

Original Research Article

Association of transfusion transmitted infections with ABO and Rh D blood group system in healthy blood donors: a retrospective analysis

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ABSTRACT

Background: Transfusion transmitted infections (TTIs) involves several adverse consequences. Studies have shown that ABO blood groups have some association with various infectious and non-infectious diseases. Few blood groups even can act as a receptor and ligand for infectious agents. The objective of the study was to find out any significant association of TTIs with various ABO and Rh D blood group system.

Methods: This retrospective study was conducted from July 2016 to October 2018. Blood donors' blood was tested for ABO and Rh D grouping and five mandatory TTI markers as per Drugs and Cosmetics Act. Chi-square test was performed to look for any association of TTIs with ABO and Rh D blood group.

Results: 10,510 healthy donors were screened for TTI and 199 (1.89%) were positive for various TTIs. Hepatitis B had maximum prevalence (102 cases, 0.97%) followed by Hepatitis C (44 cases, 0.41%) and HIV (37 cases, 0.35%). Maximum TTI seroreactive donors were found among 'B' blood group (2.21%, 77 cases) followed group 'A' donors (2.16%, 53 cases), 'O' donors (1.57%, 60 cases) and 'AB' donors (1.17%, 9 cases), respectively. However, the risk of association of TTI was not statistically significant with ABO and Rh D blood group.

Conclusions: Although no significant association was observed between ABO and Rh D blood groups with TTIs, Hepatitis B was found to be most common infection in blood donors. This high prevalence points towards critical need of comprehensive public health approach to achieve elimination of TTI.

Keywords: ABO Blood group system, Blood donor, Blood transfusion, Seroprevalence, Transfusion transmitted infections

INTRODUCTION

Blood transfusion is a lifesaving therapy in daily patient management. Every year millions of blood and its products are transfused across the world. Transfusion Transmitted Infections (TTI) especially hepatitis B virus (HBV), hepatitis C virus (HCV), human immunodeficiency virus (HIV) always pose threat to blood transfusion services.¹ National AIDS Control

Organization (NACO) guidelines on blood safety recommends mandatory testing for HIV 1 and 2, HBV, HCV, syphilis and malaria in all blood donor samples.² It has been reported globally that around 33 million people are infected with HIV, 2 billion are infected with HBV, and 150 million are infected with HCV (3-4 million infections occur per year).^{3,4} There is high burden of syphilis infection globally, with an estimated 10.6 million incident cases occurring annually.⁵ Malaria is another

major concern as it is responsible for significant global morbidity and mortality with an estimated more than half a million deaths across the world.⁶ It has been shown that ABO blood groups have some connections with a variety of infectious and non-infectious diseases along with susceptibility to some infections. Few blood groups can act as a receptor and ligand for certain bacteria, parasites and viruses. The probable mechanism for this vulnerability is that blood group antigens are glycoproteins and glycolipids which are highly charged molecules. These molecules destined to affect their molecular microenvironment which brings change in protein conformation, over expression of receptors and thus increased susceptibility to microbial infections.^{7,8} Although scientific studies available describing the seroprevalence of TTIs among blood donor population, there are hardly any literature from Eastern part of our country where any association or relations between TTIs and ABO and Rh D blood group has been discussed. Therefore, the main purpose of the present study was to find out TTI seroprevalence of HBV, HCV, HIV, syphilis and malaria among blood donors and to uncover any significant association of TTIs with ABO and Rh D blood group.

METHODS

This was a retrospective observational study conducted at Department of Transfusion Medicine in a tertiary care referral hospital from Eastern India from July 2016 to October 2018. A total of 10,510 healthy blood donors, either voluntary or replacement donors were included in this study for analysis. All donors were selected and screened for five mandatory TTI for blood donation as per the criteria set by drugs and cosmetic act, Government of India.⁹

Methods employed for blood grouping and TTI testing

As per departmental standard operating procedure, two millilitre of blood samples in EDTA pilot tube and five millilitre blood samples in plain pilot tube were taken for blood grouping and TTI testing at the time of blood donation from luer adaptor attached to pre-donation sample pouch. Blood grouping was done by forward and reverse method by column agglutination technique as per

instruction of the manufacturer (forward and reverse grouping ABO /Rho (D) card with auto control, Tulip diagnostics). Grouping was confirmed only when forward and reverse group were identical. Plain pilot tube samples were centrifuged and sera were separated and analyzed for five mandatory TTI serological markers as per standard operating procedure followed in the department. Samples were analyzed for presence of HIV 1 and 2 (4th generation, Qualisa, Tulip diagnostics), hepatitis B surface antigen (HBsAg, 3rd generation, Qualisa, Tulip diagnostics), anti-HCV (3rd generation, Qualisa, Tulip diagnostics) and malaria antigen (Qualisa, Tulip diagnostics) by ELISA method. Syphilis test was performed by dip stick method (syphicheck, Tulip diagnostics).

