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Pathology Section

Seroprevalence of Transfusion Transmitted Infections among Blood Donors at the Tertiary Care Hospital in Nadiad, Gujarat, India

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ABSTRACT

Introduction: Blood transfusion is an effective treatment for saving millions of lives, even though transfusion-transmissible infections are a major problem. An integrated approach for blood safety is required, which includes the collection of blood only from voluntary, non-remunerated blood donors.

Aim: To assess the seroprevalence of Transfusion-Transmissible Infections (TTIs) among blood donors in a tertiary care center in Nadiad, India.

Materials and Methods: A retrospective study was conducted from August 2019 to September 2022 at the blood bank of a tertiary care center in Nadiad, India. Data were collected in an Excel datasheet pertaining to all donors who were screened for Hepatitis B Surface Antigen (HBsAg), Hepatitis C virus (HCV), Human Immunodeficiency Virus (HIV), syphilis, and malaria and analysed. The associations between categorical variables were tested using the Chi-square test.

Results: A total of 6103 voluntary and replacement donors were screened, out of which 5855 (95.93%) were males and 248 (4.06%) were females. The prevalence rate was highest for syphilis 81 (1.32%), then Hepatitis B Virus (HBV) 32 (0.52%), HCV 09 (0.14%), HIV 05 (0.08%), and malaria 00 (0%) in decreasing order. Out of 6103 donors, 127 donors showed seropositivity for TTI (2.08%). The present study shows seropositivity for TTI only in male replacement donors (100%).

Conclusion: Blood is still one of the main sources of transmission of infections such as HIV, HBsAg, HCV, syphilis, and malaria. The present study showed a higher prevalence of syphilis than HBsAg, HCV, HIV, and malaria, in decreasing order. The study showed seroprevalence only in male replacement donors, so efforts to motivate and ensure the active participation of voluntary blood donors, including females, are needed. Meticulous donor screening, the use of highly sensitive techniques for the detection of TTIs, and improved post-donation counseling are highly recommended to ensure the safety of blood for recipients.

Keywords: Blood donation, Hepatitis B, Transfusion-transmissible infections

INTRODUCTION

Blood Transfusion Services (BTS) are an important part of the modern healthcare system, without which efficient medical care is impossible. The aim of BTS is to provide effective blood and blood products that are safe and adequate to meet a patient's needs [1]. However, blood transfusions are associated with certain risks that can cause adverse consequences. They may cause acute complications such as haemolysis, febrile reactions, allergy, anaphylactic reactions, and delayed complications like haemolysis, carrying the risk of transmitting infections [2].

There is a 1% chance of transfusion-associated problems, including transfusion-transmitted diseases, with every one unit of blood transfused [3]. According to the Global progress report on HIV, viral hepatitis, and sexually transmitted infections, 2021, 1.5 million (1.0 million-2.0 million) people acquired HIV infection in 2020, hepatitis B and C caused 1.1 million deaths and 3.0 million new infections per year, and 7.1 million (2.4 million-11.5 million) people were newly infected with *Treponema pallidum* (*T. pallidum*) in 2020 [4].

An integrated policy for blood safety is required for the elimination of TTIs. The main part of this strategy includes the collection of blood only from voluntary, non-remunerated blood donors, screening for all TTIs, and reduction of unnecessary transfusion. According to the National AIDS Control Organisation (NACO) guidelines, all blood samples must be tested for HIV 1 and 2, hepatitis B, hepatitis C, syphilis, and malaria [5].

Preventing the transmission of infectious diseases through blood transfusion in developing countries is difficult due to limited resources. Despite effective strategies and plans, disease transmission still occurs due to the high cost of screening, lack of trained staff, laboratory testing errors, and the inability of the test to detect the disease in the window period of infection. Therefore, the current study aimed to determine the prevalence of transfusion-transmitted infections in voluntary and replacement donors at a tertiary care hospital-based blood bank in Nadiad.

MATERIALS AND METHODS

It was a retrospective study conducted in the blood bank of a newly established Medical College in Nadiad, India, from August 2019 to September 2022.

Study population: All blood donors, whether voluntary or replacement, during the study period.

Inclusion criteria: Blood donors aged between 18 and 60 years, with a hemoglobin concentration of 12.5 g% or more, a body weight of 45 kg or more, no history of hepatitis B, hepatitis C, HIV, or sexually transmitted diseases, and no history of jaundice in the past year.

Exclusion criteria: Repeat donors and donors whose blood was not tested due to haemolysis or other reasons for TTIs were excluded from the study.

Data collection procedure: The data were collected by studying all the registration books of blood donors from August 2019 to

September 2022 maintained in the blood bank. Data of all blood donors, both voluntary and replacement, were noted.

