Transfusion Transmissible Infections Among Voluntary Blood Donors: A Cross-Sectional Study and an Overview

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Background:

Most developing nations test blood donors for transfusion-transmissible infections (TTIs) prior to donation since doing so saves a significant amount of money by avoiding the need to purchase contaminated blood units, which would have required additional resources, materials, and labour hours.

Material & methods: In health centers in India and Pakistan, a cross-sectional study was conducted in the blood banks between April 1, 2022, and March 31, 2024. A total of five hundred samples were gathered and immunologically analyzed for Syphilis, Malaria, anti-hepatitis B surface antigen (HBsAg), anti-hepatitis B core (HBc), and anti-hepatitis C virus (HCV).

Results: 500 prospective donors were tested in the study period. More blood units were found reactive for the TTIs with the ELISA.

Conclusions: We conclude that the potential benefits of routine testing for antibodies to hepatitis B and C are considered not to outweigh the disadvantages.

Keywords: transfusion transmissible, infectious disease, screened units, blood transfusion

Introduction

In current medicine, blood transfusion is an essential and life-saving procedure, but it also poses a risk of spreading transfusion-transmissible illnesses (TTIs), which can include syphilis, HIV, hepatitis B and C viruses, and hepatitis C virus[1-3]. In blood donations worldwide, the prevalence of HIV, HBV, HCV, and syphilis infections ranges from 0.003% to 1.08%, 0.03% to 3.70%, 0.02% to 1.03%, and 0.05% to 0.90%, respectively, according to WHO reports from 2018[4]. Consequently, TTIs were viewed as a primary issue by public health authorities and a serious threat to blood recipients [5]. The World Health Organization (WHO) recommends that all blood donors be screened for these risky disorders [5].

In recent years there has been increased public concern about the safety of blood transfusion with respect to transfusion transmissible infectious diseases (TTIs) like HIV, hepatitis B, hepatitis C, and human T cell leukemia/lymphoma virus[1]. Every effort should be made to minimize the risk of disease transmission. All donations are screened for hepatitis B surface antigen, antibodies to HIV and hepatitis C, and syphilis with assays of steadily increasing sensitivity [2]. A theoretical possibility of transmission

remains if the donor is in the "window period" of an infection (that is, infectious but has not developed detectable markers of infection) or if the donor is a "low level carrier" in whom the level of markers of chronic infection is below the sensitivity of currently used assays (for example, for hepatitis B surface antigen) [3]. In addition, rare strain variants of a virus may not be detectable by certain routine tests, and possibilities of technical or clerical errors in screening or quarantining blood components remain[4].

Due to a lack of accessibility and inadequate resources, the prevention of TTIs is extremely difficult in low- and middle-income nations. In Asian nations, despite the implementation of mandatory TTI screening rules, disease transmission persists. This could be the result of a screening assay that is not sensitive enough or that is unable to detect the infection during the window period. Therefore, to ensure blood safety, strict monitoring and management of TTIs among blood donors are needed. Assessing the safety of the blood supply and the danger of transfusion-transmitted infectious illnesses (TTIs) also requires looking over and analyzing blood donor data for screening methods. This study aimed to estimate directly the incidence of transfusion transmitted infections: hepatitis B, C, Syphilis , HIV, Syphilis and Malaria for which donated blood is tested, and also human T cell leukemia/ lymphoma virus, for which blood is not currently tested [5].

Material & Methods

In health centers in India and Pakistan, a cross-sectional study was conducted in the blood banks between April 1, 2022, and March 31, 2024. A total of five hundred samples were immunologically analyzed for Syphilis, Malaria, anti-hepatitis B surface

antigen (HBsAg), anti-hepatitis B core (HBc), and anti-hepatitis C virus (HCV). Prospective donors were selected according to their medical background. People with significant illnesses, recent drug histories, past blood transfusion histories, and continuing surgical procedures were not invited. Age, sex, place of residence, and other sociodemographic details were noted. All blood donors' serum samples were tested using the ELISA kit (BioKits), according to the manufacturer's instructions, for viral infections such as hepatitis B surface antigen (HBsAg), antibodies to anti-hepatitis B core (HBc), antibodies to hepatitis C antigen (anti-HCV), antibodies to HIV 1 and 2, and antibodies to Treponema pallidum. SPSS Statistics V.19.0 was used to do the statistical analysis. The threshold of $p \leq 0.05$ was deemed statistically significant.

