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A Study to Evaluate Anti-A and Anti-B Antibodies Titer in Group 'O' Plateletpheresis Donors by SPRCA (Solid Phase Red Cell Adherence) Technique at Sawai Man Singh Hospital, Jaipur, Rajasthan

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Abstract: ***Background**: Platelet transfusions from group O donors are frequently administered to recipients of other ABO blood groups. Group O plateletpheresis donors naturally possess anti-A and anti-B isoagglutinins, and high antibody titers may result in acute hemolytic transfusion reactions following ABO-incompatible platelet transfusions. Identification of high-titer donors is therefore essential for improving transfusion safety. The Solid Phase Red Cell Adherence (SPRCA) technique is an automated, sensitive, and reproducible method for the detection and titration of IgG antibodies. **Aim**: To evaluate anti-A and anti-B antibody titers among group O plateletpheresis donors using the SPRCA technique and to determine the prevalence of high-titer donors. **Materials and Methods**: This prospective observational study was conducted in the Department of Immunohematology and Transfusion Medicine, SMS Hospital, Jaipur. A total of 100 healthy group O plateletpheresis donors aged 18-60 years were included after obtaining informed consent. Anti-A and anti-B IgG antibody titers were determined using the Immucor Neo Iris automated platform based on the SPRCA technique. Statistical analysis was performed using SPSS version 20. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. An unpaired t-test was used for comparison, with $p \leq 0.05$ considered statistically significant. **Results**: The majority of donors were males aged 21-40 years and were predominantly RhD positive. The mean anti-A IgG titer was 125.12 ± 146.08, whereas the mean anti-B IgG titer was 140.00 ± 173.54, with titers ranging from 1:16 to 1:1024. Approximately 17% of donors demonstrated high antibody titers (≥1:256). Younger donors exhibited relatively higher antibody titers than older donors, while female donors showed higher mean titers than males. **Conclusion**: A significant proportion of group O plateletpheresis donors possess high anti-A and anti-B antibody titers. Routine antibody titration using the SPRCA technique can facilitate identification and labeling of high-titer donors, thereby reducing the risk of ABO-incompatible hemolytic transfusion reactions and improving transfusion safety.*

Keywords: Plateletpheresis, Group O donor, Anti-A antibody, Anti-B antibody, SPRCA, Isoagglutinin titer, Blood transfusion.

1. Introduction

Blood transfusion is an indispensable component of modern healthcare, providing life-saving support in trauma, surgery, hematological disorders, oncology, and transplantation. Ensuring compatibility between donor and recipient blood components is fundamental to transfusion safety. Among the various blood group systems, the ABO blood group system remains the most clinically significant because naturally occurring antibodies against incompatible ABO antigens can produce immediate and potentially fatal hemolytic transfusion reactions.

The ABO blood group system was discovered by Karl Landsteiner in 1901, marking a milestone in transfusion medicine. The ABO phenotype is determined by the expression of A and B antigens on red blood cells through the action of glycosyltransferases encoded by the ABO gene. Individuals lacking A or B antigens naturally develop antibodies against the absent antigen following exposure to environmental microorganisms with structurally similar carbohydrate antigens. These antibodies are predominantly immunoglobulin M (IgM), although immunoglobulin G (IgG) antibodies may also develop following pregnancy, transfusion, or repeated antigenic stimulation.

Group O individuals lack both A and B antigens and therefore possess both anti-A and anti-B antibodies. These antibodies are often present at higher titers than those observed in other blood groups. During platelet transfusion, particularly when group O platelets are transfused to non-group O recipients, donor plasma containing high-titer isoagglutinins may cause destruction of recipient red blood cells, resulting in acute intravascular hemolysis. Although such reactions are uncommon, they may be severe and potentially fatal.

The increasing demand for platelet components frequently necessitates ABO-incompatible platelet transfusions because of inventory limitations. Consequently, identification of donors with high anti-A and anti-B antibody titers has become an important component of transfusion safety programs. Several blood centers have adopted strategies including antibody titer screening, plasma volume reduction, platelet additive solutions, and donor labeling to minimize the risk associated with incompatible plasma transfusions.

Various laboratory techniques are available for antibody titration, including conventional tube testing, column agglutination technology, flow cytometry, and the Solid Phase Red Cell Adherence (SPRCA) technique. SPRCA provides enhanced sensitivity, reproducibility, and automation while specifically detecting clinically significant IgG antibodies. Compared with conventional methods, SPRCA generally yields higher endpoint titers and reduces inter-observer variability.

Previous studies have reported that approximately 10-20% of group O donors possess high-titer anti-A and anti-B

antibodies, although the prevalence varies according to ethnicity, geographical region, age, gender, diet, and laboratory methodology. Data from North India indicate a relatively higher prevalence compared with many Western populations, emphasizing the need for regional evaluation.

The present study was therefore undertaken to evaluate anti-A and anti-B antibody titers among group O plateletpheresis donors using the SPRCA technique at SMS Hospital, Jaipur, and to determine the prevalence of high-titer donors along with their demographic characteristics.

2. Materials and Methods

This prospective observational study was conducted in the Department of Immunohematology and Transfusion Medicine, Blood Centre, Sawai Man Singh Hospital, Jaipur, Rajasthan. The study was carried out over approximately one year until the calculated sample size was achieved.

A total of 100 healthy group O plateletpheresis donors between 18 and 60 years of age were enrolled consecutively after obtaining written informed consent. Only eligible donors fulfilling institutional plateletpheresis criteria were included. Donors belonging to blood groups A, B, or AB, those with a history of blood transfusion, non-consenting individuals, and donors deferred according to standard operating procedures were excluded.