Blood was collected by conducting blood donation camps in Nadiad and adjoining areas and through in-house replacement donation, mainly from friends and relatives of patients of this hospital and other healthcare institutions. Blood donors were requested to fill in the donor form of the blood bank prepared by the Departmental head. Information regarding age, sex, previous history of surgery, chronic illness, hospitalisation, blood transfusion, jaundice, high-risk behaviour, history of vaccination, etc., was recorded. After satisfaction with the answers from donors and medical examination, donors were allowed to donate blood.

Method of testing for TTIs: The method of testing for TTIs involved taking Ethylenediaminetetraacetic Acid (EDTA) and serum samples from each donor, and then separating the serum. The serum of all donors was tested for HBsAg, HCV antibodies (anti-HCV), HIV p24 antigen, antibodies 1, 2 (anti-HIV-1,2), Rapid Plasma Reagin (RPR) for syphilis antibodies, and malaria parasite antigen.

HBsAg testing was performed using the Hepalisa Enzyme Linked Immunosorbent Assay (ELISA) kit for the detection of HBsAg. The anti-HCV test was conducted using the Microlisa ELISA kit for the detection of antibodies to HCV. HIV screening was carried out using the Microlisa 4th generation ELISA test for the detection of HIV-1 p24 antigen and Antibodies to HIV-1 and HIV-2, known for its 100% sensitivity and 99.95% specificity. These in vitro diagnostic reagents were manufactured by J.Mitra and Co. Pvt., Ltd.

Syphilis screening was performed by rapid chromatographic immunoassay for the qualitative detection of antibodies (IgG and IgM) to *T. pallidum* in serum, utilising the Aspen syphilis rapid test strip (Serum/plasma/WB) insert. Malaria screening was carried out using the Falcivax rapid test for malaria Pv/Pf, manufactured by Viola Diagnostic systems, a division of Tulip Diagnostics (P) Ltd. The Falcivax test utilises the principle of agglutination of antibodies/antisera with the respective antigen in an immunochromatography format, along with the use of nano gold particles as an agglutination revealing agent.

Reactive cases of HIV were confirmed by immunochromatography and the western blot method. Reactive cases of HBsAg and HCV were confirmed by the chemiluminescence method in the biochemistry lab. Reactive cases of syphilis were confirmed by ELISA. Reactive cases of malaria were confirmed by a thick peripheral smear in the hematology lab. All first-time reactive cases were discarded while maintaining standard biomedical waste disposal procedures.

STATISTICAL ANALYSIS

The data were collected in an Excel datasheet and analysed.

RESULTS

In the present study, out of 6103 total donors, 961 were voluntary and 5142 were replacement donors. Among the total 6103 donors, 5855 (95.94%) were males and 248 (4.06%) were females [Table/Fig-1]. Males outnumbered females.

Year	Total donors	Male	Female
2019	1754	1659 (94.58%)	95 (5.41%)
2020	516	489 (94.76%)	27 (5.23%)
2021	1470	1401 (95.30%)	69 (4.69%)
2022	2363	2306 (97.5%)	57 (2.41%)
Total	6103	5855 (95.93%)	248 (4.06%)

[Table/Fig-1]: Distribution of donors in study population.

The age range in the present study was 18-60 years. The highest prevalence of seropositive donors was found within the age group 21-40 years for viral infections. The overall cumulative seroprevalence was lowest, with 3 donors (2.36%) in the age group 18-20 years, then increased up to 40 years of age, with a total of 94 donors in the 21-40 years age group, followed by a decline with increasing age. The highest prevalence of syphilis was seen in the 31-40 years of age [Table/Fig-2].

Disease	Age 18-20	21-30	31-40	41-50	51-60
HIV	00 (0%)	03 (50%)	02 (33.33%)	00 (0%)	01 (16.66)
HBV	02 (6.66%)	14 (46.66%)	11 (36.66%)	1 (3.33%)	02 (6.66%)
HCV	00 (0%)	03 (37.5%)	04 (50%)	00 (0%)	01 (12.5%)
Syphilis	01 (1.20%)	21 (25.30%)	36 (43.37%)	22 (26.50%)	03 (3.61%)
Total	3 (2.36%)	41 (32.28%)	53 (41.73%)	23 (18.11%)	7 (5.51%)

[Table/Fig-2]: Prevalence of HIV, HBV, HCV, Syphilis infection according to different age groups.

The prevalence of HIV, Hepatitis B, Hepatitis C, Syphilis, and Malaria infection among blood donors in the study population is shown in [Table/Fig-3]. The overall seroprevalence of HBV, HCV, HIV, Syphilis, and malaria was 0.52%, 0.14%, 0.08%, 1.32%, and 0%, respectively. The prevalence rate was highest for Syphilis, followed by HBsAg, HCV, HIV in decreasing order. HBsAg had the highest seroprevalence among viral infections, followed by HCV and HIV [Table/Fig-3].

