Changing trends of transfusion transmitted viral infections among blood donors in the last decade—a 10-year study in a large tertiary care blood bank (2000–2009)

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ABSTRACT

BACKGROUND

The main blood borne viruses viz. hepatitis B virus (HBV), human immunodeficiency virus (HIV), and hepatitis C virus (HCV), are a major public health issue, and represent significant causes of morbidity and mortality associated with transfusion. This study analysed the trends of blood borne infections among blood donors in a large blood bank in the last 10 years.

METHOD

Viral screening results of 80,500 voluntary and replacement donations from 2000 to 2009 were analysed. All donations were screened for HBV, HCV, and HIV. The seroprevalence rate of HBV, HCV, and HIV infections and 95% confidence interval were calculated.

RESULTS

The seroprevalence rate of HBV, HIV, and HCV, decreased during the last 10-years study from 2000 to 2009. There is significant and impressive decrease in HBV seroprevalence rate from 2.39% in 2000 to 1.28% in 2009. The seroprevalence rate of HIV appeared to have decreased with a very significant value from 1.32% to 0.30% in 2009. Hepatitis C virus seroprevalence rate showed a slight decline in blood donations from 0.48% in 2001 to 0.22% in 2009.

CONCLUSION

There is a general reduction in the seroprevalence rate of viral infections. This is probably because of discouragement of professional or paid donations; better awareness, better prophylactic measures, and availability of vaccines have played a major role.

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Key Words: transfusion transmitted infections

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INTRODUCTION

Provision of safe blood to the patient is of paramount importance. The main blood borne viruses viz. hepatitis B virus (HBV), human immunodeficiency virus (HIV), and hepatitis C virus (HCV), are a major public health issue, and represent significant causes of morbidity and mortality associated with transfusion. This is especially so in the developing countries.^{1,2} Major routes of transmission of these viruses are direct contact with blood, intravenous injections, transfusion of blood, and also sexual contact, although the latter is not considered as a major route in the case of HCV and HBV. The current risk of transmission of these transfusion transmitted infections (TTI) by blood transfusions are HBV 1:250,000–1:500,000, HIV 1:2,000,000 and HCV 1:2,000,000 (an American study, 2004 estimate).^{3,4} Thus, infectious complications of blood transfusion remain an important area of concern in transfusion medicine.

Study of seroprevalence rate of these viruses in blood donors is an accurate index for understanding their disease trends in the general population. Furthermore, such studies gives us guidance as to what further is to be done in our public education programmes, donor selection, screening methods, and in the necessity of further improving prophylactic measures including vaccinations. This study analysed the trends and changes in rates of blood borne viral infections among blood donors in the last 10 years (2000–2009) in a large blood bank.

MATERIALS AND METHOD

From the existing donor registry, data was collected for analysis in respect to donor number, type of donation (voluntary or replacement), and demographic characteristics (age and educational status). To assess changes in incidence of TTI from 2000 to 2009, screening results on 80,500 voluntary and replacement donations were analysed.

Voluntary blood donors are the people, who donate their blood without any pressure and monetary benefit, for unknown patients (recipients). While, replacement blood donors are the members of family/friends of the patients, who donate their blood in replacement of the blood needs of the particular patients. Replacement donation is a common practice in our country. Repeat blood donors are included in voluntary donation but there is at least three months interval in between.^{5,6}

All donations (voluntary and replacement) were screened mandatorily for hepatitis B surface antigen (HBsAg), anti-HCV antibody, anti-HIV one and two antibodies, malarial parasites, and treponemal antibodies, using Food and Drug Administration (FDA) approved commercial screening kits. Screened positive blood products were excluded and discarded safely, strictly adhering to FDA regulations. The deferral donor registry was maintained.

To define the seroprevalence rate of TTI, the number of positive donations was divided by defined number of blood donations for that year. For assessing frequency and seroprevalence rate of HBsAg, anti-HCV, and anti-HIV one and two, calculations were made in percentages, and 95% confidence interval (CI) was calculated using a binominal distribution. In this study data was analysed by using χ^2 test and results were considered significant if *P* value was <0.05.

