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RESEARCH ARTICLE

ASSOCIATION OF ABO AND RH BLOOD GROUPS TO HIV INFECTION AMONG BLOOD DONORS IN A BLOOD BANK OF TERTIARY CARE TEACHING HOSPITAL IN SOUTHERN INDIA: A RETROSPECTIVE STUDY

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ABSTRACT

Background: ABO blood group has been found to be associated with the risk of several malignancies, including gastric cancer, pancreatic cancer, ovarian epithelial and skin cancer. This work was therefore aimed at assessing the ABO and Rh blood group antigens and risk associated with human immunodeficiency virus (HIV) infection among blood donors.

Materials and methods: This is a retrospective cross-sectional analytical study carried out in the department of Transfusion Medicine of a tertiary care teaching hospital blood bank for a period of 6 years i.e. January 2009 to December 2014. All blood donors either voluntary or replacement were included in the study. Data retrieved from blood bank records included the ABO, Rh group and the result of HIV serology. Statistical analysis was carried out using SPSS version 16, SPSS Inc, Chicago, USA.

Results: A total number of 41652 blood donors were registered and screened during the study period. The commonest blood group was O constituting 41.5% followed by B (32.6%), A (19.8%), AB (6.1%) and Bombay (0.02%). Rh-D positive donors were 92.9% and remaining 7.1% were Rh-D negative. The overall prevalence of HIV was 0.66%. Among total HIV seroreactive donors 42.6% were O blood group, B-27.8%, A-22.2% and AB-7.4%. Among the total seroreactive group, 93.5% had Rh-D positive blood group and remaining 6.5% had Rh-D negative blood group.

Conclusion: In this study conducted to determine the predominant blood group antigen and its association with HIV seroreactivity. The frequency of HIV among blood donors had maximum association with blood group O positive but not statistically significant. Larger scale studies at molecular level are required to improve the knowledge of this aspect.

INTRODUCTION

The ABO blood group system, which was the first human blood group system to be discovered (Landsteiner *et al*., 1931), remains the most important in transfusion practice. Hirszfeld and Hirszfeld (Hirszfeld *et al*., 1919) showed the frequencies of blood groups A and B differ between populations. Their observations raised fundamental questions regarding the causes of these differences, which were eloquently summarized by Mourant *et al*. 1978. One of the most significant disease associations described for non-O (subjects of blood group A, B, or AB) versus O subjects is susceptibility to arterial and venous thromboembolism (VTE) (Jenkins and O'Donnell, 2006; Tregouet *et al*., 2009). Non–group O patients have a greater risk of VTE than patients of group O and have greater levels of von Willebrand factor (vWF) and factor VIII (Jenkins and O'Donnell, 2006; Kamphuisen *et al*., 2001). ABO blood group has been found to be associated with the risk of several malignancies, including gastric cancer, pancreatic cancer, ovarian epithelial and skin cancer (Greenwell *et al*., 1997). This work was therefore aimed at assessing the ABO and Rh blood group antigens and risk factors associated with human immunodeficiency virus (HIV) infection among blood donors.

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MATERIALS AND METHODS

This is a retrospective cross-sectional analytical study carried out in the department of Transfusion Medicine of a tertiary care teaching hospital blood bank for a period of 6 years i.e. January 2009 to December 2014. All blood donors either voluntary or replacement, eligible to donate blood and blood components as per the Drugs and Cosmetics act,1940 and rules,1945 (Malik, 2011) and who registered at our blood bank during the study period were included in the study. Voluntary donations were taken either at the blood bank or at voluntary blood donation camps. Replacement donors were either relatives or friends of patients. Data retrieved from blood bank records included the ABO, Rh group and the result of HIV serology.

Sample collection and laboratory testing

Five millilitre (5 mL) of blood samples in acid citrate dextrose (ACD) and 5 mL of plain blood samples were collected from the donors following written informed consent and phlebotomy. After blood donation, ABO grouping and Rh typing was done by tube agglutination method. Both forward (cell grouping) and reverse grouping (serum grouping) were done. Antisera used for ABD were monoclonal anti-A, monoclonal anti-B, monoclonal anti-D (IgM) and for Bombay blood group anti-H lectin (Tulip diagnostics (P) Ltd, Goa, India). Final blood group was confirmed only if both forward & reverse groups are identical. Samples were then analyzed for HIV p24 antigen and antibodies to HIV-1 and 2 (Microlisa HIV Ag and Ab, J.Mitra and Co. Pvt. Ltd, New Delhi, India) by ELISA method strictly following the manufacturer's instructions. Any serum found reactive by the first assay was retested using a second assay by different manufacturers ELISA kits (Erba Sure HIV gen4 for HIV p24, anti HIV-1 and 2). Comparison of categorical data between seroreactive and non-reactive blood donors was done using Chi-square test. All statistical analysis was carried out at 5% level of significance and a p-value <0.05 was considered significant. Statistical analysis was carried out using SPSS version 16, SPSS Inc, Chicago, USA.

