

West Nile virus IgG antibodies among blood donors in Sudan: a cross-sectional study

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Abstract

Background: while the world is concentrated on fighting SARS-CoV-2, other viruses such as West Nile virus (WNV) attack the communities silently. West Nile Virus (WNV) is established as one of the infectious agents that transmissible blood transfusion. The present study is cross-sectional, conducted in the central blood bank, Khartoum state, Sudan, and aimed to determine WNV IgG antibodies among blood donors. **Methods:** the antibodies of the IgG class against West Nile virus in the serum were determined using the ELISA technique. Ninety blood donors participated in this study. **Results:** the results showed that 67(74.4%) of participants had positive IgG for WNV. The majority of positive participants 28/67(41.8%) had an age between 28-37 years followed by an age group 18-27 years 24/67(35.8), the dominant blood group of the positive WNV IgG participants was A+ 26/67 (38.8%) followed by O+ 19/67(28.4%). The result displayed that 40(59.7%) of the positive IgG had donated blood several times and 58 (86.6%) had a blood transfusion. Statistical analysis showed an insignificant association between age group, blood group, blood donation, blood transfusion, and West Nile Virus. **Conclusions:** the high IgG seroprevalence (which indicated previous infection) in the present study suggests high virus circulation in Sudan. This situation proposed that WNF screening test should be part of blood transfusion screening tests in Sudan.

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1. Introduction

A spectrum of blood-borne infectious agents is transferred through transfusion of infected blood offered by apparently healthy blood and asymptomatic donors [1]. West Nile Virus (WNV) is one of the infectious agents which have received increased attention in the last two decades since it was established as transmissible by organ transplantation and blood transfusion [2–4]. West Nile virus (WNV) is an arthropod-borne flavivirus. It was first isolated in 1937 from a human patient in the West Nile district of Uganda [5–7]. Arthropod-borne flavivirus (arboviruses) have a zoonotic cycle that

includes both birds and mosquitoes as amplifiers and horses and humans as dead-end hosts [8–10], this cycle granted wide distribution of the virus, birds act as main of long-distance dispersal of the virus and mosquitoes diffuse the virus in a short distance) [5,8]. Currently, WNV is the widespread flavivirus exist in all continents except Antarctica [9,11,12]. Human to human transmissions of WNV do not occur in natural situations [6], it could occur through transplanted organs, blood transfusion, trans-placental infection, and mother-to-child transmission through breastfeeding [13].

Most WNV infections are asymptomatic [9] and this may be owing to the innate immune response which plays a major role in the control of WNV infection, however exaggerated inflammatory responses lead to pathology, mostly involving the central nervous system [13], about 20% of WNV infected patients showed West Nile Fever while the West Nile Neurological Disease develops in less than 1% of infected patients [5,9]. WNV was the most common cause of neuroinvasive arboviral disease in the USA, representing about 92% of stated

neuroinvasive disease cases [1]. These diseases can be fatal and present a challenge to the scientific community as there are no specific therapies or licensed vaccines available [5,10,14]. Treatment of the patients with neuro-invasive West Nile virus is supportive, often involving hospitalization, respiratory support, intravenous fluids, and prevention of secondary infections [10].

In the absence of a vaccine and specific treatment, the only way to reduce infection is by raising awareness of the risk factors, reducing the risk of transmission through organ transplant and blood transfusion [10,12]. The present study aimed to determine WNV IgG antibodies among blood donors at Khartoum central blood bank, Sudan.

2. Material and methods

This study was approved by the ethical committee of the microbiology department, faculty of Medical Laboratory Sciences, Alzaiem Alazhari University. The aim of the study and the content of the questionnaire was explained to all participants in a simple way and simple language. The samples were collected from the individual who agreed to participate.

The present study is descriptive cross-sectional, conducted in the central blood bank, Khartoum state, Sudan. Healthy adult blood donors aged between 18 and 60 years, having a weight of 50 kg or more and Hb > 12.5g/dl with normal blood pressure, pulse, and temperature were represented study population. The data related to the study such as age, blood group, previous blood donation, and previous blood transfusion were collected via a structured questionnaire.

