Original article

PREVALENCE OF TRANSFUSION TRANSMITTED INFECTION MARKERS AND GEOGRAPHIC MAPPING TO IDENTIFY SAFE AREAS FOR HOLDING BLOOD DONATION CAMPS IN SURAT CITY

Rinku V Shukla[1], Gulab R Patel[2], Avani P Shah[1], Snehalata C Gupte[3]

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Author's Affiliation:
[1]Research; [2]TTI; [3]Director, Surat Raktadan Kendra & Research Centre, Surat

Correspondence:
Dr. Snehalata C. Gupte
Email: guptesurat@yahoo.co.in

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ABSTRACT

Background: Our Regional Blood Transfusion Centre collects about 35000 blood units annually and supplies about 50000 units to about 500 hospitals and Nursing homes.

Aims: To assess variation in HBV, (HCV), human (HIV 1and 2, and syphilis infection rates in voluntary donors from different areas in Surat city and to identify trends of transfusion transmitted infections over the period of time.

Methods: This study presents data of 241915 blood units collected in 3588 camps from 2001 to 2010. In Surat city, 218497 blood units were collected in 3219 camps. The samples were screened for tests like HIV1+2, HCV, hepatitis B surface antigen (HBsAg), and VDRL. The city was divided in nine groups each having an average area of 33.24 sq. km. The prevalence of transfusion transmitted infections (TTI) among blood donors in these areas has been estimated.

Results: Camp blood collection increased from 99523 in 2001-05 to 142392 in 2006-10. The average rate of TTI in Surat was 0.24% HIV, 0.96% HBsAg, 0.17% HCV and 0.15% VDRL. HIV prevalence declined from 0.38% to 0.14%, HBsAg 1.17% to 0.83%, HCV 0.31 to 0.07% and VDRL from 0.23% to 0.09% in 2006-10 compared to 2001-05. Areas of group 1 have maximum seropositivity for HBsAg and VDRL with group 7, 8 and 9 having seropositivity more for HIV and HCV.

Conclusion: Study highlights the safe areas of collecting blood in group 5, 6 and 7. Group 1, 8 and 9 have high prevalence areas of TTI which should be avoided for holding blood donation camps.

Key words: HIV, Hepatitis B virus, Hepatitis C virus, Syphilis, Voluntary blood donation

INTRODUCTION

Blood transfusion is a life saving intervention that has an essential role in patient management**.** The transmission of infectious agents by blood products is a matter of concern. It always carries a risk of transfusion transmissible infections including human immunodeficiency virus (HIV 1and 2), hepatitis C virus (HCV), hepatitis B virus (HBV), syphilis, malaria and many more[1]. Surat is a fast developing city where people from different parts of India migrate for job opportunities. Therefore variation in infection rates particularly for infections like HIV, HCV, HBV and syphilis is expected among blood donors. Hence we analyzed our transfusion transmitted infec-

tion (TTI) testing data of blood donors donating in blood donation camps in Surat city.

METHODS

The present study was carried out in a Regional Blood Transfusion Centre supplying blood to needy patients in Surat district and blood storage centres. Surat city has an area of approximately 326.515 sq. km. and a population of 2877241(2001 census) [2]. The Surat Municipal Corporation has divided the whole city into seven different zones namely, east, west, north, south, central, south-west and south east zone[2]. For our study referring to the city map and the areas where camps were organized the city was divided in nine groups having an average area of 33.24 sq. km. **(Table 1).** Groups 6 and 7 consisted areas which were clubbed to maintain mean 33.24 sq. km. area per group for comparison. Thus for convenience both groups were further divided into a and b.