RESULTS

The data collected from our blood donation centre showed that a total of 80,500 donations were tested in screening laboratory during the 10-year period from 2000 through 2009, where 49% were voluntary, and 51% were replacement. It was noteworthy that a large percentage of donors were educated: 57% had a minimum high school certificate. There is gradual increase in number of nonremunerated voluntary donations over the years and also the seroprevalence rate of TTI is low in this group in comparison to replacement donors.^{7,9} The majority of donors were men (95%) and 81% among men were between 20 years and 39 years of age. A significant decrease in seroprevalence rate of TTI (HBV, HCV, and HIV) is observed in the last 10-years (from 2000 to 2009). Seroprevalence rate of these TTI in younger age group (20–39 years) is more compared to elderly in 2000 compared to 2009. These observations were in general in agreement with several studies done across the globe.^{7–9}

The overall seroprevalence rate of HBV in 80,500 donations in last decade was 1.7%, which showed a decline from 2.4% in 2000 to 1.2% in 2009 ($P<0.00001$; Table 1 and Figure 1). The overall seroprevalence rate of HIV infection in last decade was 0.7%. It had a decline with a very significant value from 1.3% in 2000 to 0.30% in 2009 ($P<0.000001$; Table 1 and Figure 1). The overall seroprevalence rate of anti-HCV during the study period in 80,500 donations in last decade was 0.33%. It showed a steadily decline from 0.4% in 2000 to 0.2% in 2009, which is however not statistically significant ($P=0.05$; Table 1 and Figure 1). In the central database, data of 8,046 donations in 2000 and 2009 of 8,867 donations were analysed.

The seroprevalence rate for HBsAg decreased for both voluntary and replacement donations. The seroprevalence rate decreased from 2000 to 2009 in all age groups ($P<0.00001$; Table 2). In comparison, from 2000 to 2009, the frequency of HIV in voluntary donations was significantly less than replacement donations ($P<0.000001$; Table 3). Anti-HCV showed a steady decline from 2000 to 2009 in both voluntary and replacement donations ($P=0.05$; Table 4).

Figure 1 Seroprevalence rate (%) of hepatitis B virus (HBV), human immunodeficiency virus (HIV), and hepatitis C virus (HCV) infections between 2000 and 2009.

Table 1 Seroprevalence rate of hepatitis B virus, human immunodeficiency virus, and hepatitis C virus infections between 2000 and 2009.

Year	Total donations	HBV		HIV		HCV	
		Infections (%)	95% CI	Infections (%)	95% CI	Infections (%)	95% CI
2000	8,046	192 (2.4)	2.0–2.7	106 (1.3)	1.0–1.5	32 (0.4)	0.2–0.4
2001	9,221	150 (1.6)	1.3–1.8	118 (1.3)	1.0–1.4	44 (0.5)	0.3–0.5
2002	7,105	154 (2.2)	2.1–2.3	80 (1.1)	0.8–1.3	36 (0.5)	0.3–0.6
2003	7,499	124 (1.7)	1.3–1.8	63 (0.8)	0.6–1.2	25 (0.3)	0.2–0.4
2004	7,775	128 (1.6)	1.3–1.8	45 (0.6)	0.3–0.6	35 (0.5)	0.2–0.5
2005	7,568	120 (1.6)	1.2–1.7	29 (0.4)	0.1–0.4	16 (0.2)	0.1–0.3
2006	7,876	116 (1.5)	1.1–1.6	21 (0.3)	0.2–0.4	21 (0.3)	0.2–0.4
2007	8,198	128 (1.6)	1.2–1.7	32 (0.4)	0.1–0.4	32 (0.3)	0.1–0.4
2008	8,345	123 (1.5)	1.1–1.6	30 (0.4)	0.1–0.4	16 (0.2)	0.1–0.3
2009	8,867	104 (1.2)	0.8–1.3	27 (0.3)	0.1–0.4	20 (0.2)	0.1–0.3
Total	80,500	1,339 (1.7)	1.6–1.8	551 (0.7)	0.6–0.8	271 (0.3)	0.2–0.3

CI: confidence interval, HBV: hepatitis B virus, HCV: hepatitis C virus, HIV: human immunodeficiency virus.

Table 2 Seroprevalence rate of hepatitis B virus in different donations status and age groups between 2000 and 2009.

