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The Study of the ABO Blood Group Discrepancies at a Tertiary Care Center of North Rajasthan

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Abstract: ***Background: Blood transfusion is a critical life-saving procedure, but transfusion errors due to ABO blood group discrepancies can lead to severe complications. Discrepancies in ABO blood typing can occur due to technical errors, weak antigen or antibody expression, and medical conditions like autoimmune disorders. Accurate identification and resolution of these discrepancies are vital for ensuring safe transfusions. This study aimed to determine the prevalence and causes of ABO discrepancies in a tertiary care center in North-West Rajasthan, where limited data exists. Methodology: This prospective, cross-sectional study was conducted from November 2023 to May 2024 at the Department of Immunohematology and Transfusion Medicine, Sardar Patel Medical College, Bikaner, Rajasthan. A total of 24, 849 patients requiring blood transfusions were included. Blood grouping was performed using the fully automated NEO Iris system. Forward and reverse blood group typing discrepancies were identified, analyzed, and resolved using additional antibody screening tests. Results: Out of 24, 849 patients, 24 discrepancies (0.96%) were noted. Discrepancies were more common in females (54.17%) than males (45.83%) and were most prevalent in the 21-30 years age group (25%) and patients aged 60 and above (29.17%). Type IV discrepancies were the most common (58.33%). Causes of discrepancies included autoimmune hemolytic anemia (AIHA), malignancies, weak antigen/antibody expression, and technical errors. Conclusion: This study revealed a higher prevalence of ABO discrepancies compared to previous studies, potentially due to regional genetic diversity. The findings underscore the need for rigorous testing protocols and accurate blood grouping to prevent transfusion errors.***

Keywords: ABO discrepancies, blood transfusion safety, autoimmune hemolytic anemia, blood grouping errors, regional genetic diversity

1. Introduction

Blood transfusion is a vital, life-saving procedure, but before performing it, confirming the recipient's blood group through forward and reverse blood typing or cross-matching is crucial. Discrepancies in blood group results can occur and require thorough investigation by blood transfusion staff. These discrepancies may result from weak antigen expression, missing antibodies, technical errors, or rouleaux formation. Resolving these discrepancies ensures safe transfusions and reduces complications.

The discovery of the ABO blood group system by Karl Landsteiner revolutionized transfusion medicine. ABO grouping includes cell grouping (forward) to identify A/B antigens and serum grouping (reverse) to detect antibodies. Accurate grouping requires both methods.

Newer techniques like column agglutination (CAT) and solid-phase red cell adherence assay (SPRCA) offer improved sensitivity and automation, overcoming limitations of traditional tube methods. Despite advancements, blood group discrepancies can still occur due to weak reactions, abnormal proteins, or other factors. These discrepancies are classified into four types: Type I (missing/weak antibodies), Type II (missing/weak antigens), Type III (rouleaux formation), and Type IV (miscellaneous causes like autoantibodies).

Proper ABO and Rh grouping is crucial to avoid transfusion reactions, including fatal ones. Blood group discrepancies need prompt resolution to ensure patient safety. This study aims to analyze ABO discrepancies in patients and identify measures to enhance transfusion safety.

Aims and Objectives

1) Our primary aim is to determine the prevalence and cause of ABO blood group discrepancy.
2) Secondary aim is resolution of ABO discrepancy for providing compatible blood product.

2. Materials and Methods

Study Design and Setting

This prospective, cross-sectional study was conducted at the Department of Immunohematology and Transfusion Medicine, Sardar Patel Medical College, Bikaner, Rajasthan, India, from November 2023 to May 2024. Approval for the study was obtained from the Institutional Ethics Committee, and written informed consent was taken from all participants.

Study Population

All patients admitted during the study period who required blood transfusion and had a blood sample submitted through blood requisition forms were included. Patients who declined participation or had hemolyzed or clotted samples were excluded.

Sample Collection and Blood Grouping

A 4-5 ml blood sample was collected in an EDTA tube under aseptic conditions. ABO and Rh (D) blood typing was performed using the fully automated NEO Iris system (ImmuCor, USA). This system uses direct hemagglutination microstrips with monoclonal antibodies to determine blood group.

Red Blood Cell Antibody Screening
Antibody screening was performed using the Immucor NEO Iris system, utilizing solid-phase red cell adherence technology. A gel column agglutination technique (Indirect Antiglobulin Test) was used for detecting alloantibodies, following standard protocols.

Reagents and Equipment
The following reagents and equipment were used:
- NEO Iris automated analyzer for blood grouping.
- Anti-A, Anti-B, and Anti-D monoclonal antibodies (Immuclone).
- LISS and Coombs' AHG reagents for indirect antiglobulin testing.
- ID Microtyping system (Ortho Clinical Diagnostics) for gel-based antibody detection.

ABO/Rh Blood Grouping Procedure
The ABO/Rh typing was performed by mixing the patient's red cells with known antisera (Anti-A, Anti-B, Anti-D), and the reactions were observed to determine blood group. The NEO Iris system utilized CCD cameras and multi-feature image analysis for result interpretation.

Alloantibody Detection
The antibody screening and identification were performed using the gel-based Capture-R system. This method involves adding patient serum to microwells pre-coated with reagent red blood cells. After incubation and centrifugation, the results were interpreted based on the adherence of indicator red cells, with a positive reaction indicating the presence of antibodies.

