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**SEROPREVALENCE OF HUMAN TOXOCARIASIS
(VISCERAL LARVA MIGRANS)**

**ATEF M. EI-SHAZLY¹, S.M. ABDEL BASET², A. KAMAL³, KHAIRY A. MOHAMMED⁴,
T.I. SAKR⁵ AND S.M. HAMMAD⁶**

*Departments of Parasitology^{1,3,4}, Chest Medicine², Hepatology, Gastroenterology and
Infectious Disease⁵, and Community Medicine⁶, Faculties of Medicine, Mansoura
University^{1,2,6}, El-Minia University³, Al-Azhar University⁴ and Benha University⁵, Egypt*

Abstract

Background : Human toxocariasis is one of the most commonly reported zoonotic infections worldwide (Strickland, 2000) and its global importance may be greatly underestimated (Hotez and Wilkins, 2009); Toxocariasis results from zoonotic transmission of the roundworms.

Aim of the work : This study was conducted to determine seroprevalence of human toxocariasis in patients attending Mansoura and Benha Universities' hospitals and to identify factors associated with infection.

Subjects, Materials and Methods : A total of 455 patients who fulfilled the inclusion criteria were included in the study. The enrolled patients were subjected to a questionnaire (including sociodemographic and other risk factors) and thorough clinical examination was done for the patients. Sera were collected from patients and tested for anti-Toxocara IgG antibodies using ELISA. **Results:** The overall anti-Toxocara seropositive was (7.7%). It was significantly higher than among the randomly selected 30 healthy controls. There were no significant differences between the seropositive and seronegative patients regarding age, sex, educational level and monthly family income of the patient. However, rural residence, poor house, pet's ownership and frequent contact with soil were found to be significant. Patients who had confirmed bronchial asthma were more than 2 times at higher

risk of developing toxocariasis (OR, 2.33; 95% CI, 1.09-4.98) than those with other clinical diagnosis (PUO, hepato-megaly or heptosplenomegaly, lymphadenopathy, neurological disorders, gastrointestinal troubles and dermatitis). Patients with eosinophilia were at 149 times greater risk of being *Toxocara* seropositive compared to those without eosinophilia (OR, 148.7; 95% CI: 53.5-413.3). Multivariate regression analysis showed eosinophilia and contact with soil were the most important predictors of toxocariasis. OD of anti-*Toxocara* antibodies (ELISA) was significantly positive with eosinophilia level.

Conclusion : *Toxocara* seroprevalence was much higher in studied patients especially those with bronchial asthma (13.8%) than in the general population (0.0%). These results suggest that bronchial asthma presents a high risk for *Toxocara* infection specially if associated with eosinophilia. A large population-based survey is needed to assess the magnitude of the problem and identify more details about different risk factors.

Key words: Egypt, ELISA, Human toxocariasis, eosinophilia.

INTRODUCTION

Human toxocariasis is one of the most commonly reported zoonotic infections worldwide (Strickland, 2000) and its global importance may be greatly underestimated (Hotez and Wilkins, 2009); Toxocariasis results from zoonotic transmission of the roundworms, *Toxocara canis* and *T. cati* from dogs and cats, respectively. Human infections may take place by ingestion of embryo-nated eggs, or transfer (ingestion) of encapsulated larvae of *T. canis* in the tissues of a paratenic host (Gillespie and Hawkey, 1995). In certain ethnic groups, some adults tend to eat uncooked animal tissues which contain encapsulated infective larvae. Uncooked livers of cow (Chang et al, 2006; Known et al, 2006), pig (Fan et al, 2004), lamb (Salem and Schantz, 1992), and chicken (Nagakura et al, 1989; Mo-rimatsu et al., 2006) have been reported as sources of human infections. After swallowing, the encapsulated

larvae are liberated after hatching in the small intestine, penetrate the intestinal wall, get into the portal vein, and then reach the liver and lungs. They encapsulated and remained alive for a certain period. The resulting host inflammatory response ultimately overwhelms and either kills the migrating larvae or forces them into a state of arrested development, but not before they cause both mechanical and tissues immunopathological damage (Fitzgerald and Mansfield, 1970).

Toxocara larvae secrete at least 50 distinct macro-molecules as excretory-secretory (E/S) antigens that accounts for immune evasion and pathogenesis (Nunes *et al.*, 1999), and are diagnosed by ELISA-E/S antigens specific Igs (Dubinsky *et al.*, 2000) or western blot procedure (Sarimehmetoglu *et al.*, 2001). Many researchers have suggested that intraocular parasite-specific antibody levels are indicative of ocular toxocariasis, but little is known about the time course of the changes in these levels. (Akiyama *et al.*; 2010). The prevalence estimates for toxocariasis are based on serological surveys with banked sera that detect *Toxocara* specific antibodies (Jones *et al.*, 2008; Won *et al.*, 2008). ELISA have high sensitivity and specificity with very low levels of cross-reactivity when the excretory and secretory antigens of the second-stage *T. cards* larvae were used (MagnaVal *et al.*, 1991; 1992). VLM symptoms include hepatomegaly, myocarditis, nephritis, epilepsy, fever, urticaria, central nervous system disorders, asthma, severe breathing difficulty, wheezing cough and abdominal pain. Laboratory findings include marked eosinophilia, leukocytosis, hypergammaglobulinemia and liver function disorders (Gillespie, *et al.*, 1993; Magnaval *et al.*, 1993). Morias *et al.* 2012; concluded that clinical history, systemic evaluation and serology, the ultrasound can help in the diagnosis of ocular toxocariasis. There are few studies on the association between asthma and *Toxocara* infection among adults. Feldman and Parker (1992) have reported high anti- *Toxocara* IgG levels in a 48-year-old

patient with hypereosino-philic syndrome and asthma attacks. Minvielle *et al.* (1999) found elevated levels of & anti- Toxocara IgG in asthmatic patients. The diagnosis of toxocariasis is essentially clinical, based on the lesion morphology and supportive laboratory data such as serum enzyme-linked immunosorbent assay (ELISA) titers and ELISA Toxocara titers on aqueous humor; other diagnostic methods are imaging studies including optical coherence tomography, fluorescein angiography, computed tomography, and ocular ultrasound. Arevalo JF et al, (2013).

Globally, high rates of toxocariasis have been noted in middle-income countries, with prevalence up to 40% or higher in Indonesia and Brazil (Noordin *et al.*, 2005; De Andrade *et al.*, 2005). In Egypt toxocariasis showed seroprevalence rate of 18.1% in patients with toxoplasmosis (Azab *et al.*, 1990), 10.7% of children with renal troubles in Sharkia (Nada *et al.*, 1996), 6% of children with hepatomegaly in Zagazig (Hassan *et al.*, 1996), and 6.2% in children with respiratory symptoms or PUO and 18% in adults with PUO in Tanta (Antônio *et al.*, 2008).

This study was conducted to determine seroprevalence of human toxocariasis in patients attending Mansoura and Benha University hospitals and to identify factors associated with infection.

Subjects, Materials and Methods

This study was conducted from May to December 2008, and comprised 455 patients aged 1-67 years presented to Pediatric, Internal Medicine, Dermatology, Chest, Tropical Medicine and Neurology departments of the two University Hospitals. Patients were enrolled after obtaining verbal informed consent from them or from their parents or guardians in case of diseased children. Exclusion criteria were history of allergy, hepatitis B or C, malignancy, autoimmune diseases, and systemic steroid therapy or immunotherapy.

The patients or their parents or guardians in case of diseased children were directly interviewed using a questionnaire to assess the risk factors associated with *Toxocara* infection. Pet's ownership, frequent contact with soil and the socioeconomic status of the family were considered as the risk factors for acquiring toxocariasis. The family socio-demographic status was assessed by patients' education, family income and house type. Houses were classified as good or poor depending on the materials used for roof, floor and walls.

All were subjected to thorough clinical examination. Bronchial asthmatic patients were subjected to pulmonary function tests including peak expiratory flow arte and spirometry reversibility test to confirm asthma (GINA, 2006).

Blood samples were collected from all patients and submitted to: number of eosinophils, was measured by a chamber technique and expressed as $10^9/L$. Values from $-0.4-0.9 \times 10^9/L$ were classified as low eosinophilia, between $1.0-3.0 \times 10^9/L$ as high eosinophilia and over $3.0 \times 10^9/L$ as very high eosinophilia. Blood samples were centrifuged and sera stored at $-20^\circ C$ until tested. Anti *Toxocara* antibody was detected by a commercial ELISA kit (Bordier Affinity Products SA, Crissier, Switzerland). The test is based on E/S antigens of *Toxocara* larvae. The optical density (OD) was read at 490 nm using ELISA reader. Each plate had a positive control pooled sera from patients diagnosed as visceral larva migrans (VLM) syndrome and a high antibody level, and a known negative serum sample. The mean OD of the negative control was 0.234 ± 0.159 . The cut off value (0.711) was calculated as the mean negative control ± 3 SD. Some cross reactions may occur in other human helminthiasis, such as trichinosis, fascioliasis, and strongyloidiasis, titers in the helminthiasis were lower than in positive control of toxocariasis patients (Jacquier *et al.*, 1991).

Cases were also subjected to urine and stool examination, IHA for *Fasciola*, *Schistosoma* and *Toxoplasma*, blood film, hepatitis viral markers

and auto-antibody tests for autoimmune diseases to exclude cases with other parasitic diseases, viral hepatitis and autoimmune diseases.

Statistical analysis: Data were analyzed with statistical package SPSS version 15.0. Association between *anti-Toxocara* antibodies in patients and characters (epidemiological, clinical, and eosinophilia) was studied by univariate analysis with unadjusted odds ratios (ORs). Variables significant upon univariate were analyzed by multivariate logistic regression using maximum likelihood ratio test. Based on stepwise forward method, considering $p = 0.05$ for model entry and $p = 0.10$ for removal. Significance was considered at $P < 0.05$.

At the time of the study there was no Ethical Review Board in the Faculty of Medicine, Mansoura or Benha University, Egypt, so Ethical clearance was obtained from the different departments sharing in the study.

Results

The overall seroprevalence of human *anti-Toxocara* IgG antibodies among studied patients was 7.7% (Tab. 1). It was significantly higher than among the 30 randomly selected healthy controls ($P < 0.0001$). There were no significant differences between the seropositive and seronegative patients in respect of age, sex, educational level and monthly family income of the patient. However, rural residence, poor house, pets' ownership and frequent contact with soil were found to be significantly correlated with positive serology for *anti-Toxocara* IgG antibodies. The seroprevalence of human *anti-Toxocara* IgG antibodies among patients in relation to clinical presentation and eosinophilia was presented (Tab. 2). Patients with confirmed bronchial asthma were more than 2 times at higher risk of developing toxocariasis (OR, 2.33; 95% CI, 1.09-4.98) than those with other manifestations (PUO, hepatomegaly or hepatosplenomegaly, lymphadenopathy, neurological disorders, gastrointestinal troubles or dermatitis). Patients with eosinophilia were at 149 times greater risk

of *Toxocara* seropositive compared to patients without eosinophilia (OR, 148.7; 95% CI: 53.5-413.3).

The significant variables that correlated with positive serology for *anti-Toxocara* antibodies (rural residence, poor housing, pets ownership, frequent contact with soil), together with confirmed asthma and eosinophilia, were submitted to multivariate analysis. In the final model, only the frequent contact with soil and eosinophilia remained significantly correlated with *Toxocara* infection, indicating a higher risk of infection for individuals with eosinophilia (odds ratio = 154.45, 95% CI = 53.3 to 447.8) and frequent contact with soil (odds ratio = 3.0, 95% CI = 1.02 to 8.82) (Tab.3). The association between OD of ELISA-IgG and eosinophilia showed significant positive correlation between them (i- 0.77; P <0.001) (Tab. 4).

Table 1: Anti-Toxocara IgG related to sociodemography and characters of patients and ownership to pets and frequent contact with soil:

Patient characteristic	Total No (%)	Positive No (%)	P value	OR (95% CI)
Age (years): 1-<15 15+	99 (21.8) 356 (78.2)	10(10.1) 25 (7.0)	0.309	1.44 (0.71- 2.89) r
Male Femal e	280 (61.5) 175 (38.5)	24 (8.6) 11 (6.3)	0.79	1.36 (0.69- 2.71) r
Rural urban	276 (60.7) 179 (39.3)	27 (9.8) 8 (4.5)	0.038*	2.19(1.02- 4.71) V
Illiterate/read and write primary through preparatory Secondary+	147 (32.3) 180 (39.6) 128 (28.1)	15 (10.2) 12 (6.7) 8 (6.3)	0.237 0.884	.63 (0.72-3.72) 1.07(0.45- 2.53) 1"
Housing poor Housing good	160 (35.2) 295 (64.8)	18(11.3) 17 (5.8)	0.036*	1.95 (1.03- 3.68) 1°
Income not satisfactory income satisfactory	300 (65.9) 155 (34.1)	28 (9.3) 7 (4.5)	0.068	2.06 (0.92- 4.62) R
Pet ownership: Yes No	65 (14.3) 390(85.7)	9(13.8) 26 (6.7)	0.044*	2.25 (1.0-5.05) 1"
Frequent contact with soil. Yes No	137 (30.7) 318 (69.9)	18 (13.1) 17(5.3)	0.004*	2.68 (1.34- 5.37) I"

1* = reference category, * significant, CI= confidence interval

Table 2: Anti-Toxocara IgG related to patients' clinical picture & eosinophilia

Patient characteristic		Total No (%)	Positive No (%)	P value	OR (95% CI)
Pyrexia of unknown origin:	No Yes	400 (87.9) 55 (12.1)	31 (7.8) 4 (7.3)	0.901	1" 0.99 (0.92-1.08)
Hepato-megaly or hepato-splenomegaly	No Yes	375 (82.4) 80 (17.6)	28 (7.5) 7 (8.8)	0.696	1" 1.19 (0.5-2.83)
Lymphadcnopathy:	No Yes	385 (84.6) 70 (15.4)	32 (8.3) 3 (4.3)	0.245	1" 0.49 (0.15-1.66)
Neurological disorders:	No Yes	415 (91.2) 40 (8.8)	31 (7.5) 4 (8.8)	0.566	1" 1.38 (0.46-4.12)
Bronchial asthma:	No Yes	375 (82.4) 80 (17.6)	24 (6.4) 11 (13.8)	0.025*	1" 2.33 (1.09-4.98)
Gastrointestinal troubles:	No Yes	395 (86.8) 60 (13.2)	32 (8.1) 3 (5.0)	0.401	1" 0.59 (0.17-2.01)
Dermatitis:	No Yes	385 (84.6) 70 (15.4)	32 (8.3) 3 (4.3)	0.245	1" 0.49 (0.15-1.66)
Eosinophilia:	No Yes	416 (91.4) 39 (8.6)	7 (1.7) 28 (71.8)	0.000r	R 148.7 (53.5-413.29)

Table 3: Multivariate logistic regression analysis of significant predictors of anti-Toxocara positivity

Patient characteristic	P value	OR (95% CI)
Frequent contact with soil	0.045*	3 (1.02-8.82)
Eosinophilia	0.001*	154.45 (53.26-447.8)
Constant	0.001*	
Model χ^2	133.45	
Patient characteristic classified	96. 0	

Table 4: Correlation between of ELISA-IgG and eosinophilia

Eosinophilia	No (%) N=455	ELISA			
		Less than 0.7	0.7-0.9	>0.9- 1.1	>1.1
		No (%)	No (%)	No (%)	No (%)
No	417 (91.6)	410 (98.3)	6(1.4)	1 (0.2)	0 (0.0)
Low	21 (4.6)	10 (47.6)	3(14.3)	8 (38.1)	0 (0.0)
High	13 (2.9)	0 (0.0)	0 (0.0)	5 (38.5)	8 (61.5)
Very high	4(0.9)	0(0.0)	0 (0.0)	1 (25.0)	3 (75.0)
Spearman's rank correlation	0.769				
P value	0.001'				

Discussion

Human toxocariasis is an important and common zoonotic disease worldwide. Demographic and socioeconomical factors may lead to increase in *Toxocara* seroprevalance. Infections were generally asymptomatic, and seroprevalence varied from 3% to 86% in different countries (Alderete *et al.*, 2003). Total seroprevalence rate of *Toxocara* antibodies was 7.7% or lower than 29.8% in Nigeria (Ajayi *et al.*, 2000), 38% Sao Paulo, Brazil (Alderete *et al.*, 2003), 19% in Lebanon (Kanafani *et al.*, 2006) and 12.95% in North Western Turkey (Nihal *et al.*, 2007). The results controversy can be due to several factors; study designs, heterogeneity of individuals (blood donors, hospitalized patients or toxocariasis high risk group); non-standardized lab procedures and different cutoff points in serodiagnosis.

