Internet Journal of Medical Update

Journal home page: http://www.akspublication.com/ijmu

Original Work

Seroprevalence pattern among blood donors in a tertiary health care center

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(Received 13 July 2012 and accepted 27 August 2013)

ABSTRACT: Although blood transfusion is a life-saving maneuver, it is associated with certain risks. In general, transfusion-related adverse events are categorized as infectious and noninfectious. Transfusion-transmissible infectious agents such as human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV) and syphilis are among the greatest threats to blood safety for the recipient. To assess the magnitude and dynamics of disease transmission and for its prevention and control, the study of its seroprevalence is important. Our institute, catering to the needs of a large population in the foothills of the Himalayas, represents an important center for serological surveys. This study aimed to determine the seroprevalence of HIV, HBV, HCV and syphilis infections among blood donors in a tertiary care center of this region. A retrospective analysis of medical records of blood donors who met the standard criteria for donor fitness were screened for HIV, HBS, HCV, Syphilis and Malaria, from January 2007 to December 2011 (5 years). Out of 7884 units collected, 83 (1.05%) units had seropositivity for HBsAg/anti-HCV Ab/anti-HIV Ab/anti-Treponemal Ab, 2 units each revealed dual infections with HIV-HBV and HIV-HCV. Seropositivity rates of HBsAg, anti-HCV Ab, anti-HIV Ab and anti-treponemal Ab were 0.63%, 0.20%, 0.19% and 0.02%, respectively. Even with the implementation of effective preventive strategies, there is significant risk of transmission of infectious agents in India. Efforts to ensure an adequate and safe blood supply should include proper screening and striving for optimal use of blood and its products.

KEY WORDS: ***Seroprevalence; HIV; Hepatitis B; Hepatitis C; Syphilis; Uttarakhand***

INTRODUCTION

Blood transfusion carries the risk of transfusion-transmissible infections, including HIV, Hepatitis, Syphilis, Malaria and infrequently Toxoplasmosis, Brucellosis and some other viral infections like CMV, EBV and Herpes. With every unit of blood, there is a 1% chance of transfusion-associated problems including transfusion-transmitted diseases.[1] Among all infections, HIV and hepatitis are the most dreadful.

Hepatitis B virus (HBV) infection, originally called serum hepatitis, was known to be a serious and sometimes fatal complication of blood transfusion when unscreened blood and plasma were massively transfused during World War II. Despite this clinical recognition, little was known about the causative agent until the 1960s when Australian antigen was linked to human hepatitis, and renamed hepatitis B surface antigen. Apart from blood transfusion, HBV can be transmitted during birth, by unprotected sex, and by sharing needles. The tests to detect this antigen in blood donors were introduced in the United States in 1970. Worldwide, over 2 billion people have been infected with HBV and more than 350 million are chronic carriers. Based on HBsAg carrier rates, India has been placed into the intermediate endemicity zone (2–8%), carrying high prevalence rates (5–7%) in the general population. Voluntary blood donors are reported to have a carrier rate of about 6% and the incidence of post transfusion hepatitis in multiple transfused patients can be as high as 18–30%.[2]

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Among the viral hepatitides, Hepatitis C virus is especially dangerous as it establishes a state of chronic infection in as many as 85% of acutely infected patients. Chronic hepatitis C is a ubiquitous disease affecting around 200 million people worldwide. WHO estimates that 3% of the world's population is infected with HCV and around 170 million individuals are chronic carriers at risk of developing liver cirrhosis and liver cancer. The major channels of HCV transmission are all related to exposure to blood and blood products. In India, antibodies against HCV are present in approximately 15 million people with a prevalence rate of 2%.[2]

The HIV/AIDS epidemic is one of the largest public health crises of the 21st century, which has evolved from a mysterious illness to a global pandemic in less than 20 years. In 2007, a total of 33.2 million people were living with HIV with global incidence of 2.5 million. In India, the estimated number of HIV-infected people was 2.4 million in 2007. Although globally, as well as in India, the predominant mode of HIV transmission is through heterosexual contact, the risk of contracting HIV infection from transfusion of a unit of infected blood is estimated to be over 95%.[2]

Syphilis is also a systemic disease caused by *Treponema pallidum*, which can be spread by sexual contact, blood transfusion and via vertical transmission. The true incidence of syphilis is difficult to assess, however, WHO estimated yearly incidence of 12 million in 1999. Serological surveys continue to be the best source of information on the prevalence of syphilis.[2]

Community-based seroprevalence studies are difficult to conduct in this zone because of socioeconomic hurdles and logistic difficulties. Our institute is a strategically located healthcare facility that drains a large population of Uttarakhand, local as well as rural, remote and hilly, representing an important center for serological surveys. Also, no data is available, on the seroprevalence and distribution of these blood-borne pathogens, from these zones of Uttarakhand. It was against this backdrop, that the present study was undertaken to estimate the seroprevalence of HBsAg and antibodies to Hepatitis C, HIV and Syphilis among the blood donors in this region.

