



PREVALENCE OF BLOOD GROUP A2 AMONG GROUP A AND AB DONORS

Immunohematology

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KEYWORDS

INTRODUCTION

The ABO blood group antigens are clinically significant and their discovery by Landsteiner in 1900 paved way for the performance of safe blood transfusions. These antigens are characterized by their distinct carbohydrate structures attached to the glycoprotein or glycolipid membranes of red blood cells (RBCs). Their expression can also be detected on various human cell and tissue surfaces including sensory neurons, vascular endothelium and platelets. [1] Subgroups of the ABO antigens occur and are characterized by reduced quantities of the antigens on the RBCs and saliva of secretors. [2] Landsteiner & Levine subdivided blood group A into their principal subgroups, A1 and A2. The presence of A subgroups is due to genetic variations in the coding region which leads to diminished amounts of A substance and higher amounts of H substance on red blood cells. There are weaker subgroups than A2 which do not frequently occur but when present; they show a characteristic decreased A antigen sites on their RBC and a corresponding increased H antigen activity. [3] The difference between subgroups A1 and A2 is seen in their reactivity with the *Dolichos biflorus* lectin. The *Dolichos* lectin specifically agglutinates A1 cells, leaving the A2 cells unagglutinated. The ABO antibodies occur naturally in the sera of individuals who do not have the corresponding antigens and can cause haemolysis in-vivo. They are mostly immunoglobulin M (IgM). These antibodies through complement activation can cause severe, life-threatening transfusion reactions due to incompatible ABO blood transfusions. Anti-A1 antibody appears as an atypical cold agglutinin in the sera of few people with group A2 or A2B who do not have the corresponding antigen.[4] One to eight percent of persons with blood group A2 and about 22-35% of persons with group A2B have serum anti-A1. These antibodies may cause discrepancies in ABO blood grouping which can further result in HTR.[5] Rare cases of haemolytic transfusion reaction due to anti-A1 have been reported.[4] It is estimated that about 80% of individuals with antigen A are A1 while the remaining 20% are A2.[5] Among Indians, the frequency of subgroup A2 among group A individuals is 6.58% while that of A2B among group AB is 8.99%.[6] Knowledge of the frequency and distribution of blood subgroup A2 will help to enhance blood compatibility testing, population genetic studies, investigation of transfusion reactions, studying disease associations and resolving some medico-legal issues.[7]

AIM & OBJECTIVES

- To determine the prevalence of antigen A2 among group A and AB donors who visit the S.S.G. Blood Centre.
- To determine the difference in frequency of blood group A2 between groups A and AB individuals.
- To determine the frequency of production of anti-A1 by individuals who possess the A2 antigen i.e. groups A2 and A2B.

MATERIALS AND METHODS

This was a cross-sectional study, conducted at the S.S.G. Blood Centre, Vadodara. The study population included individuals who passed the pre-donation screening and were accepted to donate blood at S.S.G. Blood Centre, Vadodara. Donors who passed the pre-donation screening and were ready to donate their blood, were taken through the consent form including an explanation of the risks and benefits of participating in the study. Blood sample was collected at the time of donation and properly labeled. The blood samples collected were used for ABO blood grouping using anti-A and anti-B monoclonal reagents. Blood group A and AB samples were used for blood group A2 and further Anti-A1 screening. Samples which came

out as blood group A and AB were used against Anti-A1 lectin for the blood group A2 screening. The reaction of the blood group A2 serum with commercial A1 cells helped to detect the number of A2 individuals with anti-A1 antibodies. A doubling dilution of the A2 serum was made to determine the titre of anti-A1 antibodies present. Controls were done alongside each batch of tests using known cells.

RESULT

A total of eleven thousand, six hundred and twenty-nine (11,629) participants (all Indians) were screened among blood donors (voluntary and family replacement donors) who donated their blood at the S.S.G. Blood Centre during the study period. The participants comprised 11302 (92.78%) males and 327 (7.21%) females, with a mean age of 25.64±6.68 years. The ages of the donors ranged from 18 to 65 years. More than half 8596 (73.92%) of the donors were first-time donors while 3033 (26.08%) were retained donors. Majority of these donors 10790(92.78%) were males most of whom are residents in the Vadodara or any village near Vadodara.

