Rate of Seroconversion in Repeat Blood Donors at The National Blood Centre, Kuala Lumpur

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Received: 26 July 2012 / Accepted: 23 October 2012 / Published online: 21 December 2012
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Abstract The World Health Organization (WHO) recommend that all donated blood are to be screened for at least three viral infections [human immunodeficiency virus (HIV), hepatitis C virus (HCV), hepatitis B virus (HBV)]. The National Blood Centre, Kuala Lumpur (NBCKL) aims to reduce transfusion transmitted infections (TTI) as it still remains as one of the major risk for blood transfusion. A cross sectional study was conducted at the National Blood Centre, Kuala Lumpur from 1st January 2009 to 31st June 2010. Data from 581,020 donors were analyzed from year 2004 to 2008. All data were retrieved from NBCKL Blood Bank Information System (BBIS). A total of 201 repeat donors were included in the study based on the inclusion criteria but only 132 repeat donors agreed to participate. Information on sociodemographic, risk factors, knowledge of donors and high risk behavior were extracted from standardize questionnaire. Data were analyzed using SPSS version 14.0. The aim of this study was to determine the predictors of the seropositive infectivity among repeat blood donors at the NBCKL. The results showed Syphilis accounts for the highest and increasing seroconversion rate among other infections from 20.83 % in year 2004 to 44.6 % in year in year 2008. HIV and HCV infection also

showed increasing seroconversion rate in 5 years' time from 6.41 % in year 2004 to 17.54 % in year 2008 and 4.8 % in year 2004 to 5.94 % in year 2008 respectively. However, HBV infection alone showed a decreasing seroconversion rate from 20.83 % in year 2004 to 10.4 % in year 2008. Level of donors' awareness regarding high risk factors (activities or behaviour) can lead to higher risk of TTI with significant p value in this predictors model ($p < 0.05$). Repeat blood donors with high risk activities are more likely to have seropositive results for HBV, HIV and Syphilis. This study found that the frequency of HCV seropositivity is higher among lapsed donor. Socio demographic factors such as male and working in the private sector predominates in all TTI markers. Majority of the respondents were aware about relation of high risk activities and risk of TTI.

Keywords Seropositivity · Hepatitis B · Hepatitis C · Human immunodeficiency virus (HIV) · Syphilis · Repeat blood donor

Introduction

The discovery of transfusion-transmissible infections (TTIs) has heralded a new era in blood transfusion practice worldwide with emphasis on two fundamental objectives; safety and protection of human life [1]. World Health Organization (WHO) recommends that all donated bloods are to be screened for at least three viral infections i.e. human immunodeficiency virus (HIV), hepatitis C virus (HCV), hepatitis B virus (HBV) and syphilis.

Hepatitis B is one of the most common diseases transmitted hematogenously and sexually. Two billion people worldwide are infected with the virus and 350–400 million

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people are chronically infected [2]. Individuals with chronic infection have high risk of developing liver cirrhosis and hepatocellular carcinoma. In Malaysia about 1.1 million people are thought to be chronically infected with hepatitis B virus. The estimated prevalence of hepatitis B carrier among the population is approximately 4.7 % [20]. Hepatitis C virus (HCV) infection is another common chronic blood born infection with an estimated 3.9 million persons infected by the virus and a high rate of development of liver cirrhosis. HBV and HCV infections cause serious mortality, morbidity and financial burden and are thus a major global health problem [3].

With reference to AIDS Epidemic Update 2009, approximately 100,000 people living with HIV/AIDS in Malaysia in 2009 with prevalence rate 0.5 % in adult aged 15–49 years old [21]. Syphilis caused by *Treponema pallidum*, is a systemic disease which can be spread by sexual contact, blood transfusion and via vertical transmission [4]. In Malaysia, data in 2008 showed incidence rate of 3.06 per 100,000 population were infected with syphilis in year 2006 [22].

At present, all collected blood in NBCKL are subjected to several tests to minimize risk of TTI which consists of screening for HIV with anti-HIV 1 and anti-HIV 2, screening for HCV with anti-HCV, screening for HBV by Hepatitis B surface antigen (HBsAg) and test for syphilis by Rapid Plasma Reagin (RPR) test. All reactive units will be subjected for a confirmation test including Neutralization test for HBV, Line-immunoassay (LIA) test for HIV, Recombinant Immunoblot Assay (RIBA) for HCV and *Treponema pallidum* Particle Agglutination (TPPA) test for syphilis.