METHODOLOGY

Study design, Setting and Study Subjects

A retrospective analysis of consecutive blood donors' records from January 2007 to December 2011 (5 years) was conducted by the Department of Pathology in collaboration with its Blood Transfusion Unit at Veer Chandra Singh Garhwali Government Medical Sciences and Research Institute. This institute, situated in the foothills of the Himalayas, provides health services to the local as well as remote population from the hilly terrain. Blood donors were either volunteers, or relatives or friends of patients. In the blood bank unit of the hospital, screening for potential blood donors was done using standard criteria for donor fitness with a questionnaire on previous or prevailing illnesses and chronic diseases, risky sex behavior and practice, previous blood transfusions, as a part of it. Apparently healthy subjects, aged 18 to 60 years with body weight >45kg and hemoglobin >12.0g/dl qualified for donation. The medical and demographic profiles of the donors were recorded and venous blood was collected in blood bags following standard procedures. Every unit was tested to exclude HIV, HBS, HCV, Syphilis and Malaria.

Tests for HIV

Each donor's serum sample was screened for HIV antibodies (anti-HIV Ab) by ELISA kits or rapid tests (J. Mitra & Co., India/Transasia, India/Bioline, Standard Diagnostics, Korea/Span Diagnostics, India) following the manufacturer's instructions.

Detection of HBsAg and HCV antibodies

Sera were checked for the presence of hepatitis B surface antigen (HBsAg) and antibodies to HCV (anti-HCV) using ELISA kits or Rapid tests (Transasia, India/J. Mitra, India/Standard Diagnostics, Korea).

Laboratory diagnosis for Syphilis

Serum from all donors was tested for the presence of treponemal antibodies using rapid plasma reagin test (RPR) following the manufacturer's instructions (Tulip, India/Agappe Diagnostics, India).

ABO blood grouping and Rhesus (Rh) typing

ABO and Rh blood groups determinations were carried out by slide/tube method using monoclonal blood grouping antisera; anti-A, anti-B, anti-AB, and anti-D (Agappe Diagnostics, India).

RESULT

In all, 7884 units of blood were collected and screened for mandatory tests in the blood transfusion unit of our Institute during the study period (**Table 1**). Of these, 83 (1.05%) units were seropositive (**Table 1**), 2 units revealing seroevidence of dual infections with HIV-HBV and HIV-HCV. Most common ABO and Rh blood group found in units collected was A (31.64%) and

Rh positive (94.25%), respectively. Maximum number of units (41.12%) belonged to donors of age group 18–25. Seroprevalence rates of HBsAg, anti-HCV Ab, anti-HIV Ab and anti-treponemal Ab were 0.63%, 0.20%, 0.19% and 0.02% respectively, with higher rates in first time donors, replacement donors and Rh-ve units, except Rh+ve for anti-treponemal Ab. The seroprevalence of HBsAg among males and females was 0.62% and 0.84%, respectively, and was found highest in females (0.84%), 36–45 years age group (1.04%) and blood group AB (1.28%). For anti-HCV Ab, females (0.28%), 46–58 years group (0.24%), blood group B (0.28%) and for anti-HIV Ab, males (0.20%), 26–35 years age group (0.28%), blood group B (0.24%) revealed highest seroprevalence rates (**Table 2**).

Table 1: Yearly distribution of seropositive blood donors

Year	Total units screened	HIV +ve (%)*	HBsAg +ve (%)*	HCV +ve (%)*	Syphilis +ve (%)*
2007	731	1(0.14)	6(0.82)	2(0.27)	1(0.14)
2008	1252	3(0.24)	9(0.72)	4(0.32)	-
2009	1739	4(0.23)	10(0.57)	7(0.40)	-
2010	1914	2(0.10)	14(0.73)	2(0.10)	1(0.05)
2011	2248	5(0.22)	11(0.49)	1(0.04)	-
Total	7884	15(0.19)	50(0.63)	16(0.20)	2(0.02)

