

Variation in the host ABO blood group may be associated with susceptibility to hepatitis C virus infection

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SUMMARY

This study aimed to determine the relationship between hepatitis C virus (HCV) infection and ABO/Rhesus blood groups, age and sex. A total of 20 000 patients who came to donate blood in the blood bank of GSVM Medical College, Kanpur were enrolled in the study. Demographic data recorded for each patient included age, sex and blood group. Blood samples were tested for anti-HCV antibodies and ABO/Rhesus blood group antigen typing was performed. The overall positive rate of anti-HCV was 0·34%. We found that seropositivity for HCV increased with age. Anti-HCV antibodies were detected in 1/765 women (0·13%), compared to 67/19 235 men (0·35%). Seroprevalence of HCV was found to be higher in blood group O individuals (0·42%) and lowest in blood group AB individuals (0·04%). The results of this study demonstrate that HCV infection may not be related to age and sex but the possible association of blood group antigens with HCV infection cannot be ruled out.

Key words: ABO blood group, blood donors, hepatitis C virus, risk factors, seroprevalence.

INTRODUCTION

Hepatitis C virus (HCV) infection is the major cause of post-transfusion non-A, non-B hepatitis. It is estimated that 3% of the world's population or almost 200 million individuals have chronic HCV infection [1]. The prevalence varies broadly according to geographic area. The reported prevalence rates range from 0·1% in countries like Iceland and Norway to 18·1%, as reported in Egypt [2]. The global seroprevalence of HCV in blood donors varies from 0·4% to 19·2% [3]. India is a country with HCV seroprevalence ranging between 0·12% and 4% [4]. The

risk of transmission of HCV varies according to the routes of infection. Epidemiological studies show that the most efficient transmission of HCV is through blood transfusion [5]. Differences in the risk of HCV transmission by blood transfusion may be related to the amounts of blood transfusion, the titre of virus and host susceptibility factors that may modify the efficiency of HCV transmission [6].

The distribution of ABO blood groups is often found to be related to the frequency of certain diseases in the population and to the resistance to infectious diseases [7, 8]. Parasitological, bacterial or viral infections have been found to occur more in persons with certain blood groups [9]. In previous studies, acute viral hepatitis has been reported to be more frequent in persons with blood group 'A' than in those with blood group 'O' [10]. ABO blood groups

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have been found to be associated with fibrosis severity in chronic hepatitis C infection [11]. Whether the statistical associations are valid or not, there is increasing evidence that some blood groups may play a biological role [12, 13].

In India there has been no reported relationship between ABO blood groups and the presence of anti-HCV antibodies. Variations in immune response to an infectious agent are often associated with age, sex and several other host factors. Given such pieces of evidence, we hypothesized that age, sex and blood group may be associated with status of anti-HCV antibodies, with emphasis on the interaction of blood groups with the risk of developing infection.

METHODS

Study population

A total of 20 000 blood donors, visiting Ganesh Shankar Vidyarthi Memorial (GSVM) Medical College, Kanpur, India from March 2004 to December 2008 were included in the current study. A blood sample (3 ml) was collected in EDTA from apparently healthy blood donors belonging to all socioeconomic groups. The blood bank caters for a wide area of Northern India, therefore healthy donors comprise most of the general population. Repeat donors were not included in the study. A thorough clinical history check, medical examination and selection of donors were performed prior to obtaining a signed consent form from all donors. The blood group of each donor was tested and the donors were categorized according to blood group, sex, age, and correlated with risk factors.

Anti-HCV antibodies detection

All the donors were subjected to anti-HCV antibodies detection by third-generation enzyme linked immunosorbent assay (anti-HCV ELISA 3.0, Span Diagnostics, India) along with other mandatory tests for blood donation.

Statistical analysis

Statistical analysis was performed with SPSS software version 11.5 (SPSS, USA). *Z* test was used for two proportions, when there were more than two groups χ^2 test was performed. A *P* value <0.05 was considered to be statistically significant.

Table 1. Relationship between HCV seropositivity and selected variables in the general population in Northern India

Risk factors	HCV			<i>P</i> value
	<i>n/N</i>	%	95% CI	
Sex				
Male	67/19 235	0.35	0.2665–0.4334	0.311
Female	1/765	0.13	0.125–0.385	
Age (years)				
19–25	14/6058	0.23	0.1093–0.3507	0.33
26–35	37/9994	0.37	0.2508–0.4892	
36–45	14/3161	0.44	0.2089–0.6711	
46–55	3/787	0.38	0.0498–0.8098	
Rhesus group				
Positive	66/19 127	0.35	0.2663–0.4337	0.7807
Negative	2/873	0.22	0.681–0.3919	
Blood group				
A	12/4618	0.25	0.106–0.394	0.0456
B	30/7426	0.40	0.256–0.544	
AB	1/2032	0.04	0.045–0.125	
O	25/5924	0.42	0.255–0.585	

n, HCV-positive cases; *N*, total donors; CI, confidence interval.

