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Original Research Article

Evaluation of ABO Blood Group Discrepancies in the Blood Donor Population of South Gujarat

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Abstract:
Introduction: Blood group discrepancies in blood donors can jeopardize transfusion safety, resulting in incompatible blood transfusions. These ABO blood group discrepancies arise when cell grouping and serum grouping does not match in blood donors. Technical errors, rare blood group variants and underlying medical conditions affecting red blood cell antigens contribute to these discrepancies. Swift resolution of these issues is vital for ensuring safe blood product transfusions. Our study aims to investigate the prevalence, causes, and resolution of blood group discrepancies among healthy blood donors, enhancing transfusion safety and patient care.
Material and Methods: From January to June 2022, a retrospective study in Gujarat, India, analyzed blood group discrepancies in healthy donors. Demographic data were collected, and advanced techniques like Biorad forward and reverse grouping and Gel Cards were used for ABO typing. Discrepancies underwent thorough investigation, including repeat testing and supplementary assays. Biological discrepancies were further explored, and statistical analysis was conducted using SPSS 21 software for comprehensive evaluation.
Results: In our study of 6,067 donors, ABO blood group distribution revealed A (23.26%), B (35.91%), O (32.19%), and AB (8.64%), B blood group as the most prevalent types. Following review, 17 (0.28%) discrepancies were identified. In our study, discrepancies fell into four types: weak or missing antibodies (Type I, 52.94%), missing antigen (Type II, 5.88%), and miscellaneous antibodies (Type IV, 41.18%). Notably, we encountered no instances of Type III discrepancies. Within Type I discrepancies, we observed 7 weak anti-B and 2 weak anti-A antibodies, while Type II discrepancies were associated with the A3 antigen. Type IV discrepancies included 3 anti-M, 2 anti-Le^{b}, and 2 unidentified antibodies.
Conclusion: In conclusion, discrepancies in ABO blood typing present notable challenges for accurate blood compatibility assessments. Understanding the nuances of ABO discrepancies is vital for implementing effective quality improvement initiatives in blood banking practices.
Keywords: ABO Blood Group Discrepancies, Blood Donors, Discrepancy Types.
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Introduction

Analysis of blood group discrepancy in healthy blood donors is a critical aspect of blood transfusion safety and compatibility. [1] These ABO blood group discrepancies arise when cell grouping and serum grouping does not match in blood donors. [2] While uncommon, these discrepancies can have serious consequences if not identified and resolved accurately. [3]

Several factors can contribute to blood group discrepancies, including technical errors during testing, rare blood group variants, or underlying medical conditions affecting red blood cell antigens. [4] Therefore, a comprehensive analysis involving repeat testing, extended antigen typing, and clinical evaluation is necessary to determine the true blood group of the donor.

In healthy blood donors, resolving discrepancies promptly is essential to ensure the safe transfusion of blood products to recipients. [5] This process typically involves collaboration between blood bank personnel, laboratory technicians, and medical professionals to investigate the cause of

the discrepancy thoroughly. [6] By implementing rigorous quality control measures and utilizing advanced testing techniques, blood banks can minimize the risk of blood group discrepancies and uphold the highest standards of transfusion medicine. [7]

In our study on blood group discrepancies in healthy blood donors, we aim to investigate the prevalence, causes, and resolution of these discrepancies within our donor population. Through meticulous data collection and analysis of donor records, laboratory test results, and clinical outcomes, we seek to identify patterns and trends that can inform best practices for blood typing and compatibility testing.

Material and Methods

The present retrospective cross-sectional study was conducted from January 2022 to June 2022 within the Department of Transfusion Medicine at a tertiary care referral hospital in Gujarat, India. The study aimed to thoroughly analyse blood group discrepancies among ostensibly healthy blood donors within this region.

A comprehensive collection of demographic data pertaining to donors was meticulously gathered from electronic repositories within the hospital's database system. Only donors fulfilling the acceptance criteria according to drug & cosmetic act, 1945 & its amendments were included, while those not fulfilling the criteria were deferred and systematically excluded from the analysis.

During the process of whole blood donation, samples were judiciously procured in Ethylenediaminetetraacetic acid and plain vials to facilitate routine ABO typing, Indirect antiglobulin test and Transfusion Transmissible Infection (TTI) screening. Employing cutting-edge methodologies, ABO typing was done by utilizing the DiaMed-ID Card Micro Typing System (BIO-RAD, Switzerland), incorporating forward and reverse grouping card and Indirect antiglobulin test was done by utilizing DiaMed-ID Card Micro Typing System (BIO-RAD, Switzerland) incorporating coomb's card by column agglutination technique. Furthermore, to ensure a robust analysis, conventional tube technique (CTT) was also harnessed for the determination of ABO/Rh blood groups. Monoclonal antisera (anti-A, anti-B, anti-AB, anti-H, anti-A_1 manufactured by Tulip Diagnostics (P) Ltd, Goa, India) and in-house prepared pooled cells constituted the cornerstone of these investigative endeavours.

