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Prevalence of Transfusion Transmissible Infections among Blood Donors in a Tertiary Care Hospital of Mysuru District – A Six Years Study

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Authors' contributions

This work was carried out in collaboration between all authors. Author PP did the study design and wrote the protocol. Author SSB wrote the first draft of the manuscript and statistical analysis. Authors PP, SSB and VB did the literature searches and analyses of study. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Blood transfusion remains a substantial source of transmissible infection in India. The prevalence of transfusion transmissible infections (TTIs) like Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), syphilis and malaria in blood donation is important for evaluating blood safety and potential risks to the population.
Aims: To determine the prevalence of HIV, HBV, HCV, syphilis and malaria among blood donors in a tertiary care hospital.
Study Design: A retrospective review of donor record over a period of 6 years between 2009 to 2014 was done at the regional blood transfusion centre (RBTC) in a tertiary care hospital of Mysuru, Karnataka, India.
Methodology: A total of 50,279 healthy donors were screened for HIV, HBV, HCV, syphilis and malaria. Screening for HIV, HBV and HCV was done by ELISA. Screening for syphilis and malaria

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was done by Rapid Plasma Reagin (RPR) method and rapid immunochromatographic test respectively.

Results: Among 50,279 donors screened, 768 (1.52%) were positive for the TTI. The overall prevalence of HIV, HBV, HCV and syphilis among the blood donors in the present study was 0.26%, 0.96%, 0.15% and 0.13% respectively. No blood donor showed positivity for malarial parasite. Majority of seropositive donors (43.35%) were in the age group of 26 to 35 years followed by 27.60% in 18 to 25 years age group.

Conclusion: The prevalence of TTIs among blood donors in Mysuru district was 1.52% with male dominated donor pool. Continuous improvement and implementation of strict donor selection criteria, sensitive screening tests and establishment of strict guidelines for blood transfusion can ensure the elimination, or at least reduction, of the risk of acquiring transfusion transmitted infections.

Keywords: Transfusion-transmissible infections; human immunodeficiency virus (HIV); hepatitis B virus (HBV); hepatitis C virus (HCV); syphilis; malaria.

1. INTRODUCTION

Transfusion medicine has a great public health importance worldwide. Blood transfusion has been used since 1930 for various indications and the demand for blood and its components is likely to increase in the future [1]. In July 1989, consequent to the reports of high seroprevalence in commercial blood donors, mandatory screening of blood and blood products for HIV antibodies was initiated by Indian National AIDS Control Origination (NACO) [2]. Indian guideline mandate routine screening of blood and its component for five most common transmissible infections in all the blood banks. These include HIV, HBV, HCV, syphilis and malaria [3]. The magnitude of the TTIs varies from country to country depending on the incidence of these infections in that particular population from where blood units are sourced. Majority of the problems are due to the prevalence of asymptomatic carriers in the society, as well as blood donations during the window period of infections [4,5]. These unsafe blood transfusions are very costly from both human and economic points of view. Hence, implementation of effective donor selection criteria and quality of screening tests are important and critical in preventing transmission of these infections. Screening for TTIs also gives clue about the prevalence of these infections in healthy populations and is the greatest challenges to transfusion medicine in developing countries like India.

The median prevalence rates of transfusion-transmissible infections in blood donations in high- income countries are considerably lower than in middle and low-income countries. This difference reflects the variable prevalence among members of the population who are eligible to donate blood, the type of donors (such as voluntary unpaid blood donors from population at lower risk) and the effectiveness of the system of educating and selecting donors [6]. There are three types of blood donors namely voluntary unpaid, family/replacement and paid. Patel *et al*. [7] from western Ahmedabad reported voluntary blood donors as 95.56%, but Kulkarni [8] from Karnataka and study from Haryana [9] reported it as 58% and 31.4% respectively. Studies [10,11] in other parts of India also reported lower proportion of voluntary donors. However, studies have reported greatest increase in the number of voluntary unpaid blood donations from 3.6 million in 2007 to 4.6 million in 2008 [12]. In contrast, majority of blood donors in Sub-Saharan Africa are family replacement donors (FRD), a donor group considered at higher risk for transfusion transmissible infections (TTI) [13]. Studies done in Sub-Saharan African countries by Kimani D and Okocha EC observed high prevalence of TTIs among replacement donors [13,14]. All blood units in the present study were collected from non-remunerative donors and most of the blood units were collected at the blood bank (in house donors) and also collected at camps. The predominant in house donors were replacement donors who were relatives and friends of the patient requiring blood.