Table 1: Areas of Surat divided in nine groups

Groups	Areas
1	Bedwad, Bhestan, Pandesara ,Udhna, Bamroli ,Vadod, Unn
2	Sonari, Jiyav, Gabhani, Bhudhiya, Bhimpor, Sarsana, Bhimrad
3	Dumas, Vanta, Gaviar, Rundh, Magdalla
4	Abhva, Vesu, Bharthana
5	Khajod, Athwa, Umra, Piplod, Bhatar, Althan, Sultanabad, Majura, Citylight, Ghod dod, Ichhanath, Parle point.
6 a	A.M.Road, Adajan Gam, Adajan Patiya, Rander, Honey Park, Jahangirpura, Morabhagal, Pal, Pal Gam, Palanpur Jakatnaka, Palanpur Patiya, Nanpura, Sagrampuara, Salabatpura
6 b	Gopipura, Kotsafil, Muglisara, Nanavat, Navsaribazar, Ruderpura, Rustampura, Soni Faliya, Ambaji Road, Lalgate, Amliran, Balaji Road, Chowk, Bhagal, Chauta
7 a	A.K.Road, Amroli, Ved Road, Katargam, Chhaprabhatha, Singanpor, Dabholi, Mahidharpura, Saiyadpura
7 b	Rampura, Haripura, Lal Darwaja, Begumpura, Zapabazar, Delhi Gate, Rughnathpura
8	L. H. Road, Sumul dairy, station, Nana Varachha, Mota Varachha, Kapodra, Karanj, Sarthana, Kosad, Utran
9	Dumbhal, Parvat, Dindoli, Limbayat, Godadra, Anajana, Maghob, Umarwada, Khatodara, Ring road, Puna Gam, Simada

Donors were selected by conducting medical interview, clinical examination and following the criteria of donor selection according to Gazette of India[3]. All the samples were screened for mandatory tests HIV-1 and 2, HBV, HCV and Syphilis. Commercially available Government approved enzyme linked immunosorbent assay (ELISA) kits were used for HIV and HCV antibodies and HBsAg and the assay was performed as per the manufacturers' instructions. After HIV reactive results the HIV 1 and 2 screening by rapid test was done. Rapid assay was used in emergency following instructions in the kit insert. Screening for treponemal antibodies was done using Rapid Plasma Reagin method as per the manufacturers' instructions. All reactive samples were retested with two different manufacturer's ELISA test kits.

The details of the donor were entered in the Integrated Blood Bank Management Software (IBBMS) developed by Applitech Solution Ltd. The records were also maintained in the Microsoft excel as well as manually as required by the drugs and cosmetics regulations. Areawise analysis for TTIs was done for ten years period from 2001 to 2010. The positive samples were decontaminated using hypochlorite solution or autoclaving before handing over the biomedical waste to Surat Municipal Corporation contractor, Envision.

The statistical analysis of the data was carried out for $\chi 2$ test with p value, relative risk (RR) and confidence interval (CI).

RESULTS

A total of 3588 camps were conducted from January 2001 to December 2010 collecting 241915 blood units. Camps conducted only in Surat city were included in the study which included 3219 camps divided in nine groups collecting 218497 blood units. Camps organized in Surat urban agglomerations area and neighbouring cities were excluded where 23,418 blood units were collected. The areas were decided referring to city map and division according to SMC where Surat city areas were included [2]. Group 6 and

group 7 had maximum number of camps. More than 98% HIV positive donors were HIV 1 positive hence HIV 2 positive donors were not separately analyzed. **Table 2** shows the comparison of data from 2001 to 2005 and 2006 to 2010.

Table 2: Comparison of TTI markers seropositivity in 2001-05 and 2006-10

Years	Camps held	Units Collection	HIV (%)	HBsAg (%)	HCV (%)	VDRL (%)
2001-2005	1510	99523	379 (0.38)	1168 (1.17)	310 (0.311)	226 (0.23)
2006-2010	2078*	142392*	200 (0.14)†	1180 (0.83)†	97 (0.07)†	134 (0.09)†
Total	**3588**	**241915**	**579 (0.24)**	**2348 (0.96)**	**407 (0.17)**	**360 (0.15)**

* Significantly increase in blood donation camps and blood collection in the camps during 2006 to 2010 compared to 2001 to 2005 by $\chi 2$ test ($p< 0.001$)

† Significantly lower prevalence of all infections during 2006 to 2010 compared to 2001 to 2005 by $\chi 2$ test ($p< 0.001$)

Comparison of five years data shows an increase in number of camps organized and number of blood units collected (P <0.001). HIV reactivity has decreased in camp donors from 0.38 % to 0.14% (P <0.001) RR= 1.59, 95%CI [1.50-1.69]. Prevalence of HBsAg also decreased from 1.17 % to 0.83% (P <0.001) RR= 1.21, 95%CI [1.16-1.26] among camp donors in last five years. The seropositivity for anti-HCV has declined from 0.31 % in 2001-05 to 0.07%

(P< 0.001) RR= 1.85, 95%CI [1.75-1.95] in 2006-10.VDRL reactivity has shown decreasing trends from 0.23% to 0.09 % (P <0.001) RR= 1.52, 95%CI [1.41-1.65]. The overall seropositivity in Surat in ten years period is 0.24% HIV antibody, 0.96% HBsAg, 0.17% HCV antibody and 0.15% reactive for syphilis antibody.

