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Evaluation of the Main Infectious Markers in Family Blood Donors at the Chad-China Friendship Hospital (HATC) in N'Djamena, Chad

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Abstract

In Chad, the majority of blood donations are family-based, so regular serosurveillance of donors for transmissible infectious agents is essential to ensure transfusion safety. The main infectious agents sought in donors are the human immunodeficiency virus (HIV), hepatitis B and C viruses, and *Treponema pallidum*, which causes syphilis. The main objective of the study was to determine the seropositivity rate of the main markers in donors in order to ensure transfusion safety at the Chad-China Friendship Hospital in N'Djamena, Chad. It was carried out during the period from January 2014 to December 2019 and is retrospective, prospective and cross-sectional, using blood bank records and information from consenting donors using a standardized form. The serological tests performed were Determine HIV1/2, SD BILONE 1/2 (HIV), HBsAg rapid test SD Bioline (HBV), Rapid test first response Ab (HCV), RPR, B/25 (T. Pallidum). A total of 18,570 donors were identified, with a sex ratio of 6.84 in favor of men. The average age was 35.5 ± 4.5 years. The overall seropositivity rate for infectious markers was (1467/18,570) (7.9%), with (236/18,750) (1.2%) for HIV, (1019/18,570) (5.4%) for hepatitis B (HBV), (26/18,570)

(0.1%) for hepatitis C (HCV) and (186/18,570) (1%) for syphilis. Male sex (16203/18,570) (87.25%) and the 26 - 35 age group (7604/18,570) (40.95%) were significantly more represented. Family blood donation remains one of the means used to save human lives in countries with limited resources. In order to ensure the safety of blood transfusions for patients, it is necessary to systematically test for the main markers recommended by the WHO. At the Chad-China Friendship Hospital, where blood donation is mainly family-based, it is therefore essential to strengthen the system of serosurveillance for infectious markers in donors, and to focus the national transfusion policy on voluntary and regular blood donation.

Keywords

Blood Transfusion, Family Donor, Infectious Agents

1. Introduction

Blood transfusion is a therapeutic medical procedure in modern medicine that saves lives and improves health [1]. Every year, more than 90 million units of blood are collected worldwide [2]. In sub-Saharan Africa, however, blood safety remains a major public health problem, due to the inadequacy of blood transfusion policies and services, appropriate infrastructures, qualified personnel and financial resources, on the one hand, and the high prevalence of transmissible infectious diseases in the general population, on the other [3]. In the same part of the world, infected blood transfusions are responsible for 5% - 10% of HIV infections, and 12.5% of patients who have received a blood transfusion are at risk of post-transfusion hepatitis [4]. An even greater number of recipients of blood products are contaminated with hepatitis B and C viruses, syphilis treponema and other infectious agents such as Chagas disease [5].

Although blood transfusion has health benefits, if it is not properly safe, it also exposes the recipient to the risk of transmission of numerous infectious agents, including the human immunodeficiency virus (HIV), hepatitis B and C viruses (HBV and HCV) and *T. pallidum* [6]. The World Health Organisation (WHO) therefore recommends systematic screening of all blood donations for infections before they are used. Screening should be mandatory for HIV, HBV, HCV and *T. pallidum* [7]. Today, HIV transmission by this route is still a reality for most of the world's population [8].

In Chad, the national blood transfusion centre (CNTS) and its blood banks are the only structures designed to supply blood and other blood products to patients who need them, in accordance with Decree No. 280/PR/PM/MSP/20007 on the organisation of blood transfusion in Chad. In our country, more than 70,000 blood donations are recorded each year [3]. However, several studies have shown that in countries with limited resources such as ours, the seroprevalence of HIV, HBV, HCV and *T. pallidum* among family donors varies between 2% and 13% [9]. With

this in mind, the study was conducted to determine the seropositivity rate of the main markers in donors in order to draw the attention of the health authorities to the need to take the necessary steps to improve this sector, which remains important for saving human lives.

2. Patients and Methods

This is a retrospective, prospective, and cross-sectional study conducted at the Blood Bank of the Chad-China Friendship Hospital in N'Djamena, from January 2014 to December 2019. It should be noted that the hospital's medical biology laboratory has a blood transfusion unit staffed by family donors. All cases of severe anemia are referred to the blood transfusion unit for typing, as well as for testing potential donors, generally related to the patient.

2.1. Sampling

Any adult who comes to the laboratory for a family donation and is deemed suitable after a clinical assessment. A small amount of blood (5 ml) in an EDTA tube is collected for blood typing and screening for infectious markers (HIV, Hepatitis B and C, and Syphilis).