Some of the reactive units appeared to come from donors who donated during ‘window period’ time [2], a time between infection and viral seropositivity detected by screening tests. Window period donation is undetected by serology screening methods [5]. However, with the introduction of nucleic acid amplification techniques (NAT) enable blood banks to detect HBV, HCV and HIV viruses in a blood collected during window period donation.

Today NAT is performed on minipools of plasma and has significantly increased the sensitivity to detect infected blood components as it reveals viral agents earlier in the ‘window period’ than antibody or antigen assays. However, it has some limitations in blood components with very low levels of viremia, which can even escape detection by NAT [6]. In Malaysia NAT has been implemented in The National Blood Centre since 5th November 2007. NAT was used to test the donated blood from the National Blood Centre and from others centers such as Hospital Klang, Hospital Kajang, Hospital Kuala Kubu Baru, Hospital Termerloh, Hospital Bentong, Hospital Raub, Hospital Kuala Lipis and Hospital Seremban [23].

Hence this study was carried out to determine the prevalence of HBV, HCV, HIV and syphilis among repeat blood donors at the National Blood Centre Kuala Lumpur from 2004 to 2008 and to identify the risk factors associated with seroconversion of the blood donors.

Materials and Methods

A cross sectional study was conducted from 1st January 2009 to 31st June 2010 at The National Blood Centre, Kuala Lumpur (NBCKL), Malaysia. Information was obtained from NBCKL database on a total of 581,020 blood donors. Of this, 313,418 were repeat donors and 201 seropositive cases were detected but only 132 seropositive repeat donors participated in this study giving rise to 66 % participating rate. Data was collected from repeat blood donors’ record covering the period between January 2004 and December 2008. A standardized questionnaire was used to extract information on sociodemographic, knowledge on blood transfusion and risk factors of blood donors. Information on high risk behavior, background history, family history and previous blood transfusion or organ donations were also taken from the database. Donors had a face to face interview with the researcher. For donors who were unable to come for the interview, they were interviewed through phone calls. Written consent was obtained prior to the interview. Consent forms were sent to donors who were unable to come for interview and the forms were returned back to the researchers. This study was approved by the Advance Medical and Dental Institute (AMDI) and the Medical Research & Ethics Committee (MREC), Ministry Of Health, Malaysia.

Data Collection

A preliminary dataset was then compiled and a new donor’s information data was generated containing donor’s name, last 4 digits of their identity card numbers, telephone numbers, donor’s address and postulated risk factors. All blood samples were screened serologically and by NAT testing. If the sample is serologically positive, the blood bag will be taken out from component preparation area and will be rescreened. Once reactivity was confirmed, the blood units were matched with Blood Banking Information System (BBIS) to match the donors’ information. Donors were divided into 4 groups according to the TTI markers and the year they were reactive. This data identified all the seropositive repeat donors from year 2004 to 2008 through NBCKL database. All donors were identified by their case number and viral infections and the year they become reactive.

Statistical Analysis

Data was analyzed using SPSS version 14.0. Univariable analysis was carried out to determine the association between sociodemographic factor, risk factor for seropositivity and high risk behavior. Multiple logistic regression was performed to determine the risk for seroconversion among repeat donors.

Results

Table 1 shows the seroconversion rate observed among 313,418 repeat donors in five years period. The seroconversion rate for different TTI were as follows; HBV (48 cases) ranging from 10 to 21 per 100,000 population, HCV (20 cases) ranging from 5 to 8 per 100,000 population, syphilis (93 cases) ranging from 19 to 45 per 100,000 population and HIV (40 cases) ranging from 6 to 18 per 100,000 population. HCV, HIV and Syphilis infections all showed an increasing seropositivity. Only HBV infection showed a decreasing seropositivity rate.

Table 2 shows that male donors outnumber female donors by more than 80 % for different TTI markers studied. Most of HBV seroconversion 18 (51.4 %) were Chinese donors followed by 12 (34.3 %) Malays donors and finally Indian donors and donors from other ethnicity (14.3 %). For HCV, 8 (57 %) donors were Malays, followed by 4 (28.6 %) Chinese donors and 2 (14.3 %) Indian donors.

