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ORIGINAL ARTICLE

Assessment of seroprevalence of *Toxoplasma gondii* in blood donors applied to the blood center of Gazi university hospital

Ayşegül Yılmaz[1*], Engin Yazıcı[2], Can Turk[1]

[1]*Department of Medical Microbiology, School of Medicine, Lokman Hekim University, Ankara, Turkey*
[2]*Department of Immunology, School of Medicine, Gazi University, Ankara, Turkey*

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ABSTRACT

Background and Objectives: Toxoplasmosis is a life-threatening zoonotic infection in immunosuppressive individuals. Determining the prevalence and seropositivity rates of toxoplasmosis in asymptomatic blood donors is crucial in terms of the risk status of the transmission of this infection to the blood recipients.

Materials and Methods: In this study, the presence and level of the specific *Toxoplasma* IgG and IgM antibodies in blood donors was investigated by electrochemiluminescence immunoassay (ECLIA). The statistical significance levels between *Toxoplasma* seropositivity and demographic characteristics of the donors such as age, educational status, raw meat consumption, drinking water supply were examined.

Results: *Toxoplasma* IgG seropositivity was found among the 225 (25.6%) of the donors present in the study group, while IgM seropositivity was detected in 20 donors (2.3%). The number of donors with only IgM (+) was 8 (0.9%). Both IgG and IgM seropositivities were found in 12 donors (1.4%).

Conclusion: Our study provides information about *Toxoplasma* seropositivity based on the samples collected from the donors who were admitted to the blood center of a university hospital in Ankara, Turkey. This study demonstrates that *Toxoplasma* seropositivity is high in the rural areas and the regions where the education level is low.

Keywords: Toxoplasmosis; Seroprevalence; Antibody; Blood transfusion; Blood donor

INTRODUCTION

Toxoplasma gondii (T. gondii) is an obligate intracellular protozoan that belongs to the phylum Apicomplexa. *T. gondii* infection affects a wide range of hosts, such as humans, poultries, and members of felines. Its prevalence in the world varies between 10-90% depending on geographic location, socio-cultural status, climate, transmission path, age average of society, immunity in the society, feeding habits, cat feeding at home (1). The prevalence of toxoplasmosis in Turkey varies between 19.5-69.5%. It is more common in hot and humid places than in dry places (2). Toxoplasmosis is transmitted in one of two ways: acquired or congenital. Infection with *T. gondii* is generally acquired by consumption of raw or undercooked meat containing tissue cysts or by ingestion of food or water contaminated with oocysts shed by cats. The habit of eating foods such as raw meatballs, sausage, salami, bacon also facilitates the spread of toxoplasmosis in the community. *T. gondii* infection during pregnancy is a crucial risk factor for infection of the fetus and consequent congenital

*Corresponding author: Ayşegül Yılmaz, MSc, Department of Medical Microbiology, School of Medicine, Lokman Hekim University, Ankara, Turkey.
Tel: +903124448548
Fax: +903125028558
Email: aysegul.yilmaz@lokmanhekim.edu.tr

toxoplasmosis.

While toxoplasmosis is generally asymptomatic in immunocompromised patients, it can cause life-threatening symptoms in immunosuppressive patients. Toxoplasmosis can be activated by reactivation of latent infection in patients with immunosuppressed (cancer chemotherapy or organ transplantation) or immunodeficiency (AIDS) (3). There is a high risk of acute toxoplasmosis infection if the necessary measures are not taken to protect organ transplantation and blood transfusion patients from *T. gondii* infection. This risk is especially associated with organ transplantation or blood transfusion from seropositive donors to seronegative recipients for toxoplasmosis (4).

In this study, *Toxoplasma* seropositivity rates in donors admitted to the blood center and the statistical significance levels between *Toxoplasma* seropositivity and the demographic characteristics of the donors were investigated.

MATERIALS AND METHODS

Donor information. Between October 2015 and December 2015, 879 donors who applied to Gazi University Hospital Blood Center to donate blood were included in the study. These date ranges were preferred by considering the increase in the number of donors in the region where the study was conducted. Donors were informed about the study and a consent form was signed by those who accepted to be donors. Sociodemographic information of the donors was included in the study, such as age, gender, occupation, place of residence, pet feeding, farm-village life, drinking water, soil contact, consumption of meat, milk, and eggs as raw, was obtained from the donor information form.