With this background the objective of the present study was to assess the prevalence of transfusion transmissible infections (TTIs) among blood donors in a tertiary care hospital.

2. MATERIALS AND METHODS

A retrospective review of donor records over a period of 6 years between 2009 to 2014 at Department of Transfusion Medicine of a tertiary

care hospital serving Mysuru district was carried out. Mysuru is in Karnataka state which is located in southern part of India and it has population of about 30 lakhs. Tourism is the major industry in Mysore. The growth of the information technology-related industry in the first decade of the 21st century has resulted in the city emerging as the second largest software exporter in the state of Karnataka. Hence, there are immigrants from different parts of India coming to Mysuru for education and also as employees in information technology-related industry. Blood was collected from the blood donors who came to donate blood in Blood Bank or in voluntary blood donation camps. The majority of contributors to our blood bank are replacement donors who donated for ailing patients and were family members, close relatives or friends of the recipient. At the time of recruitment of donors, they were counselled about risk behavior and a registration form was filled by interviewing the donors. Registration form had personal and demographic information and medical history regarding risk factors. The donors were then screened by a medical officer according to blood donor's selection criteria (National blood safety) and guideline for NACO.

The eligibility criteria for the donors, i.e., age between 18 and 60 years, minimum weight of 45 kg, hemoglobin level of 12.5 g%, no history of hepatitis B and hepatitis C and sexually transmitted infections, no history of jaundice in past 1 year was strictly adhered to for recruitment of blood donors. High-risk donors were excluded via a standard questionnaire focused on obtaining a history of jaundice as well as a history of high-risk behavior for acquisition of sexual and blood-borne infections. Blood samples from the donated unit were tested for HIV, HBV, HCV, syphilis and malaria. Antibodies to HIV 1 and 2 were tested by ELISA method using 4th generation kits manufactured by Tulip diagnostics. Hepatitis B surface antigen (HBsAg) for HBV and antibody to Hepatitis C virus (HCV) were tested by ELISA using 3rd generation kits by Tulip Diagnostics. Screening for syphilis was done by Rapid Plasma Reagin (RPR) method. One step, rapid immunochromatographic test was done for detection of plasmodium falciparum and plasmodium vivax antigen.

2.1 Statistical Analysis

Data collected was entered in MS-Excel 2010 and analyzed using the same software. Descriptive statistical measures like percentage, mean and standard deviation were applied.

3. RESULTS

A total of 50,279 blood donors donated the blood during the study period. Of these, 49,753 (98.95%) were males and 526 (1.04%) were females which shows predominance of males as compared to females for the six studied years (Table 1). Among the total number of blood donors screened, 768 (1.52%) were positive for TTIs (Table 2). None of the screened female donors were positive for any TTIs. The prevalence of HIV, HBV, HCV and syphilis in the present study was 0.26%, 0.96%, 0.15% and 0.13% respectively (Table 2). None of the blood samples showed positivity for malarial parasite. Among the seropositive donors, 333 (43.35%) were in the age group of 26 to 35 years followed by 212 (27.60%) in 18 to 25 years age group (Table 3).

4. DISCUSSION

Transfusion transmissible infections (TTIs) are the common serious hurdles of blood transfusion. TTIs like HIV, HBV, HCV and syphilis are the major public health problems in developing countries [15]. They are transmitted parenterally, vertically or through high-risk sexual behaviors and can cause fatal acute and chronic life-threatening disorders. Blood transfusion is a potential route for the transmission of these infections [1]. The present study focuses on the blood donors as they are the highly selective population motivated towards social services. Results obtained from screening donors for TTIs cannot be generalised to the prevalence of these infections in general population. However, it can be used to monitor the trend of these infections in apparently healthy adult population.Though, multiple stringent strategies targeted to prevent transfusion-transmitted diseases are followed while screening the donors, very few countries are successful in reducing the incidence of these infections. On the contrary, it is not the same in developing countries like India where policies are fragmented and the screening resources are scarce [15].

