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Seroprevalence of *Toxoplasma gondii*, cytomegalovirus and Epstein Barr virus in 578 tissue donors in Brazil

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ABSTRACT

This study aimed to verify the prevalence of IgG antibodies for *Toxoplasma gondii*, CMV, and EBV in tissue donors from different regions of Brazil between February 2016 and July 2017. In this retrospective study, 578 donors were evaluated from different regions of Brazil. The seroprevalence of *T. gondii* was 61.2%, CMV was 93%, and EBV was 98.3%. The seroprevalence increased with age, from 27.8% in donors younger than 18 years of age to 67.6% in those older than 60 years of age ($p < 0.05$). The analysis of the seroprevalence of CMV and EBV showed similar percentages (>90%) among the different states, the interior and capital of Paraná state, sex, and age. The seroprevalence of CMV, EBV and TOXO is high in all groups and age in Brazilian donors of tissues.

Introduction

Cytomegalovirus (CMV), *Toxoplasma gondii*, and Epstein Barr virus (EBV) are commonly tested for in tissues from potential donors at tissue banks [1]. *T. gondii* infections are highly prevalent among humans and animals and are typically asymptomatic in immunocompetent people, but the protozoan can cause severe disease in fetuses and in immunodepressed individuals [2]. Alternatively, CMV and EBV are viruses that are exclusively found in humans. They are associated with asymptomatic infections in newborns and young people, but they cause mononucleosis-like infections or mononucleosis when symptomatic infections occur, respectively [3,4]. The seroprevalence of *T. gondii* differs, based on the socioeconomic conditions and eating habits. In the United States, the seroprevalence ranges from 9% to 15% according to the population and age [5]. The seroprevalence is also higher in developing countries [6]. Knowledge of the local seroprevalence is important for the implementation of control measures, mainly in pregnant women, because a low seroprevalence increases the risk for congenital infections from *T. gondii* and CMV. The seroprevalence is also important for the implementation of prophylaxis strategies in those receiving organs and to define public health policies. This study aimed to verify the prevalence of IgG antibodies for *T. gondii*, CMV, and EBV in donated tissues (corneas, skeletal muscle tissues, and heart valves) from different regions of Brazil, donated between February 2016 and July 2017.

Methods

This was a retrospective study performed at the tissue bank of Pontifícia Universidade Católica do Paraná (BTH), using donated corneas, skeletal muscle tissues and heart valves, from beating and stopped heart donors; this study was approved by local Ethical Committee of Research in Human. All tissue donors had blood samples collected for serology and other tests after donation. *T. gondii* (IgG and IgM), CMV (IgG and IgM), and EBV (IgG and IgM) tests are required to be performed for heart and skeletal muscle donors, according to the Brazilian regulatory authorities (ANVISA) [7]. ELISA (enzyme-linked immunosorbent assay) was used for all of the antibodies. The BTH received tissues from donors from several cities in the state of Paraná (southern Brazil) and from other states in Brazil (heart valves).

The inclusion criteria were tissue donors (cornea, skeletal muscle, and heart valves), with blood collected for *T. gondii*, CMV, and EBV IgG tests. The samples could not have demonstrated hemolysis, and the patients could have not presented with hemodilution that

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Table 1
Positive IgGs for *T. gondii* (TOXO), cytomegalovirus (CMV), and Epstein Barr virus (EBV) in the serum of 578 tissue donors.

	TOXO (IgG)			CMV (IgG)			EBV (IgG)			TOXO	CMV	EBV
	+	–		+	–		+	–		p Value	p Value	p Value
All donors	189	120	61%	293	22	93%	113	2	98%			
Paraná	139	90	61%	218	15	94%	113	1	99%	0.919		
Bahia	15	11	58%	24	2	92%						
Ceara	1	1	50%	2	0	100%						
Pará	8	3	73%	11	0	100%						
Rio Grande do Norte	26	15	63%	38	5	94%	0	1	0%			
Other States	50	30	63%	75	7	91%	0	1	0%			
Capital	50	30	63%	75	7	91%	24	1	96%	0.459		
Interior	82	54	60%	131	8	94%	89	0	100%			
Female	114	75	60%	117	6	95%	49	1	98%	0.397		
Male	75	45	63%	176	16	92%	64	1	98%			
Age												
<18	5	13	28%	17	2	89%	4	0	100%	<0.05*	0.470	0.521
18–30	30	24	56%	49	7	88%	11	1	92%			
31–40	32	18	64%	49	1	98%	20	0	100%			
41–50	34	22	61%	50	6	89%	22	1	96%			
51–60	64	32	67%	94	4	96%	45	0	100%			
>60	23	11	68%	32	2	94%	10	0	100%			

* p Value for the specific age, compared with other age groups (<18).

made the serology unfeasible. Epidemiological data were evaluated, as age, gender, and origin of the donor (city and state of Brazil). The serology results were compared according to the epidemiological data. Data were presented as percentages for the categorical variables and as the median with quartiles for the continuous data. Statistical analysis was performed to compare the positivity of serology, according to the epidemiological data. For continuous variables, the Mann–Whitney test was performed, and a chi-square or Fisher's test was performed for the categorical variables. A correlation of positive serum tests was evaluated by kappa index. A p value <0.05 was considered statistically significant.

