

Original Article



Serological Evaluation of Human *Toxocariasis* in Patients With Hypereosinophilia Referred to Tabriz Hospitals in Iran

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Abstract

Introduction: Toxocariasis is a parasitic infection that causes eosinophilia in humans. Infection in humans is created by swallowing parasite eggs through contaminated soil or hands. Then, the larvae exit from eggs in the small intestine and enter the bloodstream through the perforation of the intestine, and from there, they migrate to all various organs, leading to the creation of visceral larva migrans syndrome and ocular larva migrans syndrome.

Methods: In this case study, a prospective study was performed on 100 patients who referred to these centers from February 2017 to January 2018 in different hospitals in Tabriz, in Iran. After the diagnosis of 50 hypereosinophilic patients (more than 10% eosinophilia) without a history of allergic disease as a case group and 50 patients without eosinophilia as a control group, we collected blood samples from these individuals and isolated their serum or plasma. Then, anti-*Toxocara* antibodies were measured by the enzyme-linked immunosorbent assay (ELISA) method in these patients. The data were analyzed by SPSS software.

Results: The prevalence of anti-*Toxocara* antibodies was observed in 20% (10 patients) and 2% (1 patient) of hypereosinophils and controls, respectively. The mean age of the case and control groups was 22–75 years and 17–79 years, respectively, and 57% and 43% of the subjects were males and females.

Conclusion: Seroepidemiological studies in Iran have shown a seroprevalence of the disease between 2% and 25.6%. Due to the fact that toxocariasis is caused by worm larvae, this disease can be diagnosed only by serological methods. Therefore, it is necessary to suspect toxocariasis in people with unspecified hypereosinophilia and perform an immunoserological test by the ELISA method. The findings demonstrated that this infection exists in the city of Tabriz.

Keywords: Human toxocariasis, Hypereosinophilic patients, ELISA, Tabriz, Iran

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Introduction

Toxocariasis is a common parasitic disease in humans and animals. Humans get the disease by eating the infectious eggs of *Ascaris*; in dogs and cats, it is called *Toxocara canis* and *Toxocara cat* (1,2). In the human body, larvae migrate through the blood to other parts of the body, leading to visceral migratory larval syndrome and ocular migratory larval syndrome. Symptoms and manifestations, including skin lesions (urticaria, eczema, and pruritus), occur in humans infected with this parasite (3). The most involved organs include the brain, liver, lungs, and eyes. Symptoms include fever, headache, cough, stomach pain or discomfort, asthma, or pneumonia. Infection of the larval stage of humans has been observed in many cases, but infection in adult worms has also been detected in several cases (4). Considering that the worms that cause toxocariasis are unable to complete the

life cycle in humans, the parasite eggs are rarely found in human feces, and only worm larvae are present in human internal organs (Figure 1). This factor has made it difficult to diagnose the disease through simple stool tests. On the other hand, these worms are one of the most important causes of eosinophilia in humans, and antibodies against disease-causing larvae can be detected in the serum of infected people by using the enzyme-linked immunosorbent assay (ELISA) method (5).

According to recent studies, the prevalence of anti-*Toxocara* antibodies is between 2% and 25.6%, as well as 5.1% and 76.6% in Iran and the world, respectively (6).

Toxocara canis and other nematodes causing visceral migratory larval syndrome are widespread in tropical and temperate areas. According to one report, 22% of dogs and 55% of cats in the United States are infected with the parasite, and in India, the rate of infection among tested



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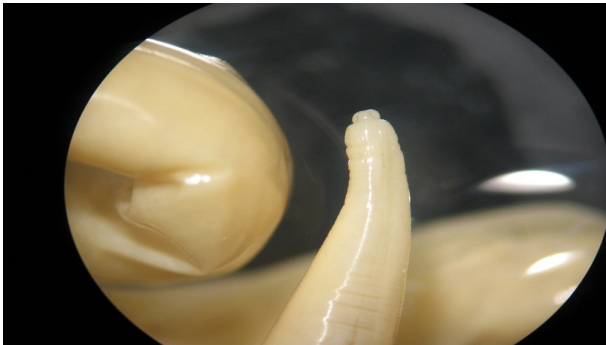


Figure 1. Adult ascaris mouth

dogs is between 82% and 100% (7).

