Prevalence of Dengue Virus, Chikungunya and Zika Infection in Blood Donors of Northern of Brazil

Leticia Martins Lamarão

Foundation Center for Hemotherapy and Hematology of Pará (HEMOPA)

Angelita Silva Miranda Corrêa

Foundation Center for Hemotherapy and Hematology of Pará (HEMOPA)

Renata Bezerra Hermes de Castro

Foundation Center for Hemotherapy and Hematology of Pará (HEMOPA)

Carlos Eduardo de Melo Amaral

Foundation Center for Hemotherapy and Hematology of Pará (HEMOPA)

Patricia Danin Jordão Monteiro

Foundation Center for Hemotherapy and Hematology of Pará (HEMOPA)

Mauricio Koury Palmeira

Foundation Center for Hemotherapy and Hematology of Pará (HEMOPA)

Luane Nascimento Lopes

Foundation Center for Hemotherapy and Hematology of Pará (HEMOPA)

Angela Neves Oliveira

Foundation Center for Hemotherapy and Hematology of Pará (HEMOPA)

Maria Salete Maciel de Lima

Foundation Center for Hemotherapy and Hematology of Pará (HEMOPA)

Rommel Rodríguez Burbano (✉ rommel@ufpa.br)

Cytogenetics Human Laboratory, Biological Sciences Institute, Federal University of Pará

Research Article

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Abstract

We identified the prevalence of infection by the Dengue virus, Chikungunya and Zika in blood donors in epidemic and non-epidemic periods in the State of Pará, in Northern Brazil, we classify the donors (symptomatic or asymptomatic) and the possibility of this screening being carried out in a sample pool.

Introduction

The global increase in reemerging pathogens such as the Dengue virus (DENV), the Zika virus (ZIKV) and the Chikungunya virus (CHIKV) poses a threat to public health and the safety of the blood supply. All three pathogens are viruses transmitted by arthropods (arboviruses), mainly by *Aedes aegypti* [1]. These arboviruses have been reported over the years as constant threats to the human population, including recipients of blood transfusions, considering the high occurrence of asymptomatic cases and the fact that the presence of viremia precedes the onset of symptoms, so it is possible that infected blood donors act as a source of dissemination [2, 3].

We identified the prevalence of infection by the DENV, CHIKV and ZIKAV viruses in blood donors. 22,291 thousand donations raised by the Hematology and Hemotherapy Foundation of the State of Pará (HEMOPA), located in the city of Belém, which supports blood transfusion in Northern Brazil, were investigated.

Methods

In the period from 01/06/2018 to 06/30/2020, donors referred for blood collection were included in this research. This survey was carried out in accordance with the guidelines and norms of the Declaration of Helsinki. All research participants signed an informed consent form.

The samples were processed for automated nucleic acid extraction and purification according to the routine of the Nucleic Acid Test Laboratory (NAT) of Foundation Center for Hemotherapy and Hematology of Pará. The genetic material was extracted from a pool of four samples and underwent detection of DENV RNA (DENV 1, DENV 2, DENV 3 and DENV 4), ZIKAV and CHIKV using the One-Step Reverse Transcription Polymerase Chain Reaction (RT-PCR) technique, in a multiplex assay, using custom primers and probes.

Results And Discussion

In the study region, the first semester coincides with the rainy season and is considered seasonally epidemic for arboviruses and contributes significantly to the proliferation and development of *Aedes aegypti* [4]. One donor was found positive for CHIKV and one for DENV. CHIKV was found in a non-epidemic period and had an estimated prevalence of 0.02%, which suggests that in non-epidemic periods, the chances of blood donors being able to transmit the virus, as they are asymptomatic or symptomatic, after donation, may be increased. DENV in an epidemic period with an annual prevalence of 0.01%. Both prevalence's match or are higher than those found for the Hepatitis C virus (0.01%) and for the Hepatitis B virus (0.02%) in the study region (Table 1). The detection of a positive case of DENV was found in the first

semester of 2019, the period of greatest circulation of the vectors of the disease, and the period in which almost all cases occur in Brazil [5], suggesting attention in relation to this agent.

