

## Research Article

# Association of ABO and Rh blood groups to HBV, HCV infections 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 diseases. Infection with hepatitis B virus (HBV) and hepatitis C virus (HCV) are also the major health problems worldwide. This work was therefore aimed at assessing the ABO and Rh blood group antigens and its association with HBV and HCV seroreactive status among healthy blood donors.

**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 (January 2009 to December 2014). Data retrieved from blood bank records included the donors' ABO group, Rh type and the result of HBV, HCV serology.

**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 HBV and HCV were 2.4% and 0.4% respectively. Among total HBV and HCV seroreactive donors 41.7% and 37.9% were O blood group, B-30.9%, 32.7% A-21.6%, 21.2% and AB-5.7%, 8% respectively. Among the total HBV and HCV seroreactive group, 93.7% and 93.1% had Rh-D positive blood group and remaining 6.3% and 6.9% had Rh-D negative blood group respectively.

**Conclusion:** In this study conducted to determine the predominant blood group antigen and its association with HBV and HCV seroreactivity, there was no association between blood group antigens with these infections.

**Keywords:** Blood donors, Seroprevalence, Hepatitis C, Hepatitis B surface antigen, ABO and Rh blood group

## INTRODUCTION

The surface of red blood cells contains different polysaccharides and proteins called blood group antigens. A complete blood type would describe a full set of 30 substances on the surface of RBCs (red blood cells), and an individual's blood type is one of many possible combinations of blood-group antigens.<sup>1</sup> Across the 33 blood groups, over 600 different blood-group antigens have been found,<sup>2</sup> part of them that are related to each other described into these blood group systems by the

International Society of Blood Transfusion (ISBT), of which ABO and Rh groups system are the most important.<sup>3</sup> The study of distribution of blood groups is important as it plays a vital role in blood transfusion, organ transplantation and some groups have shown associations with certain diseases like duodenal ulcer, gastric cancer, diabetes mellitus, urinary tract infection and ABO and Rh incompatibilities of newborn.<sup>4</sup> Some blood groups can act as a receptor and ligand for bacteria, parasites and viruses. The possible pathogenesis for this susceptibility is that as many organisms that may bind to

polysaccharide on cells and soluble blood group antigens may block this binding.<sup>5,6</sup>

HBV and HCV infections are commonly caused by exposure to infected blood. Infections also occur as a result of iatrogenic exposures (transfusion/transplantation/ dialysis of infected blood/ blood products or organs/tissues), and use of contaminated injections/equipment.<sup>7</sup> Hepatitis B prevalence is highest in sub-Saharan Africa and East Asia, accounting for about 5–10% of the adult population. In the Middle East and the Indian subcontinent, an estimated 2–5% of the general population is chronically infected. An estimated 240 million people are chronically infected with hepatitis B.<sup>8</sup> It is estimated that 130-150 million people globally have chronic hepatitis C infection. A significant number of those who are chronically infected will develop liver cirrhosis or liver cancer.<sup>9</sup> Infection with HBV and HCV are also the major health problems worldwide. To prevent transmission of these infections through blood transfusion Hepatitis B surface antigen (HBsAg) and Hepatitis C Virus antibodies (anti-HCV) screening is carried out routinely in all blood transfusion canter.

This work was therefore aimed at assessing the ABO and Rh blood group antigens and its association with HBV and HCV seroreactive status among healthy blood donors.

## METHODS

This is a retrospective cross-sectional analytical study carried out in the department of Transfusion Medicine of a tertiary care referral 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 & Cosmetics act, 1940 and rules, 1945<sup>10</sup> 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 donors' ABO group, Rh type and the results of HBV and HCV serology.

### Sample collection and laboratory testing

Five milliliter (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 & Rh typing was done by tube agglutination method. Both forward (cell grouping) & reverse grouping (serum grouping) method 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.

Plain samples were centrifuged and the sera were separated and analyzed for HBV and HCV serology as per the standard operating procedures followed in the blood bank. Samples were analyzed for hepatitis B surface antigen (HBsAg) (Hepalisa, J.Mitra & Co. Pvt. Ltd, New Delhi, India), and HCV (Microlisa HIV Ag & Ab, J. Mitra & Co. Pvt. Ltd, New Delhi, India), by ELISA. Any serum found reactive by the first assay was retested using a second assay based on different antigen preparations and/or different test principle using the HBsAg (Hepacard, Diagnostic Enterprises, Parwanoo, India) and HCV by the anti- HCV test (HCV TRI-DOT, Diagnostic Enterprises, Parwanoo, India) which are immunochromatographic sandwich assays.

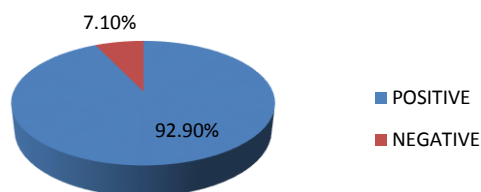
Comparison of categorical data between seropositive and seronegative blood donors was done using Chi-square test. All statistical analysis was carried out at 5% level of significance and a p-value <0.05 was considered significant. Statistical analysis was carried out using SPSS version 16, SPSS Inc, Chicago, USA.