The presence of these parasites in dogs was first reported by Dr. Sahba in the Mazandaran region, Iran. Subsequent studies also showed the presence of *T. canis* in dogs and jackals in different parts of the country and *T. cati* in cats.

It is worth mentioning that more than 500 eosinophils per milliliter of blood are called eosinophilia, and more than 1000 eosinophils per milliliter of blood are called hypereosinophilia (8).

In this study, due to the importance of *Toxocariasis*, our aim was to evaluate the response of anti-*Toxocara* antibodies in hypereosinophilic patients referred to different hospitals in Tabriz, Iran.

Materials and Methods

This was a case-control and prospective study that was performed on patients referred to medical centers in Tabriz from February 2017 to January 2018. Patients were divided into case and control groups.

Using the formula $n = Z^2P(1-P)/d^2$, the sample size for each of the two groups (control and case) was 50 people.

In this study, patients who referred to these centers, first, underwent a complete blood count or cell count test and then performed a cell count and differentiated peripheral blood eosinophils by performing a differentiation test.

If the patient's blood eosinophils are more than 1000 per microliter of blood, the person is hypereosinophilic and is in the case group, and if the person is not hypereosinophilic, he/she is in the control group.

The exclusion criteria included having any allergic disease and taking medications that cause hypereosinophilia. Personal characteristics and information about the required variables, such as age, gender, and the like, were collected with the help of a questionnaire.

Hypereosinophils as a case group and non-hypereosinophils as a control group were tested for anti-*Toxocara immunoglobulin G* (IgG) serum by the ELISA method using a commercial kit in the laboratory. Statistical data were analyzed using SPSS software version 26.

Results

In this study, experiments were performed on serum samples of 50 patients in the case group (hypereosinophilic individuals) and 50 controls (non-hypereosinophilic individuals), and the mean age of those in the case and control groups was 22–75 years and 17–79 years, respectively.

It should be noted that after ELISA tests, the number of serum-positive people in terms of anti-*Toxocara* antibody response in the case and control groups was 10 (20%) and 1 (2%), respectively.

Therefore, there was a statistically significant relationship between hypereosinophilia and a positive response to anti-*Toxocara* antibodies ($P=0.007$).

The result of the chi-square test revealed that there was a significant relationship between contact with soil and vegetables and dogs and cats in hypereosinophils (case group) and a positive response to anti-*Toxocara* antibodies ($P=0.004$).

The frequency distribution of variables and age characteristics of the subjects are presented in Tables 1 and 2, respectively.

Discussion

In this study, anti-*Toxocara* antibodies were observed in 20% of hypereosinophilic individuals and 2% in non-eosinophilic individuals. Therefore, a significant relationship was found between hypereosinophilia and the positive response of anti-*Toxocara* antibodies. In other words, eosinophilia in individuals can be used as an indicator to guide physicians in the possible diagnosis of *Toxocariasis* and prove the need for serological and immunological tests in these individuals.

In a comparative study by Karadam et al, at Aydin University in Turkey on anti-*Toxocara* IgG antibody titers in two groups with eosinophilia and no eosinophilia, 32.6% in the hypereosinophilia group and 20.3% in the non-hypereosinophilia group were positive for the anti-*Toxocara* antibody response (9).

Kwon et al from the University of Seoul, Korea, performed a serological study of toxocariasis in patients with unknown eosinophilia from 2001 to 2005. Out of 103 patients with unknown eosinophilia, 83% were positive for anti-*Toxocara* antibody titers, of which 70 (68%) were diagnosed with toxocariasis (10).

Likewise, Park et al in Korea found that the prevalence of anti-*Toxocara*-specific IgG antibodies worldwide ranged from 5.1% to 76.6%, which was due to cultural, religious, and climatic differences in different parts of the world (11).