Markers	2000				2009			
	Donations	Positive	Seroprevalence rate (%)	95% CI	Donations	Positive	Seroprevalence rate (%)	95% CI
Status of donation								
Voluntary	4,312	72	1.7	1.2–1.9	3,202	21	0.7	0.4–0.8
Replacement	3,734	120	3.2	2.7–3.7	5,665	83	1.5	1.1–1.7
Total	8,046	192	2.4	2.0–2.7	8,867	104	1.2	0.8–1.3
Age groups (yr)								
<19	330	9	2.7	1.0–4.0	448	2	0.5	0.1–0.9
20–29	4,151	91	2.2	1.7–2.5	4,642	61	1.3	1.0–1.6
30–39	2,493	70	2.8	2.2–3.4	2,597	32	1.2	0.8–1.6
40–49	929	18	1.9	1.1–2.7	1,034	14	1.4	0.7–1.9
>50	143	6	4.2	1.0–7.3	146	5	3.4	0.5–6.3
Total	8,046	192	2.4	2.0–2.7	8,867	104	1.2	0.8–1.3

CI: confidence interval.

Table 3 Seroprevalence rate of human immunodeficiency virus in different donations status and age groups between 2000 and 2009.

Markers	2000				2009			
	Donations	Positive	Seroprevalence rate (%)	95% CI	Donations	Positive	Seroprevalence rate (%)	95% CI
Status of donation								
Voluntary	4,312	23	0.5	0.5–0.7	3,202	4	0.1	0–0.2
Replacement	3,734	83	2.2	1.8–2.6	5,665	23	0.4	0.3–0.5
Total	8,046	106	1.3	1.0–1.5	8,867	27	0.3	0.1–0.4
Age groups (yr)								
<19	330	8	2.4	0.8–4.0	448	1	0.2	–0.2–0.6
20–29	4,151	51	1.2	0.9–1.5	4,642	11	0.2	0.1–0.3
30–39	2,493	35	1.4	1.0–1.8	2,597	7	0.3	0.1–0.3
40–49	929	8	0.9	0.3–1.3	1,034	6	0.6	0.1–0.9
>50	143	4	2.8	0.1–5.3	146	2	1.4	–0.5–3.1
Total	8,046	106	1.3	1.0–1.5	8,867	27	0.3	0.1–0.4

CI: confidence interval.

Table 4 Seroprevalence rate of hepatitis C virus in different donations status and age groups between 2000 and 2009.

Markers	2000				2009			
	Donations	Positive	Seroprevalence rate (%)	95% CI	Donations	Positive	Seroprevalence rate (%)	95% CI
Status of donation								
Voluntary	4,312	16	0.4	0.2–0.4	3,202	6	0.2	0–0.2
Replacement	3,734	16	0.4	0.2–0.6	5,665	14	0.2	0.1–0.3
Total	8,046	32	0.4	0.2–0.4	8,867	20	0.2	0.1–0.3
Age groups (yr)								
<19	330	2	0.6	–0.2–1.4	448	–	–	–
20–29	4,151	18	0.4	0.2–0.6	4,642	8	0.2	0.1–0.2
30–39	2,493	10	0.4	0.2–0.6	2,597	9	0.3	0.1–0.5
40–49	929	2	0.2	0–0.4	1,034	2	0.2	0–0.4
>50	143	–	–	–	146	1	0.7	–0.6–1.8
Total	8,046	32	0.4	0.2–0.4	8,867	20	0.2	0.1–0.3

CI: confidence interval.

DISCUSSION

Declining trend in seroprevalence rate of TTI is noted in donations from 2000 to 2009; HBV from 2.4% to 1.2%, HIV 1.3% to 0.3%, HCV 0.4% to 0.2%. This declining trend is due to discouragement of professional or paid donations, increased awareness, better screening procedures, and better education in general population. Seroprevalence rate in younger age group (20–39 years) is more, compared to elderly in 2000 compared to 2009. This is probably because of indulgence in unsafe practices such as intravenous drug abuse and unsafe sexual activities.

