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Original Research Article

Role of antibody screening in high titre group O donors

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ABSTRACT

Background & Objectives : Red Cells, Fresh Frozen Plasma (FFP) and Platelets (RDP/SDP) prepared from donors with group O may have high titers of anti-A, anti-B and/or anti-A,B antibodies. When such components given to non-group O patients, this high titre can result in haemolytic transfusion reactions (HTRs). Such group O donors are generally termed 'high-titer group O donors. Significant amounts of ABO antigen being present on the platelet surface and anti-ABO iso-agglutinins being present in the donor's plasma, Platelet transfusions need to take into account the issues. Although relatively rare, but acute intravascular haemolytic transfusion reaction has been caused by passive transfer of anti-A and anti-B antibodies, present in group O donors. This study aimed to identify the prevalence of high titre antibodies in group O donors. Thus, titre are performed in randomly selected group O donors from different gender and age group to identify best available source of products for Platelet and follow up transfusions.

Materials and Methods: Randomly selected 100 O blood group donors were included in the study. Samples from these donors were tested for ABO antibody (both IgM and IgG) titres using conventional tube technique at RT and 37°C at Indirect Antiglobulin phase. Statistical analysis was performed using two sample t-test and anova test.

Results : Donors included in the present study were mainly male (85%) donors. ABO antibody titres ranged from 0 to 2048. In the present study, Anti-B (IgG) titer is significantly higher than other antibodies in both genders.

There are a large proportion of group O donors having high titres of antibodies and hence a routine pretransfusion screening for such antibodies can prevent the development of hemolytic transfusion reaction by issuing only low titre components for out of group transfusions.

Conclusion: Each Blood Transfusion Service should establish a policy for testing and issue of group O platelets to non-O group recipient to avoid chances of development of adverse transfusion reaction.

1. Introduction

Plasma of group O donors can have high titers of anti-A, anti-B and/or anti-A, B. This high value of antibodies can result in hemolytic transfusion reactions (HTRs) especially Red cells, FFP and Platelets prepared from high titre group O donors given to non-group O patients. Such group O donors are generally termed 'high-titer group O donors'.[1]

Significant amounts of ABO antigen are present on the platelet surface. Platelet transfusion need to be considered as ABO antibodies present in the donor's plasma and antigens are present on platelets. Though relatively rare, acute intravascular haemolytic transfusion reaction has been caused by passive transfer of anti-A and anti-B antibodies, present in group O donors.

Reactions are more likely to occur with:

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1. The high titer of the anti-A, anti-B and/or anti-A,B in the component.
2. The high plasma volume of the transfused product.
3. The small blood volume of the recipient.

Blood and blood components are required to save lives. It plays vital role in saving life. Low titer O whole blood defined as anti-A and anti-B titer levels of <1:256. It is safe as it reduces the risk for hemolytic transfusion reactions.[2]

Environmental factors can affect levels of A and B antibodies. Anti-A and anti-B may be IgM, IgG or IgA. Some anti-sera contain all three classes and some may contain any of the three antibody. Non-stimulated individuals are predominantly containing IgM antibody. Changes in the characteristics of anti-A or anti-B antibody can occur as a result of further immunization with pregnancy or by incompatible transfusions. These antibodies are serologically detectable through increases in titers, agglutinin avidity and hemolytic activity and have greater activity at 37ºC temperature. Such "immune" sera are generally difficult to inhibit with saliva or with A or B substances. Sera from group O people contain two separable antibodies, anti-A and anti-B and a cross-reacting antibody called anti-A, B (mostly IgG).[3]

ABO antibodies play role in the fate of organ grafts after transplantation. In such case of group mismatch organ transplantation, pre-transplant preparative schedules including but not limited to titration, immunosuppression and/or splenectomy along with a therapeutic plasma exchange (TPE) program has been developed by many centres. There is only limited basic research and standard protocol available in this area and there is still a high scope for development of standardized clinical protocols for TPE in the such kind of cases.[4] On the other hand, in Transfusion Medicine including many centres in United states, 10 to 40 percent of all PLTs transfusions are from plasma-incompatible units. Only a small number of centres screen group O single donor apheresis Platelets for the presence of high titer agglutinins before issuing to the patients.[5] Similarly, there is a shortage of identical organ and blood donors. In both the situations, it is needed for blood centres to formulate strategies to minimize the biological effects of ABO antibodies. Although, two major challenges in respect to standardized, prospective screening are absence of a recognized reference method and critical end titer that will reasonably differentiate safe from high-titer donors for both clinical settings.