Table 1: Description of Demographic characteristics of blood donors

Variable	Frequency	Percentage (%)
Gender		
Male	11302	97.18
Female	327	2.81
Age (years)		
Below 25	647	56.7
25 to 34	353	31.0
Above 35	140	12.3
Nationality		
Indian	11629	100

Donor type

Voluntary		
Male	4632	39.83
Female	273	2.34
Replacement		
Male	6574	56.53
Female	54	0.46

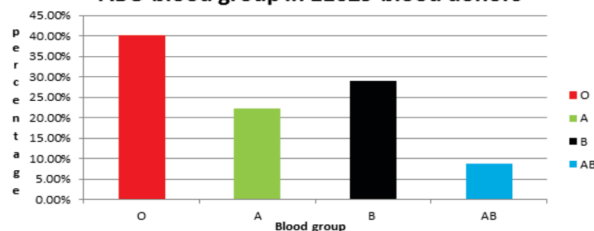
Donor History

First-time donors	8596	73.91
Retained donors	3033	26.08

ABO blood grouping results

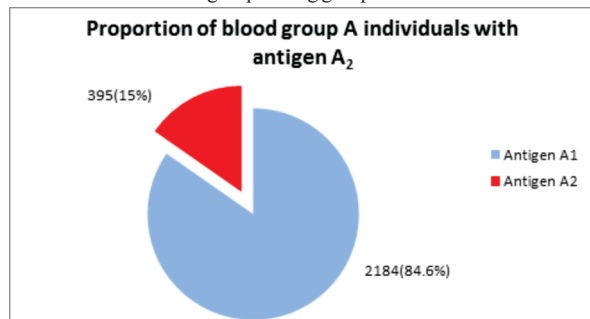
Majority 4660 (40.07%) of the donors recruited in the study were blood group O individuals. The numbers of Blood group A and B individuals obtained were, 2579(22.17%) and 3363(28.91%) respectively. The least blood group observed was AB 1027(8.83%). These are shown in Figure below.

ABO blood group in 11629 blood donors



ABO blood groups of the 11629 blood donors

Out of the 2579 blood group A individuals, 2184 (84.68%) are A1 while 395 (15.31%) are A2. The 1027 blood group AB individuals observed were also made up of 425 (41.38%) A1B and 602 (58.61%) A2B individuals. ABO subgroup A1 was the most common subgroup observed among blood group A individuals while subgroup A2 was the most common A subgroup among group AB individuals.



Proportion of group A individuals with antigen A₂

With the use of *Dolichos lectin*, the weakest agglutination was 2+ and was seen in only 14 (6.6%) samples. The rest were 3+ and 4+. This is indicative of the absence of weak forms of A.

Difference in antigen A² among blood group A and AB donors

Antigen A2					
Blood Type	Total	A2	z-value	Chi-square	p-value
A	2579	395(15.31%)	26.24	688.4628	0.001 (z-test)
AB	1027	602(58.61%)			0.00001(chi-square)

Among the study participants, no any anti-A1 antibody was recorded from a group A2 individual and A2B individuals.

DISCUSSION

The ABO blood group is the most widely studied blood group system in the world and its variation across different races and groups of people are well documented. Studies on ABO blood groups have improved our knowledge of its disease association, haemolytic transfusion reactions, population genetic studies, solving paternity disputes among others.[8] The advent of subgroups has brought more understanding to the study of ABO blood groups since it has helped to resolve some discrepancies in blood group testing. This study sought to find out the prevalence of A2 and A2B subgroups among blood groups A and AB donors who visit the S.S.G. blood centre in Vadodara, Gujarat. The findings from this study reaffirm the strong dominance of blood group O individuals among the Indian population. The frequencies of ABO blood groups in this study can be presented in the order O>B>A>AB which agrees with findings from earlier studies in India. Similar ABO blood group distribution pattern has been observed among people of several black African countries and other Blacks living in America. ABO blood group antigen distribution among the black population in America is similar to that seen in the current study. The current study shows the frequencies of antigens A1 and A2 among the study population as 18.78% and 3.4% respectively, with antigen A1 emerging as the more common A antigen. This data agree with data from other studies in India, South Africa and Japan that reported that majority of group A individuals belong to subgroup A1. A2 generally occurs in 20% of all group A individuals while A1 subgroup occurs in approximately 80%.[9] The proportion of subgroup A2 obtained among group A individuals from the current study (15%) compares very well with the worldwide proportion of A2 (20%). From the current study, 58.6% of AB individuals belong to A2B subgroup. Most studies reveal a higher antigen A2 ratio among group AB individuals. Several studies attribute this increase in A2B genotype among the AB population to suppression of the A gene when combined with a strong B gene. Although this may possibly be the reason for the outcome of study. We are unable to confirm that the higher quantities of A2 among AB individuals observed are due to the presence of a strong B gene because we did not analyze the B genes of the individuals studied. Several other factors may be responsible for a higher blood group A2 frequency among specific group of people. There is an enhanced expression of weak A genes on some occasions when they are combined with strong B genes in an AB individual.[10] In such cases, a weak A antigen may be expressed serologically as A2 due to a rise in antigen site density. The high frequency of A2B individuals in the

