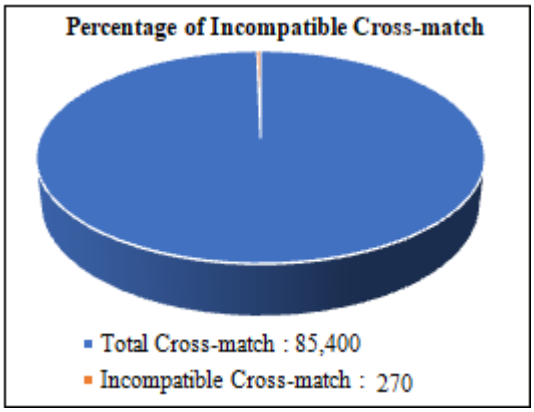


Figure 1: Total crossmatch vs incompatible cross match

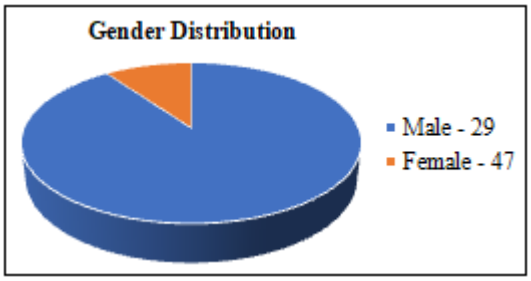


Figure 2: Gender distribution of incompatible cross matches among patients

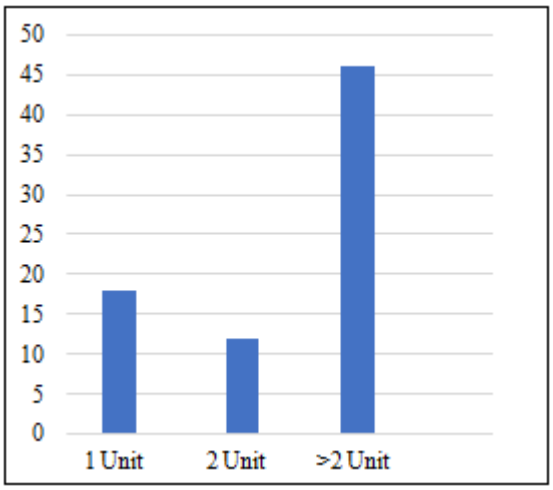


Figure 3: Incompatible cross match according to no. of unit

The above figure shows overall incidence of incompatibility in this study. Out of 76 patients, 18 patients showed incompatibility for 1 unit.12 patients showed incompatibility for 2 units and 46 patients showed incompatibility for more than two units.

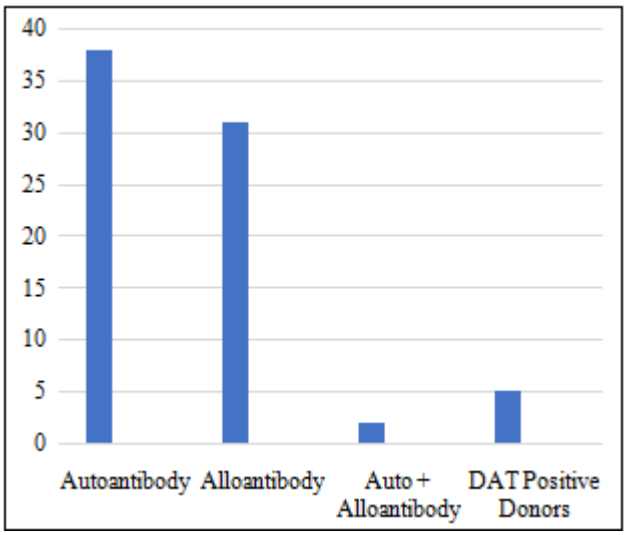


Figure 4: Antibody identification of incompatible crossmatch among patients

his figure shows that out of 76 patients, 38 patients had Autoantibody, 31 patients had Allo antibody, 2 patients had both Autoantibody + Alloantibody, remaining 5 present with DAT positive PCV.