As for CHIKV in 2009, during an epidemic in a province in Thailand, a prevalence of 0.03% was found in blood donors, such as our study (6). So far, in the world literature, it has not been possible to predict transfusion transmission of this virus. DENV is an agent recognized as a threat to transfusion safety (7) as examples of studies carried out in other countries, including Brazil, where the transmission of blood transfusion with recipients in conditions of development is known to worsen the disease, compromising the primary treatment that the patient was receiving [1, 8].

As for ZIKAV, a systematic review found a prevalence of 0.85% of the virus in blood donors, although the development of apparent symptoms of the disease by ZIKAV in blood component containers has not been proven [8]. As far as we know, there are no descriptions of prevalence in the northern region of Brazil and, in this study, we did not detect this virus in blood donors. Positive donors for DENV and CHIKV were contacted by the project team and after clinical evaluation were classified as symptomatic after donation, however, both had mild symptoms such as mild fever, malaise, body aches, tiredness and both did not seek medical attention. at the time of donation. In this research, blood donations positive for DENV and CHIKV had no recipients.

The positive DENV and CHIKV samples were simulated in different sample pool quantities, up to the amount of 14 samples in the pool (Table 2). Was observed that if the DENV positive sample had been carried out within a plasma pool of 14 donation samples, it would have been detected automatically in the system protocol, however even in a pool of 20 samples it could be detected by the operator of the device, given that there was a curve growth (amplification of viral cDNA). As for CHIKV, it was observed that even if this sample were composing a pool of 20 plasma samples, it would have been detected automatically by the system protocol.

We conclude the need for continuous monitoring of research for ZIKAV and CHIKV and there is a need to include a continuous and mandatory molecular screening test for the four subtypes of DENV in the routine of blood centers, preventing this agent from being transmitted to recipients of blood components, and that special groups of immunosuppressed receptors may die.

Abbreviations

Foundation Center for Hemotherapy and Hematology of Pará (HEMOPA)

Dengue virus (DENV)

Zika virus (ZIKV)

Chikungunya virus (CHIKV)

Nucleic Acid Test Laboratory (NAT)

Declarations

Ethics approval and consent to participate

The present research was approved by Ethics Committee of Ophir Loyola Hospital (CAAE 43610615.7.0000.5174).

Consent for publication

Not applicable.

All authors who participated in the research agree and consent to the publication of this manuscript.

Availability of data and materials

All experimental data and analysis results were stored in the NAT laboratory computer and all samples were stored in the HEMOPA Blood Bank, which are available to be reviewed. No public database is available to deposit our data. The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

All authors declare that they have no conflicts of interest.

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Authors' contributions

LML and RRB conceived and designed the study. LML, RRB, ASMC, LNL, ANO and MSML conducted the study and participated in the laboratory analysis. LML, RBHC CEMA, PDJM and RRB analysed the data. LML and RRB wrote the paper. All authors read and approved the final manuscript.

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Tables

Table 1. Donations investigated for DENV, ZIKAV and CHIKV and the prevalence found according to the period classification (epidemic and non-epidemic) and the half-yearly prevalence found during the study period.

Classification		2018		2019		2020	
		Number donations	Prevalence	Number donations	Prevalence	Number donations	Prevalence
1st period.	1st Semester	827	-	5.039	0,02%#	-	-
	2nd Semester	5.294	0,02%*	5.177	-	5.554	-
Total		6.121	0,02%*	10.216	0,01%#	5.954	-

*CHIKV, #DENV

Table 2. Identification and detection values of the positive sample for DENV and CHIKV in different quantitative sample pools.

	AVERAGE DETECTION VALUES							
Number of Pooled Samples	6	8	10	12	14	16	18	20
DENGUE	23,7	24,2	25,4	28,8	28,5	ND*	ND*	ND*
CHIKUNGUNYA	22,8	23,1	23,8	24,2	24,1	24,4	24,5	25,0

ND: not detected; * Presence of a curve below the detection limit