Hepatitis B virus is the most common TTI. There is significant and impressive decrease in hepatitis B seroprevalence rate from 2.4% to 1.2%. This is in accordance with other studies, which also show a decrease in seroprevalence rate of HBV in the past decade. However the present seroprevalence rate in the studies of Nanu et al conducted in North India is <2.5%,² in a study of Sarkodie et al conducted in West Africa is 15%,⁹ and 0.00038% by Soldan et al conducted in England.⁷ This trend is likely to be due to multiple factors which include, increased awareness and better education in general population, better screening procedures, and an active HBV vaccination programme.

Among all the TTI, HIV seroprevalence rate has shown the most significant reduction. Seroprevalence rate of HIV among blood donors has significantly declined from 1.3% to 0.30%. This is in accordance with other studies, which also show a decrease in seroprevalence rate of HIV in the past decade. However the present seroprevalence rate in the studies of Nanu et al conducted in North India is 0.55%,² in a study of Sarkodie et al conducted in West Africa is 2.4%,⁹ and 0.00012% by Soldan et al conducted in England.⁷ Declining trends are due to increased awareness in general public about the disease and its consequences, modes of spread of the disease, and also better application and acceptance of preventive measures.^{4,6}

There was a steady decrease in seroprevalence rate of HCV by transfusion over the last decade from 0.4% to 0.2%. This is in accordance with other studies, which also show a decrease in seroprevalence rate of HCV in the past decade. However, the present seroprevalence rate in the studies of Nanu et al conducted in North India is 1.49%,² in a study by Sarkodie et al conducted in West Africa it is 0.3%,⁹ and 0.00019% in a study by Soldan et al conducted in England.⁷ This is in all probability due to the use of more sophisticated and sensitive screening tests.

Overall the public propaganda and awareness measures instituted by the ministry of health have greatly contributed in increasing the general population's knowledge and awareness of blood borne infections, their routes of transmission, and preventive measures. Educational efforts at the blood bank donation centres and at organised blood camps have also played a major role in spreading awareness on TTI. Further increase in the number of voluntary donations will go a long way in substantially reducing TTI. The existence of a data registry of blood donors with history of positive results in blood screening tests is another possible important factor having a role in the observed decline in seroprevalence rate. Finally, the advent of potent vaccines and organised immunisation programmes such

as, hepatitis B immunisation programmes in children, pregnant women and healthcare workers, also play an important role in the declining trends observed in TTI.

The seroprevalence rate of TTI has significantly decreased in the last decade among the blood donors, which is indicative of the effective safety measures that have been taken both in the general population and in the field of transfusion medicine. There is an increased awareness about blood borne infections and their routes of transmission. However, important initiatives are to be taken in the future for taking blood safety to a higher level. These would include, an increase in the activity of voluntary counselling and testing centres, urgent requirement of potent vaccines for HIV and HCV, improving public health programmes with a focus on counselling and screening of those engaged in high-risk activities, and increasing regular voluntary and nonremunerated donations.

Better screening methods are required to decrease the window period of TTI. Testing for hepatitis B core antigen, along with the already existing enzyme linked immunosorbent assay (ELISA) tests for detection of hepatitis B surface antigen will aid in better detection of HBV. The introduction of fourth generation ELISA (where both antigen and antibodies are detected) for the screening tests for HIV will aid in better detection of HIV. Further improved screening methods can be achieved in future by replacement of ELISA by nucleic acid test (NAT), which is a molecular based polymerase chain reaction (PCR)/transcription mediated amplification (TMA) method, in the infectious disease screening protocol in blood banks. Future applications of NAT technology would include expanding testing platforms to enable direct detection of additional viruses and other infectious agents.

Intellectual Contributions of Authors

Study concept: Col J Philip, Col RS Sarkar

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CONFLICTS OF INTEREST

None identified.

REFERENCES

1. Pahuja S, Sharma M, Baitha B, Jain M. Prevalence and trends of markers of hepatitis C virus, hepatitis B virus and human immunodeficiency virus in Delhi blood donors: a hospital based study. *Jpn J Infect Dis* 2007;60:389–391.
2. Nanu A, Sharma SP, Chatterjee K, Jyoti P. Markers for transfusion-transmissible infections in north Indian voluntary and replacement blood donors: prevalence and trends 1989–1996. *Vox Sang* 1997;73: 70–73.
3. Simon TL, Dzik WH. *Rossi's Principles of Transfusion Medicine* 4th ed. Philadelphia: Lippincott Williams & Wilkins 2009.