Table 3: Overall rate of all infections in different areas of Surat

Groups	Sq. Km	Camps held	Units Collected	Infected Sample (Infection Rate in %)
1	32.824	289	19033	417 (2.19)*
2	33.931	29	1423	22 (1.54)*
3	32.112	79	4599	58 (1.26)*
4	33.149	21	1154	7 (0.6)
5	37.600	511	29637	394 (1.32)†
6a	34.346	713	43084	656 (1.52)†
6b		422	36652	400 (1.09)†
7a	30.973	311	23837	439 (1.84)†
7b		358	24453	300 (1.22)†
8	31.682	180	12722	245 (1.92)
9	32.570	306	21903	430 (1.96)
Total	**299.187**	**3219**	**218497**	**3368 (1.54)**

* Significant increase in infection rate in Group 1, 2 and 3 compared to other groups by $\chi 2$ test ($P< 0.001$)

† Significantly lower prevalence of infection rates in urban areas of group 5, 6 and 7 compared to other groups by $\chi 2$ test ($P < 0.005$).

Further analysis was done among donors donating blood in camps organized in different areas of Surat city. Total 3219 camps were organized in these areas from 2001 to 2010 collecting 218497 blood units. **Table 3** shows the overall infection rate amongst blood donors in different areas of Surat.

Maximum number of camps 713 was organized in group 6a collecting 43084 blood units and 6b group organizing 422 camps collecting 36652 blood units. In 6a group 190 camps were organized in Adajan area alone which collected 11103 blood units and Gopipura area in 6b group organized 153 camps collecting 13201 blood units. The overall rate of infection was maximum 2.19% (417) in group 1.Group 1, 2 and 3 showed high prevalence compared to other groups (P< 0.001) RR= 1.29, 95%CI [1.19-1.40]. Group 5, 6 and 7 contributed 72% (218497) of blood units collected. The prevalence of infection in these three areas is lower compared to other six groups (P <0.001) RR= 1.26, 95%CI [1.20-1.32].

Table 4 shows the prevalence of TTI in different areas of Surat.

Statistical analysis was done using chi square test for different groups. There is no significant statistical difference in overall prevalence of infection in different areas p>0.1. Seropositivity of HIV was more 77 (0.31%) in 7b group (P <0.050), RR= 1.26, 95%CI [1.03-1.55]. Prevalence of HBsAg was maximum in group one 281 (1.48%) (P< 0.005), RR= 1.54, 95%CI [1.38-1.71] with maximum in Bamroli area 5 (2%). The maximum seropositivity for anti-HCV was 62 (0.26 %) in 7a group (P<0.005) RR= 1.46, 95%CI [1.16-1.84] with 1(1.25 %) in Chhaprabhatha. No case of HCV was reported in group 4. VDRL reactivity was maximum in group one 46 (0.24%) particularly in Bhestan area (P<0.005), RR= 1.58, 95%CI [1.21-2.07].

Table 4: Incidence of TTI (%) in different areas of Surat

Groups	Units	HIV (%)	HBsAg (%)	HCV (%)	VDRL (%)
1	19033	51 (0.27)	281 (1.48)	39 (0.20)	46 (0.24)
2	1423	1 (0.07)	18 (1.26)	2 (0.14)	1 (0.07)
3	4599	4 (0.09)	43 (0.93)	8 (0.17)	3 (0.07)
4	1154	2 (0.17)	3 (0.26)	0 (0.00)	2 (0.17)
5	29637	42 (0.14)	262 (0.88)	46 (0.16)	44 (0.15)
6a	43084	123 (0.29)	391 (0.91)	84 (0.19)	58 (0.13)
6b	36652	74 (0.20)	233 (0.64)	53 (0.14)	40 (0.11)
7a	23837	65 (0.27)	271 (1.14)	62 (0.26)	41 (0.17)
7b	24453	77 (0.31)	148 (0.61)	43 (0.18)	32 (0.13)
8	12722	38 (0.30)	158 (1.24)	24 (0.19)	25 (0.20)
9	21903	66 (0.30)	297 (1.36)	26 (0.12)	41 (0.19)
Total	**218497**	**543 (0.24)**	**2105 (0.96)**	**387 (0.17)**	**333 (0.15)**