The present study did not find any relationship between the seropositivity rate and sex difference and age groups. Ajayi *et al.* (2000) and Nihal *et al.* (2007) reported that neither age nor gender seemed to be important factors related to a positive serology. However, literature reported a predominance of *T.*

canis in males that may be due to differences in social behaviors of boys, resulted in increasing exposure to infection (Overgaaauw, 1997; Kanafani *et al*, 2006; Antonios *et al*, 2008). Also, a predominance of seropositivity in children was due to the higher frequency of geophagia in ages (Chieffi *et al*, 1990). Theodoridis *et al*. (2001) reported that females were significantly more infected than males and Genchi *et al*. (1990) reported significant increase of seropositivity with age.

In the present study on univariate analysis we found higher *Toxocara* seroprevalence in rural than urban patients ($P < 0.005$). This data agreed with Nihal *et al*. (2007) and Antonios *et al*. (2008). But, Alavi and Sefidgaran (2008) in Iran found similar *Toxocara* sero-positive between rural and urban.

Egyptian patients with presumptive clinical syndromes. One hundred twenty eight were children suffering from respiratory symptoms or PUO and 22 were adults with PUO. Anti-*Toxocara*-IgG were detected in sera by ELISA. Sero-positivity was 6.2% in children (4% & 13.3% with respiratory symptoms and PUQ respectively). In adults, 18% were anti-*Toxocara* IgG positive that may be attributed to more outdoor activity.

In Korea, of 97 healthy people with over 10% eosinophilia, 60% was positive to *Toxocara* larvae excretory-secretory (TES) antigen by both immunoblot and ELISA (Park *et al*, 2002). In Europe, the seropositive rate is 2 to 5 % in apparently healthy urban adults, while the rate is 14.2% to 37% in rural areas (Magnaaval *et al*, 1994). In India, of 94 people of the general population and 30 patients with clinically suspected toxocariasis, 6 (6.4%) and 7 (23.3%), respectively, were seropositive to *Toxocara* (E/S) antigen (Malla *et al*, 2002). In Egypt, Ismail and Khalafallah (2005) stated that toxocariasis is a common parasite worldwide with high seroprevalence rates even among asymptomatic individuals and that diagnosis revealed a wide scope of clinical

syndromes, including dermatological diseases and chronic urticaria specially among those exposed to an increased risk of environmental toxocariasis.

The causes of eosinophilia are known to be mainly allergic diseases, parasitic diseases, cancer, and rheumatic diseases. Among the parasitic diseases, toxocariasis may be the most common cause of eosinophilia.

Consistent with previous reports (Aguilar-Santos *et al*, 2004; Nash, 2005), our study revealed that 28/39 (71.8%) patients with eosinophilia were seropositive. Also, eosinophilic patients were at 149 times greater risk of being *Toxocara* seropositive compared to patients who had no eosinophilia (OR, 148.7; 95% CI: 53.5-413.3) and eosinophilia was the most important predictor of *Toxocara* infection on multivariate regression analysis. Gueglio *et al*. (1994) tested 1836 eosinophilic patients by ELISA E/S *Toxocara* antigen and found positive results in 29% of cases. In Korea, out of 127 sera from patients with eosinophilia (more than 500 /ul or more than or equal to 10% WBC) who visited the hospital, 70 sera (68%) were positive to ES antigen and patients with lesions in the liver showed higher serum eosinophil cationic protein (ECP) values (Kwon *et al*, 2005).

Toxocara larvae induced an eosinophilic response followed by the presence of specific IgG anti-*Toxocara* in sera within 2-3 weeks. During the process of destruction of larvae in tissue, which is a slow one up to years, the circulating eosinophils decrease but *anti-Toxocara* remains for a longer time? Another cause for the lack of eosinophils in sero-positive individuals may be the low intensity of infection. Only in fully developed VLM syndrome, diagnosed clinically, can intensity of infection assumed to be high. The intensity of infection might be assessed indirectly and imprecisely only by measuring the sero-prevalence rates and the values of titers or O.D. of the serological tests (Luzna-Lyskov, 2000). However, Kim *et al*. (2008) did not find seropositive toxocariasis in population with eosinophilia (more than or equal to 10% WBC)

To detect a current active infection of toxocariasis, IgE needs to be tested by ELISA and an assessment of eosinophil cationic protein (ECP) is required. People that test positive may have covert toxocariasis, so that a screening for toxocariasis among those with eosinophilia should be done. This would prevent misdiagnosis of toxocariasis as idiopathic hypereosinophilic syndrome, which may result in inappropriate clinical interventions.

In Egypt, many authors dealt with zoonotic toxocariasis as Oteifa and Mous-tafa, 1997), El Shazly *et al* (2002a, b; 2009). Elsheikha *et al.* (2008) studied the kinetics of eosinophilia and IgE production in experimental murine toxocariasis. Ha-ridy *et al.* (2009) reported toxocariasis in street and in pet dogs.

Conclusion

Toxocara seroprevalence was much higher in studied patients especially those with bronchial asthma (13.8%) than in the general population (0.0%). These results suggest that bronchial asthma presents a high risk for *Toxocara* infection specially if associated with eosinophilia. A large population-based survey is needed to assess the magnitude of the problem and identify more details about different risk factors.

References

- Alderete, J.M.; Jacob, CM.; Pas-torino, A.C.; Elefant, G.R.; Castro, A.P.; et al., 2003:** Prevalence of *Toxocara* infection in schoolchildren from the Butanta region, Sao Paulo, Brazil. Mem. Inst. Oswaldo Cruz, 98:593-7.
- Akiyama, T .; Ohta, N.:(2010);** Parasite-specific antibody profile in the aqueous humor of rabbits with ocular toxocariasis. Parasitol Int. 59(2):112-20.
- Ajayi, O.O.; Duhlinska, D.D.; Agwale, S.M.; Njoku, M., 2000:** Frequency of human toxocariasis in Jos, Plateau State, Nigeria. Mem. Inst. Oswaldo Cruz, 95:147-9.
- Aguiar-Santos, A.M.; Andrade, L.D.; Medeiros, Z.; Chieffi, P.P.; et al., 2004:** Human toxocariasis: Frequency of *mti-Toxocara* antibodies in children and adolescent from an outpatient clinic for lymphatic filariasis in Recife, northeast Brazil. Rev Inst Med Trop S Paulo, 46, 2:25-33.
- Antonios, S.; Eid, M.M.; Khalifa, E.A.; Othman, A.A., 2008:** Sero-pre-valence study of *Toxocara canis* in selected Egyptian patients. J. Egypt. Soc. Parasitol., 38, 1:313-8.
- Arevalo, J.F.; Espinoza, J.V.; Arevalo, F.A.; 2013:** Ocular toxocariasis. J Pediatr Ophthalmol Strabismus. 50(2):76-86.
- Azab, M.E.; Safar, E.H.; Khat-tab, H.M., 1990:** Concomitant *Toxoplasma* and *Toxocara* infections. J. Egypt. Soc. Parasitol., 20, 1:235-61.
- Bouchard, O.; Arbib, F.; Para-melle, B.; Brambilla, G., 1994:** Acute eosinophilic pneumonia and the larva migrans syndrome. Rev. Mai. Respi., 11, 6:593-5.
- Buijs, J.; Borsboom, G.; Renting, M.; Hilgersom, W.J.; van Wierin-gen, J.C., 1997:** Relationship between allergic manifestations and *Toxocara* sero-positivity: a cross-sectional study among elementary school children. Eur. Respi. J., 10, 7:1467-75.

- Buijs, J.; Borsboom, G.; van Ge-mund, J.J.; Hazebroek, A.; van Dongen, P.A., 1994:** *Toxocara* seroprevalence in 5-year-old elementary schoolchildren: relation with allergic asthma. Am. J. Epidemiol., 140, 9:839-47.
- Chan, P.W.; Anuar, A.K.; Fong, M.Y.; Debruyne, J.A.; Ibrahim, J., 2001:** *Toxocara* seroprevalence and childhood asthma among ma-lay sian children. Pediatr. Int., 43, 4:350-3.
- Chang, S.; Lim, J.H.; Choi, D.; Park, C.K.; Kwon, N.H.; Cho, S. Y.; Choi, D.C., 2006:** Hepatic visceral larva migrans of *Toxocara canis*: CT & sonographic findings. Am. J. Roentgenol., 187: W622-9.
- Chieffi, P.P.; Ueda, M.; Camargo, E.D. et al, 1990:** Visceral larva migrans, a seroepidemiological survey in five municipalities of Sao Paulo State, Brazil. Rev. Inst. Med. Trop. S.Paulo, 32:204-10.
- Choi, J.H.; Suh, Y.J.; Jung, J.W.; Song, H.J.; Suh, C.H.; Huh, S.; Nahm, D.H.; Park, H.S., 2003:** Clinical significance of serum ECP and sero-prevalence of human toxocariasis in patients with eosinophilia. J. Asthma Allergy Clin. Immunol., 23:26-32.
- De Andrade, L.C.R.; De Car-valho, L.B.Jr.; Perez, E.P.; Araki, K.; Takeuchi, T., 2005:** Prevalence of toxocariasis in northeastern Brazil based on serology using recombinant *Toxocara canis* antigen. Am. J. Trop. Med. Hyg., 72, 1:103-7.
- Dubinsky, P.; Akao, N.; Re-iterovJ, K.; Konakova, G., 2000:** Comparison of the sensitive screening kit with two ELISA sets for detection of *smti-Toxocara* antibodies. Southeast-Asian J. Trop. Med. Pub. Hlth., 31, 2:394-8.
- El Shazly, A.M.; Haridy, F.M.; Haseeb, A.N.; Rifaat, M.M.A.; Abo El Sao-ud, S.F.; Morsy, T.A., 2002a:** Experimental murine toxocariasis larval migration to liver, with a general discussion. J. Egypt. Soc. Parasitol., 32, 1: 229-40.

El Shazly, A.M.; Abdel-Mageed, S.; El Hamshary, E.; El Shewey, Kh.; Da-woud, H.A.; Morsy, T.A., 2002b: Cardiopulmonary pathology in primary murine toxocariasis. J. Egypt. Soc. Parasitol., 32, 2:457-67.

El-Shazly, A.M.; Mohammed, R. M.; El-Beshbishi, S.N.; Azab, M. S.; El-Ghareeb , A.S.; Abdel Ta-wab, A.H.; Zalook, T.Kh., 2009: Soil-parasites particularly *Toxocara* eggs in Egypt. J. Egypt. Soc. Parasitol., 39, 1.T51-62.

Elsheikha, H.M.; El-Beshbishi, S. N.; El-Shazly, A.M.; Hafez, A.O.; Morsy, T.A., 2008: Kinetics of eosinophilia and IgE production in experimental murine toxocariasis. J. Egypt. Soc. Parasitol., 38, 1:53-64.

Fan, C.K.; Lan, H.S.; Hung, C.C.; Chung, W.C.; Liao, C.W.; Du, W.Y.; Su, K.E., 2004: Seroepidemiology of *Toxocara canis* among mountain ab original adults in Taiwan. Am. J. Trop. Med. Hyg., 71:216-21.

Feldman G.J.; Parker H.W., 1992: Visceral larva migrans associated with the hypereosinophilic syndrome and the onset of severe asthma, Ann. Int. Med., 116: 838-40.

Fitzgerald, P.R.; Mansfield, M.E., 1970: Visceral larva migrans (*Toxocara canis*) in calves. Am. J. Vet. Res., 31:561-5.

Genchi, C; Di Sacco, B.; Gatti, S.; Sangalli, G.; Scaglia, M., 1990: Epi-demiology of human toxocariasis in northern Italy. Parasitol., 32, 3:313-9

Gillespie, S.H.; Bidwell, D.; Vol-ler, A.; Robertson, B.; Maizels, R.M., 1993: Diagnosis of human toxocariasis by antigen capture enzyme linked immunosorbent assay. J. Clin. Pathol. 46:551-4.

Gillespie, S.H.; Hawkey, P.M., 1995: Medical Parasitology. 1st ed., New York, USA. Oxford University Press Inc.

Glickman, L.T.; Magnaval, J.F.; Domanski, L.M.; Shofer, F.S.; Lauria, S.S.; Gottstein, B.; Bro-chier, B., 1987: Visceral larva migrans in French adults: a new disease syndrome? Am. J. Epidemiol., 125, 6:1019-34.

- Gueglic, B.; de Gentile, L.; Nguyen, J.M.; Achard, J.; Cha-basse, D.; Marjolet, M., 1994:** Epidemiologic approach to human toxocariasis in western France. *Parasitol. Res.*, 80, 6:531-6.
- Haridy, F.M.; Hassan A.A.; Hafez, A.O.; El-Sherbini, G.T.; Morsy, T.A., 2009:** External and intestinal parasites of pet dogs with reference to zoonotic toxocariasis: *J. Egypt. Soc. Parasitol.*, 39, 1:321-6.
- Hassan, M.M.; Farghaly, A.M.; Gaber, N.S.; Nageeb, H.F.; Hegab, M.H.; Galal, N., 1996:** Parasitic causes of hepatomegaly in children. *J. Egypt. Soc. Parasitol.*, 26, 1:177-89.
- Hotez, P.J., 1993:** Visceral and ocular larva migrans. *Semin. Neurol.*, 13, 2: 175 -9.
- Hotez, P.J.; Wilkins, P.P., 2009:** Toxocariasis: America's most common neglected infection of poverty and a helminthiasis of global importance? *PLoS Neg. Trop. Dis.*, 3, 3:e400.
- Humbert, P.; Niezborala, M.; Sa-lemnier, R.; Aubin, F.; Piarroux, R.; Buchet, S.; Jarale T., 2000:** Skin manifestations associated with toxocariasis: a case-control study. *Dermatol.*, 201, 3:230-4.
- Ismail, M.; Khalafallah, O., 1995:** *Toxocara canis* and chronic urticaria in Egyptian patients. *J. Egypt. Soc. Parasitol.*, 35, 3:833-40.
- Jacquier, P.; Gottstein, B.; Stinge-lin, Y.; Eckert, J., 1991:** Immuno-diagnosis toxocarosis in humans: evaluation of a new enzyme-linked immunosorbent assay kit. *J. Clin. Microbiol.*, 29, 183:1-5.
- Jones, J.L.; Moran, D.K.; Won, K.; Wilson, M.; Schantz, P.M., 2008:** *Toxoplasma gondii* and *Toxocara* spp. co-infection. *Am. J. Trop. Med. Hyg.*, 78, 1:35-9.
- Kanafani, Z.A.; Skoury, A.; Araj, G.F.; El-Klioury, M.; Sawaya, R.A.; et al., 2006:** Seroprevalence of toxocariasis in Lebanon: a pilot study. *Parasitol.*, 132, 5:635-9

Kim, Y.H.; Huh S.; Chung, Y.B., 2008: Seroprevalence of toxocariasis among healthy people with eosinophilia. Korean J. Parasitol., 46, 1:29-32.