4. National Blood Data Resource Center. *Comprehensive Report on Blood Collection & Transfusion in the United States in 2001*. Bethesda, MD: American Association of Blood Banks (AABB) 2003.
5. Crookes RL, Hillyer CD. *Blood banking & Transfusion Medicine* 2nd ed. Philadelphia: Churchill Livingstone 2009.
6. Brecher ME, Leger RM. *AABB Technical Manual* 15th ed. Bethesda, MD: American Association of Blood Banks (AABB) 2005.
7. Soldan K, Barbara JA, Ramsay ME, Hall AJ. Estimation of the risk of hepatitis B virus, hepatitis C virus, and human immunodeficiency virus infectious donations entering the blood supply in England, 1993–2001. *Vox Sang* 2003;84:274–286.
8. Zou SH, Notari EP, Stramer SL, Wahab F, Musavi F, Dodd RY. Pattern of age- and sex-specific prevalence of major blood borne infections in United States blood donors, 1995 to 2002: American Red Cross blood donor study. *Transfusion* 2004;44:1640–1647.
9. Sarkodie F, Adarkwa M, Adu Sarkodie Y, Candotti D, Acheampong JW, Allain JP. Screening for viral markers in volunteer and replacement blood donors in West Africa. *Vox sang* 2001;80:142–147.

Book review

Orthodontic and dentofacial orthopedic treatment. Thomas Rakosi, Thomas M Graber. Publisher: Thieme Medical Publishers, Germany. Publication: 2010. Price: €179.99 (Hardbound). Pages: 416. Illustrations: 1260. ISBN: 9783131277619.

In the last few years there is an increasing awareness and interest in improving facial aesthetics. Notwithstanding the recent developments in science and technology which have led to the introduction of a plethora of new orthodontic products and techniques, there is no single orthodontic appliance satisfying all needs for all patients. There is now greater emphasis on soft tissue aspects of orthodontics with the earlier emphasis on dental and skeletal components, still being valid. Written by experts in this field, *Orthodontic and dentofacial orthopaedic treatment* provides a comprehensive discussion of safe, fast, and most efficient evidence-based orthodontic and dentofacial orthopaedic treatments. Each chapter of the book addresses a specific orthodontic topic and provides numerous clinical cases to illustrate the most effective patient management strategies.

This book has 16 chapters dealing with diagnosis and treatment planning, functional orthopaedics, segmented arches, asymmetries, space closure, retention procedures and chapters on implants and splint aligners. The book begins with sections related to therapeutic diagnosis, preventive and interceptive orthodontics and these are followed by chapters on treatment with functional appliances with emphasis on the Twin Block technique and a chapter outlining mandibular propulsion with a fixed inter-arch mechanism—the inter-arch compression spring. With the recent emphasis on non-extraction expansion therapies, the chapters on early maxillary expansion and mandibular distraction osteogenesis covers the topic exhaustively including timing, types of maxillary expanders, scope and

possibilities of maxillary expansion, and treatment planning for mandibular lengthening and widening. Biomechanics is among the most important aspect of the design of an orthodontic appliance and the Chapters 8 through 11 describe the basics of biomechanics and their applications together with the design of simple appliances which can be easily and successfully incorporated in any prevailing orthodontic technique and philosophy. The chapter on implants in orthodontics is a compendium for the clinical use of orthodontic implants.

The chapter dealing with treatment using the invisalign system approaches the solution of moving teeth with a series of aligners by combining three-dimensional imaging technology and mass customisation. The final few chapters cover important aspects relating to proximal stripping of teeth and addressing the problem of orthodontic retention. Retention devices that are being used in contemporary orthodontics for specific retention goals have been presented with advantages and disadvantages of each.

The book was intended to introduce the dental clinician to newer orthodontic treatment modalities and also to expand the knowledge base of experienced clinicians by pointing out potential pitfalls and proposing alternative approaches to interesting clinical situations. The authors have succeeded on both counts. This book synthesises a wealth of information gleaned from clinical experience in orthodontic practice. Packed with valuable information, *Orthodontic and dentofacial orthopaedic treatment* is recommended for all orthodontic residents, faculty, and all practitioners of orthodontics.

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