DISCUSSION

This study included 241915 blood units collected in 3588 camps from January 2001 to December 2010.The number of camps organized was 222 in 2001 which increased to 355 in 2005 and 442 in 2010. This is attributed to motivation, and awareness among people. Donor motivation, recruitment and retention of donors are important factors as blood donors are the heart of the blood bank. Voluntary blood donation (VBD) was also motivated after earthquake in state of Gujarat in 2001.

Screening of donated blood for TTI is one of the important parameters for blood safety. The first line for ensuring a safe blood supply and minimizing the risk of TTI is to recruit voluntary non-remunerated blood donors from low risk populations using stringent donor selection criteria[4]. Secondly it is also essential that we have regular voluntary blood donors. Our previous study showed increase in voluntary blood donation from 45% in the year 1996 to 100% in 2006[5].

The prevalence of TTI in voluntary non-remunerated blood donors is generally much lower than among replacement donors[6-8]. This study supports the fact that VBD are safer as prevalence of TTI declined in 2006 which included 100% VBD. The increasing VBD may be attributed to involvement of government bodies like Gujarat State AIDS Control society (GSACS) and National AIDS Control Organisation (NACO) who actively propagate VBD.

The reactivity of donors also declined from 0.38% for HIV to 0.14%, 1.17% HBsAg to 0.83%, 0.311%HCV to 0.07% and VDRL reactivity from 0.23% to 0.09% in the time period from 2001-05 to 2006-10. Gupte have also reported the seropositivity rate 0.39% HIV, 1.26% HBsAg, 0.30% HCV and 0.42% VDRL reactivity[5]. The decline may also be due to screening by third generation kits. The syphilis test is mandatory in Indian blood banks because it is a promiscuity marker and guides about suspected window period HIV infection. But it is not capable of transmitting infection by transfusion, if more than three days stored blood is used[4]. Therefore RPR test even if less sensitive is accepted by food and drugs authorities. As seen in the table 2 the incidence of TTI in the camps during ten years period shows a decreasing trend in both the groups. Institute's previous publication[5] also shows that prevalence of all infections is reduced during the period 1996 to 2006.

The incidence of TTI among donors donating blood in camps organized in Surat from 2001-10 is 0.24% HIV, 0.96% HBsAg, 0.17% HCV and 0.15% VDRL reactive. Sawke et al reported the incidence of HIV seropositivity 0.81% in 2006 in Bhopal[9]. The HIV seroprevalence in Indian scenario has been reported between 0.2% and 1% [10-11]. Gupta et al reported HIV reactivity 0.22% in 2004 in VBD[12]. In this study the prevalence was reported 0.24% among blood units donated in camps. According to HIV statistics estimated number of people living with HIV/AIDS, 2007 is 0.34% in 2.31 million populations[13]. Our prevalence in Surat city is lower than this national statistics. It is also less compared to estimated adult HIV prevalence in Gujarat 0.37% in 2010[14]. This figure was released by NACO in zee news in December'10. The incidence of HBsAg seropositivity was found to be the highest as compared to other TTI. The prevalence was 0.96 % in ten years data of blood collection which is less compared to the prevalence reported by Gupta et al and other Indian studies 1.2% - 3.5%[15]. The overall prevalence of HCV infection in Surat was 0.17% which was less compared to HBsAg. Gupte also observed higher incidence of HBsAg

1.26% compared to other TTI[5]. The long term risk of developing cirrhosis and hepatitis cellular carcinoma is greater in HCV infected individual than in those infected with Hepatitis B virus. Indian studies indicate prevalence between 0.4% and 1.09%[10, 12, 16-17]. The reactivity for VDRL was 0.15% in Surat. Transfusion transmitted syphilis is not a major hazard, it is not that the transmission of syphilis is important but this test will detect 'high risk donors' and they may be excluded as there is a possibility of other sexually transmitted infections in such donors.