The results of blood units screened for TTIs were recorded and studied.

Results:

Over 500 screened units of blood were analyzed for incidence and prevalence of TTIs in over 500 screened units of blood from blood banks of healthcare centers in India & Pakistan.It was calculated that the risk of transmission through blood was 0.6% in 500 units of red cells for hepatitis B virus; 3% in 500 units for hepatitis C virus; and 0.2 % in 500 units for HIV. This study shows no positive data regarding transfusion transmission of Syphilis & HIV. Gender, age group and blood groups of blood donors are shown in Table 1,2 and 3.

Table 1: Gender of Blood Donors

S.No	Gender	Total no of blood screened (Frequency)	Percentage(%)

1.	Male	320	64
2	Female	180	36
	Total	500	100

Of the 500 blood donors studied, 320 (64%) were males .

Table 2: Age group of Blood Donors

S.No	Age groups	Total no of blood screened Frequency (%)	< 25 years Frequency (%)	Between 25-50 years Frequency (%)	>50 years Frequency (%)
1.	Male	320 (64)	56(11)	200 (40)	64(13)
2	Female	180 (36)	36 (7)	100(20)	44(9)
	Total	500(100)	92 (18)	300(60)	108(22)

Age of majority 300(64%) of study participants was between 25 to 50 years.

Table 3: Blood groups of blood donors

S.No	Blood groups	Total no of blood screened Frequency (%)	A positive	B positive	O positive	AB+ positive	A negative	B negative	O negative	AB negative
1.	Male	320 (64)	36(7)	180 (36)	74(15)	14(3)	0	0	0	0

2	Female	180 (36)	36 (7)	120(24)	34(09)	6(1)	0	0	0	0
	Total	500(100)	62 (12)	300(60)	108(22)	20(4)	0	0	0	0

Donors with blood group B positive (B+) were 60% and that of blood group A positive (A+) were 12%, O positive(O+) were 22%, and AB positive(AB+) were 4% respectively.

Table 4: Distribution of detected transfusion transmissible diseases (TTD)

S.No	TTD	Frequency	Percentage
1.	Hepatitis B virus	3	0.6
2.	Hepatitis C virus	15	3
3.	HIV	1	0.2
4.	Syphilis	0	0
5.	Malaria	0	0
	Total	19	3.8

The risk of transmission through blood was 0.6% for hepatitis B virus; 3% for hepatitis C virus; and 0.2 % for HIV.

Table5. Distribution of detected transfusion transmissible diseases (TTD) among both genders

S.No	Gender	Total no of blood screened Frequency	Hepatitis B virus (%)	Hepatitis C virus (%)	HIV (%)	Syphilis (%)	Malaria (%)

		(%)					
1.	Male	320(64)	3(0.6)	10(2)	1(0.3)	0(0)	0(0)
2	Female	180/36	0(0)	6(1)	0(0)	0(0)	0(0)
	Total	500/100	3(0.6)	15(3)	1(0.3)	0(0)	0(0)

Hepatitis C was the most common infection detected with a prevalence of 3 % , 1 (0.2%) had Human Immunodeficiency Virus (HIV) infection, 3 (0.6%) had Hepatitis B Virus (HCB) infection. The factors associated with any TTI were found to be more in male who were elderly and of low educational status.

Discussions:

In a variety of medical procedures and illnesses, blood transfusion is essential. Significant blood loss is a common side effect of major surgeries, especially cardiovascular procedures and organ transplants, which calls for the transfusion of fresh blood to replace lost blood [2]. Blood transfusion is an essential part of emergency medical care because rapid blood loss in trauma cases—such as accidents, falls, and gunshot wounds—can be fatal [3]. Additionally, blood transfusions are essential for the long-term treatment of hematologic disorders (severe anaemia, thalassemia, or sickle cell disease), which frequently necessitate frequent blood transfusions [4]. Similarly, blood transfusions are often necessary for cancer patients undergoing chemotherapy, as this treatment can result in severe anaemia and thrombocytopenia [4-7].

Transfusion is a life-saving procedure, but it encompasses a risk of transfusion-transmissible infections (TTIs) as well as immediate and delayed complications [1]. The safest blood donors are voluntary, unpaid blood donors from low-risk populations. Blood donors are the cornerstone of a sufficient and safe supply of blood and blood products.