## RESULTS

A total of 41652 blood donors were registered during the period of study. Analysis of ABO blood group system observed 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 HBV and HCV were 2.4% and 0.4% respectively. Among total HBV seroreactive donors 41.7% (n=410) were O blood group, 30.9% (n=304) were B, 21.6% (n=213) were A and 5.7% (n=56) belongs to the blood group AB (Table 2). Among the total seroreactive group 93.7% (n=921) had Rh-D positive blood group and remaining 6.3% (n=62) had Rh-D negative blood group (Table 3).

**Table 1: Distribution of blood groups during the study period.**

Blood group	Rh-D status	Total No. of donors	Total
A	Positive	7629 (18.3)	8245 (19.8)
	Negative	616 (1.5)	
B	Positive	12665 (30.4)	13587 (32.6)
	Negative	922 (2.2)	
AB	Positive	2368 (5.7)	2537 (6.1)
	Negative	169 (0.4)	
O	Positive	16026 (38.5)	17274 (41.5)
	Negative	1248 (3)	
Bombay	Positive	8 (0.02)	9 (0.02)
	Negative	1 (0.002)	
Total		41652	41652



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

Among total HCV seroreactive donors 37.9% (n=66) were O blood group, 32.7% (n=57) were B, 21.3% (n=37) were A and 8% (n=14) belongs to the blood group AB (Table 2). Among the total seroreactive group 93.1% (n=162) had Rh-D positive blood group and remaining 6.9% (n=12) had Rh-D negative blood group (Table 3).

**Table 2: Distribution of blood groups in relation to the HBV, HCV serological status.**

Blood group	HBV serological status		HCV serological status	
	Reactive (%)	Nonreactive (%)	Reactive (%)	Nonreactive (%)
A positive	201 (20.4)	7428 (18.3)	34 (19.5)	7595 (18.3)
A negative	12 (1.2)	604 (1.5)	3 (1.7)	613 (1.5)
B positive	285 (29)	12380 (30.4)	55 (31.6)	12610 (30.4)
B negative	19 (1.9)	903 (2.2)	2 (1.1)	920 (2.2)
AB Positive	52 (5.3)	2316 (5.7)	13 (7.5)	2355 (5.7)
AB negative	4 (0.4)	165 (0.4)	1 (0.5)	168 (0.4)
O positive	383 (39)	15643 (38.5)	60 (34.5)	15966 (38.5)
O negative	27 (2.7)	1221 (3)	6 (3.4)	1242 (3)
Bombay positive	0	8 (0.02)	0	8 (0.02)
Bombay negative	0	1 (0.002)	0	1 (0.002)
Total	983 (2.4)	40669 (97.6)	174 (0.4)	41478 (99.6)
	41652		41652	

P=0.213, HBV-Hepatitis B virus, HCV-hepatitis C virus.

**Table 3: Distribution of Rh-D blood group in relation to the HBV, HCV serological status.**

Rh-D status	HBV serological status		HCV serological status	
	Reactive (%)	Nonreactive (%)	Reactive (%)	Nonreactive (%)
D-positive	921 (93.7)	37775 (92.9)	162 (93.1)	38534 (92.9)
D-negative	62 (6.3)	2894 (7.1)	12 (6.9)	2944 (7.1)
Total	983	40669	174	41478

P=0.157, HBV-hepatitis B virus, HCV-hepatitis C virus.

## DISCUSSION

An individual will have the same blood group for life, but very rarely an individual's blood type changes through addition or suppression of an antigen in infection, malignancy, or autoimmune disease.<sup>11,12,13</sup> Another more common cause in blood type change is a bone marrow transplant. If a person receives bone marrow from someone who is a different ABO type, the patient's blood type will eventually convert to the donor's type. Some blood types are associated with inheritance of other diseases; for example, the Kell antigen is sometimes associated with McLeod syndrome.<sup>14</sup> Certain blood types may affect susceptibility to infections, an example being the resistance to specific malaria species seen in individuals lacking the Duffy antigen.<sup>15</sup> The Duffy antigen, presumably as a result of natural selection, is less common in ethnic groups from areas with a high incidence of malaria.<sup>16</sup>

Hepatitis B and C are potentially life-threatening liver infections caused by the HBV and HCV viruses. These are major global health problem. These can cause chronic infections and puts people at high risk of death from cirrhosis and liver cancer. It is not possible to differentiate hepatitis B and C from hepatitis caused by other viral agents on clinical grounds alone; hence, laboratory confirmation of the diagnosis is essential. WHO recommends that all blood donations are tested for HBV and HCV to ensure blood safety and avoid accidental transmission to people who receive blood and blood components.

