



Original article

Successful exclusion of blood-borne viral disease in blood donors

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ABSTRACT

Background: All blood transfusion services have various rules to insure that blood products are kept safe for transfusion. Donor selection is crucial in providing safe blood. We propose in our study to determine the influence of donor selection on blood safety.

Methods: In this case-control study, donors who were referred to the Qazvin Blood Transfusion Organization during 2007–2009 were selected. Based on a special questionnaire, all blood donors were examined by physicians and every donor was categorized as one of two types of rejected donors (high risk and low risk) or as accepted donors. Data were analyzed by SPSS version 13.0, using chi-square and Fisher's exact tests, where $P < 0.05$ was considered significant.

Results: Single donors, the self-employed, the unemployed and students were banned from donation due to high-risk criteria ($P < 0.0001$, 0.003). Female donors were banned from donation due to low-risk criteria. Hepatitis B was more prevalent among cases rejected for donation due to high-risk criteria than among healthy controls ($P = 0.014$); but not so for hepatitis C ($P = 0.058$). Hepatitis B was not significantly more prevalent among those cases rejected for donation due to low-risk criteria, than among healthy cases.

Conclusion: Those having a history of unsafe sexual conduct and intravenous drug abusers and their spouses are at risk for hepatitis C. Cases rejected for donation due to low-risk criteria were banned from donation to maintain the donors' health, while other cases with low-risk criteria were banned to guarantee the blood recipients' health.

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1. Introduction

One of the major goals of a blood transfusion organization is to provide suitable safe blood. Using laboratory tests is not a completely reliable approach to assure the safety of blood, because of the window period for some diseases, during which the disease is not detectable by laboratory tests. Therefore, donor evaluation by a physician, and physical examination, play an important role in screening for donor selection. The physician examines the donor using a standard form, where finding even a single risk factor leads to rejection as a blood donor, either temporarily or permanently [1].

According to the probable risk factors found by using the questionnaire, blood donors are prohibited from donation in order to prevent harm to themselves or to others. Iran is located in the intermediate-risk region for hepatitis B, where most cases of transmission of the disease are by sexual contact, infected blood or blood products, transfusion and intravenous drug abuse [2–10]. Hepatitis B is more prevalent during adulthood, when people usually donate blood,

compared to childhood. Risk factors for the transmission of infectious diseases can be determined by epidemiologic studies and used for screening policies for blood donation. A history of at least one risk factor, such as a family history of hepatitis, a history of blood transfusion and unsafe sexual conduct, could be found in hepatitis B surface antigen (HBsAg)-positive and HCV antibody-positive donors. This information can be used to improve the safety of donated blood [11].

A study performed by de Almeida Neto et al. from 1999 to 2003 revealed that donors with a positive confirmatory test for AIDS infection had at least one risk factor, found on examination by a physician, such as men who have sex with men (MSM), which is one of the most important ones [12].

In another study carried out in the Netherlands in 2006, a significant correlation was found between blood-borne infectious diseases and high risk behavior [13]. There was no increase in the prevalence of markers of blood-borne infectious diseases in rejected donors, as determined by a standard screening form, after the waiting period, in a study performed in the United States in 2005 [14].

The safety of blood and blood products was improved by the use of standard screening forms, according to a study in Mexico from 2002 to 2003 [15].

In South Africa, a standard screening form was used for donors, and relevant training was implemented, resulting in a significant

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decline in the prevalence of AIDS infection among donors, from 2.6% to 1.7% [16]. Drug abuse, a history of hepatitis and prior surgery and blood transfusion were among the most important causes of the transmission of hepatitis C among American donors [17]. The prevalence of hepatitis B in married donors was higher because of family problems and for sexual reasons, in another study carried out by Alizadeh et al. [5].

“Can the application of the standard form and the asking of standard questions prevent the transmission of blood-borne infectious diseases in blood transfusion?” is the question we hope to respond to in this study and in a comparison of risk factors among healthy and rejected donors. Furthermore, it was proposed to assess whether the prevalence of infectious diseases among the rejected group was higher than among the accepted donors.