Ethical approval. The study was performed following the Declaration of Helsinki for experiments involving humans and was approved by the Research Ethics Committee of Gazi University of Medical Sciences (No. Ethical approval of 175).

Serological test. The study was carried out at Gazi University, Faculty of Medicine, Department of Immunology. Toxo IgG and Toxo IgM positivity were investigated by electrochemiluminescence immunoassay (ECLIA). The ECLIA method is applied for *in vitro* quantitative determination of antibodies against *T. gondii* in human serum and plasma. It is an immunochemical measurement technique used to show specific antigen-antibody binding to *T. gondii* by luminescence by stimulating some substances with energy obtained from a chemical reaction. The energy required for luminescence is provided by electrode reaction. Ruthenium and tripropylamine (TPA) are used in the ECLIA technique for luminescence marking. It was reported that there was a high correlation between IFAT, ELISA, and Sabin-Feldman Dye tests and that there was no significant difference. ECLIA method is widely used because it does not require much labor force, it is easy to use, faster results, and kit consumption is low. In this study, Toxo IgG kits and Toxo IgM kits were performed following the kit procedure.

Statistical analysis. For comparison of the frequencies among groups, the chi-square test was used and data obtained during the study were processed using Graph pad prism 5.0 statistical package. Statistical significance level was accepted as $p < 0.05$.

RESULTS

In our study, 790 of the donors were male (90.0%), 89 female (10.0%), and the age range was 18-65 years and the mean age was 34 years. The number of donors with *T. gondii* IgG (+) was 213 (24.2%) and the number of donors with *T. gondii* IgM (+) was 8 (0.9%). There are 12 donors (1,4%) both IgG and IgM seropositivity. 8 donors (0.9%) were found to be suspected of IgG, with no uncertain results for IgM. There is no significant difference between the level of IgM in serum samples according to demographic features. However, IgM rates at the marital status and drinking water supply features are close to the significance. The levels of IgG in serum samples infected with *Toxoplasma* are shown in Table 1.

Among all donors involved in the study, 20 donors were found to be IgM seropositive (Table 2).

DISCUSSION

Seroprevalence of *T. gondii* infection may vary between countries as well as the geographical region or communities in the same country (5). In a study that

Table 1. Distribution of *Toxoplasma* IgG results of donors. Significant differences were found in age groups, marital status, level of education, marital status, place of birth, residence type of community, pet feeding, farm-village life, consumption of raw meat, milk, egg, drinking supply, contact with soil features. *represents p-value ≤ 0.05

Demographic Feature	Demographic Sub Feature	Seropositivity	*p*-value
Sex	Male	207 (26.2%)	0.4357
	Female	18 (22.0%)	
Age (Years)	20-18	5 (9.4%)	<0.0001*
	30-21	45 (16.2%)	
	40-31	73 (25.9%)	
	50-41	78 (38.4%)	
	60-51	22 (43.1%)	
	>60	2 (40.0%)	
Marital status	Single	55 (18.2%)	0.0002*
	Married	170 (30.0%)	
Level of education	Illiterate	2 (100.0%)	<0.0001*
	Primary School	42 (49.4%)	
	Middle School	29 (28.4%)	
	High school	58 (22.4%)	
	University	94 (22.2%)	
Place of birth	Rural	134 (36.0%)	<0.0001*
	City	91 (18.2%)	
Residence type of community	Rural	25 (37.3%)	0.0254*
	City	200 (24.9%)	
Job	Public sector	75 (29.0%)	0.3548
	Private sector	98 (24.8%)	
	Student- Unemployed	52 (23.8%)	
Pet feeding	No	210 (27.1%)	0.0115*
	Yes	15 (15.3%)	
Consumption of raw meat	No	217 (25.4%)	0.0435*
	Yes	8 (47.0 %)	
Consumption of raw milk-egg	No	210 (25.0%)	0.0130*
	Yes	15 (44.1%)	
Drinking water supply	Carboy water	164 (24.0%)	0.0222*
	Tap water	61 (32.3%)	
Contact with the stray cat	No	215 (25.7%)	0.7853
	Yes	10 (27.7%)	
Contact with soil	No	145 (22.5%)	<0.0001*
	Yes	80 (35.4%)	