Table 1. Distribution of blood groups during the study period

Blood group	Rh-D status	Total No. of donors (x)	Total (x)
A	Positive	7629 (18.3)	8245 (19.8)
	Negative	616 (1.5)	
B	Positive	12665 (30.4)	13587 (326)
	Negative	922 (2.2)	
AB	Positive	2368 (5.7)	2537 (6.1)
	Negative	169 (0.4)	
O	Positive	16026 (38.5)	17274
	Negative	1248 (3)	(41.5)
Bombay	Positive	8 (0.02)	9 (0.02)
	Negative	1 (0.002)	
Total		41652	41652

RESULTS

A total of 41652 blood donors were registered during the period of study. Analysis of ABO blood group system observed

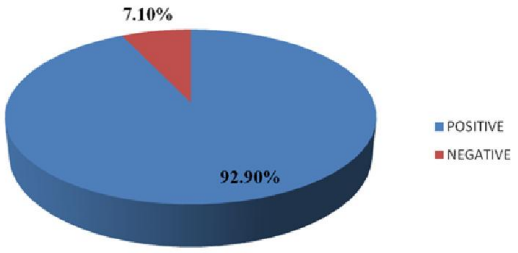

Figure 1. Distribution of Rh-D among the study population

Table 2. Distribution of blood groups in relation to the HIV serological status

Blood group	HIV* seropositive (%)	HIV seronegative (%)
A positive	46 (16.7)	7583 (18.3)
A negative	1 (0.4)	615 (1.5)
B positive	82 (29.7)	12583 (30.4)
B negative	7 (2.5)	915 (2.2)
AB Positive	19 (6.9)	2349 (5.7)
AB negative	0 (0)	169 (0.4)
O positive	111 (40.2)	15915 (38.5)
O negative	10 (3.6)	1238 (3)
Bombay positive	0	8 (0.02)
Bombay negative	0	1 (0.002)
Total	276 (0.7)	41376

*Human Immunodeficiency Virus P=0.157

Table 3. Distribution of Rh-D blood group in relation to the HIV serological status

Rh-D status	HIV seropositive (%)	HIV seronegative (%)
D-positive	258 (93.5)	38438 (92.9)
D-negative	18 (6.5)	2938 (7.1)
Total	276 (0.7)	41376

*Human Immunodeficiency Virus P=0.157

Table 4. Comparative data on distribution of blood groups in relation to the HIV serological status

Study done by	Place and population of the study	Blood group			
		O (%)	A (%)	B (%)	AB (%)
Sayal *et al.* (1996)	Pune, India. HIV infected patients, HIV surveillance centre.	38.5	26.9	25	9.6
Tyagi *et al.* (2013)	Greater Noida, India. Healthy blood donors	18.2	36.4	44.5	0
Ravikumar *et al.* (2013)	Guntur, India. ZED research lab. Patients requested for serological status.	57.14	13.09	28.57	0.59
Mohammad Ali *et al.* (2014)	Tehran. Iran. Blood donors	29.6	44.4	16.7	8.3
Abdulazeez *et al.* (2008)	Adamawa state, Nigeria. Apparently healthy subjects	42.1	11.1	9.4	8.7
Otori *et al.* (2013)	Zaria, North western zone in Nigeria. HIV positive patients	45.5	26.8	24	4.3
Nneli *et al.* (2004)	Enugu, Nigeria. Pregnant women	65.05	19.45	14.24	1.74
Igbeneghu *et al.* (2015)	South Western Nigeria. Individuals attending to HIV clinics	47	27.3	23.1	2.6
Damulak *et al.* (2011)	North central Nigeria. Blood donors	55.6	11.1	27.8	5.5
Our study	Tirupati, India. Blood donors	43.8	17.1	32.2	6.9

that O blood group was the commonest among the total donors 17274 (41.5%), B blood group was seen in 13587 (32.6%), 8245 (19.8%) had A blood group, 2537 (6.1%) had AB blood group and 9 (0.02%) had Bombay blood group (Table 1). Among total blood donors 38696 (92.9%) were Rh-D positive and remaining 2956 (7.1%) were Rh-D negative (Figure 1). In the current study, the overall prevalence of HIV was 0.7% (n=276). Among total HIV seroreactive donors 42.6% (n=121) were O blood group, 27.8% (n=89) were B, 22.2% (n=47) were A and 7.4% (n=19) were belongs to the blood group AB (Table 2). Among the total seroreactive group 93.5% (n=258) had Rh-D positive blood group and remaining 6.5% (n=18) had Rh-D negative blood group (Table 3).