2. Materials and Methods

In the blood centres, blood donors including apheresis donors are voluntary. The practice for platelet transfusion and apheresis platelets is mainly for group specific. In case of apheresis procedures and transfusion, all donors are from the same group as of patients.

Randomly selected 100 group O voluntary blood donors were included in the present study. Samples were tested for antibody titration using conventional tube technique. IgM antibody titration was performed using the immediate spin tube technique and IgG antibody titration were performed using the conventional tube technique with use of Anti-human globulin (AHG). Titration is a semi quantitative method used to determine the concentration of antibody in the serum. Titration is performed by using serial dilution of serum of the donor samples. Reciprocal of the highest dilution giving positive reaction (agglutination) is considered as titre value.

Treating IgM antibodies with sulfhydryl reagents (DTT) eliminates both agglutinating and complement binding activities. After DTT treatment, titration method is performed and the level of titre were considered as a IgG titre.

2.1. Study design

Retrospective.

2.2. Study period

1 Year.

2.3. Inclusion criteria

Randomly selected blood donors of blood group O who had donated blood our centre.

2.4. Statistical analysis

Descriptive statistics were used to describe the age, gender and level of anti-A and anti-B titres in the samples. The data were converted into decimal form for analysis and statistical analysis were performed by using two sample T-test and ANOVA test. For analysis, all values were converted into numerical form. (Software- Mini tab license version 21.1, Dec-2021)

2.5. Ethical clearance

The current study was retrospective data analysis. The ethical clearance was taken from institutional ethical committee.

3. Results

Present study was performed on 100 randomly selected group O blood donors comprised of 85 % male and 15% female donors. Donor's age group were between 18 to 60 years. For analysis, all titre value converted into decimal form and follow normal distribution. Histogram was plotted for titre versus gender. (Figure 1)

Most of the high titre values lie in age group of 20-30 & 30-40 years. (Figure 2)

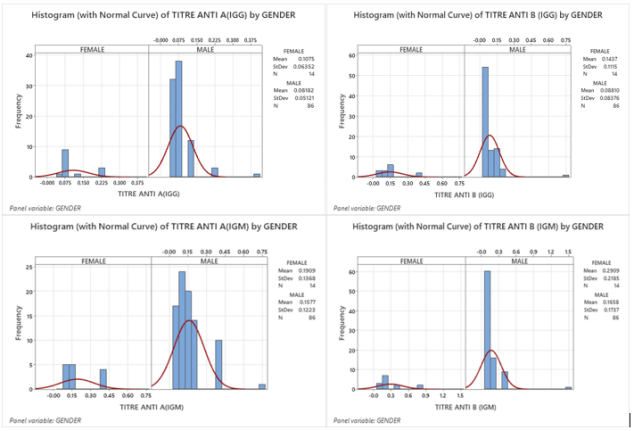


Fig. 1: Histogram were plotted for titre versus gender.