An exhaustive approach was undertaken to address any discrepancies between the forward and reverse grouping results. This involved a systematic investigation to differentiate between clerical or technical errors and true biological discrepancies. Upon identifying a biological discrepancy, a series of meticulously crafted protocols were implemented. These protocols encompass repeat testing utilizing diverse techniques, ruling out a Bombay phenotype, meticulous examination of potential issues concerning red blood cells or plasma, and the undertaking of supplementary tests such as antibody screening and identification. Finally, the cause of the discrepancy is meticulously documented to ensure comprehensive understanding and resolution.

In our study, upon encountering a discrepancy in ABO typing, we first repeat the typing using a fresh blood sample in gel card and conventional tube technique (CTT). Additionally, in cases where serum reactions were unexpectedly weak or missing while cell grouping displayed strong agglutination, we suspected the presence of weak antibodies. To address this, tests were repeated after prolonged incubation at room temperature or incubation at 4°C, and after increased serum-to-cell ratio. Saliva inhibition testing and adsorption elution testing were also done to confirm the grouping. Autocontrols along with in house prepared group O red cells were used as controls. When there was an agglutination with O cell or positive Indirect antiglobulin test either in gel card or CTT, the antibody screening was done using three-cell antigen panel ID-DiaCell I-II-III (DiaMed GmbH, BIO-RAD, Switzerland), antibody identification was done using 11-cell antigen panel, ID- DiaCell Panel (DiaMed GmbH, BIO-RAD, Switzerland), and select cells were used. Treatment with proteolytic enzymes and subsequent testing for antibody identification were performed to assess the possibility of low avidity antibodies in serum.

The collected data were systematically transcribed into spreadsheet software, whereupon they underwent rigorous analysis utilizing a diverse array of statistical methodologies. Incidence, prevalence, and various rates pertinent to the study were meticulously computed utilizing established formulae. The statistical analyses were conducted utilizing SPSS 21 software specifically tailored to facilitate such comprehensive assessments.

Results

In our study, we examined a cohort of 6,067 donors for ABO typing, with a majority of male donors comprising 5,979 (98.55%) individuals, while females accounted for 1.45% (88 individuals). The ABO blood group distribution among the donors was notable, with A (23.26%), B (35.91%), O (32.19%), and AB (8.64%), with B blood group as the most prevalent type.

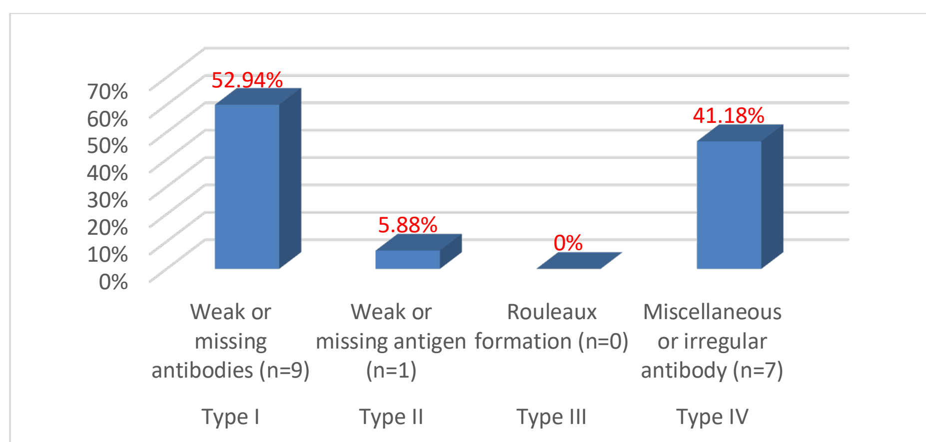

Figure 1: ABO discrepancies n(%)

Following meticulous review to eliminate clerical errors, we identified 17 (0.28%). instances of ABO blood group discrepancies. These discrepancies were exclusively observed in male donors, with a mean age of 29.8 years.

In our study, blood group discrepancies were categorized into four types. Type I (52.94%) involved weak or missing antibodies, Type II (5.88%) resulted from a missing antigen (A3), Type III (0%) indicated no rouleaux formation, and Type IV (41.18%) included miscellaneous or irregular antibodies. Notably, no instances of type III discrepancies were encountered during the study period. (Fig 1)Type I: 52.94% due to weak antibodies (7 anti-B, 2 anti-A). Type II: 5.88% linked to A3 antigen. Type III: No rouleaux formation observed. Type IV: 41.18% miscellaneous antibodies (3 anti-M, 2 anti-Le^b, 2 unidentified).

Table 1 displays the serological characteristics of weak A subgroups. Notable reactions in cell and serum grouping, auto control, with a specific focus on the A3 subgroup.