Kroegel, C, 2007: Global initiative for asthma management and prevention-GINA 2006. Pneumol., 61, 5:295-304.

Kuk, S.; Ozel, E.; Oguzturk, H.; Kirkil, G.; Kaplan, M., 2006: Se-ro-prevalence of *Toxocara* antibodies in patients with adult asthma. South Med. J., 99, 7:719-22.

Kwon, N.H.; Oh, M.J., Lee, S.P.; Lee, B.J.; Choi, D., 2005: Clinical impact of toxocariasis in patients with unknown eosinophilia. J. Asthma Allergy Clin. Immunol., 25:299-304.

Kwon, N.H.; Oh, M.J.; Lee, S.P.; Lee, B.J.; Choi, D., 2006: The prevalence and diagnostic value of toxocariasis in unknown eosinophilia. Ann. Hematol., 85:233-8.

Magnaval, J.F.; Fabre, R.P.; Mariners, J.P.; Charlet, J.P.; de Lar-rard, B., 1991: Application of Western blotting procedure for the immunodiagnosis of human toxocariasis. Parasitol. Res., 77:697-702

Magnaval, J.F.; Fabre, R.P.; Mariners, J.P.; Charlet, J.P.; de Lar-rard, B., 1992: Evaluation of an immunoenzymatic assay detecting specific *anti-Toxocara* IgE for diagnosis and post treatment follow-up of human toxo-cariasis. J. Clin. Microbiol. 30:2269-74.

Magnaval, J.F.; Michault, A.; Ca-lon, N.; Charlet, J.P., 1994: Epidemiology of human toxocariasis in La Reunion. Trans. R. Soc. Trop. Med. Hyg., 88:531-3.

Magnaval, J.F.; Glickman, L.T.; Dorchies, P.; Morassin, B., 2001: High-lights of human toxocariasis. Korean J. Parasitol., 39:1-11.

Malla, N.; Aggarwal, A.K.; Maha-jan, R.C., 2002: A serological study of human toxocariasis in north India. Natl. Med. J. India,15:145-7.

Marx, C; Lin, J.; Masruha, M.R.; Rodrigues, M.G.; da Rocha, A.J.,

2007: Toxocariasis of the CNS simulating acute disseminated encephalomyelitis. *Neurol.*, 69, 8: 806-7.

Minvielle, G.; Niedfeld, M.; Ci-armela, A.; De Falco, H.; Ghiani, J., 1999: Asthma and covert toxocariasis. *Med.*, 59: 243-8. **Mizgajski, H., 1997:** Role of some environmental factors in contamination of soil with *Toxocara* spp. and other geohelminth eggs. *Parasit. Int.*, 46: 67-72.

Morais, F.B.1.; Maciel, A.L.; Arantes, T.E.; Muccioli, C.; Allemann, N.; (2012); Ultrasonographic findings in ocular toxocariasis. *Arq Bras Oftalmol.* 75(1): 43-7.

Morimatsu, Y.; Akao, N.; Aki-yosh, H.; Kawazu, T.; Okabe, Y.; Aizawa, H., 2006: A familial case of visceral larva migrans after ingestion of raw chicken livers, appearance of specific antibody in bronchoalveolar lavage fluid of the patients. *Am. J. Trop. Med. Hyg.*, 75: 303-6.

Nada, S. M.; Abbaza, B.E.; Mah-moud, L.A.; Habeeb, Y.S.; Hussein, H.F.; Amer, O.T., 1996: Toxocariasis as a cause of renal disease in children in Sharkia Governorate, Egypt. *J. Egypt. Soc. Parasitol.*, 26, 3: 709-17.

Nagakura, K.; Tachibana, H.; Kaneda, Y.; Kato, Y., 1989: Toxocariasis possibly caused by ingesting raw chicken. *J. Infect. Dis.*, 160: 735-6.

Nash, T.E., 2005: Visceral Larva Migrans and Other Unusual Helminth Infection. In: *Principles and Practice of Infectious Diseases* Mandel, Douglas, Bennett. 6th ed.; Churchill Livingstone Philadelphia.

Nihal, D.; Ener, C.; Ozcan, B.; Seray, O.; Yusuf O., 2007: Seroprevalence Survey for *Toxocara canis* infection in the Northwestern Part of Turkey. *Turk. Parasitol. Dergisi.* 31, 4: 288-91

Noordin, R.; Smith, H.V.; Mohamad, S.; Maizels, R.M.; Fong, M.Y., 2005: Comparison of IgG-ELISA and IgG4-ELISA for *Toxocara* serodiagnosis. *Acta Trop.*, 93, 1: 57-62.

Nunes, CM.; Tundisi, R.; Heine-mann, M.; Ogassawara, S.; Rich-tzenhain, L.J., 1999: Toxocariasis: serological diagnosis by indirect antibody competition ELISA. Rev. Inst. Med. Trop. Sao. Paulo, 41, 2:95-100.

Oteifa, M.N.; Moustafa, M.A., 1997: Potential risk of contracting toxocariasis in Heliopolis district, Cairo, Egypt. J. Egypt. Soc. Parasitol., 27, 1: 197-203.

Overgaauw, P.A., 1997: Aspects of *Toxocara* epidemiology: toxocarosis in dogs and cats. Crit. Rev. Microbiol., 23:233-51.

Park, H.Y.; Lee, S.U.; Huh, S.; Kong, Y.; Magnaval, J.F., 2002: A sero-epidemiological survey for toxocariasis in apparently healthy residents in Gangwon-do, Korea. Korean J. Parasitol., 40:113-7.

Pawlowski, Z., 2001: Toxocariasis in humans: clinical expression and treatment dilemma. J. Helminthol., 75, 4:299-305.

Salem, G.; Schantz, P., 1992: Toxocaral visceral larva migrans after ingestion of raw lamb liver. Can. Infect. Dis., 15:743-4.

Sarimehmetoglu, H.; Burgu, A.; Aycicek, H.; Gonenc, B.; Ta-nyukse, M.; Kara, M., 2001: Application of western blotting procedure for immuno-diagnosis of visceral larva migrans in mice by using excretory/secretory antigens. Dtsch. Tierarztl. Wochenschr., 108, 9:390-2.

Schantz, P.M.; Weis, P.E.; Pollard, Z.F.; White, M.C., 1980: Risk factors of toxocaral ocular larva migrans: a case-control study. Amer. J. Publ. Hlth., 70:1269-72.

Strickland, G.T., 2000: Hunter's Tropical Medicine and Emerging Infectious Diseases. 8th ed.. W.B. Saunders Co. Philadelphia. London, Toronto, Montreal. Sydney. Tokyo.

Taylor, M.R.; Keane, C.T.; O'Connor, P.; Multihull, E.; Holland, C., 1988: The expanded spectrum of toxocaral disease. Lancet **1**, 8587:692-5.

Theodoridis, I.; Frydas, S.; Papazahariadou, M.; Hatzistil-ianou, M.; Adamama, K.K., 2001:Toxocarosis as zoonosis: A review of literature and the prevalence of *Toxocara canis* antibodies in 511 serum samples. Int. J. Immuno-pathol. Pharmacol., 14:17-23.

Won, K.Y.; Moran, D.; Schantz, P.; Jones, J.P., 2008: National sero-prevalence and risk factors for zoonotic *Toxocara* spp. infection. Am. J. Trop. Med. Hyg.,79,4:552-7.

(VISCERAL LARVA MIGRANS)

**ATEF M. EI-SHAZLY¹, S.M. ABDEL BASET², A. KAMAL³, KHAIRY A. MOHAMMED⁴,
T.I. SAKR⁵ AND S.M. HAMMAD⁶**

Departments of Parasitology^{1,3,4}, Chest Medicine², Hepatology, Gastroenterology and Infectious Disease⁵, and Community Medicine⁶, Faculties of Medicine, Mansoura University^{1,2,6}, El-Minia University³, Al-Azhar University⁴ and Benha University⁵, Egypt

Abstract

Background : Human toxocariasis is one of the most commonly reported zoonotic infections worldwide (Strickland, 2000) and its global importance may be greatly underestimated (Hotez and Wilkins, 2009); Toxocariasis results from zoonotic transmission of the roundworms.

Aim of the work : This study was conducted to determine seroprevalence of human toxocariasis in patients attending Mansoura and Benha Universities' hospitals and to identify factors associated with infection.

Subjects, Materials and Methods : A total of 455 patients who fulfilled the inclusion criteria were included in the study. The enrolled patients were subjected to a questionnaire (including sociodemographic and other risk factors) and thorough clinical examination was done for the patients. Sera were collected from patients and tested for anti-Toxocara IgG antibodies using ELISA. **Results:** The overall anti-Toxocara seropositive was (7.7%). It was significantly higher than among the randomly selected 30 healthy controls. There were no significant differences between the seropositive and seronegative patients regarding age, sex, educational level and monthly family income of the patient. However, rural residence, poor house, pet's ownership and frequent contact with soil were found to be significant. Patients who had confirmed bronchial asthma were more than 2 times at higher

risk of developing toxocariasis (OR, 2.33; 95% CI, 1.09-4.98) than those with other clinical diagnosis (PUO, hepato-megaly or heptosplenomegaly, lymphadenopathy, neurological disorders, gastrointestinal troubles and dermatitis). Patients with eosinophilia were at 149 times greater risk of being *Toxocara* seropositive compared to those without eosinophilia (OR, 148.7; 95% CI: 53.5-413.3). Multivariate regression analysis showed eosinophilia and contact with soil were the most important predictors of toxocariasis. OD of anti-*Toxocara* antibodies (ELISA) was significantly positive with eosinophilia level.

Conclusion : *Toxocara* seroprevalence was much higher in studied patients especially those with bronchial asthma (13.8%) than in the general population (0.0%). These results suggest that bronchial asthma presents a high risk for *Toxocara* infection specially if associated with eosinophilia. A large population-based survey is needed to assess the magnitude of the problem and identify more details about different risk factors.

Key words: Egypt, ELISA, Human toxocariasis, eosinophilia.

INTRODUCTION

Human toxocariasis is one of the most commonly reported zoonotic infections worldwide (Strickland, 2000) and its global importance may be greatly underestimated (Hotez and Wilkins, 2009); Toxocariasis results from zoonotic transmission of the roundworms, *Toxocara canis* and *T. cati* from dogs and cats, respectively. Human infections may take place by ingestion of embryo-nated eggs, or transfer (ingestion) of encapsulated larvae of *T. canis* in the tissues of a paratenic host (Gillespie and Hawkey, 1995). In certain ethnic groups, some adults tend to eat uncooked animal tissues which contain encapsulated infective larvae. Uncooked livers of cow (Chang et al, 2006; Known et al, 2006), pig (Fan et al, 2004), lamb (Salem and Schantz, 1992), and chicken (Nagakura et al, 1989; Mo-rimatsu et al., 2006) have been reported as sources of human infections. After swallowing, the encapsulated

larvae are liberated after hatching in the small intestine, penetrate the intestinal wall, get into the portal vein, and then reach the liver and lungs. They encapsulated and remained alive for a certain period. The resulting host inflammatory response ultimately overwhelms and either kills the migrating larvae or forces them into a state of arrested development, but not before they cause both mechanical and tissues immunopathological damage (Fitzgerald and Mansfield, 1970).

Toxocara larvae secrete at least 50 distinct macro-molecules as excretory-secretory (E/S) antigens that accounts for immune evasion and pathogenesis (Nunes *et al.*, 1999), and are diagnosed by ELISA-E/S antigens specific Igs (Dubinsky *et al.*, 2000) or western blot procedure (Sarimehmetoglu *et al.*, 2001). Many researchers have suggested that intraocular parasite-specific antibody levels are indicative of ocular toxocariasis, but little is known about the time course of the changes in these levels. (Akiyama *et al.*; 2010). The prevalence estimates for toxocariasis are based on serological surveys with banked sera that detect *Toxocara* specific antibodies (Jones *et al.*, 2008; Won *et al.*, 2008). ELISA have high sensitivity and specificity with very low levels of cross-reactivity when the excretory and secretory antigens of the second-stage *T. cards* larvae were used (MagnaVal *et al.*, 1991; 1992). VLM symptoms include hepatomegaly, myocarditis, nephritis, epilepsy, fever, urticaria, central nervous system disorders, asthma, severe breathing difficulty, wheezing cough and abdominal pain. Laboratory findings include marked eosinophilia, leukocytosis, hypergammaglobulinemia and liver function disorders (Gillespie, *et al.*, 1993; Magnaval *et al.*, 1993). Morias *et al.* 2012; concluded that clinical history, systemic evaluation and serology, the ultrasound can help in the diagnosis of ocular toxocariasis. There are few studies on the association between asthma and *Toxocara* infection among adults. Feldman and Parker (1992) have reported high anti- *Toxocara* IgG levels in a 48-year-old

patient with hypereosino-philic syndrome and asthma attacks. Minvielle *et al.* (1999) found elevated levels of & anti- Toxocara IgG in asthmatic patients. The diagnosis of toxocariasis is essentially clinical, based on the lesion morphology and supportive laboratory data such as serum enzyme-linked immunosorbent assay (ELISA) titers and ELISA Toxocara titers on aqueous humor; other diagnostic methods are imaging studies including optical coherence tomography, fluorescein angiography, computed tomography, and ocular ultrasound. Arevalo JF et al, (2013).

Globally, high rates of toxocariasis have been noted in middle-income countries, with prevalence up to 40% or higher in Indonesia and Brazil (Noordin *et al.*, 2005; De Andrade *et al.*, 2005). In Egypt toxocariasis showed seroprevalence rate of 18.1% in patients with toxoplasmosis (Azab *et al.*, 1990), 10.7% of children with renal troubles in Sharkia (Nada *et al.*, 1996), 6% of children with hepatomegaly in Zagazig (Hassan *et al.*, 1996), and 6.2% in children with respiratory symptoms or PUO and 18% in adults with PUO in Tanta (Antônio *et al.*, 2008).

This study was conducted to determine seroprevalence of human toxocariasis in patients attending Mansoura and Benha University hospitals and to identify factors associated with infection.