Analysis of data among different areas of Surat shows the maximum number of camps organized in Adajan area and maximum collection of blood units in Gopipura area. Perhaps VBD, awareness and willingness is maximum in this area. In Gopipura camps are organized regularly every three months by many organizers which decline the TTI incidence as donors are regularly screened. The overall rate of infection was maximum 2.19% (417) in group 1 (Table 3). Group 1, 2 and 3 showed high prevalence of TTI compared to other groups because areas included in these groups were mainly with illiterate and migrant population. Presence of large population with limited literacy and different sexual norms may affect the prevalence rate of TTI. Blood donated in camps organized in different areas of Group 5, 6 and 7 contribute to 72% (218497) of blood collection. However the possible reasons for low prevalence of TTI are in these areas may be due to urbanization, literacy and awareness in these people. The National figure of HIV shows the prevalence 0.35% in urban areas and 0.25% in rural areas [13].

Surat is one of the most dynamic cities of Gujarat with fastest growth rate. It is well known as 'Silk city' and Diamond city where people from all around the country flock in for business and jobs in these industries[2]. Certain factors such as massive industrialization, urbanization, migration (both intra and inter state) mostly males alone in the city without their families may influence the HIV prevalence and other sexually transmitted disorders. With many migrant populations the prevalence of TTI is affected due to high risk behaviour. HIV seropositivity trend in migrants in Surat has been reported between 1.2 - 2.4%.in 2008[18].

The maximum reactivity of HIV was in group 7b with 77 (0.31%) comparable to group 8 and 9 with prevalence of 38 (0.30%) and 66 (0.30%) respectively. The areas included in 7b group are mainly slums and the population is of sailors or fishermen. Illiteracy may also attribute to high seropositivity. In Rampura there are maximum labourers working in diamond industry and sweepers living in slum areas. This population may be considered as high risk donors. These areas are known as an old Surat city. Groupwise analysis showed highest rate of seropositivity for HIV in 6b group in Variyali Bazaar 2.78%. This area was known as a red light area for many years with many female sex workers. Positivity trend at female sex workers sites from 2004-08 is reported from 13.2% in 2005 declined to 4.4 % in 2008[19]. High prevalence may be due to this or less number of blood units. Group 8 and 9 mainly includes slum areas, and labourers working in textile and diamond industries which may be involved in high risk behaviour.

The prevalence of HBsAg was maximum 1.48% among 19033 blood donations in group 1 which is more than the prevalence in Surat 0.96%. The areas of Bamroli, Bhestan, Pandesara and Udhana has migrated people and slum areas which may be the main reason of high prevalence of HBsAg.

Maximum reactivity for anti-HCV was in Group 7a with 0.26%. Amroli, A.K road, Chhaprabhata, Katargam and Ved road have high prevalence which is more than overall incidence of 0.17 % in Surat. Amroli again is an area of migrated population from Orissa, Saurashtra mainly and other areas of Gujarat. The people stay overnight in looms and diamond industries. Ved road has maximum migrated population from Maharashtra, Orissa and other parts of India. Migrated population may contribute to high incidence in these areas.

No reactivity of HCV was reported in group 4. VDRL reactivity was 0.24% in group 1 and 0.20% in group 8. Pandesara (group 1) has significant number of migrants, where high prevalence of HBsAg was observed. Varachha area of group 8 also had high prevalence 0.24% of this infection. Varachha has mainly labour class population and migrated people from Bihar and Uttar Pradesh working in diamond industries.

CONCLUSION

The study concludes that the prevalence of TTI in Surat might be attributed to migrated population working in different industrial sectors in the city. Significant increase in number of blood camps and blood units collected over 2006-10 as

compared to 2001-05; might be due to higher awareness and willingness of blood donation. Safe areas for holding blood donation camps are group 5, 6 and 7. Camps organized in groups 1, 8 and 9 are attended by high risk population hence we plan to avoid these areas. We also would like to create awareness among them by proper counseling about the way of transmission of infections and to make them understand the risk to the patients.

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