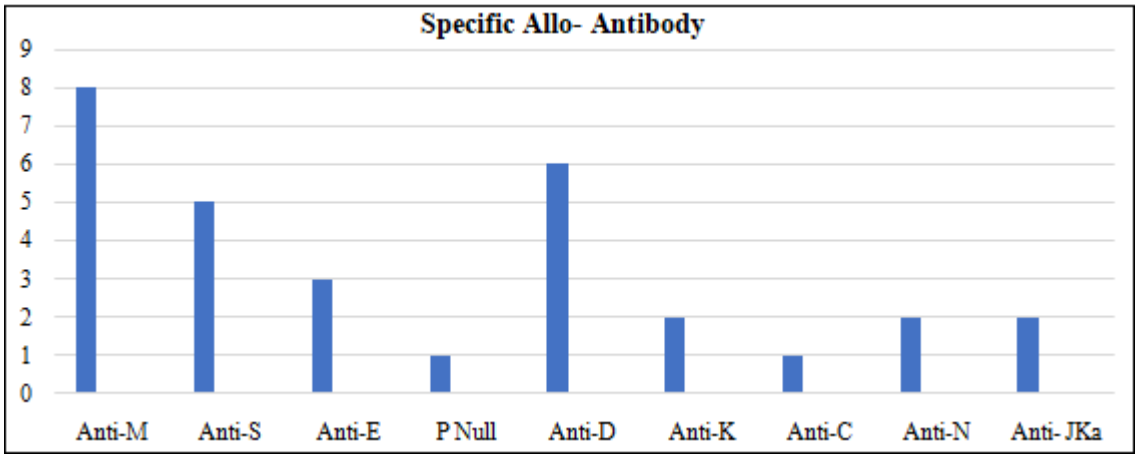


Figure 5: Presence of specific allo- antibody in incomaptible Cross-Match

This figure shows the number of different Allo-Antibodies which caused Incompatibility. Total 30 patients present with Allo-Antibody. Out of which 8 present with Anti-M Antibody, 5 present with anti-S Antibody, 3 present with Anti-E Antibody, 1 present with P Null Phenotype, 6 present with Anti-D Antibody (This Anti-D show Rh incompatibility in fetus &neonate), 4 present with Anti-K Antibody (Mostly in Thalassemic-Multi transfused patients), 1 present with Anti-C Antibody, 2 Present with Anti-N Antibody, Remaining 2 present with Anti-JK[a]

Out of 76 Patients, 1 showed incompatibility due to Clerical Error (2%). Other Causes of Incompatibility shown in Table 1.

Table 1: Distribution of incompatible crossmatch in patients with underlying disease

Causes	Total No. of patients
AIHA	36
Multiple Transfusion	9
HDFN	9
Trauma	4
Cardiac Disease	8
ABO Incompatibility	4
DAT Positive Blood Units	2
SLE	2
Arthritis	1
Total	75

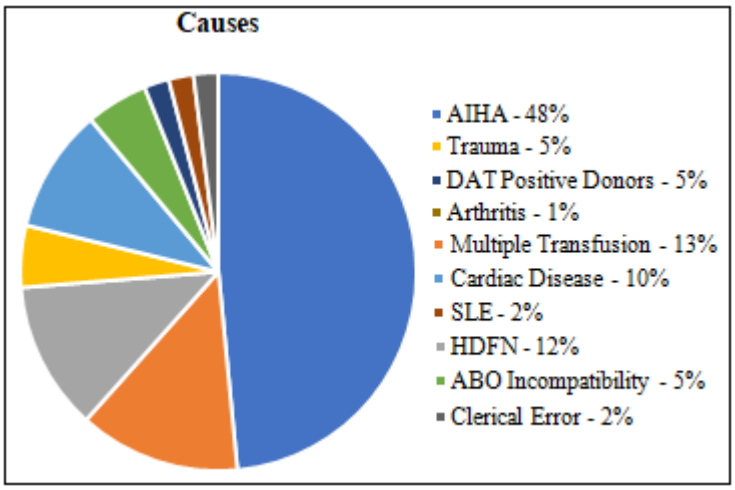


Figure 6: Causes of Incompatible Cross Matches among Patients

This figure shows the common causes of incompatibility as follows-Autoimmune Hemolytic Anemia (AIHA) (48%), Multiple Transfusion (13%), HDFN (12%), Trauma (5%), Cardiac Disease (10%), ABO Incompatibility (5%) DAT Positive bag (2%), SLE (2), Clerical Error (2%), Arthritis (1%).