Year	Total donor	HCV	HBV	HIV	Syphilis	MP
2019	1754	02 (0.11%)	10 (0.57%)	01 (0.05%)	16 (0.91%)	00 (0%)
2020	516	00 (0%)	01 (0.19%)	01 (0.19%)	00 (0%)	00 (0%)
2021	1470	06 (0.40%)	07 (0.47%)	01 (0.06%)	23 (1.56%)	00 (0%)
2022	2363	01 (0.04%)	14 (0.59%)	02 (0.08%)	42 (1.77%)	00 (0%)
Total	6103	09 (0.14%)	32 (0.52%)	05 (0.08%)	81 (1.32%)	00 (0%)

[Table/Fig-3]: Prevalence of HCV, Hepatitis B, HIV, Syphilis and Malaria infections among blood donors.
MP: Malarial parasite

In our study, three cases of co-infections were detected: HIV and HCV, HIV and HBsAg, HIV and syphilis.

DISCUSSION

Blood transfusion is an important and life-saving procedure in today's medical practice. However, it also carries the threat of various TTIs such as HIV, hepatitis B, and Hepatitis C, which can be fatal [6]. The occurrence of TTIs ranges as follows: HBV - 0.66% to 12%, HCV - 0.5% to 1.5%, HIV - 0.084% to 3.87%, and syphilis 0.85% to 3% among the Indian population [7].

The high prevalence of TTIs has increased the problems of blood safety. It is essential to continuously monitor the magnitude and trend of TTIs in blood donors. This is important for assessing the effectiveness of screening programs, which might also be directly related to the prevalence of the disease in the community. The present study showed that transfusion-transmitted diseases are more common among males than females, which is comparable to other studies [8,9]. This inequality may be due to the large number of male donors in our study and differences in high-risk behaviour. The smaller number of female donors in the study could be due to less awareness, low education levels, and increased deferral rates among Indian female donors because of the high incidence of anemia and underweight.

The study showed seropositivity only in male replacement donors. Voluntary blood donors and female donors (0%) showed no seropositivity. Replacement donors may conceal some facts related to high-risk behaviour and illness as there is a compulsion to donate blood to get blood for their patients. Most of the infected donors in this study were from the 21-40 years (74%) age group. The findings are similar to studies done by Varma AV et al., and Karmakar PR et al., [3,10]. This might be due to the sexual transmission of diseases in this age group.

The overall seroprevalence of 2.08% of various TTIs among apparently healthy adults indicates the need for sensitive and stringent screening of all blood donors, public awareness programs, and behaviour change communication to the young strata of society to keep them free of these infections.

Though the concern for blood safety is mainly due to HIV infection, Hepatitis B was a more prevalent infection in the present study, similar to other studies from India [11,12]. In the study, the seroprevalence of HBV was 0.52% among the donors, similar to the findings by Cheema S et al., (0.49%) and Sundaramurthy R et al., (0.42%) [13,14]. Lower prevalence was reported by Sharma RI et al., (0.29%) and Adhikari L et al., (0.28%) [15,16]. Higher occurrences than the present study were seen in many other Indian studies [Table/Fig-4] [3,6,10,13-28]. The major route of HBV infection is parenteral. It is most infective among blood-borne viruses, and the chronic carrier state is associated with cirrhosis and hepatocellular carcinoma. Even though there is a safe and effective vaccine, the seroprevalence of HBsAg in India is high. This is because of a long window period between initial HBV infection and the detection of HBsAg, during which the virus is transmissible [29].

Studies	HBsAg%	HIV%	HCV%	Syphilis%	MP
Pahuja S et al., (2007), Delhi, India [17]	2.23	0.56	0.66	-	
Bhattacharya P et al., (2007), West Bengal, India [18]	1.46	0.28	0.31	0.72	
Adhikari L et al., (2010), Sikkim, India [19]	0.78	0.32	0.27	0.27	
Arora D et al., (2010), Southern Haryana, India [20]	1.7	0.3	1	0.9	
Pallavi P et al., (2011), Mysore, India [21]	1.27	0.44	0.23	0.28	00
Anjali et al., (2012), Kerala, India [22]	1.5	0.6	0.4	0.1	
Giri PA et al., (2012), India [6]	1.09	0.07	0.74	0.07	
Negi et al., (2014), Uttarakhand, India [23]	1.2	0.2	0.9	0.3	0.002
Mandal R et al., (2016), Darjeeling India [24]	1.24	0.42	0.62	0.65	
Rawat A et al., (2017), Delhi, India [25]	1.61	0.32	0.73	1.62	0.06
Sundaramurthy R et al., (2018), Madurai, India [14]	0.42	0.13	0.56	00	0.01
Omhare A et al., (2018), Kanpur, India [26]	1.45	0.068	0.33	0.15	0.007
Sharma RI et al., (2018), Gujarat, India [15]	0.29	0.03	-	0.04	-
Varma AV et al., (2019), central India [3]	1.29	0.076	0.072	-	
Bhutia CT and Das D (2019), Sikkim, India [27]	0.91	0.22	0.15	0.04	-
Patil PU et al., (2020), Maharashtra, India [28]	1.027	0.131	0.140	0.001	0.01
Adhikary M et al., (2021), Eastern India [16]	0.28	0.01	0.12	0.004	00
Cheema S et al., (2022), north India [13]	0.49	0.03	0.50	0.05	
Karmakar PR et al., (2022), West Bengal, India [10]	1.41	0.60	0.59	0.23	-
Present study 2023	0.52	0.08	0.14	1.32	00