The antibodies of the IgG class against West Nile virus in serum were determined using the ELISA technique. The data were analyzed using statistical analysis software SPSS (statistical

package for social sciences) version 20, namely Chi-square, the difference considered significant when P-value is less or equal to 0.05.

3. Results

The present study was a screening study based on determining the WNV IgG. The serology tests continue to have a dominant role in the laboratory diagnosis of West Nile viral infections in human beings [15]. Specific antibody testing is currently the most widely used approach for WNV diagnosis and therefore detection of IgM antibodies alone or IgG seroconversion can point to a WNV acute infection [5].

Ninety blood donors were agreed to participate in this study. The results showed that 67(74.4%) of participants had positive IgG for WNV. The majority of positive candidates 28/67(41.8%) had an age between 28-37 years followed by age group 18-27 years 24/67(35.8), the dominant blood group of the positive WNV IgG participants was A+ 26/67 (38.8%) followed by O+ 19/67(28.4%). The results displayed that 40/67(59.7%) of the positive IgG had previously donated blood and 58/67 (86.6%) had a blood transfusion. Statistical analysis showed an insignificant association between age group, blood group, previous blood donation, previous blood transfusion, and West Nile Virus (Table 1).

4. Discussion

The present study showed that 67(74.4%) of participants had positive WNV IgG, these results indicate high IgG seroprevalence, which suggests high virus circulation. In alignment with these findings, several authors displayed high seroprevalence of

TABLE 1. Distribution of risk factors and the serological result of WNV among blood donors at Khartoum state, Sudan

Factor		Result		Total (%)	P value
		Positive (%)	Negative (%)		
Age/year	18-27	24(35.8%)	9(39.1%)	33(36.7%)	0.876
	28-37	28(41.8%)	10(43.5%)	38(42.2%)	
	38-47	15(22.4%)	4(17.4%)	19(21.1%)	
Blood grouping	A+	26(38.7%)	8(34.8%)	34(37.8%)	0.671
	A-	1(1.5%)	0(0.0%)	1(1.1%)	
	B+	14(20.9%)	5(21.7%)	19(21.1%)	
	B-	1(1.5%)	0(0.0%)	1(1.1%)	
	AB+	3(4.5%)	0(0.0%)	3(3.3%)	
	O+	19(28.4%)	10(43.5%)	29(32.3%)	
	O-	3(4.5%)	0(0.0%)	3(3.3%)	
Previously donated a blood	Yes	40(59.7%)	12(52.2%)	52(57.8%)	0.348
	No	27(40.3%)	11(47.8%)	38(42.2%)	
Previously received a blood transfusion	Yes	9 (13.4%)	1(4.3%)	10(11.1%)	0.215
	No	58(86.6%)	22(95.7%)	80(88.9%)	
Total		67(74.4%)	23(25.55%)	90(100%)	

WNV among different Sudanese populations; Abdelhalim and Kafi determined the WNV in suburban areas in Khartoum State, Sudan, and reported a seropositive of 64(70.3%) [16]. Abd-Allah and Alhag were conducted a study on hemodialysis patients at Khartoum state, they reported that (22.2%) of the study population have positive IgG for WNV [17]. Globally the Sudanese showed a high prevalence of WNV antibodies; Dargham et al. determined the age and nationality specific West Nile virus (WNV) seroprevalence in populations residing in Qatar, they found the WNV specific IgG was most commonly among Sudanese, it estimated to be 37.0% [18]. nevertheless, the epidemiological data throughout the world showed that the WNV is widely distributed; Eybpoosh et al. carried systemic review for West Nile Virus in the Eastern Mediterranean region and stated that the WNV antibodies were detected in the general population of Sudan (2.2–47%), Pakistan (0.6– 65.0%), Egypt (1–61%), Djibouti (0.3–60%), Tunisia (4.3–31.1%), Iran (0–30%), Morocco (0–18.8%), Iraq (11.6– 15.1%), Jordan (8%), Libya (2.3%), and Lebanon (0.5–1%) [19]. In previous years, even in developed countries such as the USA, WNV was the most common cause of neuroinvasive arboviral disease, accounting for 92% of reported neuroinvasive disease cases [7]. The high prevalence of WNF in Sudan could be attributed to the tropic climate and agricultural nature of Sudan. García-Carrasco et al. reported that rain-fed agricultural zones aid the circulation of WNF cases in Europe by reducing the diversity of avians, as the diversity of birds allows the dilution of disease transmission between competent hosts and vectors. The high temperature has a significant role on the mosquitoes and virus, it shortens the gonotrophic cycle, increasing the rates of replication and bite, making vectors transmit the virus earlier [20].