RESULTS

Of the 20 000 study subjects, only 68 (0.34%) were HCV seropositive and 19 932 (99.66%) were HCV seronegative (Table 1). The prevalence of HCV in male individuals was 0.35% (67/19 235) compared to 0.13% in females (1/765). The difference was found to be statistically non-significant (*P*=0.311). HCV seroprevalence increased with age, 0.23% in the 19–25 years age group to 0.44% in the 35–45 years age group. The difference was statistically non-significant (*P*=0.33). The HCV seroprevalence did not vary significantly (*P*=0.7807) and was marginally high in the Rhesus-positive group (0.34%) compared to the Rhesus-negative group (0.22%). HCV prevalence was found to be higher in blood group O at 0.42% (25/5924) and lowest in blood group AB at 0.04% (1/2032). The proportion of HCV in AB blood group was found to be significantly lower compared to A, B, and O blood groups (*P*=0.0456).

DISCUSSION

In our study 20 000 random blood donors were screened for HCV status and were correlated with individual characteristics such as sex, age and blood

group. The current study showed 0.34% anti-HCV seropositivity in healthy blood donors which is in accord with previous reports from North India (ranging from 0.3% to 5.1%) [4, 6, 14] and from Western India (ranging from 0.34% to 2.5%) [15, 16]. The variation in HCV seropositivity may be due to differences in the donor base, testing methodology and its stringent regulation, the degree to which risk factors are prevalent in the donor population, literacy rate and self-exclusion by high-risk donors [17].

ABO blood groups are the most investigated erythrocyte antigen system, and owing to the ease of identifying their phenotypes they have been used as genetic markers in studies of their associations with various diseases [18]. Over the past 25 years, there has been a large amount of work published on the chemistry of blood group antigens and tumour immunology [12, 13]. Several studies have demonstrated the association of blood groups with HBV infection [19–22]. Poujol-Robert *et al.* [11] reported the association of ABO blood group antigen with fibrosis severity in HCV infection. A study conducted in Taiwan showed the prevalence of HCV to be higher in individuals with blood group O [23]. In our study, individuals with blood group AB are found to be the least susceptible to HCV infection. It is clear from previous studies that blood group antigens do have a significant biological role in several diseases. Although the exact mechanism underlying the association of blood group with HCV infection is unclear, it is plausible to hypothesize that blood group antigens can influence HCV susceptibility via their receptor-mediated affinity binding. These blood group antigens (A, B, H, I, P, Lewis) apart from their regular occurrence on red blood cell surface, are also widely distributed throughout the body (e.g. on other cells and sometimes in body fluids). On the other hand, it is well known that HCV is an enveloped virus, made up of glycoproteins [24]. Blood group antigens are proven to be receptors for several microorganisms [25–27]. Boren *et al.* [28] reported that the Lewis blood group antigen, Leb (which has close associations with the ABO system) was the receptor for *Helicobacter pylori*. A negative relationship of blood group AB with *H. pylori* infection was reported by Kanbay *et al.* [29]. Although the data is preliminary, based on the current study as well as previous studies, the role of blood group antigens in causing HCV infection or in disease progression can not be ruled out.

The current study showed no significant difference or association between HCV infectivity with sex

which is in accord with previous studies [14, 30, 31]. In our study, in accord with earlier studies [31, 32], younger individuals were found to be the least susceptible for HCV infectivity.

To the best of our knowledge, our study is the first report from India to analyse the possibility of an association of blood groups with HCV seropositivity. Our findings suggest that further detailed multicentre studies are warranted to confirm this relationship. In addition, further molecular and functional studies are warranted to investigate the association between blood group antigens and HCV infection, in other regions with a larger sample size.

In conclusion, our results implicate that individuals with blood group AB may be associated with reduced susceptibility to HCV infectivity. It will be of interest to investigate whether blood group antigens play a role in the binding of HCV to PBMCs/other cells or if glycosyltransferases responsible for the formation of blood group antigens create a stress that blocks HCV replication.

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DECLARATION OF INTEREST

None.

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