6. Discussion

Pretransfusion testing includes reviewing blood sample acceptability, determining ABO and RhD type, screening for unexpected antibodies, Identifying the specificity of unexpected antibodies that are detected, selecting donor RBC units that are appropriate for recipient's ABO and RhD type and unexpected antibody status, and performing a crossmatch between recipient and the unit to be transfused. The causes of incompatible crossmatch could be due to patient or donor unit factors and technical or clerical errors [5], [6].

Compatibility testing of donor RBC unit with recipient serum for detection of naturally occurring antibodies against ABO antigens and detection of other unexpected antibodies against other blood group antigen system is absolute requirement for prevention of acute or delayed hemolytic transfusion reaction as well as normal survival of transfused RBCs [5], [6].

In our study, majority of incompatible crossmatches were found in females (61%) which is comparable to a study conducted by Bhatt et al. in the Western part of India [7] and Bhattacharya et al. in the eastern part of India [8]. In Our study Autoimmunization (48%) was the most prevalent cause of incompatible crossmatch which is similar to study conducted by Bhatt et al [8] where AIHA (40%) was the most prevalent causes of incompatible crossmatch, whereas in contrast to the study connected by Bhattacharya et al [8] in this Alloimmunization (38%) was the most prevalent cause of incompatible crossmatch. Another study by Shiju et al, in Which Main cause of incompatibility was multiple transfusion. Stainsby et al (2005) have given a thorough overview of the causes of ABO incompatible blood transfusion in the UK.

The antibodies present in recipient's serum that can give incompatible result during crossmatch are either alloantibody which are generated due to previous exposure to foreign RBCs, typically transfusions or pregnancy or autoantibody which are generated due to loss of immunological tolerance to see RBCs antigens. The main purpose of the study was to analyze the incidence and causes of incompatible cross matches, therby to prevent the transfusion of incompatible RBCs that might results in an immune mediated transfusion reaction or shorten RBCs survival [9].

Whenever any alloantibody (s) were being detected corresponding antigen (s) negative compatible or best-matched unit was issued after consultation with the treating clinician [3]. In the Autoimmune Patients Cell panel present with "PANAGGLUTINATION". These patients always present with low Hb. So in emergency we can issue "LEAST INCOMPATIBLE" Blood Units were provided as emergency lifesaving resort. If there is no emergency, consultation give steroids to AIHA patients for 5 days. After 5 days, they send new sample of patient, & again we do all work-up. After that if Grading of incompatibility is decreased or may compatible unit we find, we reserve this unit for the patient.

Each of these transfusion was under the supervision of treating clinician. Transfusion started slowly and under strict observation. If any reaction occur immediately stop the transfusion & informed to Blood Center. Every successful transfusion events were monitored with a posttransfusion 24 hour increase in hemoglobin (Hb) and clinical improvement of signs and symptoms. A fresh set of blood samples (EDTA & Clotted) were required for each and every transfusion requisition, irrespective of the time interval between two consecutive transfusions.

7. Conclusion

Incompatible crossmatch poses a challenge in the field of transfusion medicine. This study was undertaken to analyze the incidence and causes of incompatible cross matches. Commonest cause of incompatibility found were Auto Immune Hemolytic Anemia (AIHA) (48%). Incompatibility was found more in females than males. The resolution requires a thorough serological work-up and underlying pathology to identify the cause. Root Cause Analysis is a systemic method for identifying all contributing factors to a problem. So that corrective action can be taken. A logistic stepwise approach will enable the provision of safe transfusion.

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