DISCUSSION

Blood groups are inherited as Mendelian codominant traits and expected to occur in somewhat comparable frequencies in the human race (Neil *et al*., 2003) But the differences exist in the distribution of blood groups in various human populations. This has been largely attributed to selection pressure as endemic diseases appear to have a predilection for selected blood groups leading to the demise of individuals bearing those susceptible blood group antigens (Anstee, 2010; Pendu *et al*., 2006). Blood groups have been reported by many researchers in different parts of the world as factors predisposing to some disease conditions (Jains, 1970; Aird and Bentall, 1953). Among these, HIV has emerged as one of the major public health concerns of the 21st century. Some genetic factors have been cited as contributors to HIV susceptibility or resistance, among them blood groups such as ABO/Rh (Neil *et al*., 2003; Sayal *et al*., 1996; Arendrup *et al*., 1991; Abdulazeez *et al*., 2008- and Dirisu *et al*., 2011), Duffy (Bolton *et al*., 2011; Lachgar *et al*., 1998; Lachgar *et al*., 2011 and He *et al*., 2008), and P (Lund *et al*., 2009). As the Swedish researchers investigated, P_1^k Peripheral blood mononuclear cell were highly resistant to R5 and X4 HIV-1 infection. In contrast, p PBMCs showed 10- to 1000-fold increased susceptibility to HIV-1 infection. Surface and total cell expression of P^k, but not CD4 or chemokine co receptor expression, correlated with infection, ABO and Rh blood group polymorphisms may be involved in viral transmission (Lund *et al*., 2009). HIV infection has been reported to occur in select blood groups in some regions of the world. Most of the studies from India (Sayal *et al*., 1996) and abroad (Dirisu *et al*., 2011 and Nneli *et al*.,2004) reported a preponderance for infection in O Rh (D)-positive and least among groups B positive and D-negative ones. However, the results reveal insufficient statistical analysis rendering the differences statistically insignificant.

In a study done by Bhanu *et al.* 2011 observed O Rh positive blood group was the commonest in 702 (40.13%) adult seropositives, B Rh positive blood group was the next commonest in 457(26.12%) followed by A Rh positive blood group in 395(22.58%) and AB Rh negative was the least commonly observed blood group. An Indian study which determined the distribution of blood groups in 104 HIV seropositives observed O blood group in 40 (38.5%) individuals which was most common, A blood group was seen in 28 (26.9%), 26 (25%) had B blood group and 10 (9.6%) had AB blood group [(14)]. In another Nigerian study which determined ABO blood groups for 216 seropositives, 42.1% were O group, 11.1% A group, 9.4% B group and 8.7% were AB group and 5 out of 7 (71.4%) infected subjects with HIV-2 only, belonged to blood group AB (Abdulazeez *et al*., 2008). Our study fairly correlating with these studies showing the maximum seroreactivity in group O Rh positive blood donors (40.2%), B Rh positive blood group donors were next commonest in 29.7% followed by A Rh positive blood donors in 16.7% and none of the AB Rh negative blood donors were reactive for HIV. The seroreactive donors had 93.5% Rh positive blood group while 6.5% were Rh negative. Bhanu *et al* [(24)] in their study observed, the adults seropositive group had 1649(94.28%) Rhesus positive blood group while 100(5.72%) were Rhesus negative (Sayal *et al*., 1996). Most of the studies showed that blood group "O" had maximum association for HIV (Table 4) (Tyagi *et al*., 2013; Ravi kumar *et al*., 2013; Mohammadali *et al*., 2014; Otori1 *et al*., 2013 Igbeneghu *et al*., 2015 and Damulak *et al*., 2013). This current scientific information does not support a potential role for ABO blood groups in HIV infection. We also don't find any of statistical significant correlation between the blood groups and HIV seropositivity (p=0.157). In fact, evidence from other studies would suggest the contrary for group O individuals. Since HIV virions have been shown to acquire the blood group antigens of the infected individuals (Neil *et al*., 2003; Arendrup *et al*., 1991; Rachkewich *et al*., 1978), such virions would be neutralized by naturally occurring antibodies in group O individuals, thus offering protection in blood group-discordant couples (Neil *et al*., 2003). It is noted, however, that this protection will not be available if the source of infection was of a similar blood group. Moreover, given the apparently uniform risk of infection among ABO blood groups, it is doubtful if this neutralization is of any clinical consequence, especially with reference to HIV infection. It remains to be demonstrated then whether HIV from blood group A or B is able to infect group O CD_4 cells.

Conclusion

In this study conducted to determine the predominant blood group antigen and its association with HIV seroreactivity, there was no statistically significant association between blood group antigens with HIV infection. We also attempted to create a blood group database in our donor population which would play a vital role in transfusion practices and future protocols. Wide range of studies across nation would be required to substantiate any association between blood groups and HIV infection.

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