Subjects, Materials and Methods

This study was conducted from May to December 2008, and comprised 455 patients aged 1-67 years presented to Pediatric, Internal Medicine, Dermatology, Chest, Tropical Medicine and Neurology departments of the two University Hospitals. Patients were enrolled after obtaining verbal informed consent from them or from their parents or guardians in case of diseased children. Exclusion criteria were history of allergy, hepatitis B or C, malignancy, autoimmune diseases, and systemic steroid therapy or immunotherapy.

The patients or their parents or guardians in case of diseased children were directly interviewed using a questionnaire to assess the risk factors associated with *Toxocara* infection. Pet's ownership, frequent contact with soil and the socioeconomic status of the family were considered as the risk factors for acquiring toxocariasis. The family socio-demographic status was assessed by patients' education, family income and house type. Houses were classified as good or poor depending on the materials used for roof, floor and walls.

All were subjected to thorough clinical examination. Bronchial asthmatic patients were subjected to pulmonary function tests including peak expiratory flow arte and spirometry reversibility test to confirm asthma (GINA, 2006).

Blood samples were collected from all patients and submitted to: number of eosinophils, was measured by a chamber technique and expressed as $10^9/L$. Values from $-0.4-0.9 \times 10^9/L$ were classified as low eosinophilia, between $1.0-3.0 \times 10^9/L$ as high eosinophilia and over $3.0 \times 10^9/L$ as very high eosinophilia. Blood samples were centrifuged and sera stored at $-20^\circ C$ until tested. Anti *Toxocara* antibody was detected by a commercial ELISA kit (Bordier Affinity Products SA, Crissier, Switzerland). The test is based on E/S antigens of *Toxocara* larvae. The optical density (OD) was read at 490 nm using ELISA reader. Each plate had a positive control pooled sera from patients diagnosed as visceral larva migrans (VLM) syndrome and a high antibody level, and a known negative serum sample. The mean OD of the negative control was 0.234 ± 0.159 . The cut off value (0.711) was calculated as the mean negative control ± 3 SD. Some cross reactions may occur in other human helminthiasis, such as trichinosis, fascioliasis, and strongyloidiasis, titers in the helminthiasis were lower than in positive control of toxocariasis patients (Jacquier *et al.*, 1991).

Cases were also subjected to urine and stool examination, IHA for *Fasciola*, *Schistosoma* and *Toxoplasma*, blood film, hepatitis viral markers

and auto-antibody tests for autoimmune diseases to exclude cases with other parasitic diseases, viral hepatitis and autoimmune diseases.

Statistical analysis: Data were analyzed with statistical package SPSS version 15.0. Association between *anti-Toxocara* antibodies in patients and characters (epidemiological, clinical, and eosinophilia) was studied by univariate analysis with unadjusted odds ratios (ORs). Variables significant upon univariate were analyzed by multivariate logistic regression using maximum likelihood ratio test. Based on stepwise forward method, considering $p = 0.05$ for model entry and $p = 0.10$ for removal. Significance was considered at $P < 0.05$.

At the time of the study there was no Ethical Review Board in the Faculty of Medicine, Mansoura or Benha University, Egypt, so Ethical clearance was obtained from the different departments sharing in the study.

Results

The overall seroprevalence of human *anti-Toxocara* IgG antibodies among studied patients was 7.7% (Tab. 1). It was significantly higher than among the 30 randomly selected healthy controls ($P < 0.0001$). There were no significant differences between the seropositive and seronegative patients in respect of age, sex, educational level and monthly family income of the patient. However, rural residence, poor house, pets' ownership and frequent contact with soil were found to be significantly correlated with positive serology for *anti-Toxocara* IgG antibodies. The seroprevalence of human *anti-Toxocara* IgG antibodies among patients in relation to clinical presentation and eosinophilia was presented (Tab. 2). Patients with confirmed bronchial asthma were more than 2 times at higher risk of developing toxocariasis (OR, 2.33; 95% CI, 1.09-4.98) than those with other manifestations (PUO, hepatomegaly or hepatosplenomegaly, lymphadenopathy, neurological disorders, gastrointestinal troubles or dermatitis). Patients with eosinophilia were at 149 times greater risk

of *Toxocara* seropositive compared to patients without eosinophilia (OR, 148.7; 95% CI: 53.5-413.3).

The significant variables that correlated with positive serology for *anti-Toxocara* antibodies (rural residence, poor housing, pets ownership, frequent contact with soil), together with confirmed asthma and eosinophilia, were submitted to multivariate analysis. In the final model, only the frequent contact with soil and eosinophilia remained significantly correlated with *Toxocara* infection, indicating a higher risk of infection for individuals with eosinophilia (odds ratio = 154.45, 95% CI = 53.3 to 447.8) and frequent contact with soil (odds ratio = 3.0, 95% CI = 1.02 to 8.82) (Tab.3). The association between OD of ELISA-IgG and eosinophilia showed significant positive correlation between them (i- 0.77; P <0.001) (Tab. 4).

Table 1: Anti-Toxocara IgG related to sociodemography and characters of patients and ownership to pets and frequent contact with soil:

Patient characteristic	Total No (%)	Positive No (%)	P value	OR (95% CI)
Age (years): 1-<15 15+	99 (21.8) 356 (78.2)	10(10.1) 25 (7.0)	0.309	1.44 (0.71-2.89) r
Male Female	280 (61.5) 175 (38.5)	24 (8.6) 11 (6.3)	0.79	1.36 (0.69-2.71) r
Rural urban	276 (60.7) 179 (39.3)	27 (9.8) 8 (4.5)	0.038*	2.19(1.02-4.71) V
Illiterate/read and write primary through preparatory Secondary+	147 (32.3) 180 (39.6) 128 (28.1)	15 (10.2) 12 (6.7) 8 (6.3)	0.237 0.884	.63 (0.72-3.72) 1.07(0.45-2.53) 1"
Housing poor Housing good	160 (35.2) 295 (64.8)	18(11.3) 17 (5.8)	0.036*	1.95 (1.03-3.68) 1°
Income not satisfactory income satisfactory	300 (65.9) 155 (34.1)	28 (9.3) 7 (4.5)	0.068	2.06 (0.92-4.62) R
Pet ownership: Yes No	65 (14.3) 390(85.7)	9(13.8) 26 (6.7)	0.044*	2.25 (1.0-5.05) 1"
Frequent contact with soil. Yes No	137 (30.7) 318 (69.9)	18 (13.1) 17(5.3)	0.004*	2.68 (1.34-5.37) I"

1* = reference category, * significant, CI= confidence interval

Table 2: Anti-Toxocara IgG related to patients' clinical picture & eosinophilia

Patient characteristic		Total No (%)	Positive No (%)	P value	OR (95% CI)
Pyrexia of unknown origin:	No Yes	400 (87.9) 55 (12.1)	31 (7.8) 4 (7.3)	0.901	1" 0.99 (0.92-1.08)
Hepato-megaly or hepato-splenomegaly	No Yes	375 (82.4) 80 (17.6)	28 (7.5) 7 (8.8)	0.696	1" 1.19 (0.5-2.83)
Lymphadcnopathy:	No Yes	385 (84.6) 70 (15.4)	32 (8.3) 3 (4.3)	0.245	1" 0.49 (0.15-1.66)
Neurological disorders:	No Yes	415 (91.2) 40 (8.8)	31 (7.5) 4 (8.8)	0.566	1" 1.38 (0.46-4.12)
Bronchial asthma:	No Yes	375 (82.4) 80 (17.6)	24 (6.4) 11 (13.8)	0.025*	1" 2.33 (1.09-4.98)
Gastrointestinal troubles:	No Yes	395 (86.8) 60 (13.2)	32 (8.1) 3 (5.0)	0.401	1" 0.59 (0.17-2.01)
Dermatitis:	No Yes	385 (84.6) 70 (15.4)	32 (8.3) 3 (4.3)	0.245	1" 0.49 (0.15-1.66)
Eosinophilia:	No Yes	416 (91.4) 39 (8.6)	7 (1.7) 28 (71.8)	0.000r	R 148.7 (53.5-413.29)

Table 3: Multivariate logistic regression analysis of significant predictors of anti-Toxocara positivity

Patient characteristic	P value	OR (95% CI)
Frequent contact with soil	0.045*	3 (1.02-8.82)
Eosinophilia	0.001*	154.45 (53.26-447.8)
Constant	0.001*	
Model χ^2	133.45	
Patient characteristic classified	96. 0	

Table 4: Correlation between of ELISA-IgG and eosinophilia

Eosinophilia	No (%) N=455	ELISA			
		Less than 0.7	0.7-0.9	>0.9- 1.1	>1.1
		No (%)	No (%)	No (%)	No (%)
No	417 (91.6)	410 (98.3)	6(1.4)	1 (0.2)	0 (0.0)
Low	21 (4.6)	10 (47.6)	3(14.3)	8 (38.1)	0 (0.0)
High	13 (2.9)	0 (0.0)	0 (0.0)	5 (38.5)	8 (61.5)
Very high	4(0.9)	0(0.0)	0 (0.0)	1 (25.0)	3 (75.0)
Spearman's rank correlation	0.769				
P value	0.001'				

Discussion

Human toxocariasis is an important and common zoonotic disease worldwide. Demographic and socioeconomical factors may lead to increase in *Toxocara* seroprevalance. Infections were generally asymptomatic, and seroprevalence varied from 3% to 86% in different countries (Alderete *et al.*, 2003). Total seroprevalence rate of *Toxocara* antibodies was 7.7% or lower than 29.8% in Nigeria (Ajayi *et al.*, 2000), 38% Sao Paulo, Brazil (Alderete *et al.*, 2003), 19% in Lebanon (Kanafani *et al.*, 2006) and 12.95% in North Western Turkey (Nihal *et al.*, 2007). The results controversy can be due to several factors; study designs, heterogeneity of individuals (blood donors, hospitalized patients or toxocariasis high risk group); non-standardized lab procedures and different cutoff points in serodiagnosis.

The present study did not find any relationship between the seropositivity rate and sex difference and age groups. Ajayi *et al.* (2000) and Nihal *et al.* (2007) reported that neither age nor gender seemed to be important factors related to a positive serology. However, literature reported a predominance of *T.*

canis in males that may be due to differences in social behaviors of boys, resulted in increasing exposure to infection (Overgaaauw, 1997; Kanafani *et al*, 2006; Antonios *et al*, 2008). Also, a predominance of seropositivity in children was due to the higher frequency of geophagia in ages (Chieffi *et al*, 1990). Theodoridis *et al*. (2001) reported that females were significantly more infected than males and Genchi *et al*. (1990) reported significant increase of seropositivity with age.

In the present study on univariate analysis we found higher *Toxocara* seroprevalence in rural than urban patients ($P < 0.005$). This data agreed with Nihal *et al*. (2007) and Antonios *et al*. (2008). But, Alavi and Sefidgaran (2008) in Iran found similar *Toxocara* sero-positive between rural and urban.

Egyptian patients with presumptive clinical syndromes. One hundred twenty eight were children suffering from respiratory symptoms or PUO and 22 were adults with PUO. Anti-*Toxocara*-IgG were detected in sera by ELISA. Sero-positivity was 6.2% in children (4% & 13.3% with respiratory symptoms and PUQ respectively). In adults, 18% were anti-*Toxocara* IgG positive that may be attributed to more outdoor activity.

In Korea, of 97 healthy people with over 10% eosinophilia, 60% was positive to *Toxocara* larvae excretory-secretory (TES) antigen by both immunoblot and ELISA (Park *et al*, 2002). In Europe, the seropositive rate is 2 to 5 % in apparently healthy urban adults, while the rate is 14.2% to 37% in rural areas (Magnaival *et al*, 1994). In India, of 94 people of the general population and 30 patients with clinically suspected toxocariasis, 6 (6.4%) and 7 (23.3%), respectively, were seropositive to *Toxocara* (E/S) antigen (Malla *et al*, 2002). In Egypt, Ismail and Khalafallah (2005) stated that toxocariasis is a common parasite worldwide with high seroprevalence rates even among asymptomatic individuals and that diagnosis revealed a wide scope of clinical

syndromes, including dermatological diseases and chronic urticaria specially among those exposed to an increased risk of environmental toxocariasis.

The causes of eosinophilia are known to be mainly allergic diseases, parasitic diseases, cancer, and rheumatic diseases. Among the parasitic diseases, toxocariasis may be the most common cause of eosinophilia.

Consistent with previous reports (Aguilar-Santos *et al*, 2004; Nash, 2005), our study revealed that 28/39 (71.8%) patients with eosinophilia were seropositive. Also, eosinophilic patients were at 149 times greater risk of being *Toxocara* seropositive compared to patients who had no eosinophilia (OR, 148.7; 95% CI: 53.5-413.3) and eosinophilia was the most important predictor of *Toxocara* infection on multivariate regression analysis. Gueglio *et al*. (1994) tested 1836 eosinophilic patients by ELISA E/S *Toxocara* antigen and found positive results in 29% of cases. In Korea, out of 127 sera from patients with eosinophilia (more than 500 /ul or more than or equal to 10% WBC) who visited the hospital, 70 sera (68%) were positive to ES antigen and patients with lesions in the liver showed higher serum eosinophil cationic protein (ECP) values (Kwon *et al*, 2005).

Toxocara larvae induced an eosinophilic response followed by the presence of specific IgG anti-*Toxocara* in sera within 2-3 weeks. During the process of destruction of larvae in tissue, which is a slow one up to years, the circulating eosinophils decrease but *anti-Toxocara* remains for a longer time? Another cause for the lack of eosinophils in sero-positive individuals may be the low intensity of infection. Only in fully developed VLM syndrome, diagnosed clinically, can intensity of infection assumed to be high. The intensity of infection might be assessed indirectly and imprecisely only by measuring the sero-prevalence rates and the values of titers or O.D. of the serological tests (Luzna-Lyskov, 2000). However, Kim *et al*. (2008) did not find seropositive toxocariasis in population with eosinophilia (more than or equal to 10% WBC)

To detect a current active infection of toxocariasis, IgE needs to be tested by ELISA and an assessment of eosinophil cationic protein (ECP) is required. People that test positive may have covert toxocariasis, so that a screening for toxocariasis among those with eosinophilia should be done. This would prevent misdiagnosis of toxocariasis as idiopathic hypereosinophilic syndrome, which may result in inappropriate clinical interventions.

In Egypt, many authors dealt with zoonotic toxocariasis as Oteifa and Mous-tafa, 1997), El Shazly *et al* (2002a, b; 2009). Elsheikha *et al.* (2008) studied the kinetics of eosinophilia and IgE production in experimental murine toxocariasis. Ha-ridy *et al.* (2009) reported toxocariasis in street and in pet dogs.

Conclusion

Toxocara seroprevalence was much higher in studied patients especially those with bronchial asthma (13.8%) than in the general population (0.0%). These results suggest that bronchial asthma presents a high risk for *Toxocara* infection specially if associated with eosinophilia. A large population-based survey is needed to assess the magnitude of the problem and identify more details about different risk factors.