For syphilis, 29 (47.5 %) donors were Malays, followed by 17 (27.9 %) Chinese and 14 (23 %) were Indian donors. For HIV seroconversion, rate of distribution 36.4 % (8 donors each) among Malays and Indian donors were the same which and 4 (18.2 %) donors were Chinese ethnicity.

Most of the respondents that were positive for HBV, HIV and syphilis were among young donors age between 17 and 30 years old (ranging from 48.6 to 52.2 %), followed by donors in 31–45 year group and only minority of

donors belongs to 46–60 year age group. Different patterns were observed in HCV where 8 (57.1 %) donors were in 31–45 year age-group, followed by 5 (35.7 %) donors in 17–30 year age-group and one (7.2 %) donor in 46–60 year age-group.

For educational level, it was found that the higher the educational level, the lower the rate of seroconversion in each TTI marked studied. There were six donors (4.8 %) with primary level of education in which 3/6 (50 %) donors were positive for HCV and another 3/6 (50 %) were positive for syphilis. For all markers reactivity, more than 40 % of donors completed their secondary education level and 21 (15.9 %) donors have tertiary level of education.

Majority of donors 73 (55.3 %) were working in the private sectors. Seropositivity among students was observed in HBV, HIV and syphilis. 13 (9.8 %) repeat donor donors from uniform bodies found to be seroconvert and only one donor were seropositive for HIV.

Married donors found to be reactive for HBV and syphilis (24 and 51 respectively). In HIV cases, 17 (77.3 %) donors were single and for HCV cases, the number of married and single donors was about the same.

Table 3 shows that only level of donors' awareness that high risk factors (activities or behaviour) can lead to higher risk of TTI with significant p value in this predictors model ($p < 0.05$). R^2 value is 0.187 which indicated that 18.7 % variation in regular and lapsed donor distribution is contributed by this predictor. β value of this predictor is 4.14 which indicate that this predictor has 4 times risk to influence repeat donors evaluation and represent the best predictor of TTI.

Discussion

Various precautionary actions and measures had been implemented into the blood banking service in order to obtain a safer donor and reduce the infectious hazard for the patient through blood transfusion. Among these

Table 1 Seroconversion rate for different TTI cases among repeat donors at NBCKL

Years	2004	2005	2006	2007	2008
No of repeat donors	62,398	63,002	59,704	61,063	67,251
No of repeat blood donors tested positive for HBV rate of seroconversion for HBV per 100,000 person years	13 20.83	12 19.04	9 15.07	7 11.46	7 10.4
No of repeat blood donors tested positive for HCV rate of seroconversion for HCV per 100,000 person years	3 4.8	5 7.93	5 8.37	3 4.91	4 5.94
No of repeat blood donors tested positive HIV rate of seroconversion for HIV per 100,000 person years	4 6.41	4 6.34	10 16.74	10 16.37	12 17.54
No of repeat blood donors tested positive for Syphilis rate of seroconversion for Syphilis per 100,000 person years	13 20.83	12 19.04	18 30.14	20 32.75	30 44.6

measures are: promoting voluntary non-remunerated donors, repeated donations, self-deferral measures, strict donor selection and screening for viral markers on donated blood.

Basically, repeat donors and voluntary non-remunerated donors were believed to be the safest donors based on their regularity and number of donations and their voluntary participation [7]. Unfortunately, numbers of seropositive cases among them were also increasing. Studies on underlying risk factors that was associated with or contributes to seropositivity among blood donors were done and various findings were found [8–12]. Among postulated reasons why the reactivity is increasing among repeat donors were concealing their high risk activities during pre-donation interview and blood donation in the window period time where we are not able to detect antigen by serology testing [13, 14]. Accordingly, blood banks nowadays has implemented an up-to date and advanced screening methods either serologically or via nucleic acid testing to be able to detect the infections as early as possible.

Table 2 Distribution of socio-demographic characteristics of the repeat donors (according to different TTI markers)