[Table/Fig-4]: Transfusion Transmissible Infections (TTIs) prevalence in various studies.

In this study, the prevalence of HIV was found to be 0.08%. Similar findings by Varma AV et al., (0.076%), Giri PA et al., (0.07%), and Omhare A et al., (1.45%) have been reported [3,6,26]. Lower prevalence was reported by Cheema S et al., (0.03%), Sharma RI et al., (0.03%), and Adhikari L et al., (0.01%) [13,15,16]. Many other Indian studies show a higher prevalence of HIV compared to this study [Table/Fig-4]. According to WHO, transfusion of one unit of infected blood with HIV can lead to death in children and adults after 2 years and 3-5 years, respectively [30].

The prevalence of Hepatitis C in the present study was 0.14%, similar to findings by Adhikari L et al., (0.12%), Bhutia CT and Das D (0.15%), and Patil PU et al., (0.14%) [16,27,28]. Lower seroprevalence was seen in the study done by Varma AV et al., (0.072%) [3]. Seroprevalence is higher in many other Indian studies than in our study [Table/Fig-4]. Hepatitis C is a blood-borne infection. Compared to Hepatitis B, the chances of progression to cirrhosis and hepatocellular carcinoma are higher in hepatitis C infection.

The prevalence of syphilis in the present study was 1.32%, similar to findings by Rawat A et al., (1.62%) [25]. The study showed a higher prevalence of syphilis than many other Indian studies [Table/Fig-4]. Syphilis is a sexually transmitted disease, which is likely to be associated with an increasing risk of HIV infection and hence increasing the risk of morbidity and mortality [27].

Globally, there were an estimated 247 million malaria cases in 2021 in 84 malaria-endemic countries. India accounted for 79% of cases in the region [31]. The NACO guidelines state that donors affected with Malaria should be deferred for at least the next three months [10]. In the study, no malaria cases were detected (0%), similar to the findings by Adhikari L et al., (0%) and Pallavi P et al., (0%) [16,21]. Though malaria constitutes a significant health problem globally, the prevalence of malaria among the blood donors is low in most studies and ranges from 0% to 0.06% [Table/Fig-4]. The absence of malaria prevalence may be due to proper history taking and effective screening methods used in our blood bank.

In our study, three cases of co-infections were detected: HIV and HCV, HIV and HBsAg, HIV and syphilis. Chandekar SA et al., study also reported six cases of coinfections, commonly HIV and HBsAg followed by HIV and syphilis [32]. As these pathogens share common modes of transmission and risk groups, that is the reason for the occurrence of coinfections.

The wide variations of HCV seroprevalence are different in Indian studies. The main reason for this variation can be the use of different ELISA kits with different specificity and sensitivity [25]. In India, both HBV and HCV infections occur with variable numbers because of variation in ethnicity and geography [33].

The introduction of more sensitive tests such as the Nucleic Acid Testing (NAT) that can detect acute viral infections during the serological window period when all serological markers are still negative is another strategy to improve the safety of blood donation. The main reason for not using this technique in the present study area is unaffordability [34].

Limitation(s)

The major limitation of the study is that there is no previous data available from this area for comparison. Another limitation of the study may be associated with intrinsic weaknesses of the diagnostic test - the use of serological as opposed to nucleic acid-based techniques. Therefore, the results may underestimate the frequency of TTIs among donors in this population.

CONCLUSION(S)

Blood is one of the main sources of transmission of HBV, HCV, HIV, syphilis, and malaria infections. The study showed that TTIs were seen in male replacement donors. Thus, there is a need to increase public awareness regarding voluntary donation and its benefits. Female participation is also encouraged for blood donation. The study also shows a higher prevalence of syphilis. Therefore, it requires improved post-donation counseling for continued and sustained efforts for case detection, treatment, and other preventive measures to contain the disease. Availability of safe blood for transfusion is a must for the recipients and the communities. Meticulous donor screening and the use of highly sensitive techniques for the detection of TTIs are highly recommended to ensure the safety of blood for the recipient.

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