Iran is an intermediate endemic area for HBV Infection [2]. The prevalence of HBV has decreased significantly in the Iranian population over the last decade [18]. The safety measures employed in Iran in the past few years seem to have been effective, considering the trends of transfusion-transmitted infection prevalence in Iranian blood donors. The prevalence of confirmed seropositivity was 0.6%, for HBsAg, 0.1%, for HCV RNA, 0.004%, for HIV western blot and 0.004% for FTA-ABS in 2005 in Iran [19,20]. The prevalence rates were almost the same in 2007: 0.56% for HBV, 0.13% for HCV, and 0.004 for HIV among Iranian blood donors [21].

2. Materials and methods

Our study was performed on donors in 2007, 2008 and 2009. Donors were divided into two groups, according to their reason for rejection: a high-risk group characterized by: unsafe sexual conduct, intravenous drug abuse or that of his/her spouse, a history of blood transfusion, a positive surgical history, or a history of endoscopy, etc.; a low-risk group: with hypertension, polycythemia, anemia, positive drug history, common cold, travel to endemic areas, heart disease, thyroid diseases, etc. A questionnaire was filled out for each high-risk donor according to the demographic status, laboratory tests and the reason for rejection. A low-risk group and another healthy donor group were matched the same day or the day before or the day after a high-risk, rejected donor was referred to the BTO. The total number of 616 high-risk donors, 616 low-risk donors and 616 accepted donors were compared, and the data were analyzed using the statistical package for the social sciences (SPSS

(version 13 for Windows) by Fisher's exact test and the chi-square test and a $P < 0.05$ was considered significant.

3. Results

3.1. Comparison of high-risk rejected donors with healthy donors

More single donors were rejected than married donors ($P < 0.001$). More non-governmental employees, unemployed donors and students were rejected due to high risk criteria ($P < 0.003$). High school graduates and junior college students were prohibited from donation due to high risk criteria ($P < 0.05$). There was no significant correlation concerning donors' gender (Table 1). More first-time donors were rejected because of high risk criteria ($P < 0.001$), while the same was true for donors aged 17 to 33 ($P < 0.001$).

Hepatitis B was more prevalent among the high-risk group ($P = 0.014$); 1% (6/616) of the high-risk subjects were positive, in comparison to none of the accepted donors (0/616). There was no significant difference between the two groups in comparing the prevalence of hepatitis C ($P = 0.058$): 1% (6/616) in the high-risk group compared to 0.2% (1/616) in the accepted donors.

This means that the questionnaire is compatible with the requirement to uncover HCV. The group with the most important risk factor for this disease is IDUs and this group can be rejected easily [22].

3.2. Comparisons within the rejected group according to high- and low-risk criteria

Male donors were rejected mostly because of high-risk criteria ($P < 0.001$) and donors aged 17 to 33 were rejected for the same reasons ($P < 0.001$). Single donors' rejection was mainly because of high risk criteria as well; and this group was considered a high-risk group.

High school students and graduates were rejected for high-risk reasons more frequently than other educational groups ($P < 0.01$).

A significant relationship could not be found between low-risk and high-risk groups, according to donation history. Retired donors, farmers, house-wives and truck drivers were rejected due to low-risk, while unemployed donors were rejected due to high-risk criteria (unsafe sexual conduct was more common in this group) ($P < 0.03$) (Table 1).

Hepatitis C was more prevalent among the high-risk than among the low-risk group ($P = 0.014$): 1% (6/616) in the high-risk group compared

Table 1
Frequency of high risk donors, low risk donors, and healthy donors according to age, gender, marital status, education and history of blood donation.