Statistical Analysis
Data were analyzed using SPSS version 21. Descriptive statistics (percentages, means) were calculated. The Chi-square test was used for qualitative data comparison, and t-tests were used for quantitative data. A p-value of <0.05 was considered statistically significant.

3. Observations and Results

In this study, a total of 24, 849 patients were included for ABO typing, with 24 (0.96%) discrepancies observed. The discrepancies were resolved using appropriate measures, including forward and reverse typing for both in-patients and out-patients.

Table 1: Patient Details

Month	No. of Patients Blood Grouped	Discrepancies Noted	No Discrepancy
November	3130	4	3126
December	3227	4	3223
January	3058	2	3056
February	3346	2	3344
March	3851	3	3848
April	3705	4	3701
May	4532	5	4527
Total	24849	24	24825

Chi-square = 24, 849
Degree of freedom = 7
p-value = <0.0000001

This data shows a very high accuracy in blood grouping, with a discrepancy rate of only 0.96% over seven months.

Table 2: Distribution of Cases According to Gender

Gender	Number	Percentage
Male	11	45.83%
Female	13	54.17%
Total	24	100%

This shows that discrepancies were slightly more common in females (54.17%) than in males (45.83%).

Table 3: Distribution of Cases According to Age Group

Age Group	Female	%	Male	%	Total	%
0-9 years	1	4.17%	1	4.17%	2	8.33%
10-20 years	0	0%	1	4.17%	1	4.17%
21-30 years	5	20.83%	1	4.17%	6	25%
31-40 years	1	4.17%	2	8.33%	3	12.5%
41-50 years	3	12.5%	1	4.17%	4	16.67%
51-60 years	0	0%	1	4.17%	1	4.17%
60+ years	3	12.5%	4	16.67%	7	29.17%
Total	13	54.17%	11	45.83%	24	100%

Mean age = 42.96 years
Standard deviation = 22.98 years
Most discrepancies were observed in the 60+ age group (29.17%).

Table 4: Distribution of Cases According to Type of Discrepancy

Type of Discrepancy	No. of Cases	Percentage
Type 1	2	8.33%
Type 2	4	16.67%
Type 3	3	12.5%
Type 4	14	58.33%
Technical Error	1	4.17%
Total	24	100%

Type 4 discrepancies (58.33%) were the most common, often associated with autoimmune conditions.

Table 5: Causes of Discrepancies

Type of Discrepancy	Causes	No. of Patients
Technical Error	Technical error	1
Type 1	Weak expression of antigen	2
Type 2	Malignancy (2), Subgroups (1), Weak antibody (1)	4
Type 3	Multiple Myeloma (2), Abnormal plasma proteins (1)	3
Type 4	AIHA (8), ITP (1), Other DCT/ICT positives (4), Pregnancy (1)	14
Total		24

Most discrepancies were due to **AIHA** (Autoimmune Hemolytic Anemia), with **8 cases** (33.33%), followed by other causes like malignancy and technical errors.

4. Discussion

In this prospective cross-sectional study, we observed a prevalence of ABO discrepancies at 0.96% among 24, 849 patients. This rate is slightly higher compared to other studies from different regions, where the prevalence ranged from

0.02% to 1.2%. The observed difference could be attributed to genetic diversity and demographic variations in the population. Additionally, a smaller sample size in our study might have contributed to the higher discrepancy rate.

Our study identified Type IV discrepancies (58.33%) as the most common, which aligns with the findings of Sahu et al. (2020), where Type IV discrepancies also had a high prevalence. This type of discrepancy is primarily associated with irregular antibodies, particularly in conditions like autoimmune hemolytic anemia (AIHA). Other types of discrepancies, such as Type 2 and Type 3, were also noted, with technical errors contributing to a small portion.

In terms of demographic distribution, we observed a slightly higher prevalence of discrepancies in females (54.17%) compared to males (45.83%), which contrasts with Sahu et al. 's study, where discrepancies were exclusively found in male donors. The age group most affected by discrepancies was 60 years and above (29.17%), followed by the 21-30 year age group (25%).

The prevalence of ABO discrepancies in our study is comparable to other regional studies but highlights the importance of continuous improvement in blood typing protocols. Factors such as autoimmune diseases, malignancies, and technical issues contribute significantly to discrepancies, underlining the complexity of accurate ABO blood grouping in clinical settings. The consistent finding of Type IV discrepancies across multiple studies suggests that irregular antibodies continue to pose challenges in blood transfusion practices.

5. Conclusion

This study on ABO blood group discrepancies at a tertiary care center in North-West Rajasthan involved 24, 849 patients, with 24 discrepancies (0.96%) observed. Despite the low discrepancy rate, this highlights the importance of accurate blood typing and resolving discrepancies through meticulous testing procedures. The study found a slightly higher prevalence of discrepancies compared to other regional studies, with Type IV discrepancies (irregular antibodies) being the most common.

The demographic analysis revealed a slightly higher number of discrepancies in females (54.17%) and a significant prevalence in the 60 and above age group. The primary causes of discrepancies included autoimmune hemolytic anemia (AIHA), malignancies, technical errors, and weak antigen/antibody expressions.

In comparison to other studies, such as that by Sahu et al., our study found a slightly higher discrepancy rate, which could be attributed to regional and population-based factors. The findings underscore the necessity of rigorous blood typing protocols and proper resolution strategies to ensure safe transfusion practices. Continuous efforts to improve diagnostic accuracy and minimize discrepancies are essential for enhancing patient safety in clinical settings.

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