Currently, a number of techniques are being used to identify these illnesses. Nucleic acid testing (NAT) is widely utilized for HIV, HCV, and HBV screening because it directly

detects viral genomes in blood donations [8]. Blood donors are routinely subjected to an enzyme-linked immunosorbent assay (ELISA) to screen for antibodies or antigens associated with HIV, HBV, HCV, HTLV-1, and Syphilis [9]. Both serological testing and rapid diagnostic tests (RDTs) are quick, low-cost methods used for screening for syphilis, HIV, HCV, and malaria as well as for identifying antibodies or antigens in blood [9]. When compared to other third-world countries, the target population of the current study had relatively low proportions of TTIs [5,6]. In comparison to the current study, the reported prevalence of HIV and Syphilis seropositivity among blood donors in India was likewise fairly high [7]. However, a few additional studies conducted in wealthy nations have also reported a relatively low prevalence of TTIs, such as infection with the hepatitis B virus (HBV) [-9].

Transfusion transmissible infections share a number of characteristics. All result in chronic, long-term infections, often in the absence of obvious disease for many years, or even for life [10]. All are transmissible parenterally: a common route is via sexual exposure. In addition, (with the exception of syphilis) they are transmitted by needle exposure, especially among injection drug abusers [11]. As a result, a great deal of reliance has been placed upon assessment of donor suitability by questioning for behavioral and other risk characteristics associated with these infections, even in the face of increasingly sensitive and effective test methods [12]. More specifically, in few countries, the prevalence of HBV, HCV and HIV markers among donors is one third to one thirteenth of that among the general population and the incidence rate is one tenth or less than that for the population at large [1,13]. Second, the viral infections in this group are characterized by a window period in early infection, during which the infectious agent is present in the blood, but not detectable through the use of available screening tests [2,14]; appropriate questioning should result in the deferral of individuals who are aware of recent risk and potential exposure [15].

Blood-associated TSE infectivity presents unique challenges to risk management absent from other blood-borne pathogens [16]. The low concentration of infectivity, although difficult to detect, has nevertheless been sufficient for efficient transfusion transmission of these fatal diseases. People with certain genotypes could harbor the infection in a transmissible but undetectable form for decades [17]. The form that the infectivity takes in blood is unknown but might be different from that associated with brain. No pathogen-specific antibodies have been identified for diagnosis, and infection-associated forms of the prion protein constitute only a minuscule proportion of the total prion protein present in blood, thereby presenting a formidable challenge to detection [18-22].
Important information about the demographics of the donor community and the frequency of various serological markers-particularly those connected to hepatitis B—is provided by this study. These results could direct the development of public health initiatives targeted at enhancing blood supply safety and boosting hepatitis B immunization rates[23-25]. Furthermore, our findings emphasize the value of utilizing complementary testing techniques for blood screening in order to guarantee the identification of both previous and current illnesses, hence enhancing patient care and blood safety [26-27].

Conclusions:

We conclude that the potential benefits of routine testing for antibodies to hepatitis B and C are considered not to outweigh the disadvantages (such as uncertainties in confirmation of infection and wastage of falsely reactive units). Irrespective of the wastage of falsely reactive units routine testing for antibodies to hepatitis B and C is mandatory.

References:

1. Blood transfusion reactions-a comprehensive review of the literature including a Swiss perspective. Ackfeld T, Schmutz T, Guechi Y, Le Terrier C. *J Clin Med.* 2022;11

2. Correlation between mortality and blood transfusion in patients with major surgery initially admitted to intensive care unit: a retrospective analysis. Xiao H, Song W, Ai H, et al. *BMC Anesthesiol.* 2023;23:298. 3. Perioperative blood transfusion is associated with post-operative infectious complications in patients with Crohn's disease. Lan N, Stocchi L, Li Y, Shen B. *Gastroenterol Rep (Oxf)* 2018;6:114–121.

4. Transfusion support in patients with hematologic disease: new and novel transfusion modalities. Panch SR, Savani BN, Stroncek DF. *Semin Hematol.* 2019;56:227–228.

5. Transfusion-transmitted infections. Bloch EM. *Ann Blood.* 2022;7:1–19.

6. Transfusion transmissible infections among voluntary blood donors at Dessie blood bank, northeast Ethiopia: cross-sectional study. Kebede E, Getnet G, Enyew G, Gebretsadik D. *Infect Drug Resist.* 2020;13:4569–4576.