References

- Alderete, J.M.; Jacob, C.M.; Pas-torino, A.C.; Elefant, G.R.; Castro, A.P.; et al., 2003:** Prevalence of *Toxocara* infection in schoolchildren from the Butanta region, Sao Paulo, Brazil. Mem. Inst. Oswaldo Cruz, 98:593-7.
- Akiyama, T .; Ohta, N.:(2010);** Parasite-specific antibody profile in the aqueous humor of rabbits with ocular toxocariasis. Parasitol Int. 59(2):112-20.
- Ajayi, O.O.; Duhlinska, D.D.; Agwale, S.M.; Njoku, M., 2000:** Frequency of human toxocariasis in Jos, Plateau State, Nigeria. Mem. Inst. Oswaldo Cruz, 95:147-9.
- Aguiar-Santos, A.M.; Andrade, L.D.; Medeiros, Z.; Chieffi, P.P.; et al., 2004:** Human toxocariasis: Frequency of *mti-Toxocara* antibodies in children and adolescent from an outpatient clinic for lymphatic filariasis in Recife, northeast Brazil. Rev Inst Med Trop S Paulo, 46, 2:25-33.
- Antonios, S.; Eid, M.M.; Khalifa, E.A.; Othman, A.A., 2008:** Sero-pre-valence study of *Toxocara canis* in selected Egyptian patients. J. Egypt. Soc. Parasitol., 38, 1:313-8.
- Arevalo, J.F.; Espinoza, J.V.; Arevalo, F.A.; 2013:** Ocular toxocariasis. J Pediatr Ophthalmol Strabismus. 50(2):76-86.
- Azab, M.E.; Safar, E.H.; Khat-tab, H.M., 1990:** Concomitant *Toxoplasma* and *Toxocara* infections. J. Egypt. Soc. Parasitol., 20, 1:235-61.
- Bouchard, O.; Arbib, F.; Para-melle, B.; Brambilla, G., 1994:** Acute eosinophilic pneumonia and the larva migrans syndrome. Rev. Mai. Respi., 11, 6:593-5.
- Buijs, J.; Borsboom, G.; Renting, M.; Hilgersom, W.J.; van Wierin-gen, J.C., 1997:** Relationship between allergic manifestations and *Toxocara* sero-positivity: a cross-sectional study among elementary school children. Eur. Respi. J., 10, 7:1467-75.

- Buijs, J.; Borsboom, G.; van Ge-mund, J.J.; Hazebroek, A.; van Dongen, P.A., 1994:** *Toxocara* seroprevalence in 5-year-old elementary schoolchildren: relation with allergic asthma. Am. J. Epidemiol., 140, 9:839-47.
- Chan, P.W.; Anuar, A.K.; Fong, M.Y.; Debruyne, J.A.; Ibrahim, J., 2001:** *Toxocara* seroprevalence and childhood asthma among ma-lay sian children. Pediatr. Int., 43, 4:350-3.
- Chang, S.; Lim, J.H.; Choi, D.; Park, C.K.; Kwon, N.H.; Cho, S. Y.; Choi, D.C., 2006:** Hepatic visceral larva migrans of *Toxocara canis*: CT & sonographic findings. Am. J. Roentgenol., 187: W622-9.
- Chieffi, P.P.; Ueda, M.; Camargo, E.D. et al, 1990:** Visceral larva migrans, a seroepidemiological survey in five municipalities of Sao Paulo State, Brazil. Rev. Inst. Med. Trop. S.Paulo, 32:204-10.
- Choi, J.H.; Suh, Y.J.; Jung, J.W.; Song, H.J.; Suh, C.H.; Huh, S.; Nahm, D.H.; Park, H.S., 2003:** Clinical significance of serum ECP and sero-prevalence of human toxocariasis in patients with eosinophilia. J. Asthma Allergy Clin. Immunol., 23:26-32.
- De Andrade, L.C.R.; De Car-valho, L.B.Jr.; Perez, E.P.; Araki, K.; Takeuchi, T., 2005:** Prevalence of toxocariasis in northeastern Brazil based on serology using recombinant *Toxocara canis* antigen. Am. J. Trop. Med. Hyg., 72, 1:103-7.
- Dubinsky, P.; Akao, N.; Re-iterovJ, K.; Konakova, G., 2000:** Comparison of the sensitive screening kit with two ELISA sets for detection of *smti-Toxocara* antibodies. Southeast-Asian J. Trop. Med. Pub. Hlth., 31, 2:394-8.
- El Shazly, A.M.; Haridy, F.M.; Haseeb, A.N.; Rifaat, M.M.A.; Abo El Sao-ud, S.F.; Morsy, T.A., 2002a:** Experimental murine toxocariasis larval migration to liver, with a general discussion. J. Egypt. Soc. Parasitol., 32, 1: 229-40.

El Shazly, A.M.; Abdel-Mageed, S.; El Hamshary, E.; El Shewey, Kh.; Da-woud, H.A.; Morsy, T.A., 2002b: Cardiopulmonary pathology in primary murine toxocariasis. J. Egypt. Soc. Parasitol., 32, 2:457-67.

El-Shazly, A.M.; Mohammed, R. M.; El-Beshbishi, S.N.; Azab, M. S.; El-Ghareeb , A.S.; Abdel Ta-wab, A.H.; Zalook, T.Kh., 2009: Soil-parasites particularly *Toxocara* eggs in Egypt. J. Egypt. Soc. Parasitol., 39, 1.T51-62.

Elsheikha, H.M.; El-Beshbishi, S. N.; El-Shazly, A.M.; Hafez, A.O.; Morsy, T.A., 2008: Kinetics of eosinophilia and IgE production in experimental murine toxocariasis. J. Egypt. Soc. Parasitol., 38, 1:53-64.

Fan, C.K.; Lan, H.S.; Hung, C.C.; Chung, W.C.; Liao, C.W.; Du, W.Y.; Su, K.E., 2004: Seroepidemiology of *Toxocara canis* among mountain ab original adults in Taiwan. Am. J. Trop. Med. Hyg., 71:216-21.

Feldman G.J.; Parker H.W., 1992: Visceral larva migrans associated with the hypereosinophilic syndrome and the onset of severe asthma, Ann. Int. Med., 116: 838-40.

Fitzgerald, P.R.; Mansfield, M.E., 1970: Visceral larva migrans (*Toxocara canis*) in calves. Am. J. Vet. Res., 31:561-5.

Genchi, C; Di Sacco, B.; Gatti, S.; Sangalli, G.; Scaglia, M., 1990: Epi-demiology of human toxocariasis in northern Italy. Parasitol., 32, 3:313-9

Gillespie, S.H.; Bidwell, D.; Vol-ler, A.; Robertson, B.; Maizels, R.M., 1993: Diagnosis of human toxocariasis by antigen capture enzyme linked immunosorbent assay. J. Clin. Pathol. 46:551-4.

Gillespie, S.H.; Hawkey, P.M., 1995: Medical Parasitology. 1st ed., New York, USA. Oxford University Press Inc.

Glickman, L.T.; Magnaval, J.F.; Domanski, L.M.; Shofer, F.S.; Lauria, S.S.; Gottstein, B.; Bro-chier, B., 1987: Visceral larva migrans in French adults: a new disease syndrome? Am. J. Epidemiol., 125, 6:1019-34.

- Gueglic, B.; de Gentile, L.; Nguyen, J.M.; Achard, J.; Cha-basse, D.; Marjolet, M., 1994:** Epidemiologic approach to human toxocariasis in western France. *Parasitol. Res.*, 80, 6:531-6.
- Haridy, F.M.; Hassan A.A.; Hafez, A.O.; El-Sherbini, G.T.; Morsy, T.A., 2009:** External and intestinal parasites of pet dogs with reference to zoonotic toxocariasis: *J. Egypt. Soc. Parasitol.*, 39, 1:321-6.
- Hassan, M.M.; Farghaly, A.M.; Gaber, N.S.; Nageeb, H.F.; Hegab, M.H.; Galal, N., 1996:** Parasitic causes of hepatomegaly in children. *J. Egypt. Soc. Parasitol.*, 26, 1:177-89.
- Hotez, P.J., 1993:** Visceral and ocular larva migrans. *Semin. Neurol.* 13, 2: 175 -9.
- Hotez, P.J.; Wilkins, P.P., 2009:** Toxocariasis: America's most common neglected infection of poverty and a helminthiasis of global importance? *PLoS Neg. Trop. Dis.*, 3, 3:e400.
- Humbert, P.; Niezborala, M.; Sa-lemnier, R.; Aubin, F.; Piarroux, R.; Buchet, S.; Jarale T., 2000:** Skin manifestations associated with toxocariasis: a case-control study. *Dermatol.*, 201, 3:230-4.
- Ismail, M.; Khalafallah, O., 1995:** *Toxocara canis* and chronic urticaria in Egyptian patients. *J. Egypt. Soc. Parasitol.*, 35, 3:833-40.
- Jacquier, P.; Gottstein, B.; Stinge-lin, Y.; Eckert, J., 1991:** Immuno-diagnosis toxocarosis in humans: evaluation of a new enzyme-linked immunosorbent assay kit. *J. Clin. Microbiol.*, 29, 183:1-5.
- Jones, J.L.; Moran, D.K.; Won, K.; Wilson, M.; Schantz, P.M., 2008:** *Toxoplasma gondii* and *Toxocara* spp. co-infection. *Am. J. Trop. Med. Hyg.*, 78, 1:35-9.
- Kanafani, Z.A.; Skoury, A.; Araj, G.F.; El-Klioury, M.; Sawaya, R.A.; et al., 2006:** Seroprevalence of toxocariasis in Lebanon: a pilot study. *Parasitol.* 132, 5:635-9

Kim, Y.H.; Huh S.; Chung, Y.B., 2008: Seroprevalence of toxocariasis among healthy people with eosinophilia. Korean J. Parasitol., 46, 1:29-32.

Kroegel, C, 2007: Global initiative for asthma management and prevention-GINA 2006. Pneumol., 61, 5:295-304.

Kuk, S.; Ozel, E.; Oguzturk, H.; Kirkil, G.; Kaplan, M., 2006: Se-ro-prevalence of *Toxocara* antibodies in patients with adult asthma. South Med. J., 99, 7:719-22.

Kwon, N.H.; Oh, M.J., Lee, S.P.; Lee, B.J.; Choi, D., 2005: Clinical impact of toxocariasis in patients with unknown eosinophilia. J. Asthma Allergy Clin. Immunol., 25:299-304.

Kwon, N.H.; Oh, M.J.; Lee, S.P.; Lee, B.J.; Choi, D., 2006: The prevalence and diagnostic value of toxocariasis in unknown eosinophilia. Ann. Hematol., 85:233-8.

Magnaval, J.F.; Fabre, R.P.; Mariners, J.P.; Charlet, J.P.; de Lar-rard, B., 1991: Application of Western blotting procedure for the immunodiagnosis of human toxocariasis. Parasitol. Res., 77:697-702

Magnaval, J.F.; Fabre, R.P.; Mariners, J.P.; Charlet, J.P.; de Lar-rard, B., 1992: Evaluation of an immunoenzymatic assay detecting specific *anti-Toxocara* IgE for diagnosis and post treatment follow-up of human toxo-cariasis. J. Clin. Microbiol. 30:2269-74.

Magnaval, J.F.; Michault, A.; Ca-lon, N.; Charlet, J.P., 1994: Epidemiology of human toxocariasis in La Reunion. Trans. R. Soc. Trop. Med. Hyg., 88:531-3.

Magnaval, J.F.; Glickman, L.T.; Dorchies, P.; Morassin, B., 2001: High-lights of human toxocariasis. Korean J. Parasitol., 39:1-11.

Malla, N.; Aggarwal, A.K.; Maha-jan, R.C., 2002: A serological study of human toxocariasis in north India. Natl. Med. J. India,15:145-7.

Marx, C; Lin, J.; Masruha, M.R.; Rodrigues, M.G.; da Rocha, A.J.,

2007: Toxocariasis of the CNS simulating acute disseminated encephalomyelitis. *Neurol.*, 69,8:806-7.

Minvielle, G.; Niedfeld, M.; Ci-armela, A.; De Falco, H.; Ghiani, J., 1999: Asthma and covert toxocariasis. *Med.*, 59:243-8. **Mizgajski, H., 1997:** Role of some environmental factors in contamination of soil with *Toxocara* spp. and other geohelminth eggs. *Parasit. Int.*, 46: 67-72.

Morais, F.B.1.; Maciel, A.L.; Arantes, T.E.; Muccioli, C.; Allemann, N.; (2012); Ultrasonographic findings in ocular toxocariasis. *Arq Bras Oftalmol.* 75(1):43-7.

Morimatsu, Y.; Akao, N.; Aki-yosh, H.; Kawazu, T.; Okabe, Y.; Aizawa, H., 2006: A familial case of visceral larva migrans after ingestion of raw chicken livers, appearance of specific antibody in bronchoalveolar lavage fluid of the patients. *Am. J. Trop. Med. Hyg.*, 75:303-6.

Nada, S. M.; Abbaza, B.E.; Mah-moud, L.A.; Habeeb, Y.S.; Hussein, H.F.; Amer, O.T., 1996: Toxocariasis as a cause of renal disease in children in Sharkia Governorate, Egypt. *J. Egypt. Soc. Parasitol.*, 26, 3:709-17.

Nagakura, K.; Tachibana, H.; Kaneda, Y.; Kato, Y., 1989: Toxocariasis possibly caused by ingesting raw chicken. *J. Infect. Dis.*, 160:735-6.

Nash, T.E., 2005: Visceral Larva Migrans and Other Unusual Helminth Infection. In: *Principles and Practice of Infectious Diseases* Mandel, Douglas, Bennett. 6th ed.; Churchill Livingstone Philadelphia.

Nihal, D.; Ener, C.; Ozcan, B.; Seray, O.; Yusuf O., 2007: Seroprevalence Survey for *Toxocara canis* infection in the Northwestern Part of Turkey. *Turk. Parasitol. Dergisi.* 31, 4:288-91

Noordin, R.; Smith, H.V.; Mohamad, S.; Maizels, R.M.; Fong, M.Y., 2005: Comparison of IgG-ELISA and IgG4-ELISA for *Toxocara* serodiagnosis. *Acta Trop.*, 93, 1:57-62.

Nunes, CM.; Tundisi, R.; Heine-mann, M.; Ogassawara, S.; Rich-tzenhain, L.J., 1999: Toxocariasis: serological diagnosis by indirect antibody competition ELISA. Rev. Inst. Med. Trop. Sao. Paulo, 41, 2:95-100.

Oteifa, M.N.; Moustafa, M.A., 1997: Potential risk of contracting toxocariasis in Heliopolis district, Cairo, Egypt. J. Egypt. Soc. Parasitol., 27, 1: 197-203.

Overgaauw, P.A., 1997: Aspects of *Toxocara* epidemiology: toxocarosis in dogs and cats. Crit. Rev. Microbiol., 23:233-51.

Park, H.Y.; Lee, S.U.; Huh, S.; Kong, Y.; Magnaval, J.F., 2002: A sero-epidemiological survey for toxocariasis in apparently healthy residents in Gangwon-do, Korea. Korean J. Parasitol., 40:113-7.

Pawlowski, Z., 2001: Toxocariasis in humans: clinical expression and treatment dilemma. J. Helminthol., 75, 4:299-305.

Salem, G.; Schantz, P., 1992: Toxocaral visceral larva migrans after ingestion of raw lamb liver. Can. Infect. Dis., 15:743-4.