The majority of the donors in the present study were males (98.95%) with a very small percentage (1.04%) of female donors (Table 1). This is comparable to the studies done by Pahuja et al. [16], Karmakar PR et al. [6] and Shrestha AC et al. [17] noting more than 90% of the male donors. Similarly, male dominated donor pool was noted by the studies done in South-East Nigeria by Okacha [14] and in Tanzania by Matee [18]. They also recorded the higher

prevalence of all TTIs in male donors than females. In contrast, a study in China showed higher rate of female donors (44.5%) which was attributed to increased knowledge regarding the blood donation [19]. The present study also obseverd that none of the female donors screened were positive for any TTIs which could be attributed to the small sample size. Though present study result showing low percentage of female donors is comparable to other studies done in India, it highlights that increased awareness has to be generated to motivate females towards blood donation.

The prevalence range of anti-human immuno-deficiency virus (HIV), hepatitis B surface antigen (HBsAg), anti- hepatitis C virus (HCV) and syphilis positivity in Indian blood donors is 0.084-3.87%, 0.66-12%, 0.5-1.5% and 0.85-3% respectively [1,20]. The prevalence of HIV, HBV, HCV and syphilis in the present study was 0.26%, 0.96%, 0.13% and 0.15% respectively (Table 2). The overall seroprevalence of TTIs in the present study was 1.52% which is comparable to the study done in Mangalore, Karnataka by Lathamani et al. reporting TTIs of 0.82% [21]. Howerver, the present study seroprevalence is low when compared to the studies done by Chaurasia et al. and Karmakar et al. noting 2.5% and 2.79% respectively [5,6]. High prevalence rate of 15.9% and 20.09% was observed in African countries of Tanzania and Nigeria [18,14]. This variation in magnitude of TTIs from country to country depends on loads in that particular population. The differences in prevalence of TTIs in different studies in India might be due to the use of different generation of ELISA test kits, having different sensitivities and specificities. This could also be due to study site lacking sensitive donor screening program and public awareness and education so that infected persons can self-select themselves and opt out from donating blood due to problem of asymptotic carriers, window period, and false negative tests [6]. Serosurveys are one of the primary methods to determine the prevalence of TTIs because blood safety in very important especially in patients requiring regular blood transfusion such as those with sickle cell disease. Studies done by Bolarinwa et al. [22] and Ségbéna et al. [23] have shown high rate of transfusion transmissible viral infections in such high risk patients. Hence, the assessment helps in determining the safety of blood products and also gives an idea of the epidemiology of these diseases in the community.

Table 1. Yearly gender vise distribution of blood donors in the present study

Year	Total samples tested	Males	Females
2009	9361	9253(98.85%)	108(1.15%)
2010	8244	8210(99.60%)	34(0.40%)
2011	8313	8266(99.40%)	47(0.60%)
2012	8360	8260(98.80%)	100(1.20%)
2013	7107	6988(98.33%)	119(1.67%)
2014	8894	8776(98.67%)	118(1.33%)
Total	50279	49753(98.95%)	526(1.04%)

Table 2. Prevalence of HBV, HIV, HCV and syphilis among blood donors in the present study

Year	Samples tested	Positive samples (%)	HBV (%)	HIV (%)	HCV (%)	Syphilis (%)
2009	9361	157(1.67)	78(0.83)	35(0.37)	31(0.33)	13(0.14)
2010	8244	183(2.21)	129(1.56)	31(0.37)	09(0.11)	14(0.17)
2011	8313	111(1.33)	75(0.90)	15(0.18)	05(0.06)	16(0.19)
2012	8360	134(1.60)	83(1.00)	27(0.32)	09(0.10)	15(0.17)
2013	7107	87(1.22)	55(0.77)	18(0.25)	02(0.03)	12(0.17)
2014	8894	96(1.07)	67(0.75)	09(0.10)	12(0.13)	08(0.09)
Total	50279	768(1.52)	487(0.96)	135(0.26)	68(0.13)	78(0.15)

Table 3. Prevalence of transfusion transmitted infections among different age groups

Age (years)	18-25 (%)	26-35 (%)	36-45 (%)	46-55 (%)	Total
HIV	31(22.90)	56(41.40)	34(25.1)	14(10.37)	135
HBV	134(27.50)	220(45.10)	81(16.6)	52(10.6)	487
HCV	21(30.80)	23(33.80)	13(19.1)	11(16.1)	68
Syphilis	26(33.30)	34(43.50)	12(15.3)	6(7.6)	78
Total	212(27.60)	333(43.35)	140(18.23)	83(10.80)	768