**Yearly seropositivity (in percentage among total units in particular year)*

Table 2: Profile of seropositive blood donors

Characteristics		No. of units (%)	HIV +ve (%)*	HBsAg+ve (%)*	HCV+ve (%)*	VDRL+ve (%)*
Age group	18-25	3242(41.12)	4 (0.12)	20 (0.62)	7 (0.21)	2 (0.06)
	26-35	2801 (35.53)	8 (0.28)	12 (0.43)	6 (0.21)	-
	36-45	1430 (18.14)	3 (0.21)	15 (1.05)	2 (0.14)	-
	46-58	411 (5.21)	-	3 (0.73)	1 (0.24)	-
Gender	Male	7528 (95.48)	15 (0.20)	47 (0.62)	15 (0.20)	2 (0.03)
	Female	356 (4.51)	-	3 (0.84)	1 (0.28)	-
Type of donation	Replacement	3938 (49.95)	9 (0.23)	26 (0.66)	11 (0.28)	1 (0.02)
	Voluntary	3946 (50.05)	6 (0.15)	24 (0.61)	5 (0.13)	1 (0.02)
Blood groups	A	2495 (31.64)	6 (0.240)	15 (0.60)	5 (0.20)	1 (0.04)
	B	2456 (31.15)	6 (0.244)	10 (0.41)	7 (0.28)	-
	O	2072 (26.28)	1 (0.05)	14 (0.67)	3 (0.14)	1 (0.05)
	AB	861 (10.92)	2 (0.23)	11 (1.28)	1 (0.12)	-
	Rh positive	7431 (94.25)	12 (0.16)	47 (0.62)	13 (0.17)	2 (0.03)
	Rh negative	453 (5.74)	3 (0.66)	3 (0.66)	3 (0.66)	-
No. of donations	First	6553 (83.12)	15 (0.23)	49 (0.75)	16 (0.24)	2 (0.03)
	Repeat	1331 (16.88)	-	1 (0.07)	-	-

**Seropositivity in percentage among respective groups (characteristics), not among total units*

DISCUSSION

Blood safety remains an issue of major concern in transfusion medicine as transfusion forms an integral part of medical and surgical therapy. The discovery of transfusion-transmissible infections (TTIs) has heralded a new era in blood transfusion practice worldwide with emphasis on safety and protection of human life. Human immunodeficiency virus (HIV), hepatitis B virus (HBV) and hepatitis C virus (HCV) are of great concern because of their prolonged viremia and carrier or latent state. They also cause fatal, chronic and life-threatening disorders.

The seroprevalence of 0.63% for hepatitis B surface antigen noted in this study, lower than previous studies in Kerala[3], Andhra Pradesh[4], Haryana[5], Uttarpradesh[6] and Rajasthan[7], which reported seroprevalence rates of 1.3%, 1.41%, 1.7%, 1.96% and 3.4%, respectively. Lodha et al in their review article on Hepatitis B epidemiology have suggested the true prevalence rate in India as 1–2%[8]. The prevalence of Hepatitis B varies from country to country and even in different regions of our country, and may depend upon a complex mix of behavioral, environmental, and host factors. Among blood donors in Nigeria[9], Northwest Ethiopia[10] and Nepal[11], the prevalence rates of viral hepatitis B have been found to be 13.2%, 4.7% and 0.47%, respectively. In general, it appears to be lowest in countries or areas with high standards of living (e.g., Australia, North America, and North Europe) and highest in countries or areas with low socioeconomic levels (e.g., China, South East Asia, and South America). In India, the highest prevalence has been reported among the aborigines of Andaman as well as from Arunachal Pradesh[12].

The seroprevalence of anti-HCV Ab among blood donors in our blood bank was 0.20%, approaching the levels reported by a study of Rajasthan (0.28%) by Garg et al[7], but lower than 0.84%, 0.85%, 1.0% and 1.4% in studies in Andhra Pradesh,[4] Uttarpradesh[6], Haryana[5] and Kerala[3] respectively. In India, the seroprevalence of HCV varies among hospital-based populations with 1.57% reported from Cuttack (Orissa)[13], 4.8% from Pondicherry[14] and 0.28% from Rajasthan[15]. Geographical variation in the seroprevalence of HCV has also been documented by Sun et al in Taiwan[16]. Studies in Nigeria[9], Ethiopia[10] and Nepal[11] have showed a seroprevalence of 3.6%, 0.7% and 0.64%, respectively.

Acquisition of HIV disease through blood transfusion is a relatively efficient mode of transmission, with rates over 95%[2]. A WHO report states that the viral dose in HIV transmission through blood is so large that one HIV-positive transfusion leads to death, on an average, after two years in children and after three to five years in adults[1]. Moreover, it should never be forgotten that blood donations collected in the latent period of infection might be infectious despite a negative antibody test. In the present study, seropositivity for HIV was 0.19%, similar to studies by Mathai et al in Kerala[3], and Chandra et al in Uttar Pradesh[6], and a little lower than Arora D et al[15] and UNDP's 2010 report[17] with seroprevalence of 0.3%. Our results were much lower than those reported by Ramanamma et al in Vishakhapatnam[18] and Kulkarni et al in Mumbai[19] probably indicating a geographical variation. National data also states that higher incidence of HIV is found in Maharashtra and South India. In comparison to Northern and Western India, seropositivity for HIV in our study was slightly less[20,21]. Seroprevalence in our study was higher than reported in a workshop on Health Policy Issues and Health Programmes in Uttaranchal, 2001[22] and a study in Nepal[11].