Sarimehmetoglu, H.; Burgu, A.; Aycicek, H.; Gonenc, B.; Ta-nyukse, M.; Kara, M., 2001: Application of western blotting procedure for immuno-diagnosis of visceral larva migrans in mice by using excretory/secretory antigens. Dtsch. Tierarztl. Wochenschr., 108, 9:390-2.

Schantz, P.M.; Weis, P.E.; Pollard, Z.F.; White, M.C., 1980: Risk factors of toxocaral ocular larva migrans: a case-control study. Amer. J. Publ. Hlth., 70:1269-72.

Strickland, G.T., 2000: Hunter's Tropical Medicine and Emerging Infectious Diseases. 8th ed.. W.B. Saunders Co. Philadelphia. London, Toronto, Montreal. Sydney. Tokyo.

Taylor, M.R.; Keane, C.T.; O'Connor, P.; Multihull, E.; Holland, C., 1988: The expanded spectrum of toxocaral disease. Lancet **1**, 8587:692-5.

Theodoridis, I.; Frydas, S.; Papazahariadou, M.; Hatzistil-ianou, M.; Adamama, K.K., 2001:Toxocarosis as zoonosis: A review of literature and the prevalence of *Toxocara canis* antibodies in 511 serum samples. Int. J. Immuno-pathol. Pharmacol., 14:17-23.

Won, K.Y.; Moran, D.; Schantz, P.; Jones, J.P., 2008: National sero-prevalence and risk factors for zoonotic *Toxocara* spp. infection. Am. J. Trop. Med. Hyg., 79,4:552-7.

الانتشار المصلي لداء التوكسوكارا في الإنسان (داء هجرة اليرقات الحشوي)
 عاطف الشاذلي^١ – سيد عبدالباسط^٢ – احمد كمال^٣ – خيرى عبدالحميد محمد
 حسن^٤ – طاهر ابراهيم صقر^٥ – سامي حماد^٦
 أقسام الطفيليات^(١,٣,٤) ، الصدرية^٢ ، امراض الجهاز الهضمي^٥ ، الصحة العامة^٦
 ، كليات الطب جامعة المنصورة^(١,٢,٦) ، المنيا^٣ ، الأزهر^٤ ، بنها^٥

تم تضمين عدد إجمالي ٤٥٥ مريضاً و الذين يستوفون المعايير المطلوب إدراجها في الدراسة. تم عمل استبيان للمرضى المسجلين (بما في ذلك العوامل الاجتماعية والديموغرافية وغيرها من المخاطر) وتم اجراء فحص سريري دقيق للمرضى وكذلك تم جمع الأمصال من المرضى واختبارها للأجسام المضادة من النوع جي باستخدام اختبار الأليزا وكانت نسبة الأمصال الايجابية للأجسام المضادة للتوكسوكارا (٧.٧٪) وكانت هذه النسبة أعلى بكثير عنها من بين ٣٠ شخص تم اختيارهم عشوائياً من الاصحاء.

ولم تكن هناك فروق ذات دلالة إحصائية بين المرضى الايجابيين والسلبين مصليا للأجسام المضادة للتوكسوكارا من حيث السن والجنس والمستوى التعليمي والدخل الشهري للأسرة المريض. ومع ذلك، وجدت فروق ذات دلالة إحصائية كبيرة بالنسبة للإقامة في المناطق الريفية، البيوت الفقيرة، امتلاك الحيوانات الأليفة والاتصال المتكرر مع التربة.

وكان المرضى الذين قد تأكد اصابتهم بالربو الشعبي أكثر عرضة لخطر الإصابة بالتوكسوكارا أكثر من مرتين من هؤلاء المصابون بأعراض اكلينيكية أخرى (حمى مجهولة السبب، تضخم الكبد والطحال ، اعتلال الغدد اللمفاوية، الاضطرابات العصبية، الاضطرابات الهضمية والتهاب الجلد).

كان المرضى الذين يعانون من فرط زيادة الخلايا الحمضية (الايزينوفيل) وجدوا أنهم أكثر (١٤٩) مرة عرضة لوجود أجسام مضادة للتوكسوكارا مقارنة بهؤلاء الذين ليس لديهم ارتفاع في الخلايا الحمضية (الايزينوفيل). وأظهر تحليل الارتداد متعدد المتغيرات أن فرط زيادة الخلايا الحمضية

(VISCERAL LARVA MIGRANS)

ATEF M. EI-SHAZLY¹, S.M. ABDEL BASET², A. KAMAL³, KHAIRY A. MOHAMMED⁴,
T.I. SAKR⁵ AND S.M. HAMMAD⁶

Departments of Parasitology^{1,3,4}, Chest Medicine², Hepatology, Gastroenterology and
Infectious Disease⁵, and Community Medicine⁶, Faculties of Medicine, Mansoura
University^{1,2,6}, El-Minia University³, Al-Azhar University⁴ and Benha University⁵, Egypt

Abstract

Background : Human toxocariasis is one of the most commonly reported zoonotic infections worldwide (Strickland, 2000) and its global importance may be greatly underestimated (Hotez and Wilkins, 2009); Toxocariasis results from zoonotic transmission of the roundworms.

Aim of the work : This study was conducted to determine seroprevalence of human toxocariasis in patients attending Mansoura and Benha Universities' hospitals and to identify factors associated with infection.

Subjects, Materials and Methods : A total of 455 patients who fulfilled the inclusion criteria were included in the study. The enrolled patients were subjected to a questionnaire (including sociodemographic and other risk factors) and thorough clinical examination was done for the patients. Sera were collected from patients and tested for anti-Toxocara IgG antibodies using ELISA. **Results:** The overall anti-Toxocara seropositive was (7.7%). It was significantly higher than among the randomly selected 30 healthy controls. There were no significant differences between the seropositive and seronegative patients regarding age, sex, educational level and monthly family income of the patient. However, rural residence, poor house, pet's ownership and frequent contact with soil were found to be significant. Patients who had confirmed bronchial asthma were more than 2 times at higher

risk of developing toxocariasis (OR, 2.33; 95% CI, 1.09-4.98) than those with other clinical diagnosis (PUO, hepato-megaly or heptosplenomegaly, lymphadenopathy, neurological disorders, gastrointestinal troubles and dermatitis). Patients with eosinophilia were at 149 times greater risk of being Toxocara seropositive compared to those without eosinophilia (OR, 148.7; 95% CI: 53.5-413.3). Multivariate regression analysis showed eosinophilia and contact with soil were the most important predictors of toxocariasis. OD of anti-Toxocara antibodies (ELISA) was significantly positive with eosinophilia level.

Conclusion : *Toxocara seroprevalence was much higher in studied patients especially those with bronchial asthma (13.8%) than in the general population (0.0%). These results suggest that bronchial asthma presents a high risk for Toxocara infection specially if associated with eosinophilia. A large population-based survey is needed to assess the magnitude of the problem and identify more details about different risk factors.*

Key words: *Egypt, ELISA, Human toxocariasis, eosinophilia.*

INTRODUCTION

Human toxocariasis is one of the most commonly reported zoonotic infections worldwide (Strickland, 2000) and its global importance may be greatly underestimated (Hotez and Wilkins, 2009); Toxocariasis results from zoonotic transmission of the roundworms, *Toxocara canis* and *T. cati* from dogs and cats, respectively. Human infections may take place by ingestion of embryonated eggs, or transfer (ingestion) of encapsulated larvae of *T. canis* in the tissues of a paratenic host (Gillespie and Hawkey, 1995). In certain ethnic groups, some adults tend to eat uncooked animal tissues which contain encapsulated infective larvae. Uncooked livers of cow (Chang et al, 2006; Known et al, 2006), pig (Fan et al, 2004), lamb (Salem and Schantz, 1992), and chicken (Nagakura et al, 1989; Morimatsu et al., 2006) have been reported as sources of human infections. After swallowing, the encapsulated

larvae are liberated after hatching in the small intestine, penetrate the intestinal wall, get into the portal vein, and then reach the liver and lungs. They encapsulated and remained alive for a certain period. The resulting host inflammatory response ultimately overwhelms and either kills the migrating larvae or forces them into a state of arrested development, but not before they cause both mechanical and tissues immunopathological damage (Fitzgerald and Mansfield, 1970).

Toxocara larvae secrete at least 50 distinct macro-molecules as excretory-secretory (E/S) antigens that accounts for immune evasion and pathogenesis (Nunes *et al.*, 1999), and are diagnosed by ELISA-E/S antigens specific Igs (Dubinsky *et al.*, 2000) or western blot procedure (Sarimehmetoglu *et al.*, 2001). Many researchers have suggested that intraocular parasite-specific antibody levels are indicative of ocular toxocariasis, but little is known about the time course of the changes in these levels.(Akiyama *et al*; 2010).The prevalence estimates for toxocariasis are based on serological surveys with banked sera that detect *Toxocara* specific antibodies (Jones *et al.*, 2008; Won *et al*, 2008). ELISA have high sensitivity and specificity with very low levels of cross-reactivity when the excretory and secretory antigens of the second-stage *T. cards* larvae were used (MagnaVal *et al*, 1991; 1992) VLM symptoms include hepatomegaly, myocarditis, nephritis, epilepsy, fever, urticaria, central nervous system disorders, asthma, severe breathing difficulty, wheezing cough and abdominal pain. Laboratory findings include marked eosinophilia, leukocytosis, hypergammaglobulinemia and liver function disorders (Gillespie, *et al.*, 1993; Magnaval *et al*, 1993). Morias *et al.* 2012; concluded that clinical history, systemic evaluation and serology, the ultrasound can help in the diagnosis of ocular toxocariasis. There are few studies on the association between asthma and *Toxocara* infection among adults. Feldman and Parker (1992) have reported high anti- *Toxocara* IgG levels in a 48-year-old

patient with hypereosino-philic syndrome and asthma attacks. Minvielle *et al.* (1999) found elevated levels of & anti- Toxocara IgG in asthmatic patients. The diagnosis of toxocariasis is essentially clinical, based on the lesion morphology and supportive laboratory data such as serum enzyme-linked immunosorbent assay (ELISA) titers and ELISA Toxocara titers on aqueous humor; other diagnostic methods are imaging studies including optical coherence tomography, fluorescein angiography, computed tomography, and ocular ultrasound. Arevalo JF *et al.* (2013).

Globally, high rates of toxocariasis have been noted in middle-income countries, with prevalence up to 40% or higher in Indonesia and Brazil (Noordin *et al.*, 2005; De Andrade *et al.*, 2005). In Egypt toxocariasis showed seroprevalence rate of 18.1% in patients with toxoplasmosis (Azab *et al.*, 1990), 10.7% of children with renal troubles in Sharkia (Nada *et al.*, 1996), 6% of children with hepatomegaly in Zagazig (Hassan *et al.*, 1996), and 6.2% in children with respiratory symptoms or PUO and 18% in adults with PUO in Tanta (Antônio *et al.*, 2008).

This study was conducted to determine seroprevalence of human toxocariasis in patients attending Mansoura and Benha University hospitals and to identify factors associated with infection.

Subjects, Materials and Methods

This study was conducted from May to December 2008, and comprised 455 patients aged 1-67 years presented to Pediatric, Internal Medicine, Dermatology, Chest, Tropical Medicine and Neurology departments of the two University Hospitals. Patients were enrolled after obtaining verbal informed consent from them or from their parents or guardians in case of diseased children. Exclusion criteria were history of allergy, hepatitis B or C, malignancy, autoimmune diseases, and systemic steroid therapy or immunotherapy.

The patients or their parents or guardians in case of diseased children were directly interviewed using a questionnaire to assess the risk factors associated with *Toxocara* infection. Pet's ownership, frequent contact with soil and the socioeconomic status of the family were considered as the risk factors for acquiring toxocariasis. The family socio-demographic status was assessed by patients' education, family income and house type. Houses were classified as good or poor depending on the materials used for roof, floor and walls.

All were subjected to thorough clinical examination. Bronchial asthmatic patients were subjected to pulmonary function tests including peak expiratory flow arte and spirometry reversibility test to confirm asthma (GINA, 2006).

Blood samples were collected from all patients and submitted to: number of eosinophils, was measured by a chamber technique and expressed as $10^9/L$. Values from $-0.4-0.9 \times 10^9/L$ were classified as low eosinophilia, between $1.0-3.0 \times 10^9/L$ as high eosinophilia and over $3.0 \times 10^9/L$ as very high eosinophilia. Blood samples were centrifuged and sera stored at $-20^\circ C$ until tested. Anti *Toxocara* antibody was detected by a commercial ELISA kit (Bordier Affinity Products SA, Crissier, Switzerland). The test is based on E/S antigens of *Toxocara* larvae. The optical density (OD) was read at 490 nm using ELISA reader. Each plate had a positive control pooled sera from patients diagnosed as visceral larva migrans (VLM) syndrome and a high antibody level, and a known negative serum sample. The mean OD of the negative control was 0.234 ± 0.159 . The cut off value (0.711) was calculated as the mean negative control ± 3 SD. Some cross reactions may occur in other human helminthiasis, such as trichinosis, fascioliasis, and strongyloidiasis, titers in the helminthiasis were lower than in positive control of toxocariasis patients (Jacquier *et al.*, 1991).

Cases were also subjected to urine and stool examination, IHA for *Fasciola*, *Schistosoma* and *Toxoplasma*, blood film, hepatitis viral markers

and auto-antibody tests for autoimmune diseases to exclude cases with other parasitic diseases, viral hepatitis and autoimmune diseases.

Statistical analysis: Data were analyzed with statistical package SPSS version 15.0. Association between *anti-Toxocara* antibodies in patients and characters (epidemiological, clinical, and eosinophilia) was studied by univariate analysis with unadjusted odds ratios (ORs). Variables significant upon univariate were analyzed by multivariate logistic regression using maximum likelihood ratio test. Based on stepwise forward method, considering $p = 0.05$ for model entry and $p = 0.10$ for removal. Significance was considered at $P < 0.05$.

At the time of the study there was no Ethical Review Board in the Faculty of Medicine, Mansoura or Benha University, Egypt, so Ethical clearance was obtained from the different departments sharing in the study.

Results

The overall seroprevalence of human *anti-Toxocara* IgG antibodies among studied patients was 7.7% (Tab. 1). It was significantly higher than among the 30 randomly selected healthy controls ($P < 0.0001$). There were no significant differences between the seropositive and seronegative patients in respect of age, sex, educational level and monthly family income of the patient. However, rural residence, poor house, pets' ownership and frequent contact with soil were found to be significantly correlated with positive serology for *anti-Toxocara* IgG antibodies. The seroprevalence of human *anti-Toxocara* IgG antibodies among patients in relation to clinical presentation and eosinophilia was presented (Tab. 2). Patients with confirmed bronchial asthma were more than 2 times at higher risk of developing toxocariasis (OR, 2.33; 95% CI, 1.09-4.98) than those with other manifestations (PUO, hepatomegaly or hepatosplenomegaly, lymphadenopathy, neurological disorders, gastrointestinal troubles or dermatitis). Patients with eosinophilia were at 149 times greater risk

of *Toxocara* seropositive compared to patients without eosinophilia (OR, 148.7; 95% CI: 53.5-413.3).