7. Attitude to blood donation in Saudi Arabia. Abdel Gader AG, Osman AM, Al Gahtani FH, Farghali MN, Ramadan AH, Al-Momen AK. *Asian J Transfus Sci.* 2011;5:121–126.

8. Dental students' motivations and perceptions of dental professional career in India. Aggarwal A, Mehta S, Gupta D, Sheikh S, Pallagatti S, Singh R, Singla I. http://www.ncbi.nlm.nih.gov/pubmed/23144490. *J Dent Educ.* 2012;76:1532–1539.

9. Comparison of different rapid screening tests and ELISA for HBV, HCV, and HIV among healthy blood donors and recipients at Jibla University Hospital Yemen. Al-Matary AM, Al Gashaa FA. *J Med Life.* 2022;15:1403–1408.

10. Blood donors deferral prevalence and causes in a tertiary health care hospital, southern Nigeria. Okoroiwu HU, Asemota EA. *BMC Health Serv Res.* 2019;19:510.

11. Prevalence of transfusion-transmissible infections in donors to an Ethiopian blood bank between 2009 and 2013 and donation factors that would improve the safety of the blood supply in underdeveloped countries. Birhaneselassie M. *Lab Med.* 2016;47:134–139.

12. Blood transfusion safety; current status and challenges in Nigeria. Aneke JC, Okocha CE. *Asian J Transfus Sci.* 2017;11:1–5.

13. ABO and Rh blood group distribution in Kayseri Province, Turkey. Torun YA, Kaynar LG, Karakükcü C, et al. *Turk J Haematol.* 2012;29:97–98.

14. Genotyping of Dombrock blood group system in blood donors from Saudi Arabia: a single-center study. Bawazir WM. *Saudi Med J.* 2022;43:244–251.

15. Prevalence and trends of major transfusion transmissible infections among blood donors in Dire Dawa blood bank, eastern Ethiopia: retrospective study. Ataro Z, Urgessa F, Wasihun T. *Ethiop J Health Sci.* 2018;28:701–710.

16. Global, regional, and national burden of hepatitis B, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet Gastroenterol Hepatol.* 2022;7:796–829.

17. Chronic hepatitis B: update 2009. Lok AS, McMahon BJ. *Hepatology.* 2009;50:661–662.

18. Trends of the global hepatitis C disease burden: strategies to achieve elimination. Brunner N, Bruggmann P. *J Prev Med Public Health.* 2021;54:251–258.

19. Geographic distribution, clinical epidemiology and genetic diversity of the human oncogenic retrovirus HTLV-1 in Africa, the world's largest endemic area. Gessain A, Ramassamy JL, Afonso PV, Cassar O. *Front Immunol.* 2023;14:1043600.

20. The impact of nucleic acid testing to detect human immunodeficiency virus, hepatitis C virus, and hepatitis B virus yields from a single blood center in China with 10-years review. Wu D, Feng F, Wang X, et al. *BMC Infect Dis.* 2022;22:279.

21. EASL 2017 clinical practice guidelines on the management of hepatitis B virus infection. *J Hepatol.* 2017;67:370–398.

22. Nucleic acid testing-benefits and constraints. Hans R, Marwaha N. *Asian J Transfus Sci.* 2014;8:2–3.

23. Global epidemiology of hepatitis B virus infection: new estimates of age-specific HBsAg seroprevalence and endemicity. Ott JJ, Stevens GA, Groeger J, Wiersma ST. *Vaccine.* 2012;30:2212–2219.

24. Bhawani Y, Rao PR, Sudhakar V. Seroprevalence of transfusion transmissible infections among blood donors in a tertiary care hospital of Andhra Pradesh. *Biol Med.* 2010;2(4):45–48.

25. Khan S, Attaullah S, Ayaz S, Khan SN, Shams S, Ali I, Bilal M, Siraj S. Molecular epidemiology of HCV among the health care workers of Khyber Pakhtunkhwa. *Virol J.* 2011;8(1):105.

26. Naseem Lubna, Haque Anwar UI., editors. *Pre-donation Testing of the Potential Blood Donors -A Pilot Study at a Tertiary Care Hospital.* www.jpathology.com/issues/IJPissue12/original article 4.

27. Ofori S O, Temple J, Sarkodie F, et al. Predonation screening of blood donors with rapid test. *Transfusion.* 2005;45(2):133–140.