included 10,295 patients from the Marmara region of Turkey, *T. gondii* IgG seropositivities found 28.8%, and *T. gondii* IgM seropositivities found 1.9%. In another study from a hospital in the Central region of Turkey, *T. gondii* IgG and IgM seropositivities were found 29.5% and 2.4% respectively (6). Sert et al. found 22.3% IgG positivity and 0.64 % IgM positivity following our results in their study in Ankara, Turkey. Moreover, they found a significant difference between age groups and IgG seropositivities (7). In a study involving hospitalized patients in Ethiopia, the highest prevalence rate of *T. gondii* was reported in the age group of 15-49 years (8). In a survey conducted with healthy blood donors in Colombia, the bivariate analysis indicated there was an association between *Toxoplasma* seropositivity and donors over 26 years of age (9).

IgM antibody is a marker of acute or recent infection as well as potentially persistent infection or reinfection (10). By monitoring a cohort of 446 wom-

Table 2. *Toxoplasma* IgG and IgM indexes in 20 IgM-positive blood donors

NO	IgM level*	IgG level**
1	1.06	0.67
2	2.06	0.45
3	2.10	0.72
4	2.08	0.54
5	1.04	0.32
6	3.59	0.68
7	1.63	>650
8	1.11	>650
9	1.18	499.1
10	1.06	>650
11	1.03	397.8
12	1.61	382.8
13	1.45	179.3
14	1.00	>650
15	1.13	433.0
16	1.23	585.7
17	1.41	>650
18	1.35	>650
19	1.67	369.8
20	1.66	362.2

* Non-reactive: <0.8, Indeterminate: ≥ 0.8 - < 1.0, Reactive: ≥1.0

**Non-reactive: < 1, Indeterminate: ≥ 1-< 30, Reactive: ≥ 30

en who acquired toxoplasmosis during pregnancy, Gras et al. showed that IgM detection persisted beyond 2 years in 27% and 9% of women, respectively. Thus, the IgG avidity test could be an effective method for confirming or ruling out a recent infection. False-positive and long-lasting IgM results are usually of low titer, and not considered important in diagnosing the infection. If there is any relatively high-level IgM result, the presence of recent infection is more suspected. In such cases, IgG avidity test for IgG and IgM positive samples might help resolve the issue and decide if there is any risk of parasite transmission through blood donors (11). The limitation of this study is the lack of IgG avidity test, which distinguishes acute infection from long-term positive IgM response or false positive IgM result.

In North Africa, several studies showed that domestic cats were effective in increasing seropositivity (12). It is known that felines play a role in the spread of oocysts to the environment. Therefore, it is emphasized that people should be more careful about hygiene rules in their relations with cats (13). In a study, waterborne toxoplasmosis has been reported from Brazil, in both epidemics as well as endemic transmission patterns. The largest outbreak in the published literature, with 290 human cases, was reported in Brazil and involved an unfiltered water reservoir (14).

In our study, higher *Toxoplasma* seropositivity was found in donors working with raw meat such as farmers and butchers and in occupations requiring contact with soil. Simon et al. found that six French dairy farms were found to be contaminated by *T. gondii*, and the proportion of contaminated soil samples was high (37.7% to 66.3%) compared with contaminated soils that have been found in other rural areas (15). In two locations of Tunisia seroprevalences of *T. gondii* among healthy blood donors showed that participants from urban areas (42.8%) are less infected than those living in rural areas (54.05%), where contamination of the environment by *T. gondii* oocysts and exposure to the parasite is higher (16).

CONCLUSION

In this study conducted with donors who applied to the Blood Center of Gazi University Hospital, it was found that demographic characteristics were effective to different degrees of *Toxoplasma* seropositivity. It is known that donation of blood from seropositive donors to individuals under immunosuppression or seronegative recipients for organ transplantation may cause *Toxoplasma* contamination and create serious vital problems for these patients. *T. gondii* causes serious infections of this type which can be fatal in people with a weak immune system. This study provided up to date information about *Toxoplasma* seropositivity in donors admitted to the blood center and it was found that donors should be informed about toxoplasmosis more often.

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