Variables	HBV n (%)	HCV n (%)	HIV n (%)	Syphilis n (%)	Total (N)
Gender					
Male	28 (80)	12 (85.7)	19 (86.4)	55 (90.2)	114
Female	7 (20)	2 (14.3)	3 (13.6)	6 (9.8)	18
Ethnicity					
Malay	12 (34.3)	8 (5.7)	8 (36.4)	29 (47.5)	57
Chinese	18 (51.4)	4 (28.6)	4 (18.2)	17 (27.9)	43
Indian	4 (11.4)	2 (14.3)	8 (36.4)	14 (23.0)	28
Others	1 (2.9)	–	2 (9.0)	1 (1.6)	4
Age group (year)					
17–30	17 (48.6)	5 (35.7)	11 (50.0)	32 (52.5)	65
31–45	13 (37.1)	8 (57.1)	9 (40.9)	26 (42.6)	56
46–60	5 (14.3)	1 (7.2)	2 (9.1)	3 (4.9)	11
Education level					
Primary	–	3 (21.4)	–	3 (4.9)	6
Secondary	16 (45.7)	7 (50.0)	11 (50.0)	27 (44.3)	61
Certificate	12 (34.3)	3 (21.4)	6 (27.3)	23 (37.7)	44
Degree and beyond	7 (20.0)	1 (7.2)	5 (22.7)	8 (13.1)	21
Occupation					
Student	7 (20.0)	–	3 (13.6)	9 (14.8)	19
Government	–	1 (7.2)	5 (22.7)	–	6
Private	19 (54.3)	6 (42.8)	10 (45.5)	38 (62.3)	73
Uniform body	4 (11.4)	3 (21.4)	1 (4.6)	5 (8.1)	13
Others	5 (14.3)	4 (28.6)	3 (13.6)	9 (14.8)	21
Marital status					
Single	11 (31.4)	8 (57.1)	17 (77.3)	10 (16.4)	46
Married	24 (68.6)	6 (42.9)	5 (22.7)	51 (83.6)	86

In this study, according to the preliminary data from year 2004 to 2008 which was gathered from the donors' registration unit and BBIS, there were an increasing numbers of total blood collection and total donation from repeat donors. This finding reflects the good donors' procurement and recruitment programs done by NBCKL in maintaining national blood supplies and promoting repeated donation among donors. Lower seroprevalence of TTI among blood donors at NBCKL could be due to stringent pre-donation selection, increase donor understanding regarding self-deferral policy, improved donors' understanding on safe blood donation and recruitment of voluntary non-remunerated donors.

The total numbers of repeat donors in five year study period were 313,418 and total numbers of seropositive cases were 201 represent a seroconversion rate of 0.064 %. The seropositive cases among repeat donors showed a total gradual increment from only 33 cases in 2004 to a total 53 cases in 2008.

Among the viral markers observed in repeat donors, seroprevalence of HBV showed a declining pattern over five year period ranging from 20.83 % per 100,000 person years to 10.4 % per 100,000 person years. Similar finding were observed in Abdul Mujeeb et al. [15] in Pakistan. Seroprevalence for HCV were floating around 4.8–8.37 % per 100,000 person years with only 3–5 donors per year.

Seroprevalence for HIV showed increasing pattern ranging from 6.34 to 16.74 % per 100,000 per person years with only four cases detected in 2004 and 2005 to a total of 12 cases in 2008 (three fold increase). Syphilis seropositivity within this five year period was increased up to three folds from 10 cases in 2004 to a total of 30 cases in 2008.

None of the socio-demographic characteristics were found to be statistically significant or can be predictors for seroconversion among repeat donors. In term of gender, male donors were found to be dominant in the respondent group with more than 85 % were male donors. This is most likely due to the facts that majority of Malaysian donors were male donors which consist of more than 60–70 % of the total blood collection annually compared to female donors.

Concerning the ethnicity among the respondents, more than 40 % were Malay followed by Chinese 34 % and Indian 29.6 %. These findings were in keeping with the scenario at NBCKL from year 2004 to 2008 whereby 46–51 % of blood donors were among Malay ethnicity followed by Chinese community with 37–42.9 % and the rest collection were from Indian donors, Sikh community and natives of Sabah and Sarawak from East of Malaysia. Therefore this study found that 57 (43.0 %) cases were among Malay donors and 43 (32.6 %) were among Chinese donors and few cases involving Indians.