current study cannot be attributed to this allelic enhancement phenomenon due to the absence of weak forms of A in the current study. Out of the 997 A2 and A2B samples received, none of the A2 and A2B individuals who are known to produce anti-A₁ had developed the antibody. The lack of anti-A1 production among the A2 and A2B study participants may be associated with increased levels of Ac and Ad determinants on their RBC surfaces. Anti-A1 is believed to be an antibody to Ac and Ad determinants because A2 individuals who produce anti-A1 in their serum lack these determinants.

CONCLUSION

This study shows that 5.8% of the entire blood donor populations who visit the S.S.G. Blood center were group A2 or A2B. Among group A individuals, 15.3% were group A2 while 84.6% were group A1. This study shows that majority of group A individuals in India are A1 while majority of the AB individuals are A2B. The distribution of ABO blood group antigens among the donor population can therefore be arranged in the order O>B>A1>A2>A2B>A1B. By knowing the prevalence of A1 and A2 subgroups in a blood bank at tertiary care hospital, the dangerous transfusion reactions occurring due to these minor incompatibilities can be avoided. Therefore, implementation of A1 and A2 grouping is vital for preventing the avoidable reactions leading to overall improvement in blood transfusion practices.

REFERENCES

- 1) Szulman, Aron E. (1971). The histological distribution of the blood group substances in man as disclosed by immunofluorescence: IV. The ABH antigens in embryos at the fifth week post fertilization. *Human pathology*, 2(4), 575-585.
- 2) Race, R., & Sanger, R. (1975). Blood groups in man (6th ed.): Blackwell Scientific publications Oxford
- 3) Economidou, J, Hughes-Jones, N, C. & Gardner, B. (1967). Quantitative measurements concerning A and B antigen sites. *Vox Sanguinis*, 12(5), 321-328.
- 4) Chaudhari, C. N., Misra, R. N., & Nagpal, A. K. (2008). Transfusion in blood group A2B with anti A1 Recipient. *Medical journal, Armed Forces India*, 64(4), 371-372
- 5) Cooling, Laura. (2014). ABO, H, and Lewis blood groups and structurally related antigens *Technical Manual* (18 ed., pp. 291-315). Bethesda, Maryland: AABB Press.
- 6) Shastri, S., & Bhat, S. (2010). Imbalance in A2 and A2B phenotype frequency of ABO group in South India. *Blood Transfusion*, 8(4), 267.
- 7) Tesfaye, K., Petros, Y., & Andargie, M. (2015). Frequency distribution of ABO and Rh (D) blood group alleles in Silte Zone, Ethiopia. *Egyptian Journal of Medical Human Genetics*, 16(1), 71-76.
- 8) Kassahun, T., Yohannes, P., & Mebeasellie, A. (2015). Frequency distribution of ABO and Rh (D) blood. *The Egyptian Journal of Medical Human Genetics*. 16(1), 71-76.
- 9) Schenkel-Brunner, Helmut. (1982). Studies on blood - groups A1 and A2: Further Evidence for the Predominant Influence of Quantitative Differences in the Number of A Antigenic Sites Present on A1 and A2 Erythrocytes. *European journal of biochemistry*, 122(3), 511-514.
- 10) Schenkel-Brunner, Helmut. (2000). *Human Blood Groups* (2nd ed.). Wien: Springer-verlag Schenkel-Brunner, H., Chester, Alan M., & Watkins, W. M. (1972), α -1-Fucosyltransferases in Human Serum from Donors of Different ABO, Secretor and Lewis Blood-Group. Phenotypes. *European journal of biochemistry*, 30(2), 269-277.