Only 2 cases were positive for syphilis, with rate lower than 0.22%, 0.2% and 0.08% noted in previous studies in Rajasthan[7], Kerala[3], and Andhra Pradesh[4] respectively, and higher than 0.01% in Lucknow[6]. Higher seroprevalence rates of 0.48% and 1.3% have also been reported from Nepal[11] and Ethiopia[10].

In the present study, only 2 units had evidence of co-infections, one with HIV-HBV, while other with HIV-HCV. Although these pathogens share common modes of transmission and risk groups, the reported prevalence of HIV/HCV and HBV/HIV co-infection varies significantly among studies. Although HIV and HCV are both transmitted through parenteral, sexual, and vertical exposure, they differ in the transmission efficiencies of these routes[23]. Thus, the risk factors of the population under study directly influence the prevalence in that particular population. Although co-infection with Hepatitis B virus and HIV is common, factors affecting the prevalence of chronic HBV include age at time of infection and mode of acquisition, which vary geographically. However, none of the units showed the presence of three or four markers (HIV, HBS, HCV, Syphilis). The co-infection rate observed matched the results of Bhawani et al[4] and was lower than results of Kaur et al[23].

In the preesent study, majority (95.48%) of the donors were males (**Table 2**) similar to the study done by Bhawani et al in Andhra Pradesh[14] and Arora et al in Haryana[5], since more males qualified following the criteria of fitness and a higher proportion of males came for voluntary donations, especially in camps. In our study, no female donor was found to be positive for HIV (similar to study by Bhawani et al[4]), while for HBsAg, seroprevalence rate was higher in units of female donors as compared to male donors. Maximum (41.12%) units belonged to the young, ageing 18–25 years, which is in concurrence with previous

reports[5,24]. Significantly increased seroprevalence of HBV was observed in the age groups of 36–45 and 18–25 years and that of HIV in 26–35 and 36–45 compared to the age group of greater than 45 years (**Table 2**). This observation is worrisome since the most productive and economically viable age group of the population is worst hit, emphasizing the need to intensify preventive programmes aimed at high-risk behavioral change.

The seropositivity rate of HIV and HBV was increased among first time donors and replacement donors compared to repeat and voluntary donors. This is in agreement with previous studies[4,5,24]. The significantly increased HIV and HBV seroprevalence among first time donors might be due to lesser chance of these infections by time-to-time screenings and selection in repeat donors. Most common blood group among units collected was A followed by B in contrast to O in study in Andhra Pradesh and South India, while least common was AB, similar to other studies[4,25]. Maximum seropositive cases (27/83) were found among units with blood group A, which was commonest blood group, while the seroprevalence rates for HBsAg, HIV and HCV were highest in blood groups AB, B and B, respectively (**Table 2**).

The reason(s) for the relatively lower rate of seroprevalence of HIV, HBV, HCV and syphilis in this study compared with other studies cannot be discerned. Low seropositivity for diseases in our study could be attributed to proper counseling of blood donors and donor selection criteria followed by rationale use of blood, and due to the inclusion of larger number of voluntary donors in the hospital as well as camps. The improvement in technology might make current screening reagents more specific and reliable and could also be a pointer that there are geographical differences in prevalence and/or declining trends. According to UNDP, the estimated number of new annual HIV infections has declined by more than 50% over the past decade, and India had 2.39 million people living with HIV at the end of 2009 (equating a prevalence of 0.3%) and the estimated adult HIV prevalence was 0.32% in 2008 and 0.31% in 2009[17]. The estimation of the seroprevalence of HIV provides essential information for effective implementation of AIDS control programs and also for monitoring HIV spread within the country. To our knowledge, this is the first report defining rates of infection with all these blood-borne agents among blood donors in Srinagar, Uttarakhand. The observed rates likely reflect the patient population served by our Institute and do not necessarily apply to other centers. However, the study does throw light on the dynamics of viral transmission in the community in this part of the country and provides a good reference for future studies.

CONCLUSION

Even with the implementation of effective preventive strategies, including new laboratory tests, there is significant risk of transmission of infectious agents, including viruses, bacteria, and parasites, through blood transfusion in India. Today we know that all countries are joining hands to fight against transfusion- transmissible infections, especially HIV. Educating people, creating awareness, encouraging voluntary blood donations and vigorous screening of donors and donated blood are important. Efforts to ensure an adequate and safe blood supply should include striving for optimal use of blood and its products.

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