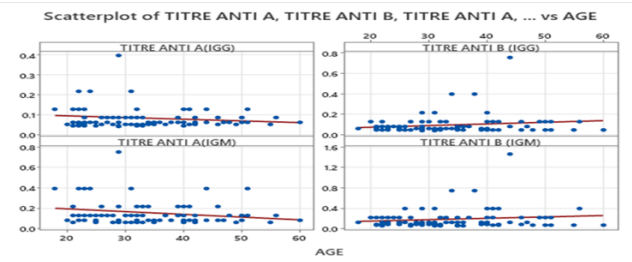


Fig. 2: Scatter plot of titre vs age group

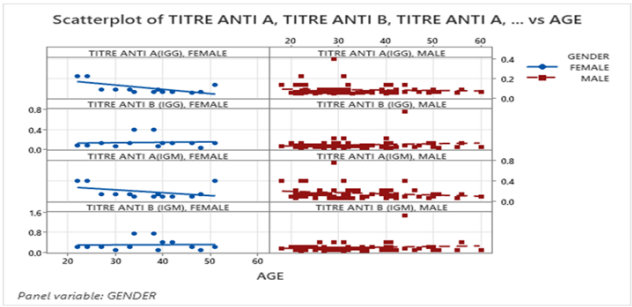


Fig. 3: Scatter plot of titre vs gender

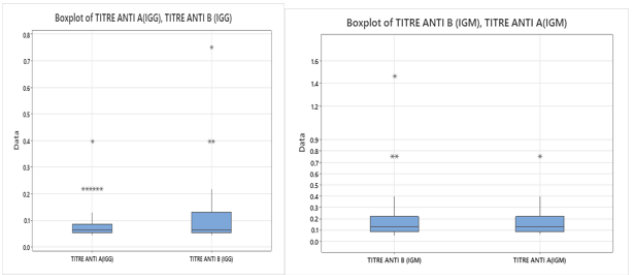


Fig. 4: Box Plots for different titre comparison

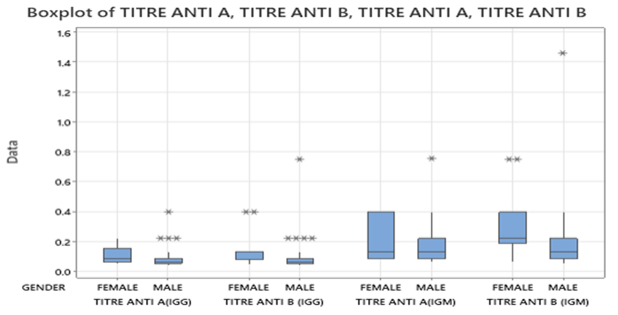


Fig. 5: Boxplot of titre for gender comparison

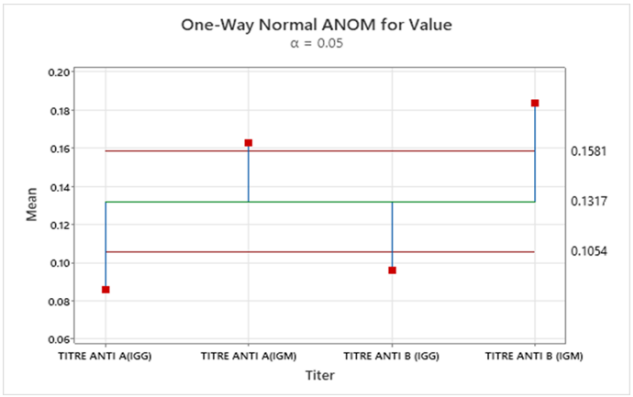
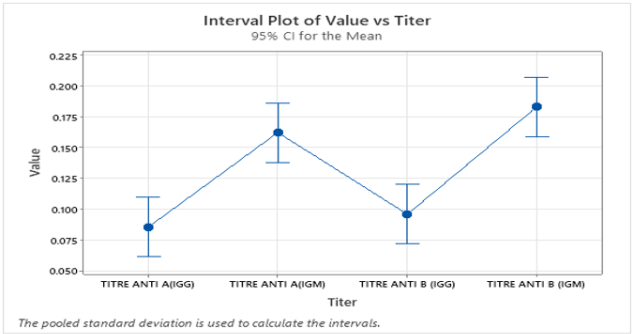


Fig. 6: One way normal ANOM for value.



Two sample T-test for Titre Anti A (IGG) & Anti B (IGG)

Fig. 7: Interval plot of value vs titre

Scatter plot of gender indicates that titre value decreases in Anti A (IgG) & Anti A (IgM) as the age increases. (Figure 3)

Analysis of Titre Anti A (IgG) & B (IgG) indicates Anti A (IgG) has very less variation in comparison with Anti B (IgG). Both Anti A (IgM) and anti-B (IgM) has same data range and same median. Titre Anti A (IgG) is significant in terms of lower titre value and variability. (Figure 4)

Analysis of all 4 titre indicates that Anti A (IgG) is significant followed by Anti B (IgG) where both Anti A & Anti B (IgM) has same value. Analysis of gender

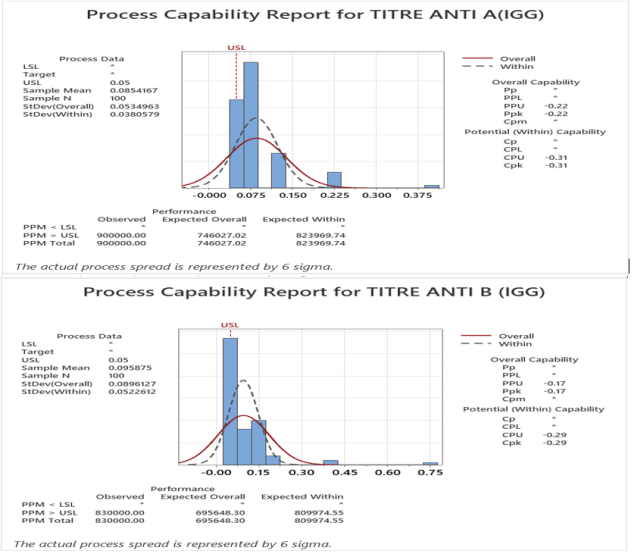


Fig. 8: Process capability report for titre

comparison indicates in Male both IgG has same value <0.1 (1:64) and both IgM value varies between 0.1 to 0.2 (>1:64) In Female Anti B (IgG) is significant. (Figure 5)