Table 4. Distribusion of transfusion transmitted infections among 18 - 25 age group

Age (years)	18	19	20	21	22	23	24	25	Total 18-25
HIV	-	1	02	07	04	05	07	05	31
HBV	3	5	19	17	20	18	19	33	134
HCV	1	-	05	-	-	07	04	04	21
Syphilis	-	1	02	03	01	05	06	08	26
Total	4	7	28	27	25	35	36	50	212

In the present study, the seropositivity was high (43.35%) among the age group of 26-35 years and a small fraction 10.80% were in the age category of 46 - 55 years. The 18-25 years age group showed the second highest clustering of TTIs with 27.60% positive rates (Table 3). This is comparable to the study done by Karmakar et al. [6] who noted more than two-third seropositivity (69.36%) in the age group of 21-40 years of age. The WHO theme for World Blood Donor day 2015 focuses more on recruitment of young donors as they are the main source of safe blood. Though the present study showed slightly high prevalence of TTIs in the age group of 18 to 25 years, the seropositivity was low in young donors less than 21 years but was largely distributed among donors more than 21 years (Table 4 above). The same trend was noted by Karmakar et al. showing low seropositivity in the 18-20 years age group [6]. This observation needs to be highlighted by capturing the uncorrupt behavior of young population and motivate them for blood donation. Once these young individuals enter the donor population there can also be the possiblity of reduction in TTI prevalence since they are conselled before blood donation about the possible routes of transmission of these infections. Hence, predonation counselling plays a very important role in educating the young donors about the risk factors of HIV, hepatitis and sexually transmissible diseases and also reducing the risk of TTI.

The prevalence of HIV in the present study was 0.26%, which is comparable to the studies done by Chaurasia et al. and Makroo et al. reporting 0.27% and 0.25%, respectively [5,24]. In contrast, low prevalence of HIV was observed in studies done by Giri et al. (0.07%), Shrestha (0.12%) and Chattoraj et al.(0.13%) [1,17,20]. Compared to present study, studies done by Karmakar et al., Pahuja et al. and Raut et al. have reported higher HIV seropositivity among blood donors of 0.60%, 0.56% and 0.53% respectively [6,16,4]. Seropositivity in the present study was higher (41.4%) among donors aged between 26 and 35 years. This finding is similar to study results performed in Kathmandu where the seropositivity for HIV was high among 21 to 30 years of age group [17]. Nationally, the prevalence rate of HIV for adult males in active sexual age group is 0.43%. Which is in concurrence with the findings in the present study and other studies on blood donors [24]. Heterosexual promiscuity seems to be the only cause of higher seropositivity in males who usually visit the“ hot spots“ areas where commercial sex work is common, such as in coastal Andhra Pradesh, Northern Karnataka and Southern Maharastra [24]. Hence predonation counselling of blood donors and seeking the history of high risk behavior aids in preventing the infective donors entering the blood donation.

India is still in the intermediate prevalence zone for the HbsAg and has been estimated to be a home for over 40 million HbsAg carriers [25]. Despite of the fact that safe and effective vaccine has been available since 1982; the HbsAg prevalence in India is still high. This is because of the fact that hepatitis B vaccination is not a part of our National Immunization Programme in India [16]. Supporting this fact, among all the TTI’s reported hepatitis B was the most prevalent infection. Seroprevalence of HBsAg in blood donors of present study was 0.99% which is

comparable to the studies done by Giri et al. (1.09%) and Chattoraj et al. (0.99%) [1,20]. Howerever, low prevalence rate was noted by Shrestha et al. (0.47%) and Lathamani et al. (0.53%) [17,21]. Relatively higher prevalence rate was shown in Delhi (2.23%) by Pahuja et al. [16]. In 2015, the 67th World Health Assembly (WHA) reaffirmed the global commitment to prevent and control viral hepatitis through the passage of resolution WHA 67.6, which calls for raising public awareness, improving surveillance, strengthening preventive interventions and increasing access to care and treatment services [26]. Despite these gains, prevention and control of hepatitis remains a major challenge in many developing countries.