Variable		High-risk rejected donor frequency (%) (group 1)	Low-risk rejected donor frequency (%) (group 2)	Healthy donor frequency (%) (group 3)	P-value		
					(Groups 1 and 3)	(Groups 2 and 3)	(Groups 1 and 2)
Age	17–33	490 (79.5%)	390 (63.3%)	389 (63.1%)	0.001	0.95	0.001
	34–50	112 (18.2%)	198 (32.1%)	201 (32.6%)			
	51–65	14 (2.3%)	28 (4.5%)	26 (4.2%)			
Marital status	Single	378 (61.4%)	216 (35.1%)	228 (37%)	0.001	0.47	0.001
	Married	238 (38.6%)	400 (64.9%)	388 (53%)			
Gender	Male	561 (91.1%)	523 (84.9%)	547 (88.7%)	0.18	0.043	0.001
	Female	55 (8.9%)	93 (15.1%)	69 (11.3%)			
Education	Illiterate	3 (0.48%)	11 (1.78%)	5 (0.81%)	0.05	0.47	0.01
	School student	228 (37%)	252 (40.9%)	231 (37.5%)			
	High-school graduate	281 (45.6%)	241 (39.1%)	251 (40.7%)			
	Associate's degree	47 (7.62%)	33 (5.35%)	38 (6.16%)			
	Bachelor's degree	51 (8.27%)	69 (11.2%)	80 (12.98%)			
History of blood donation	Master's degree	6 (0.97%)	10 (1.62%)	11 (1.78%)	0.001	0.001	0.203
	Negative	549 (89.1%)	532 (86.37%)	216 (35.06%)			
	Positive	9 (1.46%)	7 (1.13%)	113 (18.34%)			
Prevalence of HBsAg	Persistent	58 (9.41%)	58 (9.41%)	287 (46.6%)	0.014	0.083	0.31
		6 (1%)	3 (0.5%)	0 (0%)			
Prevalence of HCV Ab		6 (1%)	0 (0%)	1 (0.2%)	0.058	0.31	0.014
		6 (1%)	0 (0%)	1 (0.2%)			
Average age		29.47	29.47	31.27			
Standard deviation		9.208	9.310	9.649			

to none (0/616) in the low-risk group. On the other hand, no significant relationship could be found for hepatitis B. The prevalence of HBsAg was 0.5% (3/616) in the low-risk group compared to 1% (6/616) in the high-risk group ($P=0.31$).

3.3. Correlation of reason for rejection (high-risk group) and age, gender and marital status

Male donors were rejected mostly due to unsafe sexual conduct, needlestick injury, hepatitis after 10 years of age, endoscopy and confidential unit exclusion and the probability of being a virus carrier ($P<0.001$). Female donors were rejected mostly due to tattooing. Hejamat (traditional phlebotomy), a family history of hepatitis, endoscopy, dental procedures, surgical procedures and being the spouse of an intravenous drug user were the leading causes for female donors' rejection. Single donors were prohibited from donation because of unsafe sexual conduct, needlestick injury, prior confidential unit exclusion and drug abuse.

3.4. Correlation between low-risk factors for rejection, and age and gender

All donors rejected because of polycythemia were male. Rejection because of allergy and hypersensitivity was more prevalent among male donors. Female donors were rejected for anemia and low blood pressure more often than were male donors ($P<0.001$).

The most important reasons for rejection of donors in different age groups were as follows: anemia in donors aged 17 to 33 years, polycythemia in donors aged 51 to 65 years and hypertension in donors aged 34 to 50 ($P<0.001$).

Assessment of the correlation between donors infected with hepatitis C and reason for rejection, revealed significant correlation between HCV-positive donors and reasons for rejection, such as their own intravenous drug abuse or that of his or her spouse, being a probable virus carrier and unsafe sexual conduct ($P<0.05$).

Most common criteria among rejected donors with hepatitis B were: being a probable virus carrier, hypertension, hepatitis after 10 years of age, family history of hepatitis, a history of hejamat (traditional phlebotomy) and unsafe sexual conduct ($P<0.05$).