Based on mean, comparison indicates means are not the same. Based on the anova for comparison of means p-value is <0.05 indicates, all 4 means are different. (Figure 6)

Based on two sample t-test p value is 0.318 > 0.05 that accept null hypothesis that there is no significant difference between mean of both titre Anti A (IgG) & Anti B (IgG). (Figure 7)

Process capability taking 1:16 as upper specification limit for current data set indicates most of the value lie above 0.05 (1:16) for both titre anti A (IgG) & B (IgG) (Figure 8).

In the present study, based on all descriptive statistics of all different titre value of 1:32 for IgG and 1:128 for IgM were considered as High titre value.

4. Discussion

Patients with thrombocytopenia or platelet function defects requires platelet transfusions for the prevention and/or treatment of hemorrhage. ABO antigens are well expressed on platelet surface. Platelet components are usually suspended in small volume of donor's plasma. In a recent study by Kannan et al observed that A or B antigen may not be expressed on platelets but anti-A, anti-B and anti-A,B isoagglutinin in the plasma. If these antibodies present in high titre, they have the potential to haemolyse the red cell of non O group recipient. In ABO major incompatibility, platelet transfusion with anti-A/anti-B in the recipient may reduce platelet increment.[6]

In the present study, titre Anti A (IgG) look significant with most value under 0.1 (1:64) followed by Titre Anti B (IgG). Titre Anti A (IgG) is significant in terms of lower titre value and variability. Study conducted by Hashim Musa et al showed that anti-A titres were significantly higher than anti-B.[7] Platelet prepared from Group O donors, particularly single donor platelets (SDP) are most commonly associated with transfusion reactions. Unusually high titers of antibodies can be found in SDPs due to high volume of plasma. These products may cause significant amount of hemolysis when infused into a Group A or AB recipient.[8] Both studied show that anti-A IgG titre were higher whereas our study shows higher anti-B IgG titre.

Present study did not show significant association between high titer and gender. Similarly, a study conducted by Khampanon et al at the Thailand National Blood Centre also not found any association between IgM, IgG titer and gender (P >0.05). A similar study by Mavichak et al conducted in same setting demonstrated some tendency of higher anti-A and anti-B titers in female than male though not statistically significant.[9]

The age of the donor in present study was 18-60 years. In the present study, it has been shown that young population between 20-30- and 30-40-years age group showed high titre. In the present study significant association between high titer and age was observed. There are few publications that have described a relationship between titer and age[10,11] mostly pointing out higher prevalence among young age group. Study by Rachel beddard at al showed a positive correlation between donor age and high titre of antibody. It was observed that with older age there is a less chance of high titers.[8]

Each Blood Transfusion Services (BTS) can establish their own policy and procedure for a testing and issuing of Group O blood components to non-O group recipient to avoid the use of high-titer components especially in high risk cases where a significant adverse transfusion reaction is likely to occur.

The policy should cover all plasma containing components. It should include Whole Blood, and plasma non-reduced red cells (excluding red cells in additive solution), FFP, SDP, Pooled platelets etc. All blood and components for neonatal transfusions, and infants under one year of age should also be incorporated in the policy.

Each BTS should have a procedure in place to collect and review data regarding testing and outcome of patient and to implement changes in policy in the coordination with titers of anti-A, anti-B and/or anti-A,B which can cause intravascular hemolysis in non-group O recipients if given in large volumes. Testing for high-titre ABO antibodies in blood donors may reduce the risk of HTR in out of group transfusion. But it cannot be entirely excluded through this route. Group O platelets can cause HTR even when tested and labelled negative for high-titre hemolysins. They should only be used for non-group O patients (particularly infant and pediatric patients) as a last resort.[1]

Clinically significant hemolysis is a potentially severe complication. It can occur by administering an ABO-mismatched platelet transfusion but it rarely occurs. Platelet products from Group O donors, particularly single donor platelets (SDP) can most commonly associated with such type of reactions. This may be due to the presence of unusually high titers of antibodies which can be found in the plasma of some Group O donors and SDPs contains the large plasma volume. These components can lead to development of hemolysis when transfused to a Group A or AB recipient.[8] Random donor platelets from Group O donors can also of concern but chances are less as single unit of RDP contains less volume of plasma.