Results

From 578 donors, 38.9% were female, and the median age was 48.5 years old (IQ25-75%: 32–57). The majority of donors, 465, were from the Paraná state (80.4%), followed by the Bahia state (n = 53, 9.2%), the Rio Grande do Norte state (n = 44, 7.6%) and the Pará state (n = 11, 1.9%). Considering only the Paraná state, 259 donors (44.8%) were from the capital (Curitiba city) and 206 donors (35.6%) were from the interior of the state of Paraná.

Serology for *T. gondii*, CMV, and EBV was not tested in most of the patients (cornea donors). The results are detailed in Table 1 and Fig. 1. The seroprevalence of *T. gondii* was 61.2%, CMV was 93%, and EBV 98.3%. The seroprevalence of *T. gondii* was similar among the evaluated states. There was no statistical difference between the capital and interior region of the Parana state (60.3% vs. 62.5%). The seroprevalence increased with age, from 27.8% in donors younger than 18 years of age to 67.6% in those older than 60 years of age ($p < 0.05$). The analysis of the seroprevalence of CMV and EBV showed similar percentages among the different states, the interior and capital of Paraná state, sex, and age. The seroprevalence was high (>90%) in all of these groups of donors. There was correlation of positive serum tests between toxoplasmosis and CMV (kappa index = 0.87; $p < 0.05$)

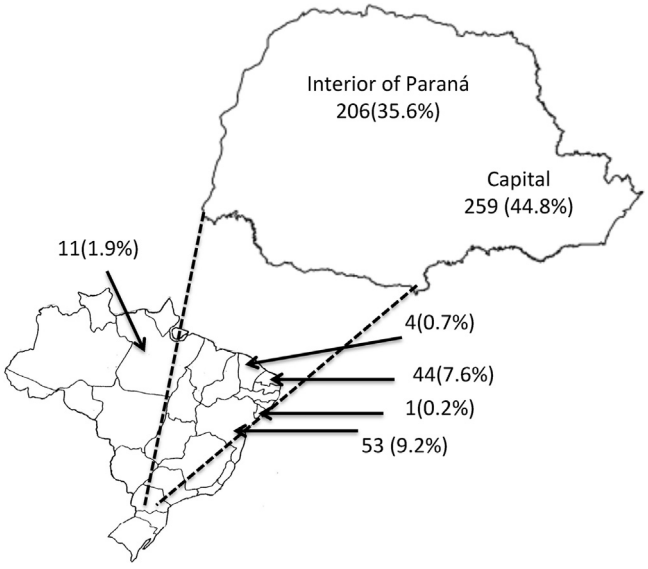

Fig. 1. Chart of 578 tissue donors and positive serum test results (percentage) of IgG for *T. gondii* (TOXO), cytomegalovirus (CMV) and Epstein Barr virus (EBV). Upper: according with age in years and bottom according with Brazilian state.

Discussion

This is the first study in Brazil to evaluate seroprevalence in bank tissue donors. In this study, the seroprevalence of *T. gondii* was high in comparison with other countries, like the United States. Nevertheless, the data from the current study are similar to those from other developing countries [8,9]. The seroprevalence of CMV in developed countries is lower than that in Brazil. In a recent and large Japanese surveillance study, the seroprevalence in pregnant women was 66% [10]; the seroprevalence was even lower in Europe (<30%) and North America children (<25%) [11,12]. In our study, 93% of donors were seropositive for CMV, which is a common finding in developing countries, as described in other seroprevalence studies from Iraq [13], the Sudan [14], and China [15]. CMV prevalence is low in childhood of developed countries, but increase in age, instead of developing countries where seroprevalence is high in the first year of life. The EBV seroprevalence is similar to that of CMV. A study from a developing country evaluated the EBV seroprevalence 20 years after the improvement of the socioeconomic aspects of the country, but the seroprevalence remained higher than 90% in the younger population, but has decreased in develop countries, like France, a future risk for more cases of severe cases [16]. A higher seroprevalence is not only associated with financial

conditions, but also regional habits that can contribute to the dissemination of the virus among people. The correlation of CMV and toxoplasmosis suggest social condition favoring transmission, once the mechanisms of transmission are different. This is the first study to evaluate the seroprevalence profile of tissue donors. The study contributes to the demonstration of current CMV, EBV, and *T. gondii* infections in a specific population with different ages and a comparison across different states of Brazil, which demonstrated similar rates of seroprevalence.

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Competing interests

Felipe Tuon is CNPQ researcher.

Ethical approval

Not required.
None

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