Ethical permission and data collection

Data were retrieved after taken prior permission from Institute Ethics Committee (Ethics committee permission letter no: T/IM-NF/Trans.Med/18/35. Data records related to donor's ABO group and Rh typing, sex and TTI seroprevalence for HBV, HCV, HIV, Syphilis and malaria were included for analysis of the study.

Statistical analysis

Statistical analysis was done by entering the data into Microsoft office excels worksheet. Categorical variables were represented as percentage to calculate the prevalence of TTIs with respect to blood group and total number of donations. Chi-square test was applied to compare the categorical variables and to find out any significant association. Odds ratios (OR) for and against TTI infection based on ABO and Rh D blood groups and the respective 95% confidence interval (CI) for blood groups were estimated. Statistical analyses were done at 5% level of significance with p value <0.05 was considered statistically significant. Analyses were performed by using SPSS (Statistical Package of Social Sciences, Chicago, IL, USA) version 23.0.

RESULTS

A total of 10,510 healthy donors registered during the study period were included.

Table 1: Seroprevalence of TTI according to ABO and Rh blood groups.

Blood group	Total Donations	TTI Positive	HIV	HBV	HCV	Malaria	Syphilis
A+	2375	50 (2.10%)	11 (0.46%)	22 (0.92%)	14 (0.58%)	3(0.12%)	0
B+	3376	74 (2.19%)	14 (0.41%)	37 (1.09%)	14 (0.41%)	4 (0.11%)	5 (0.14%)
O+	3686	60 (1.62%)	10 (0.27%)	34 (0.92%)	14 (0.38%)	1 (0.027%)	1 (0.027%)
AB+	745	9 (1.208%)	1 (0.134%)	5 (0.671%)	1 (0.134%)	0	2(0.268%)
A-	74	3 (4.05%)	1 (1.35%)	2(2.70%)	0	0	0
B-	102	3 (2.94%)	0	2 (1.96%)	1 (0.98%)	0	0
O-	130	0	0	0	0	0	0
AB-	22	0	0	0	0	0	0
Total	10,510	199 (1.89%)	37 (0.35%)	102 (0.97%)	44 (0.41%)	8 (0.07%)	8 (0.07%)

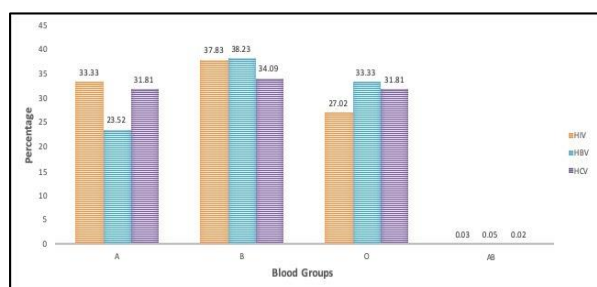


Figure 1: The percentage frequency of TTI among various blood groups.

Out of them, 199 donors (1.89%) were seroreactive. HBV had maximum seroprevalence of 102 cases (0.97%) followed by HCV (44 cases, 0.41%) and HIV (37 cases, 0.35%) respectively. Malaria and syphilis were positive for eight cases of each (0.07%) (Table 1).

Frequency of distribution of ABO and Rh D blood group of the donors has been shown in Table 2.

Table 2: Distribution of ABO and Rh (D) blood groups.

Blood group	RhD Positive	RhD Negative	Total
A	2375 (23.4%)	74 (22.7%)	2449 (23.3%)
B	3376 (33.35%)	102 (31.3%)	3478 (33.1%)
O	3686 (36.38%)	130 (39.8%)	3813 (36.29%)
AB	745 (7.36%)	22 (6.74%)	767 (7.3%)
Total	10182 (96.9%)	328 (3.1%)	10,510 (100%)

Table 3: Association of ABO and Rh blood group with Transfusion transmitted infection.

Blood Group	HBsAg		OR [†] (95% CI) [‡]	p	HIVPos	HIVNeg	OR (95% CI)	p	HCV		OR (95% CI)	p
	Pos*	HBsAgNeg*							Pos	Neg		
A v/s O, B, AB	24	2425	0.987 (0.623-1.564)		12	2437	0.632 (0.317-1.259)		14	2435	0.65 (0.344-1.227)	
	78	7983	-	0.956	25	8036	-	0.188	30	8031	-	0.181
B v/s A, B, AB	39	3439	0.797 (0.534-1.191)		14	3464	0.812 (0.417-1.580)		15	3463	0.956 (0.512-1.786)	
	63	6969	-	0.267	23	7009	-	0.539	29	7003	-	0.888
O v/s A, B, AB	34	3782	1.142 (0.755-1.726)		10	3806	1.541 (0.745-3.188)		14	3802	1.223 (0.647-2.308)	
	68	6626	-	0.53	27	6667	-	0.24	30	6664	-	0.535
AB v/s O, A, B	5	762	1.533 (0.622-3.776)		1	766	2.841 (0.389-20.748)		1	766	3.396 (0.467-24.692)	
	97	9646	-	0.35	36	9707	-	0.282	43	9700	-	0.199
Rh D+ v/s Rh D-	98	10084	1.27 (0.465-3.474)		36	10146	0.862 (0.118-6.305)		43	10139	0.721 (0.099-5.252)	
	4	324	-	0.64	1	327	-	0.884	1	327	-	0.746