In regular practice at many places, platelets are frequently transfused across ABO blood group. To prevent or diminish chances of hemolytic reactions, platelet transfusions that are matched for ABO should be administered. However, limited availability of donor platelets as well as more number of Group O donors makes this a difficult standard to adhere to. So often platelets are transfused across the group. Methods to improve the safety of Group O products have focused on defining a safe level of isohemagglutinin so that the risk of hemolysis is alleviated when mismatched products are transfused.

It remains challenging to determine the critical titer level above which a mismatched product should not be administered. There is an absence of a standardized methods of isohemagglutinin titer and varying reports in the literature where products with a wide range of titers have been associated with acute hemolytic transfusion reactions. This has made it difficult to determine a cut-off for labeling a product as high titer and restricting its use. According to US Standards it is the responsibility of each BTS to design and implement policies for the use of mismatched platelet components. In contrast, European strategies have defined the low-end titer for which an out-of-group transfusion should not be given to an ABO-incompatible recipient. This testing is performed centrally at the Blood Centers who then make the resolve on the status of a "dangerous donor".[12]

5. Conclusion

This study confirms that group O whole blood donors over 50-year of age can be selected for non-identical ABO transfusions. There are a substantial proportion of group O donors with high titres of antibodies and hence a routine pretransfusion screening for such antibodies can prevent the development of hemolytic transfusion reaction by issuing only low titre products out of group transfusions.

Each Blood Transfusion Service should establish a testing and issuing policy to avoid the use of high-titer anti-A and/or anti-B in circumstances where chances of development of adverse transfusion reaction is high.

6. Limitation

Limitation of our study was may be due to less sample size.

7. Conflict of Interest

The author has no conflict of interest

8. Source of Funding

None.

9. Acknowledgment

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References

1. Joint United Kingdom (UK) Blood Transfusion and Tissue Transplantation Services Professional Advisory Committee. [Last updated 22/05/2015]. Available from: https://www.transfusionguidelines.org/.
2. Koch EJ, Snow R, Cook JT, Wickman D, Lee J, Zarow GJ, et al. Variation of anti-A and anti-B titers in group O potential blood donors: A pilot study. *J Trauma Acute Care Surg*. 2021;91(2S Suppl 2):221–5. doi:10.1097/TA.0000000000003274.
3. Daniels G. Human Blood Groups 2nd edn. 10.1002/9780470987018. Blackwell Publishing; 2002. p. 7.
4. Tobian AA, Shirey RS, Montgomery RA, Ness PM, King KE. The critical role of plasmapheresis in ABO-incompatible renal transplantation. *Transfusion*. 2008;48(11):2453–60. doi:10.1111/j.1537-2995.2008.01857.x.
5. Cooling LL, Downs TA, Butch SH, Davenport RD. Anti-A and anti- B titers in pooled platelets are comparable to apheresis platelets. *Transfusion*. 2008;48(10):2106–13.
6. S K, Kulkarni R, Basavarah. Prevalence of high titres anti-A and anti-B antibodies among O blood group individuals and their associated factors. *Glob J Transfus Med*. 2020;5:187–91.
7. Musa H, Abdallah F. Prevalence of High Titre Anti-A and Anti-B Antibodies among Blood Group O Donors at Kenyatta National Hospital Blood Transfusion Unit, Kenya. *JMSCR*. 2019;7. doi:10.18535/jmscr/v7i10.15.
8. Beddard R. Immunoglobulin M Anti-A & Anti-B titres in south texas group o male donors. *Transfusion*. 2019;59(7):2207–10. doi:10.1111/trf15273.
9. Kavallierou L, Bazigou F, Lempesopoulos K, Cheropoulou A, Mouratidou M, Baliaga S, et al. Evaluation of anti-a and anti-b in group O plateletpheresis donors. hmatol transfus int. *Hematol Transfus Int J*. 2015;1(3):76–81. doi:10.15406/htij.2015.01.00017.
10. Mavichak W, Chiewsilp P, Tubrod J, Ovataga P. ABO Antibodies Among Group O Thai Blood Donors. *J Hematol Transfus Med*. 2013;23(3):203–9.
11. Godin MM, De OSL, Schmidt LC, Vieira LM, Diniz RS, Dusse L, et al. Dangerous universal donors: the reality of the Hemocentro in Belo Horizonte, Minas Gerais. *Rev Bras Hematol Hemoter*. 2016;38(3):193–8. doi:10.1016/j.bjhh.2016.05.007.
12. ABO-mismatched platelet transfusions: Strategies to mitigate patient exposure to naturally occurring hemolytic antibodies. *Transfusion Apheresis Sci*. 2010;42(1):83–8. doi:10.1016/j.transci.2009.10.013.

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