The present study showed that the younger age groups 28–37 years followed by 18–27 years were more likely to have and transfer the infection in which they showed (41.8%) and 27(40.3%) positive WNV IgG respectively, these results relatively consists with Mohamed et al. who reported that the WNV infections in Sudan have been observed mainly among children [21]., and has disagreed with the earlier report which stated that the prevalence of WNV antibody tended to rise with age [22]. Pacenti et al. determined and analyzed the WNV infection during the Italy outbreak and reported that the incidence of WNF progressively increased with age [23]. This variation may be due to the difference in the study population. However, the first report of WNV in Sudan was in 1956 when WNV antibodies were detected in children aged up to 14 years in the Nuba Mountains. WNV outbreaks occurred in Northern Sudan and in the Nuba mountains in 1989 and 2002 respectively [21].

Our study showed that the majority 40/52 (76.9%) of the donors who previously donated blood had positive WNV IgG,

this group represents 40/67 (59.7%) of the positive IgG for WNV. The phenomenon of repeating blood donation in Sudan is the habit, associated with social satisfaction which encourages the charity of blood and thus the unnoted diseases of donors could be passed to several blood receivers, particularly the majority of WNV infected patients are asymptomatic [11,24]. The present study showed that the majority 80(88.9%) of the blood donors did not receive a blood transfusion, out of that 72.5 % (58/80) showed positive antibodies of WNV. Nine blood donors out of ten who received blood transfusion had positive IgG for WNV. These results might suggest that the virus is highly circulating in the community. In alignment and supporting to these findings Al Hag. et al. determined the prevalence of WNV IgG and IgM in multi-blood transfused patients in Sudan and showed that 50(54%) and 11(12.1)% of the studied population were positive for WNV IgG and WNV IgM respectively [25]. Another study conducted in Khartoum (Sudan) showed that 6 (13.3%) of a healthy control group had IgG for WNV [17]. Therefore blood donation could be considered a risk factor for transmissions of WNV in Sudan, particularly the screening of WNV is not a part of blood donation screening tests. However, in developed countries screening of WNV is a part of blood donation screening tests [4,7].

Our study showed that the WNV IgG was more common among blood group A 40.1% (27/67). Several studies have shown a selective binding of some pathogens to blood group carbohydrate moieties. The attachment of WNV to human RBCs and the association of specific blood groups with WNV pathogenesis and disease outcome have also been suggested [26]. Lanteri et al. revealed that WNV RNA persisted in the whole blood group A donors at higher levels than in whole blood from blood group O donors, indicating that binding to red blood cells may be connected to blood group glycoproteins or controlled by molecules present at a high frequency on blood group A red blood cells [27]. Similarly, Politis et al. stated that blood group A was more common in WNV cases and proposed blood group A/D negativity as a possible risk factor for the development of symptoms [26].

5. Conclusion

The high WNV IgG seroprevalence (which indicated previous infection) in the present study suggests high virus circulation in Sudan. This situation proposed that WNF screening test should be part of blood transfusion screening tests in Sudan as the blood transfusion is one of the routes that lead to WNV distribution.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRedit authorship contribution statement

Yasir Ezzeldien Salih Amin: The present work entitled “West Nile Virus IgG antibodies among blood donors in Sudan: a cross-sectional study” is shared equally between the two mentioned authors, starting from writing the research proposal, performing the experiment, data analysis and ending by writing the manuscript. Both authors agreed to submitted this work to *New Microbes and New Infections* journal. **Eltayib Hassan Ahmed-Abakur:** The present work entitled “West Nile Virus IgG antibodies among blood donors in Sudan: a cross-sectional study” is shared equally between the two mentioned authors, starting from writing the research proposal, performing the experiment, data analysis and ending by writing the manuscript. Both authors agreed to submitted this work to *New Microbes and New Infections* journal.

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