*Positive /Negative, [†] Odds ratio, [‡] 95 % Confidence Interval

Among all blood groups, 'B' blood group had shown maximum seropositivity with HBV, HIV and HCV in terms of percentage frequency of TTI infection as well as total number of donations. The percentage frequency of HCV infection was equal among O and A blood groups but the percentage frequency of HIV was higher in A in comparison to O blood group (Figure 1).

Seroprevalence of malaria and syphilis among ABO blood group was too low to be considered for statistical analysis.

Chi-square test did not reveal any significant association between ABO and Rh D blood groups and TTIs as shown in the Table 3.

DISCUSSION

In our study blood group B Rh (D) positive blood donors had highest percentage (1.09%) of HBsAg seropositivity and had overall highest percentage of seropositivity with various TTIs (2.19%). In India blood group distribution has a lot of diversity. Therefore, it is essential to have knowledge on frequency of ABO blood groups in particular region in determining the course prevalence of TTIs. Many studies have been done to explore association of ABO and Rh blood group and risk of TTIs; but the results obtained from such studies are contradictory. This is because such studies have adopted different sample size, different screening methods and different social and geographical factors. Few studies observed higher seroprevalence of HBV, HCV and HIV, among O positive blood group.^{10,11} However, studies with large sample size did not find any statistically significant association between ABO blood groups and hepatitis B, and between ABO blood groups and HIV infection.¹²⁻¹⁴ Similarly, in our study, no statistically significant association was observed between risk of acquiring HBV, HIV and HCV infection and any of the above blood groups.

The seropositivity of syphilis (0.076%) was lower as compared to other studies by Makroo et al. and Kaur et al. who found a prevalence of 0.23% and 0.7% respectively.^{14,15} The higher prevalence of syphilis observed in other studies could be because of testing with non treponemal tests which gives rise to biological false positive reactions. Nonspecific antigens used in non treponemal test cross react in conditions like autoimmune diseases, viral infections, pregnancy and malignant neoplasm.¹⁶ The possible reason of getting lower seroprevalence of syphilis might be because we adopted the highly specific test which qualitatively captures the presence of both IgM and IgG class of treponema specific antibodies. Although the survival time of treponema pallidum in the stored blood varies between 72 to 120 hours, it is considered to be an important lifestyle marker for blood donors as far as co infection of other sexually transmitted diseases are concerned.¹⁷

We also had 8 cases of malaria out of 10510 donors with prevalence rate of 0.076%, which was much higher than the other studies where hardly any case of malaria reported.^{18,19} The high number of malaria cases was observed in our study possibly because of high endemicity of malaria in this region. In addition, testing of malaria antigen by ELISA technique could be another explanation of getting higher prevalence, as ELISA cannot differentiate present or recent infection from past subclinical infection.

Among Rh (D) negative blood donors, A Rh (D) negative donor had maximum percentage of seropositivity for HBsAg (2.70%) and HIV (1.35%). Study from Tyagi et al. had shown that the negative blood groups were more affected with TTIs and especially blood Group A

negative individuals had more seropositivity for HIV, HBsAg and Syphilis while blood Group B negative had more seropositivity with HCV.²⁰ We also found similar observation with A RhD negative donors having maximum seroprevalence (4.05%). Liu et al. found Rh-D positive participants were at higher risk of HBV infection than Rh-D negative participants.²¹ However, our study did not find any statistically significant association of Rh(D) blood group with various TTIs. None of our RhD negative blood donors in our study found seropositive for malaria and syphilis.

We had some limitations in our study. We did not apply advanced TTI testing methods such as fourth generation ELISA for HCV or molecular testing such as nucleic acid amplification technology (NAT) for testing of viral markers. However, we applied better screening technology especially for HIV (fourth generation ELISA), malaria (used ELISA) and syphilis (used more specific dipstick card for treponema specific antibodies) which could be considered as strength of our study.

CONCLUSION

The present study was carried out to determine the prevalence of TTI and its association with the ABO and Rh D blood group. There was no association observed between blood group antigens with these infections. However, the highest frequency of infected donors was observed in blood group 'B'. High number of HBV infection in blood donor in our study points towards need of public health measures in general population such as donor awareness programmes on blood safety and risk of TTI, improved standards for donor selection criteria, improved serological screening protocols, use of advanced techniques like NAT, universal pathogen reduction system and last but not the least, recommendation of active immunization programme for HBV to all recipients who are on repeated blood transfusion therapy.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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