Das *et al.*,<sup>17</sup> observed that frequency of HBsAg antigen and Anti-HCV among blood donors had maximum association with blood group O positive constituting about 49.8% (118/237), 61.1% (44/72) respectively, but there is no statistically significant difference between the two. In our study we observed the maximum association of HBsAg and anti-HCV with O blood group constituting 39% (383/983) and 34.5% (60/174) respectively which is less compare to the study, but we also didn't find any of significant difference between the blood groups of HBsAg and anti-HCV reactive donors. Behal *et al.*,<sup>18</sup> observed higher prevalence of HBsAg (38.7%) in blood group B, they assumed that could be because of the higher prevalence of blood group B in their area. In our study, among the HBsAg seroreactive blood donors 2.4% (921/38696) were Rh-D positive and 2.1% (62/2956) were Rh-D negative. This is similar to the study done by Behal *et al.*,<sup>18</sup> they also demonstrated HBsAg positivity among donors with 2.4% and 2.24% in Rh-negative group and Rh-positive group respectively. There is no statistically significant difference in both studies. Jeremiah *et al.*<sup>19</sup> observed the total prevalence of HCV of about 5%, among this blood group O positive (60%) was commonly associated followed by AB positive (20%) and A positive (20%). In our study the overall prevalence of HCV was 0.4%, the commonly associated blood group was O positive. We didn't find any of statistically

significant difference between the blood groups. Omar and co-workers who reported that seroprevalence of HBsAg and anti-HCV were found to be higher in donors of blood group O and lowest in blood group AB donors, while the distribution of Rh in these infections was higher between Rh positive donors.<sup>20</sup> This is similar to our study where we also observed that HBsAg and anti-HCV were higher in blood group O constituting 41.7% and 37.9% respectively, while AB blood group was least commonly associated with these infections.

Many studies observed that blood group O positive has higher seroprevalence of HBsAg, anti HCV<sup>20-25</sup> (Table 4). However Tyagi *et al.*,<sup>21</sup> observed that the negative blood groups are more prone to TTIs and blood Group A negative donors are more affected with HBsAg, while blood Group B negative was more commonly affected by

HCV. Furthermore, the results showed that patients with the blood group O and Rh positive were most susceptible towards HBV and HCV infections. With the help of scientific evidence it can be correlated that the level of natural antibodies resistance against the viral antigens depends on the individual's blood group<sup>26</sup> and Group O individuals were more resistant to dangerous sequelae of acute viral hepatitis.<sup>27</sup> A disproportionate excess of blood group O was found in our study. It is, however, important to point out that the results obtained in our study do not reflect the prevalence of HBsAg and anti-HCV in the unselected general population because blood donors are a pre-selected group and most of them are within the sexually active age group. Further studies aimed at determining the epidemiology of these infections among the general population will be of value in determining the safety of blood /blood components.

**Table4: Comparative data on distribution of blood groups in relation to the HBV, HCV serological status.**

Sl. No	Study done by	Place and study population	Blood group and seroreactivity							
			O		A		B		AB	
			HBV	HCV	HBV	HCV	HBV	HCV	HBV	HCV
1.	Omar et al <sup>20</sup>	Baghdad N=430	45.1	41.7	21.1	33.3	29.6	16.7	4.2	8.3
2.	Tyagi S et al <sup>21</sup>	Greater Noida N=6000	33.7	35.1	28.4	24.7	28.4	35.1	9.5	5.2
3.	Kumar MR et al <sup>22</sup>	Guntur, India N=488	46.2		15.2		35.2		3.4	
4.	Das et al <sup>17</sup>	Kolar, Karnataka N=26,847	50.6	63.9	23.6	18.1	21.9	12.5	3.8	5.6
5.	Behal R et al <sup>18</sup>	Kanpur, India N=20000	29.3	-	23.6		38.7	-	8.4	-
6.	Nigam JS et al <sup>23</sup>	Anwarpur, Harpur, Uttarpradesh. N=4128	37.5	19.2	30	30.8	27.5	42.3	5	7.7
7.	Saeed Anwar <sup>24</sup>	Lahore N=16695	44.5	39.4	22.1	23.2	29.8	33.4	3.6	4
8.	Mohammadali et al. <sup>25</sup>	Tehran-Iran N=2031451	34.5	35.3	32.5	32.9	24.9	24.4	8	7.1
9.	Present study	Tirupati, India N=41652	41.7	37.9	21.6	21.2	30.9	32.7	5.7	8

HBV-hepatitis B virus, HCV-hepatitis C virus.

## CONCLUSION

In this study conducted to determine the predominant blood group antigen and its association with HBV and HCV seroreactivity, there was no association between blood group antigens with these infections. 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. There is a need to collect data at the national, state, and district level for evaluation and supervision of the public health programme. As viral hepatitis is potentially life-threatening and major global health problem, it requires support from governmental, academic, and community based organizations. Strict screening of blood and blood components, nucleic acid amplification test and other sensitive markers to be included to screen blood donations.

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