The significant variables that correlated with positive serology for *anti-Toxocara* antibodies (rural residence, poor housing, pets ownership, frequent contact with soil), together with confirmed asthma and eosinophilia, were submitted to multivariate analysis. In the final model, only the frequent contact with soil and eosinophilia remained significantly correlated with *Toxocara* infection, indicating a higher risk of infection for individuals with eosinophilia (odds ratio = 154.45, 95% CI = 53.3 to 447.8) and frequent contact with soil (odds ratio = 3.0, 95% CI = 1.02 to 8.82) (Tab.3). The association between OD of ELISA-IgG and eosinophilia showed significant positive correlation between them (i- 0.77; P <0.001) (Tab. 4).

Table 1: Anti-Toxocara IgG related to sociodemography and characters of patients and ownership to pets and frequent contact with soil:

Patient characteristic	Total No (%)	Positive No (%)	P value	OR (95% CI)
Age (years): 1-<15 15+	99 (21.8) 356 (78.2)	10(10.1) 25 (7.0)	0.309	1.44 (0.71- 2.89) r
Male Femal e	280 (61.5) 175 (38.5)	24 (8.6) 11 (6.3)	0.79	1.36 (0.69- 2.71) r
Rural urban	276 (60.7) 179 (39.3)	27 (9.8) 8 (4.5)	0.038*	2.19(1.02- 4.71) V
Illiterate/read and write primary through preparatory Secondary+	147 (32.3) 180 (39.6) 128 (28.1)	15 (10.2) 12 (6.7) 8 (6.3)	0.237 0.884	.63 (0.72-3.72) 1.07(0.45- 2.53) 1"
Housing poor Housing good	160 (35.2) 295 (64.8)	18(11.3) 17 (5.8)	0.036*	1.95 (1.03- 3.68) 1°
Income not satisfactory income satisfactory	300 (65.9) 155 (34.1)	28 (9.3) 7 (4.5)	0.068	2.06 (0.92- 4.62) R
Pet ownership: Yes No	65 (14.3) 390(85.7)	9(13.8) 26 (6.7)	0.044*	2.25 (1.0-5.05) 1"
Frequent contact with soil. Yes No	137 (30.7) 318 (69.9)	18 (13.1) 17(5.3)	0.004*	2.68 (1.34- 5.37) I"

1* = reference category, * significant, CI= confidence interval

Table 2: Anti-Toxocara IgG related to patients' clinical picture & eosinophilia

Patient characteristic		Total No (%)	Positive No (%)	P value	OR (95% CI)
Pyrexia of unknown origin:	No Yes	400 (87.9) 55 (12.1)	31 (7.8) 4 (7.3)	0.901	1" 0.99 (0.92-1.08)
Hepato-megaly or hepato-splenomegaly	No Yes	375 (82.4) 80 (17.6)	28 (7.5) 7 (8.8)	0.696	1" 1.19 (0.5-2.83)
Lymphadcnopathy:	No Yes	385 (84.6) 70 (15.4)	32 (8.3) 3 (4.3)	0.245	1" 0.49 (0.15-1.66)
Neurological disorders:	No Yes	415 (91.2) 40 (8.8)	31 (7.5) 4 (8.8)	0.566	1" 1.38 (0.46-4.12)
Bronchial asthma:	No Yes	375 (82.4) 80 (17.6)	24 (6.4) 11 (13.8)	0.025*	1" 2.33 (1.09-4.98)
Gastrointestinal troubles:	No Yes	395 (86.8) 60 (13.2)	32 (8.1) 3 (5.0)	0.401	1" 0.59 (0.17-2.01)
Dermatitis:	No Yes	385 (84.6) 70 (15.4)	32 (8.3) 3 (4.3)	0.245	1" 0.49 (0.15-1.66)
Eosinophilia:	No Yes	416 (91.4) 39 (8.6)	7 (1.7) 28 (71.8)	0.000r	R 148.7 (53.5-413.29)

Table 3: Multivariate logistic regression analysis of significant predictors of anti-Toxocara positivity

Patient characteristic	P value	OR (95% CI)
Frequent contact with soil	0.045*	3 (1.02-8.82)
Eosinophilia	0.001*	154.45 (53.26-447.8)
Constant	0.001*	
Model χ^2	133.45	
Patient characteristic classified	96.0	

Table 4: Correlation between of ELISA-IgG and eosinophilia

Eosinophilia	No (%) N=455	ELISA			
		Less than 0.7	0.7-0.9	>0.9- 1.1	>1.1
		No (%)	No (%)	No (%)	No (%)
No	417 (91.6)	410 (98.3)	6(1.4)	1 (0.2)	0 (0.0)
Low	21 (4.6)	10 (47.6)	3(14.3)	8 (38.1)	0 (0.0)
High	13 (2.9)	0 (0.0)	0 (0.0)	5 (38.5)	8 (61.5)
Very high	4(0.9)	0(0.0)	0 (0.0)	1 (25.0)	3 (75.0)
Spearman's rank correlation	0.769				
P value	0.001'				

Discussion

Human toxocariasis is an important and common zoonotic disease worldwide. Demographic and socioeconomical factors may lead to increase in *Toxocara* seroprevalance. Infections were generally asymptomatic, and seroprevalence varied from 3% to 86% in different countries (Alderete *et al.*, 2003). Total seroprevalence rate of *Toxocara* antibodies was 7.7% or lower than 29.8% in Nigeria (Ajayi *et al.*, 2000), 38% Sao Paulo, Brazil (Alderete *et al.*, 2003), 19% in Lebanon (Kanafani *et al.*, 2006) and 12.95% in North Western Turkey (Nihal *et al.*, 2007). The results controversy can be due to several factors; study designs, heterogeneity of individuals (blood donors, hospitalized patients or toxocariasis high risk group); non-standardized lab procedures and different cutoff points in serodiagnosis.

The present study did not find any relationship between the seropositivity rate and sex difference and age groups. Ajayi *et al.* (2000) and Nihal *et al.* (2007) reported that neither age nor gender seemed to be important factors related to a positive serology. However, literature reported a predominance of *T.*

canis in males that may be due to differences in social behaviors of boys, resulted in increasing exposure to infection (Overgaaauw, 1997; Kanafani *et al*, 2006; Antonios *et al*, 2008). Also, a predominance of seropositivity in children was due to the higher frequency of geophagia in ages (Chieffi *et al*, 1990). Theodoridis *et al*. (2001) reported that females were significantly more infected than males and Genchi *et al*. (1990) reported significant increase of seropositivity with age.

In the present study on univariate analysis we found higher *Toxocara* seroprevalence in rural than urban patients ($P < 0.005$). This data agreed with Nihal *et al*. (2007) and Antonios *et al*. (2008). But, Alavi and Sefidgaran (2008) in Iran found similar *Toxocara* sero-positive between rural and urban.

Egyptian patients with presumptive clinical syndromes. One hundred twenty eight were children suffering from respiratory symptoms or PUO and 22 were adults with PUO. Anti-*Toxocara*-IgG were detected in sera by ELISA. Sero-positivity was 6.2% in children (4% & 13.3% with respiratory symptoms and PUQ respectively). In adults, 18% were anti-*Toxocara* IgG positive that may be attributed to more outdoor activity.

In Korea, of 97 healthy people with over 10% eosinophilia, 60% was positive to *Toxocara* larvae excretory-secretory (TES) antigen by both immunoblot and ELISA (Park *et al*, 2002). In Europe, the seropositive rate is 2 to 5 % in apparently healthy urban adults, while the rate is 14.2% to 37% in rural areas (Magnaaval *et al*, 1994). In India, of 94 people of the general population and 30 patients with clinically suspected toxocariasis, 6 (6.4%) and 7 (23.3%), respectively, were seropositive to *Toxocara* (E/S) antigen (Malla *et al*, 2002). In Egypt, Ismail and Khalafallah (2005) stated that toxocariasis is a common parasite worldwide with high seroprevalence rates even among asymptomatic individuals and that diagnosis revealed a wide scope of clinical

syndromes, including dermatological diseases and chronic urticaria specially among those exposed to an increased risk of environmental toxocariasis.

The causes of eosinophilia are known to be mainly allergic diseases, parasitic diseases, cancer, and rheumatic diseases. Among the parasitic diseases, toxocariasis may be the most common cause of eosinophilia.

Consistent with previous reports (Aguilar-Santos *et al*, 2004; Nash, 2005), our study revealed that 28/39 (71.8%) patients with eosinophilia were seropositive. Also, eosinophilic patients were at 149 times greater risk of being *Toxocara* seropositive compared to patients who had no eosinophilia (OR, 148.7; 95% CI: 53.5-413.3) and eosinophilia was the most important predictor of *Toxocara* infection on multivariate regression analysis. Gueglio *et al*. (1994) tested 1836 eosinophilic patients by ELISA E/S *Toxocara* antigen and found positive results in 29% of cases. In Korea, out of 127 sera from patients with eosinophilia (more than 500 /ul or more than or equal to 10% WBC) who visited the hospital, 70 sera (68%) were positive to ES antigen and patients with lesions in the liver showed higher serum eosinophil cationic protein (ECP) values (Kwon *et al*, 2005).

Toxocara larvae induced an eosinophilic response followed by the presence of specific IgG anti-*Toxocara* in sera within 2-3 weeks. During the process of destruction of larvae in tissue, which is a slow one up to years, the circulating eosinophils decrease but *anti-Toxocara* remains for a longer time? Another cause for the lack of eosinophils in sero-positive individuals may be the low intensity of infection. Only in fully developed VLM syndrome, diagnosed clinically, can intensity of infection assumed to be high. The intensity of infection might be assessed indirectly and imprecisely only by measuring the sero-prevalence rates and the values of titers or O.D. of the serological tests (Luzna-Lyskov, 2000). However, Kim *et al*. (2008) did not find seropositive toxocariasis in population with eosinophilia (more than or equal to 10% WBC)

To detect a current active infection of toxocariasis, IgE needs to be tested by ELISA and an assessment of eosinophil cationic protein (ECP) is required. People that test positive may have covert toxocariasis, so that a screening for toxocariasis among those with eosinophilia should be done. This would prevent misdiagnosis of toxocariasis as idiopathic hypereosinophilic syndrome, which may result in inappropriate clinical interventions.

In Egypt, many authors dealt with zoonotic toxocariasis as Oteifa and Mous-tafa, 1997), El Shazly *et al* (2002a, b; 2009). Elsheikha *et al.* (2008) studied the kinetics of eosinophilia and IgE production in experimental murine toxocariasis. Ha-ridy *et al.* (2009) reported toxocariasis in street and in pet dogs.

Conclusion

Toxocara seroprevalence was much higher in studied patients especially those with bronchial asthma (13.8%) than in the general population (0.0%). These results suggest that bronchial asthma presents a high risk for *Toxocara* infection specially if associated with eosinophilia. A large population-based survey is needed to assess the magnitude of the problem and identify more details about different risk factors.

References

- Alderete, J.M.; Jacob, C.M.; Pas-torino, A.C.; Elefant, G.R.; Castro, A.P.; et al., 2003:** Prevalence of *Toxocara* infection in schoolchildren from the Butanta region, Sao Paulo, Brazil. Mem. Inst. Oswaldo Cruz, 98:593-7.
- Akiyama, T .; Ohta, N.:(2010);** Parasite-specific antibody profile in the aqueous humor of rabbits with ocular toxocariasis. Parasitol Int. 59(2):112-20.
- Ajayi, O.O.; Duhlinska, D.D.; Agwale, S.M.; Njoku, M., 2000:** Frequency of human toxocariasis in Jos, Plateau State, Nigeria. Mem. Inst. Oswaldo Cruz, 95:147-9.
- Aguiar-Santos, A.M.; Andrade, L.D.; Medeiros, Z.; Chieffi, P.P.; et al., 2004:** Human toxocariasis: Frequency of *mti-Toxocara* antibodies in children and adolescent from an outpatient clinic for lymphatic filariasis in Recife, northeast Brazil. Rev Inst Med Trop S Paulo, 46, 2:25-33.
- Antonios, S.; Eid, M.M.; Khalifa, E.A.; Othman, A.A., 2008:** Sero-pre-valence study of *Toxocara canis* in selected Egyptian patients. J. Egypt. Soc. Parasitol., 38, 1:313-8.
- Arevalo, J.F.; Espinoza, J.V.; Arevalo, F.A.; 2013:** Ocular toxocariasis. J Pediatr Ophthalmol Strabismus. 50(2):76-86.
- Azab, M.E.; Safar, E.H.; Khat-tab, H.M., 1990:** Concomitant *Toxoplasma* and *Toxocara* infections. J. Egypt. Soc. Parasitol., 20, 1:235-61.
- Bouchard, O.; Arbib, F.; Para-melle, B.; Brambilla, G., 1994:** Acute eosinophilic pneumonia and the larva migrans syndrome. Rev. Mai. Respi., 11, 6:593-5.
- Buijs, J.; Borsboom, G.; Renting, M.; Hilgersom, W.J.; van Wierin-gen, J.C., 1997:** Relationship between allergic manifestations and *Toxocara* sero-positivity: a cross-sectional study among elementary school children. Eur. Respi. J., 10, 7:1467-75.

- Buijs, J.; Borsboom, G.; van Ge-mund, J.J.; Hazebroek, A.; van Dongen, P.A., 1994:** *Toxocara* seroprevalence in 5-year-old elementary schoolchildren: relation with allergic asthma. Am. J. Epidemiol., 140, 9:839-47.
- Chan, P.W.; Anuar, A.K.; Fong, M.Y.; Debruyne, J.A.; Ibrahim, J., 2001:** *Toxocara* seroprevalence and childhood asthma among ma-lay sian children. Pediatr. Int., 43, 4:350-3.
- Chang, S.; Lim, J.H.; Choi, D.; Park, C.K.; Kwon, N.H.; Cho, S. Y.; Choi, D.C., 2006:** Hepatic visceral larva migrans of *Toxocara canis*: CT & sonographic findings. Am. J. Roentgenol., 187: W622-9.
- Chieffi, P.P.; Ueda, M.; Camargo, E.D. et al, 1990:** Visceral larva migrans, a seroepidemiological survey in five municipalities of Sao Paulo State, Brazil. Rev. Inst. Med. Trop. S.Paulo, 32:204-10.
- Choi, J.H.; Suh, Y.J.; Jung, J.W.; Song, H.J.; Suh, C.H.; Huh, S.; Nahm, D.H.; Park, H.S., 2003:** Clinical significance of serum ECP and sero-prevalence of human toxocariasis in patients with eosinophilia. J. Asthma Allergy Clin. Immunol., 23:26-32.
- De Andrade, L.C.R.; De Car-valho, L.B.Jr.; Perez, E.P.; Araki, K.; Takeuchi, T., 2005:** Prevalence of toxocariasis in northeastern Brazil based on serology using recombinant *Toxocara canis* antigen. Am. J. Trop. Med. Hyg., 72, 1:103-7.
- Dubinsky, P.; Akao, N.; Re-iterovJ, K.; Konakova, G., 2000:** Comparison of the sensitive screening kit with two ELISA sets for detection of *smti-Toxocara* antibodies. Southeast-Asian J. Trop. Med. Pub. Hlth., 31, 2:394-8.
- El Shazly, A.M.; Haridy, F.M.; Haseeb, A.N.; Rifaat, M.M.A.; Abo El Sao-ud, S.F.; Morsy, T.A., 2002a:** Experimental murine toxocariasis larval migration to liver, with a general discussion. J. Egypt. Soc. Parasitol., 32, 1: 229-40.