Alavi et al in Ahvaz attempted to determine the prevalence of *T. canis* in children aged 6–15 years and concluded that out of 203 students, 10.3% had eosinophilia, of which 2% were positive for *Toxocara* (12). In this study, as in other studies, including the

Table 1. Frequency Distribution of Variables in Case (Hypereosinophilia) and Control Groups in Patients Referred to Tabriz Hospitals in 2017

		Case	Control	P Value
Gender	Male (man)	30 (60%)	22 (44%)	0.004
	Female (woman)	20 (40%)	28 (56%)	
Contact with dogs, cats, and soil	Positive serum	10 (50%)	1 (5%)	0.004
	Negative serum	10 (50%)	20 (52%)	
Abundance of people in terms of response to antibodies anti- <i>Toxocara</i>	Positive	10 (20%)	1 (2%)	0.007
	Negative	40 (80%)	49 (98%)	

Table 2. The Average Age of the Case and Control Groups in Patients Referred to Tabriz Hospitals in 2017

Age (y)	Group	
	Case	Control
Age (maximum)	75	79
Age (minimum)	22	17
Mean or average	48/5	48

recent study, there was a significant relationship between hypereosinophilia and positive anti-*Toxocara* antibody titer, but there was no significant relationship between *Toxocara* antibody titer and gender and age.

In a study conducted by Dr. Nasiri et al among 270 patients with the symptoms of blurred vision and high eosinophilia who referred to the ophthalmology ward in a hospital in Tehran, 38% of patients reported being infected with *Toxocariasis* (13).

Another finding from recent research is that in hypereosinophilic individuals who tested positive for anti-*Toxocara* antibodies, there were those who had some contact with soil, vegetables, dogs, and cats (14,15). In other words, people's jobs are effective at having high antibody titers; for example, housewives are more exposed to soil and vegetables than female employees, and farmers and ranchers are more exposed to soil, vegetables, dogs, and cats than employees.

In fact, there is a significant association between contact with soil, vegetables, dogs, and cats with high titers of effective anti-*Toxocara* antibodies (16,17).

Therefore, it is observed that the serum prevalence of toxocariasis in different geographical areas with different climatic conditions and among different countries can be due to the degree of contact with dogs and cats in different religions and breeds (e.g., among Muslims), close contact with dogs and objects that the dog has been in contact with is forbidden, which could be one of the reasons for the decrease in the prevalence of *Toxocara* in Muslim countries (18,19). In addition, the titles used to interpret the test results, as well as the sensitivity of the kit used in different studies, may have varied (20,21).

In any case, the overall serum prevalence of *Toxocara* obtained in this study was lower than in other studies,

which can be due to the religious beliefs of people in different parts of Tabriz to avoid close contact with dogs and cats, as well as the cold and mountainous climate of the region, which provides unfavorable conditions for the parasite's eggs to survive. For example, in a country like Turkey, which has a higher percentage of humidity than our country, the survival of parasite eggs, including *Toxocara*, is higher; thus, the serum prevalence of *Toxocara* is extremely higher among people than in our country, which has a dry climate. Therefore, it is suggested that more extensive epidemiological studies be conducted in the East Azerbaijan province of Iran to provide more complete information to infectious disease specialists and health professionals in the province to take steps to improve health and prevent toxocariasis infection.

Conclusion

Based on the findings of this study, there was a significant relationship between hypereosinophilia and a positive *Toxocara* titer. Another conclusion drawn from this study is that in hypereosinophils, a significant relationship was found between the positive response of anti-*Toxocara* antibodies and contact with soil, dogs, and cats. In other words, people with hypereosinophilia who were exposed to soil, dogs, and cats due to more occupational activity had a higher prevalence of *Toxocara* serum. It is also necessary that the ELISA test be performed on people with unspecified hypereosinophilia suspected of toxocariasis. Finally, people who have a positive anti-*Toxocara* antibody response should be screened for toxocariasis.

Authors' Contribution

Conceptualization: Yagoob Garedaghi, Ali Shabestari Asl.

Data curation: Yagoob Garedaghi.

Formal analysis: Yagoob Garedaghi, Ali Shabestari Asl.

Funding acquisition: Yagoob Garedaghi.

Investigation: Ali Shabestari Asl.

Methodology: Ali Shabestari Asl.

Project administration: Yagoob Garedaghi.

Resources: Ali Shabestari Asl.

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Validation: Ali Shabestari Asl.

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Competing Interests

The authors declare that they have no conflict of interests.

Ethical Approval

Ethical considerations have been fully observed in this research.

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