Each donor who is free of these four markers is sampled in a 450 ml bag. Family donors were male and female, with an average age of 35.5 ± 4.5 years. Data were collected from registries and consenting donors during the study period.

2.2. Serological Tests

The serological tests performed were Determine HIV1/2, SD BILONE 1/2 (HIV), HBsAg rapid test SD Bioline (HBV), Rapid test first response Ab (HCV), RPR, B/25 (T. pallidum).

2.3. Rapid Test Principle

The DETERMINE™ HIV test is a qualitative immunoassay based on the lateral flow principle for the simultaneous detection of immune complex-free HIV 1 p24 antigen (Ag) and antibodies (Ab) to HIV 1 and HIV 2 in human plasma and serum or venous and capillary whole blood samples. The test can be evaluated in just 20 minutes. Abbott's rapid test is therefore ideal for point-of-care HIV testing and minimizes the number of undetected cases. SD BILONE, AGBS and RPR are all qualitative immunoassays.

2.4. Sampling

Blood is drawn from the elbow using a vacutainer needle. 5 ml of blood is collected in an EDTA tube. After centrifugation, the plasma is then used to test for markers of HIV, hepatitis B and C and syphilis.

2.5. Data Collection

Data is collected on a pre-established data collection form.

2.6. Principle of Rapid Tests Ethics

The study was authorised by the administrator of the structure and all conditions of confidentiality were respected.

2.7. Statistical Analysis

The data were analysed using Excel and the 2007 version of Epi Info. Significance was set at $p < 0.05$.

3. Results

During our study conducted from January 2014 to December 2019, we recorded 18,570 family blood donations of all sexes, the details of which are summarised in Table 1 below. We observed an increase in the rate of blood donations in 2018 (3947/18,670) (0.21%) compared with the other years. A predominance of males (87.26%) compared with females (12.74%) was observed in family donations, *i.e.*, a sex ratio of 6.84 males to females. In terms of age group, the majority of family blood donors were aged between 26 and 35 (7604/18,750) (40.95%). Among family blood donors, a high level of the hepatitis B marker was found. (1019/18,750) (5.49%), followed by HIV (236/18,750) (1.27%), syphilis (186/18,750) (1.00%) and hepatitis C (26/18,750) (0.14%). We also found that donors aged between 26 and 35 were the most affected by HIV (140/18,570) (1.84%), whereas for hepatitis B, our data showed that the high rate was found in the 36 - 45 age group (451/18,570) (7.01%) and the 26 - 35 age group (465/18,670) (6.11%). With regard to hepatitis C, we noted a high rate of (17/18,570) (0.26) in the 36 - 45 age group, and a positive rate of 1.85% for syphilis in the same age group. With regard to gender, our results showed that males were most affected by HIV (956/18,570) (5.90%), hepatitis B (956/18,570) (5.90%), hepatitis C (26/18,570) (0.16%) and syphilis (164/18,570) (1.01%).

Table 1. Number of family donors by year.

Year	Number	Percentage
2014	2705	14.57%
2015	2961	15.95%
2016	3382	18.21%
2017	3297	17.75%
2018	3947	21.25%
2019	2278	12.27%
	18,570	100%

Table 2. Donor results by gender.

Gender	VIH−	VIH+	VHB−	VHB+	VHC−	VHC+	Syphilis−	Syphilis+
Female n. (%)	2304 (97.34)	63 (2.66)	2304 (97.34)	63 (2.66)	2367 (100)	0 (0.00)	2345 (99.08)	22 (0.92)
Male n. (%)	15,247 (94.10)	956(5.90)	15,247 (94.10)	956 (5.90)	16,177 (99.84)	26(0.16)	16,039 (98.99)	164 (1.01)

Table 3. Breakdown of study population by age group.

Age group	Number	Percentage
18 - 25 n. (%)	3314	17.85%
26 - 35 n. (%)	7604	40.95%
36 - 45 n. (%)	6432	34.63%
46 - 60 n. (%)	1220	6.57%

Table 4. Test results.

	Tested	Positive	Positivity rate
VIH n. (%)	18,334	236	1.27%
VHB n. (%)	17,551	1019	5.49%
VHC n. (%)	18,544	26	0.14%
***T. Pallidum* n. (%)**	18,384	186	1.00%

Table 5. Distribution of donors tested by age group.