Table 1: Serological details of weak subgroups of A

Cell grouping				**Serum grouping**			**Auto control**	**Anti-H lectin**	**Anti-A1 lectin**	**Possible weak subgroup**
Anti-A	Anti-B	Anti-D	Anti-AB	A cell	B cell	O cell				
2+mf*	0	4+	2+mf*	0	4+	0	0	3+	0	A3

*mf: mix field

Discussion

The observed differences in ABO blood group discrepancy rates across various studies highlight the variability in the prevalence of such discrepancies among different populations and settings. Our study identified a discrepancy rate of 0.28%, indicating that a small but notable proportion of blood samples exhibited inconsistencies in ABO typing. This finding suggests the importance of rigorous quality control measures in blood typing procedures to minimize errors and ensure accurate blood compatibility assessments. Comparatively, the discrepancy rates reported in other studies varied, with some studies reporting lower rates, such as Shahshahani et al. [8] (0.04%) and Sharma et al. [9] (0.04%), while others reported higher rates, such as Desai et al. [10] (0.15%) and Chiaroni et al. [11] (0.03%).

In our study, we identified four types of blood group discrepancies. Type I (52.94%) involved weak or missing antibodies, with anti-B antibodies being the most common. Type II (5.88%) resulted from the A_3 antigen. Notably, no instances of Type III discrepancies were observed, indicating no rouleaux formation. Type IV (41.18%) discrepancies encompassed miscellaneous or irregular antibodies, with anti-M and anti-Le^b antibodies being prevalent. Comparing our findings with those of other studies, we observe variability in the distribution and causes of ABO discrepancies. For instance, Jain et al. [12] identified weak anti-B antibodies as the predominant cause, while Desai et al. [10] reported discrepancies arising from weakened or missing antibodies, antigens, pan agglutination, and miscellaneous factors in both blood donor and patient samples. Similarly, Sahu et al. [13] categorized discrepancies into types but observed different proportions of each type compared to our study. In the study by Shahshahani et al. [8], technical and clerical errors were identified as contributing factors to ABO blood group discrepancies, accounting for 9.3% of cases. They

observed that subgroups of the A antigen were the primary cause in forward grouping (44.6%), while cold autoantibodies predominated in reverse grouping (23.9%). Additionally, alloantibodies were detected in 8.4% of cases, and two rare Bombay phenotype donors were identified.

A study by Chiaroni et al. [11] highlighted that most ABO discrepancies were due to phlebotomy errors, particularly collection from the wrong patient, which accounted for the majority of cases. They also noted clerical errors during patient registration or identification as another common cause of discrepancies. In the study conducted by Sharma et al. [9], ABO discrepancies were found in 51 cases (0.04%). The primary causes included low avidity anti-B antibodies (58.8%), weaker expression or subgroups of A (19.6%), and unexpected alloantibodies (9.8%). One case involved the Bombay blood group, and three unresolved discrepancies required referral to a reference laboratory for molecular analysis. They also observed that weak A or B antigen expressions were common causes of discrepancies in forward grouping, while decreased anti-B titers were prevalent in reverse grouping.

These variations may stem from differences in study populations, laboratory methodologies, and sample sizes. Moreover, discrepancies in blood typing can result from a myriad of factors, including technical errors, biological variations, and rare blood group subtypes. [11,14,15] Understanding these nuances is essential for implementing targeted quality control measures and ensuring the accuracy and reliability of blood typing procedures in clinical practice.

All discrepancies observed in ABO cell and serum grouping warrant thorough investigation to ensure accurate blood group reporting, thereby minimizing the risk of transfusion reactions. It is imperative to include a cautionary note on blood group cards to prevent ABO incompatibility during transfusion. The study findings underscore the significance of addressing errors not only during phlebotomy but also during registration and identification by clerical staff, emphasizing the need for standardized data transmission among healthcare personnel. To mitigate technical and clerical errors, implementing accurate blood donor or sample identification programs is crucial. Each case of blood group discrepancy should be meticulously investigated, and donors should be appropriately informed. At our center, the prevalence of ABO group discrepancy was 0.28%, highlighting the importance of resolving discrepancies before reporting blood groups to minimize transfusion reactions. Both cell and serum grouping are vital for accurate ABO group determination, emphasizing the necessity of a comprehensive serological workup. [16]

One limitation of our study is the lack of molecular analysis or advanced testing methods to further characterize the ABO discrepancies encountered. While we thoroughly investigated discrepancies using conventional serological techniques, additional molecular analyses could have provided deeper insights into the underlying causes of these discrepancies. Moreover, our study did not explore the impact of potential factors such as donor demographics or laboratory protocols on the occurrence of ABO discrepancies, which could have provided valuable insights for future research and quality improvement initiatives in blood banking practices.

Conclusion

In conclusion, discrepancies in ABO blood typing pose significant challenges in ensuring accurate blood compatibility assessments. The variability in discrepancy rates and causes across different studies underscores the importance of standardized protocols and rigorous quality control measures in blood banking practices. Understanding the nuances of ABO discrepancies, including technical errors, biological variations, and rare blood group subtypes, is essential for implementing targeted quality improvement initiatives.

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