Correlation between different age groups and being infected with hepatitis B or C was not significant.

4. Discussion

Among rejected donors with low-risk criteria, hepatitis B was significantly more prevalent than in healthy donors accepted for blood donation. The most common reason for hepatitis B infection among donors remains having a positive family history [23]. In addition, the prevalence of hepatitis C among low-risk and high-risk rejected donors is found to be significantly different. Donors aged 17 to 33 are mostly banned from donation for high-risk reasons. Female donors are found often in the low-risk group. The most common risk factor found among rejected unemployed donors was unsafe sexual conduct. Higher prevalence of HBV in high-risk and low-risk groups in addition to that of HCV in the high-risk group in comparison to accepted donors, confirms that acquiring answers to standard questions from blood donors can prevent the transmission of blood-borne infectious diseases in blood transfusion.

Hepatitis C could be found mostly among intravenous drug abusers and their spouses, probable virus carriers and donors with a history of unsafe sexual conduct, respectively. Most cases of hepatitis B could be found among donors who were probable virus carriers, those with hypertension, hepatitis after 10 years of age, a family history of hepatitis, a history of hejamat (traditional phlebotomy) and finally a history of unsafe sexual conduct. In this study no case of HIV infection was detected. The most important reasons for HIV infection among blood donors have been reported to be MSM, sexual contact

with sex workers, a history of sexually transmitted illness, and sexual contact with an intravenous drug user or multiple sexual partners among female donors [24].

Although one study has shown no significant correlation between hepatitis B, C and HIV infections and tattooing, in many studies a positive correlation has been found between tattooing and the aforementioned infections. As tattooing is more common among intravenous drug users or those in prison, it may be considered a combination risk factor [24]. In a similar study in Canada, a positive correlation was found between tattooing and hepatitis B and C [25]. In the United States, the prevalence of hepatitis B and C has been reported to be greater among rejected donors than among healthy ones [26]. In 2010, marker rates in apheresis collections in the USA were found to be 1.41, 7.83, 2.04, and 0.28 in 100,000 for HIV, HCV, HBsAg, and HTLV, respectively [27]. Important reasons for hepatitis C infection in Sweden have been found to be intravenous drug abuse, a history of blood transfusion, tattooing and a history of syphilis in the past 12 months [28]. In Germany, the prevalence for HIV was shown to be 6.2, for HCV 76.2, for HBV 150.2 and for syphilis 34.4 in 100,000 blood donors [29].

In this study, spouses of intravenous drug users were more frequently infected with hepatitis C, which was compatible with the study carried out in the United States, which demonstrated that the probability of hepatitis C infection among females with HCV-positive husbands was 3.7 times greater than among females with HCV-negative husbands [30].

A similar study in Isfahan of risk factors among hepatitis B cases reported a history of surgery, use of shared razorblades, a history of jaundice in the mother and a hepatitis B-positive or intravenous-drug-using family member [31]. In Tehran, significant correlation was found between the prevalence of hepatitis B and C, and risk factors such as age under 40, having high school or less education and marital status [32].

Most of the cases infected with hepatitis B and C were aged between 30 and 32, in a study performed in Jahrom comparable to this study [33]. A history of surgery was found to be an important risk factor among blood donors in Guilan province [34].

Learning points

- Since Iran is situated in an endemic area for hepatitis B [2], this study demonstrated the high prevalence of this disease; and so vaccination in older age groups seems necessary.
- Furthermore, this study could be performed repeatedly in order to find at-risk populations and to implement an educational plan to improve the safety of blood and blood products.
- As first-time donors consist of most of the rejected cases either because of low-risk or high-risk factors, an educational plan about low-risk factors may be effective in encouraging continuing donation.
- In accordance with this study, it seems wise to design a plan for educating women and regular donors in order to improve the safety of blood transfusion.

Conflict of interest statement

Hereby we declare that there is no conflict of interest according to this work.

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