Age groups	VIH−	VIH+	VHB−	VHB+	VHC−	VHC+	Syphilis−	Syphilis+
18 - 25 n. (%)	3308 (99.82)	6 (0.18)	3236 (97.65)	78 (2.35)	3313 (99.97)	1 (0.03)	3313 (99.97)	1 (0.03)
26 - 35 n. (%)	7464 (98.16)	140 (1.84)	7139 (93.89)	465 (6.11	7598 (99.92)	6 (0.08)	7545 (99.23)	59 (0.77)
36 - 45 n. (%)	6344 (98.63)	88 (1.37)	5981 (92.99)	451 (7.01)	6415 (99.74)	17 (0.26)	6313 (98.15)	119 (1.85)
46 - 60 n. (%)	1218 (99.84)	2 (0.16)	1195 (97.96)	25 (2.04)	1218 (99.84)	2 (0.16)	1213 (99.43)	7 (0.57)

4. Discussion

The results of our study show that the frequency of family blood donors increased from 2014 to 2018. This shows the considerable impact of malaria on the population, given that it often leads to severe anemia if treatment is delayed.

A drop in the number of family donations was noted in 2019. This is the result of the multiple shortages of materials and reagents that the blood transfusion service experienced in 2019, according to service managers (Table 1).

In our study, a male predominance of 87.26% was noted against 12.74% females, *i.e.*, a sex ratio of 6.84 (Table 2). This male predominance could be linked to certain socio-cultural behaviors, convictions or traditional African beliefs according to which the woman is always weak compared to the man in most decisions. Certain physiological constraints on women, such as the menstrual cycle, pregnancy and breastfeeding, also influence their readiness to donate [3] [6].

The mean age of the donors was 35.5 ± 4.5 years. The age range 26 to 35 years was the most represented with 40.94% (Table 3). This corroborates with work reported by Goïta *et al.* in 2019, Katile *et al.* in 2018 [6] [10]. The least represented age group was between 46 and 60 years, which is similar to the results found by Goïta *et al.* in 2019 [10]. Elderly individuals are not solicited first when it comes to family blood donation.

For all donors, the human immunodeficiency virus (HIV) marker seropositivity rate was 1.27% (Table 4). This result is similar to that reported (1.2%) by Ataro

et al. in 2018 and Mohamed (1.24%) in 2016 [11] [12], but higher than that reported by Koné *et al.* in Mali [13]. The results of work by Fisher *et al.* (2000), which were 5.6% [14], are slightly higher.

The HIV seropositivity rate had increased between 2014 (1.73%) and 2016 (1.95%), which is close to the result obtained by Tagny *et al.* (2009) [15]. However, a significant drop in the seroprevalence rate was observed in 2018 (0.76%).

The male sex was the most affected, with 1.39%, in contrast to the results of Nagalo *et al.* in Burkina Faso, where an identical rate was observed for both sexes [16].

The 26 - 35 age group was the most affected with 1.84%, while Tounkara *et al.* in 2009 observed a higher rate in donors aged between 18 and 25 [17].

The seroprevalence of Hbs antigen was 5.48% for all donors (**Table 4**). Higher rates were reported by Bérré in 2011 in Bamako (16.6%); Buseri *et al.* in 2009 in Nigeria (18.6%) [18] [19]. A seroprevalence of 5.90% was observed in males. Significant seroprevalence was noted in the 36 - 45 age group (7.01%). The low rate among the youngest donors in our study could be explained by the fact that they were born in the 2000s, when the hepatitis B vaccine was already introduced as part of the Expanded Programme on Immunization (EPI), so the majority of these young people would be immunized through vaccination.

For the hepatitis C virus, seroprevalence was 0.14% for all donors. This result is lower than those reported by Buseri *et al.*, who found 6% [19].

We obtained a rate of 1.00% of infection caused by syphilis *T. pallidum* for all donors (**Table 5**). This result is lower than those found by Nagalo *et al.* in Burkina Faso, which were 4.9% [17]. The seroprevalence of syphilis was almost the same in both men and women (1.01%) vs. women (0.92%). Our results corroborate with those reported by Bessimbay *et al.* (2014) including 1.64% in men and 0.32% in women [20]. Our study was limited to donors collected at the laboratory of the Chad-China Friendship Hospital.

5. Conclusion

This 5-year retrospective and prospective study on the seroprevalence of the four infectious markers sought in blood donations provided data on hepatitis B and C and syphilis, which are highly prevalent in sub-Saharan Africa, but whose overall prevalence in the Chadian population has not been measured. The seroprevalence of HIV AIDS is the same as that of the general population. These data on family donors will open the door to large-scale studies to find out the true prevalence of viral hepatitis, in this case hepatitis B and C and syphilis in Chad.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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