Ethical approval was obtained from the Research Review Board of SMS Medical College, Jaipur, prior to commencement of the study. Written informed consent was obtained from all participants in their local language.

Approximately 4-6 mL of whole blood was collected from the diversion pouch into K_2EDTA tubes during the plateletpheresis procedure. Anti-A and anti-B IgG antibody titers were determined using the Immucor Neo Iris automated analyzer employing the Solid Phase Red Cell Adherence (SPRCA) technique with Capture-R plates. In this method, antigen-coated microwells bind donor antibodies, which are subsequently detected using anti-IgG indicator red blood cells. A positive reaction is indicated by adherence of indicator cells as a uniform monolayer across the well surface.

The sample size of 100 donors was calculated at a 95% confidence interval with 80% study power and a 7% absolute error. Data were entered into Microsoft Excel and analyzed using SPSS version 20. Continuous variables were expressed as mean ± standard deviation, whereas categorical variables were presented as frequencies and percentages. Statistical significance was assessed using the unpaired Student's t-test, and a p-value ≤ 0.05 was considered statistically significant.

3. Results

A total of 100 group O plateletpheresis donors were included in the study. The majority of donors were male and belonged to the 21-40-year age group. Most participants were RhD positive.

The mean anti-A IgG antibody titer was **125.12 ± 146.08**, whereas the mean anti-B IgG antibody titer was **140.00 ± 173.54**. Antibody titers ranged from **1:16 to 1:1024**, demonstrating considerable inter-individual variation. Anti-B titers were generally higher than anti-A titers among the study population.

Using a cutoff value of **≥1:256**, approximately **17% of donors** were identified as high-titer plateletpheresis donors. Identification of these donors is clinically important because transfusion of plasma-rich platelet components from such donors may increase the risk of hemolytic transfusion reactions in ABO-incompatible recipients.

Analysis according to age revealed that younger donors exhibited relatively higher anti-A and anti-B antibody titers compared with older donors, with a gradual decline in antibody levels observed with advancing age. Female donors demonstrated higher mean antibody titers than male donors, particularly for anti-B antibodies.

The findings indicate that a measurable proportion of group O plateletpheresis donors possess clinically significant isoagglutinin titers. Routine antibody titration and labeling of high-titer donors may therefore improve transfusion safety by facilitating appropriate selection of platelet components for ABO-incompatible transfusions.

4. Discussion

The present study evaluated the anti-A and anti-B IgG antibody titers among group O plateletpheresis donors using the Solid Phase Red Cell Adherence (SPRCA) technique. Group O donors are known to possess naturally occurring anti-A and anti-B isoagglutinins, which can cause hemolytic transfusion reactions when plasma-rich platelet components are transfused to ABO-incompatible recipients. Therefore, identifying donors with high antibody titers is an important strategy to enhance transfusion safety.

In the present study, the mean anti-A IgG titer was **125.12 ± 146.08**, while the mean anti-B IgG titer was **140.00 ± 173.54**, with titers ranging from **1:16 to 1:1024**. Anti-B titers were generally higher than anti-A titers, a finding that has been reported in several Indian studies. Variations in isoagglutinin titers may be influenced by genetic background, environmental exposure, dietary habits, intestinal microbiota, and regional epidemiological factors.

Approximately **17%** of donors exhibited high antibody titers (≥1:256). This prevalence is comparable with reports from North India, where the proportion of high-titer group O donors has ranged from approximately 15% to 25%. In contrast, studies from Europe and North America have generally reported lower frequencies, often between 5% and 15%. Such geographical differences may reflect variations in donor characteristics, laboratory techniques, and definitions of high titer.

The SPRCA technique proved to be a reliable method for antibody titration. Compared with conventional tube testing and column agglutination technology, SPRCA provides improved standardization, greater analytical sensitivity, and reduced observer variability through automation. Previous studies have demonstrated that SPRCA may detect antibody

titers one to two dilution steps higher than manual methods, making it particularly suitable for identifying clinically significant IgG isoagglutinins.

The demographic analysis showed that younger donors tended to have higher antibody titers, while titers gradually declined with increasing age. Female donors demonstrated relatively higher mean antibody titers than male donors, particularly for anti-B antibodies. These observations may be explained by immune stimulation during pregnancy and hormonal influences, although differences were not evaluated separately according to parity in the present study.

Routine screening of group O plateletpheresis donors for anti-A and anti-B antibody titers can facilitate identification and labeling of high-titer donors. Such labeling enables blood centers to allocate platelet components appropriately, reduce the risk of ABO-incompatible hemolytic transfusion reactions, and optimize patient safety without significantly affecting platelet inventory management.

The major strengths of this study include the use of an automated and standardized SPRCA platform and the prospective study design. However, limitations include the relatively small sample size, the single-center nature of the study, and the absence of correlation with clinical transfusion outcomes or molecular immunohematological investigations. Larger multicenter studies are warranted to establish standardized cutoff values and donor management protocols.

5. Conclusion

The present study demonstrates that a considerable proportion of group O plateletpheresis donors possess clinically significant anti-A and anti-B IgG antibody titers. Approximately 17% of donors exhibited high antibody titers (≥1:256), emphasizing the importance of routine antibody titration in blood centers.

The SPRCA technique proved to be a sensitive, reproducible, and automated method for determining isoagglutinin titers. Routine identification and labeling of high-titer donors can substantially reduce the risk of ABO-incompatible hemolytic transfusion reactions while improving the overall safety of platelet transfusion practices.

Implementation of standardized antibody titration protocols and the establishment of institution-specific cutoff values may further strengthen transfusion safety. Future multicenter studies involving larger donor populations and correlation with clinical outcomes are recommended to develop national guidelines for the management of high-titer group O platelet donors.

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