El Shazly, A.M.; Abdel-Mageed, S.; El Hamshary, E.; El Shewey, Kh.; Da-woud, H.A.; Morsy, T.A., 2002b: Cardiopulmonary pathology in primary murine toxocariasis. J. Egypt. Soc. Parasitol., 32, 2:457-67.

El-Shazly, A.M.; Mohammed, R. M.; El-Beshbishi, S.N.; Azab, M. S.; El-Ghareeb , A.S.; Abdel Ta-wab, A.H.; Zalook, T.Kh., 2009: Soil-parasites particularly *Toxocara* eggs in Egypt. J. Egypt. Soc. Parasitol., 39, 1.T51-62.

Elsheikha, H.M.; El-Beshbishi, S. N.; El-Shazly, A.M.; Hafez, A.O.; Morsy, T.A., 2008: Kinetics of eosinophilia and IgE production in experimental murine toxocariasis. J. Egypt. Soc. Parasitol., 38, 1:53-64.

Fan, C.K.; Lan, H.S.; Hung, C.C.; Chung, W.C.; Liao, C.W.; Du, W.Y.; Su, K.E., 2004: Seroepidemiology of *Toxocara canis* among mountain ab original adults in Taiwan. Am. J. Trop. Med. Hyg., 71:216-21.

Feldman G.J.; Parker H.W., 1992: Visceral larva migrans associated with the hypereosinophilic syndrome and the onset of severe asthma, Ann. Int. Med., 116: 838-40.

Fitzgerald, P.R.; Mansfield, M.E., 1970: Visceral larva migrans (*Toxocara canis*) in calves. Am. J. Vet. Res., 31:561-5.

Genchi, C; Di Sacco, B.; Gatti, S.; Sangalli, G.; Scaglia, M., 1990:Epi-demiology of human toxocariasis in northern Italy. Parasitol., 32, 3:313-9

Gillespie, S.H.; Bidwell, D.; Vol-ler, A.; Robertson, B.; Maizels, R.M., 1993: Diagnosis of human toxocariasis by antigen capture enzyme linked immunosorbent assay. J. Clin. Pathol. 46:551-4.

Gillespie, S.H.; Hawkey, P.M., 1995: Medical Parasitology. 1st ed., New York, USA. Oxford University Press Inc.

Glickman, L.T.; Magnaval, J.F.; Domanski, L.M.; Shofer, F.S.; Lauria, S.S.; Gottstein, B.; Bro-chier, B., 1987: Visceral larva migrans in French adults: a new disease syndrome? Am. J. Epidemiol., 125, 6:1019-34.

Gueglic, B.; de Gentile, L.; Nguyen, J.M.; Achard, J.; Cha-basse, D.; Marjolet, M., 1994: Epidemiologic approach to human toxocariasis in western France. *Parasitol. Res.*, 80, 6:531-6.

Haridy, F.M.; Hassan A.A.; Hafez, A.O.; El-Sherbini, G.T.; Morsy, T.A., 2009: External and intestinal parasites of pet dogs with reference to zoonotic toxocariasis: *J. Egypt. Soc. Parasitol.*, 39, 1:321-6.

Hassan, M.M.; Farghaly, A.M.; Gaber, N.S.; Nageeb, H.F.; Hegab, M.H.; Galal, N., 1996: Parasitic causes of hepatomegaly in children. *J. Egypt. Soc. Parasitol.*, 26, 1:177-89.

Hotez, P.J., 1993: Visceral and ocular larva migrans. *Semin. Neurol.*, 13, 2: 175 -9.

Hotez, P.J.; Wilkins, P.P., 2009: Toxocariasis: America's most common neglected infection of poverty and a helminthiasis of global importance? *PLoS Neg. Trop. Dis.*, 3, 3:e400.

Humbert, P.; Niezborala, M.; Sa-lemnier, R.; Aubin, F.; Piarroux, R.; Buchet, S.; Jarale T., 2000: Skin manifestations associated with toxocariasis: a case-control study. *Dermatol.*, 201, 3:230-4.

Ismail, M.; Khalafallah, O., 1995: *Toxocara canis* and chronic urticaria in Egyptian patients. *J. Egypt. Soc. Parasitol.*, 35, 3:833-40.

Jacquier, P.; Gottstein, B.; Stinge-lin, Y.; Eckert, J., 1991: Immuno-diagnosis toxocarosis in humans: evaluation of a new enzyme-linked immunosorbent assay kit. *J. Clin. Microbiol.*, 29, 183:1-5.

Jones, J.L.; Moran, D.K.; Won, K.; Wilson, M.; Schantz, P.M., 2008: *Toxoplasma gondii* and *Toxocara* spp. co-infection. *Am. J. Trop. Med. Hyg.*, 78, 1:35-9.

Kanafani, Z.A.; Skoury, A.; Araj, G.F.; El-Klioury, M.; Sawaya, R.A.; et al., 2006: Seroprevalence of toxocariasis in Lebanon: a pilot study. *Parasitol.*, 132, 5:635-9

- Kim, Y.H.; Huh S.; Chung, Y.B., 2008:** Seroprevalence of toxocariasis among healthy people with eosinophilia. *Korean J. Parasitol.*, 46, 1:29-32.
- Kroegel, C, 2007:** Global initiative for asthma management and prevention-GINA 2006. *Pneumol.*, 61, 5:295-304.
- Kuk, S.; Ozel, E.; Oguzturk, H.; Kirkil, G.; Kaplan, M., 2006:** Se-ro-prevalence of *Toxocara* antibodies in patients with adult asthma. *South Med. J.*, 99, 7:719-22.
- Kwon, N.H.; Oh, M.J., Lee, S.P.; Lee, B.J.; Choi, D., 2005:** Clinical impact of toxocariasis in patients with unknown eosinophilia. *J. Asthma Allergy Clin. Immunol.*, 25:299-304.
- Kwon, N.H.; Oh, M.J.; Lee, S.P.; Lee, B.J.; Choi, D., 2006:** The prevalence and diagnostic value of toxocariasis in unknown eosinophilia. *Ann. Hematol.*, 85:233-8.
- Magnaval, J.F.; Fabre, R.P.; Mariners, J.P.; Charlet, J.P.; de Lar-rard, B., 1991:** Application of Western blotting procedure for the immunodiagnosis of human toxocariasis. *Parasitol. Res.*, 77:697-702
- Magnaval, J.F.; Fabre, R.P.; Mariners, J.P.; Charlet, J.P.; de Lar-rard, B., 1992:** Evaluation of an immunoenzymatic assay detecting specific *anti-Toxocara* IgE for diagnosis and post treatment follow-up of human toxo-cariasis. *J. Clin. Microbiol.* 30:2269-74.
- Magnaval, J.F.; Michault, A.; Ca-lon, N.; Charlet, J.P., 1994:** Epidemiology of human toxocariasis in La Reunion. *Trans. R. Soc. Trop. Med. Hyg.*, 88:531-3.
- Magnaval, J.F.; Glickman, L.T.; Dorchies, P.; Morassin, B., 2001:** High-lights of human toxocariasis. *Korean J. Parasitol.*, 39:1-11.
- Malla, N.; Aggarwal, A.K.; Maha-jan, R.C., 2002:** A serological study of human toxocariasis in north India. *Natl. Med. J. India*, 15:145-7.
- Marx, C; Lin, J.; Masruha, M.R.; Rodrigues, M.G.; da Rocha, A.J.,**

2007: Toxocariasis of the CNS simulating acute disseminated encephalomyelitis. *Neurol.*, 69, 8: 806-7.

Minvielle, G.; Niedfeld, M.; Ci-armela, A.; De Falco, H.; Ghiani, J., 1999: Asthma and covert toxocariasis. *Med.*, 59: 243-8. **Mizgajski, H., 1997:** Role of some environmental factors in contamination of soil with *Toxocara* spp. and other geohelminth eggs. *Parasit. Int.*, 46: 67-72.

Morais, F.B.1.; Maciel, A.L.; Arantes, T.E.; Muccioli, C.; Allemann, N.; (2012); Ultrasonographic findings in ocular toxocariasis. *Arq Bras Oftalmol.* 75(1): 43-7.

Morimatsu, Y.; Akao, N.; Aki-yosh, H.; Kawazu, T.; Okabe, Y.; Aizawa, H., 2006: A familial case of visceral larva migrans after ingestion of raw chicken livers, appearance of specific antibody in bronchoalveolar lavage fluid of the patients. *Am. J. Trop. Med. Hyg.*, 75: 303-6.

Nada, S. M.; Abbaza, B.E.; Mah-moud, L.A.; Habeeb, Y.S.; Hussein, H.F.; Amer, O.T., 1996: Toxocariasis as a cause of renal disease in children in Sharkia Governorate, Egypt. *J. Egypt. Soc. Parasitol.*, 26, 3: 709-17.

Nagakura, K.; Tachibana, H.; Kaneda, Y.; Kato, Y., 1989: Toxocariasis possibly caused by ingesting raw chicken. *J. Infect. Dis.*, 160: 735-6.

Nash, T.E., 2005: Visceral Larva Migrans and Other Unusual Helminth Infection. In: *Principles and Practice of Infectious Diseases* Mandel, Douglas, Bennett. 6th ed.; Churchill Livingstone Philadelphia.

Nihal, D.; Ener, C.; Ozcan, B.; Seray, O.; Yusuf O., 2007: Seroprevalence Survey for *Toxocara canis* infection in the Northwestern Part of Turkey. *Turk. Parasitol. Dergisi.* 31, 4: 288-91

Noordin, R.; Smith, H.V.; Mohamad, S.; Maizels, R.M.; Fong, M.Y., 2005: Comparison of IgG-ELISA and IgG4-ELISA for *Toxocara* serodiagnosis. *Acta Trop.*, 93, 1: 57-62.

- Nunes, CM.; Tundisi, R.; Heine-mann, M.; Ogassawara, S.; Rich-tzenhain, L.J., 1999:** Toxocariasis: serological diagnosis by indirect antibody competition ELISA. Rev. Inst. Med. Trop. Sao. Paulo, 41, 2:95-100.
- Oteifa, M.N.; Moustafa, M.A., 1997:** Potential risk of contracting toxocariasis in Heliopolis district, Cairo, Egypt. J. Egypt. Soc. Parasitol., 27, 1: 197-203.
- Overgaauw, P.A., 1997:** Aspects of *Toxocara* epidemiology: toxocarosis in dogs and cats. Crit. Rev. Microbiol., 23:233-51.
- Park, H.Y.; Lee, S.U.; Huh, S.; Kong, Y.; Magnaval, J.F., 2002:** A sero-epidemiological survey for toxocariasis in apparently healthy residents in Gangwon-do, Korea. Korean J. Parasitol., 40:113-7.
- Pawlowski, Z., 2001:** Toxocariasis in humans: clinical expression and treatment dilemma. J. Helminthol., 75, 4:299-305.
- Salem, G.; Schantz, P., 1992:** Toxocaral visceral larva migrans after ingestion of raw lamb liver. Gun. Infect. Dis., 15:743-4.
- Sarimehmetoglu, H.; Burgu, A.; Aycicek, H.; Gonenc, B.; Ta-nyukse, M.; Kara, M., 2001:** Application of western blotting procedure for immuno-diagnosis of visceral larva migrans in mice by using excretory/secretory antigens. Dtsch. Tierarztl. Wochenschr., 108, 9:390-2.
- Schantz, P.M.; Weis, P.E.; Pollard, Z.F.; White, M.C., 1980:** Risk factors of toxocaral ocular larva migrans: a case-control study. Amer. J. Publ. Hlth., 70:1269-72.
- Strickland, G.T., 2000:** Hunter's Tropical Medicine and Emerging Infectious Diseases. 8th ed.. W.B. Saunders Co. Philadelphia. London, Toronto, Montreal. Sydney. Tokyo.
- Taylor, M.R.; Keane, C.T.; O'Connor, P.; Multihull, E.; Holland, C., 1988:** The expanded spectrum of toxocaral disease. Lancet **1**, 8587:692-5.

Theodoridis, I.; Frydas, S.; Papazahariadou, M.; Hatzistil-ianou, M.; Adamama, K.K., 2001:Toxocarosis as zoonosis: A review of literature and the prevalence of *Toxocara canis* antibodies in 511 serum samples. Int. J. Immuno-pathol. Pharmacol., 14:17-23.

Won, K.Y.; Moran, D.; Schantz, P.; Jones, J.P., 2008: National sero-prevalence and risk factors for zoonotic *Toxocara* spp. infection. Am. J. Trop. Med. Hyg.,79,4:552-7.

الانتشار المصلي لداء التوكسوكارا في الإنسان (داء هجرة اليرقات الحشوي)
عاطف الشاذلي^١ – سيد عبدالباسط^٢ – احمد كمال^٣ – خيرى عبدالحميد محمد
حسن^٤ – طاهر ابراهيم صقر^٥ – سامي حماد^٦
أقسام الطفيليات^(١،٣،٤) ، الصدرية^٢ ، امراض الجهاز الهضمي^٥ ، الصحة العامة^٦
، كليات الطب جامعة المنصورة^(١،٢،٦) ، المنيا^٣ ، الأزهر^٤ ، بنها^٥

تم تضمين عدد إجمالي ٤٥٥ مريضا و الذين يستوفون المعايير المطلوب إدراجها في الدراسة. تم عمل استبيان للمرضى المسجلين (بما في ذلك العوامل الاجتماعية والديموغرافية وغيرها من المخاطر) وتم اجراء فحص سريري دقيق للمرضى وكذلك تم جمع الأمصال من المرضى واختبارها للأجسام المضادة من النوع جي باستخدام اختبار الأليزا وكانت نسبة الأمصال الايجابية للأجسام المضادة للتوكسوكارا (٧.٧٪) وكانت هذه النسبة أعلى بكثير عنها من بين ٣٠ شخص تم اختيارهم عشوائيا من الاصحاء.

ولم تكن هناك فروق ذات دلالة إحصائية بين المرضى الايجابيين والسلبيين مصليا للأجسام المضادة للتوكسوكارا من حيث السن والجنس والمستوى التعليمي والدخل الشهري للأسرة المريض. ومع ذلك، وجدت فروق ذات دلالة احصائية كبيرة بالنسبة للإقامة في المناطق الريفية، البيوت الفقيرة، امتلاك الحيوانات الأليفة والاتصال المتكرر مع التربة.

وكان المرضى الذين قد تأكد اصابتهم بالربو الشعبي أكثر عرضة لخطر الإصابة بالتوكسوكارا أكثر من مرتين من هؤلاء المصابون بأعراض اكلينيكية أخرى (حمى مجهولة السبب، تضخم الكبد والطحال ، اعتلال الغدد اللمفاوية، الاضطرابات العصبية، الاضطرابات الهضمية والتهاب الجلد).

كان المرضى الذين يعانون من فرط زيادة الخلايا الحمضية (الايزينوفيل) وجدوا أنهم أكثر (١٤٩) مرة عرضة لوجود أجسام مضادة للتوكسوكارا مقارنة بهؤلاء الذين ليس لديهم ارتفاع في الخلايا الحمضية (الايزينوفيل). وأظهر تحليل الارتداد متعدد المتغيرات أن فرط زيادة الخلايا الحمضية

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