Table 3 Predictors for seroconversion among repeat donors

Predictors	Regular donor		Lapsed donor		<i>p</i> value	Adjusted OR	95 % CI	
	<i>N</i>	%	<i>N</i>	%			Lower	Upper
Knowledge of partners background								
Yes	15	30.0	4	10.2	0.059	4.308	0.948	19.585
No	35	70.0	35	89.8				
Understanding questionnaire's content								
Yes	71	98.6	49	91.0	0.100	8.561	0.665	110.27
No	1	1.4	5	9.0				
Awareness of risk of TTI with high risk activities								
Yes	67	93.1	44	81.4	0.047	4.148	1.024	16.798
No	5	6.9	10	18.5				
I practice safe sex								
Yes	53	73.6	48	88.9	0.984	0.972	0.063	15.069
No	19	26.4	6	11.1				
Thought 'high risk' only concern recent activities								
Yes	48	66.7	48	88.9	0.213	0.238	0.025	2.279
No	24	33.3	6	11.1				

Regarding the risk of TTI, the findings were different according to different TTI markers. More than 20 % of HBV seroconversion in this study was among Chinese donors. The majority of HCV and syphilis cases were observed more in Malay donors and the HIV seropositivity were higher among Malays and Indians.

With regards to age group, majority of the respondents that were positive for HBV, HIV and syphilis were among young donors in 17–30 years of age-group. However, a study among blood donors in Northwest Ethiopia, [16] observed a high prevalence of HIV in 36–45 year age-group. This finding could be due to more donations made by this young age group.

For HCV, majority of donors belongs to young (31–45 years) age-group in concordance with findings by Luksamijarulkul et al. [10] in the Central and Northern Thailand. However, the majority of donors at NBCKL were younger than 45 year old. Probably for this reason, the prevalence among young donors (age 45 and below) was more than older donors. This study found that the higher the educational level, the lower the rate of seroconversion. This might reflect that these donors were more aware about the risk of TTI compared to those donors with lower educational background. In additions; donors with high educational background were less likely to donate compared to the lower educational group.

Occupation wise, majority of donors were those who work in the private sectors as also cited by Jutavijittum et al. [17] in Lao People's Democratic Republic. Students were among donors contributed to seropositive of HBV, HIV and syphilis. This finding contradicts the findings among blood donors in Thailand reported by Promwong et al. [18] where students

represent the safest group with low prevalence of TTI. This finding also contradicts study reported by Zachariah et al. [19] whereby the lowest prevalence for HIV in Malawi was among male donors and students.

This finding may be due to low level of awareness of among students regarding the TTI risk before blood donation, current lifestyle that might contribute to the seropositivity and increasing number of donation made by students compared to others.

From this study, we found that male donors and working in private sectors predominates in all TTI markers studied, the same finding found in Lao People's Democratic Republic [17] during profiling done on their blood donors on HBV and HCV seropositivity.

A statistically significant association was found between the risk of infections with high risk activities and repeat donors with 93.1 % regular donors and 81.5 % lapsed donor were aware about the risk of infections if they involves in any high risk activities. This variable has four times risk to influence repeat donors for seroconversion. Continuous educational program for donors must be improved in order to increase donors' awareness regarding pre-donation measures taken to reduce the risk of TTI and probably once the donors aware about donation process, the seroprevalence among them will be further reduced.

When asked regarding why they still donated even they already know they involved in a high risk activities and can transmit infections through blood donations, majority respondents admit they practice safe sex and will never be infected and most of the respondents thought that high risk activities asked during pre-donation interview only concerning recent activities. One of the preventive measures

implemented at NBCKL to prevent the TTI is to defer donor with potential to spread viruses such as donors who involve in high risk activities.

Conclusion

Overall, we could see an increasing number for blood donation in Malaysia. From this study, we could conclude that among the respondents, repeat donors was found to contributes more towards the seropositivity than first time blood donor. HBV accounts for the highest seropositivity in repeat donors meanwhile HCV was seen more in lapsed donor but both showed decreasing number of infectivity. This may be contributed by pre-donation screening, awareness and knowledge of the donors. HIV and syphilis seropositivity were the same in both groups and showed increasing trend of seropositivity. This may be due to increase level of free sexual activity and high risk activities among Malaysian population. Most of the respondents were aware about relation of high risk activities and the risk of TTI. However, repeat donors who think they practiced safe sex believed that they did not contribute to the risk of seropositivity during blood donation therefore lead to increasing trend of seropositive cases every year.

Acknowledgments We would like to thank the Director-General of Health and Deputy Director-General of Health (Research and Technical Support), Ministry of Health Malaysia for permission to publish this paper. We would also like to extend our appreciation to all staff at National Blood Centre, Kuala Lumpur from their support and help during this study. We would also like to thank Advanced Medical and Dental Institute (AMDI), University of Science, Malaysia, Penang for excellent assistance and dedication in this study.

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Electronic Citation

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