The seroprevalence for hepatitis C in our study was 0.13% which is comparable to the studies done by Raut et al. and Chattoraj et al. documenting HCV seroprevalence of 0.14% and 0.19%, respectively [4,20]. A study done in Mangalore, Karnataka by Lathamani et al. noted very low seropositivy of 0.098% [21]. Higher seroprevalence was reported by studies done by Giri et al.(0.74%), Pahuja et al.(0.66%) and Shreshta et al.(0.64%) [1,16,17]. Similarly, high seropositivity of 0.59% was noted in kolkatta by Karmarkar et al. [6] and 0.54% in Delhi by Chaurasia et al. [5]. The worldwide prevalence of hepatitis C virus infection is estimated by the World Health Organization (WHO) to be approximately 3% corresponding to 130–150 million infected persons [27]. As transmission of HCV is through blood exposure and in majority of cases progress to chronic infections, chances of cirrhosis and hepatocellular carcinoma are more than HBV. Hence, diagnosis of this infection has evolved remarkably, progressing from the simple detection of anti-HCV antibodies by ELISA to molecular methods. The latest development is the qualitative determination of HCV-RNA which allows early diagnosis and detection of viremia and provides products for viral genotyping [27].

The seropositivity for syphilis in the present study was 0.15%. Similar findings were noted by Karmarkar et al. (0.23%), while Giri et al., Raut et al. and Lathamani et al. reported lower prevalences of 0.07%, 0.03% and 0.09%, respectively [6,1,4,21]. Higher prevalence of 0.62% was documented from tertiary care hospital of the armed forces by Chattoraj et al. [20]. Though very few cases of transfusion-transmitted syphilis have been described for over four decades, there is mandatory transfusion screening for syphilis. The absence of transmission is in part ascribed to a low prevalence of syphilis in the blood donor population, the concomitant use of antibiotics in a high proportion of transfusion recipients, allied with poor survival of Treponema pallidum during refrigerated storage of blood products [28].

Approximately, 5% of the world's population is infected with malaria, mostly people from high-transmission zones which include African regions, which report vast number of cases (81%), followed by the South-East Asia (13%), and the Eastern Mediterranean region (5%) withover 1 million deaths each year in the world [29]. In 2001, India had population of 1.02 billion with 2.1 million malaria positive cases with about 1005 deaths, which suggests that, the Annual Parasite Index (API) was around 2 to 3. In the present situation, malaria is in the control phase, but India still contributes 66% of the incidence recorded in South-East Asia [29]. Karnataka state has shown steady decline in the number of malaria cases with Mysuru district having API below 0.1 in 2011 which contributed only 0.35% of state's malaria [29]. This may be responsible for the zero prevalence rates for malaria among the donor set in this study. This may also be due to the fact that infection with malarial parasite results in development of fever and weakness. Because of the prominent signs and symptoms majority of the infected persons will not visit the blood donation camp/centre and even if they come, will be readily excluded by medical fitness examination and counselling [4]. Raut et al. and Chattoraj et al. have also not found any of the donors positive for malaria [4,20].

The greatest threat to the safety of the blood supply is the donation of blood by seronegative donors during the infectious window period when the donors are undergoing seroconversion. Such people represent new, or incident infections. Although new techniques of testing will bring us closer to the goal of zero risk, it is unlikely that any test or combination of tests will be 100 percent effective in detecting window-period infections. It is also important to recognize that new, direct viral-detection tests will supplement existing screening assays rather than replace them [30]. A considerable portion of this improvement is due to the introduction of nucleic acid testing (NAT), rather than relying solely on measuring pathogen-specific humoral immune responses in the donor. This will decrease the window period and hence decrease the incidence of TTI. But the cost-effectiveness of NAT is poor. The NAT has added benefits but its high financial cost is of concern, especially in economically restricted countries [5]. Currently,

no technology exists to completely detect all window period donations. No matter how sensitive NAT becomes, we will never be able to completely close the exposure-to-seroconversion window period. The general public and media might believe that with the advancement in testing technologies zero risk blood products are currently available. This generalization is far from reality as judged by our current experience with new testing methodologies [5].

5. CONCLUSION

There is a need for increased awareness for safe blood which can be obtained by motivating young donors. Also, implementation of strict donor selection criteria, use of sensitive screening tests and establishment of strict guidelines for blood transfusion are highly recommended to reduce the incidence of TTI and ensure the safety of blood for recipient.

CONSENT

All authors declare that written informed consent was obtained from the donors for testing of HIV, HBV, HCV, syphilis and malaria and analyzing the data for research purpose.

ETHICAL APPROVAL

All authors hereby declare that all procedure have been examined and approved by the institutional ethics committee.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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