Journal of the Egyptian Society of Parasitology, Vol. 47, No. 1, April 2017
J. Egypt. Soc. Parasitol. (JESP), 47(1), 2017: 145- 150

SEROPREVALENCE OF TOXOPLASMA GONDII AMONG COMMENSAL RODENTS FROM GIZA GOVERNORATE, EGYPT

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Abstract

Toxoplasma gondii is an obligate intracellular zoonotic parasite that infects a large spectrum of warm-blood animals, including humans. Congenital toxoplasmosis is a worldwide problem. Rodents are intermediate hosts and serve as food for felids, the definitive hosts. A serological survey for antibodies to *T. gondii* was carried out among two species of commensal rodent species *Rattus norvegicus* and *R. rattus*, trapped from different localities within Abu-El-Nomros center, Giza Governorate. Of 125 rats, 5 (4.0%) had anti-*Toxoplasma* antibodies. Of 79 *R. nor- vegicus* 3 (3.8%), and 46 *R. rattus* 2 (4.3%). The results showed that mature and immature of males and females of both species had anti-toxoplasmal. This result was not statistically significant between two species of *R. norvegicus* and *R. rattus* and also between the two sexes of each species.

Key Words: Giza, Rural areas, Toxoplasmosis, Human risk, Rodents, *R. norvegicus*, *R. rattus*.

Introduction

Rodents are very common animals in many Egyptian Governorates (Rifaat *et al*, 1969, Shoukry *et al*, 1986; Morsy *et al*, 1988; Mikhail *et al*, 2010). Besides their economic hazard causing damage to agriculture and contamination of stored food materials, they also play an important role as reservoir host for many zoonotic diseases such as toxoplasmosis (Haridy *et al*, 2010), leishmaniasis (Morsy *et al*, 1982; El-Kady *et al*, 1998), and trichinosis (Morsy *et al*, 2000), plaque and murine typhus (Abdon and Samaan, 1962; Butler, 2013, Stenseth, *et al*, 2008). They act as reservoir host for intestinal parasites such as hymenolepiasis, giardiasis, amoebiasis and *schistosomiasis* (Morsy *et al*, 1981; El-Nahal *et al*, 1982). *Toxoplasma gondii* is an increasing zoonosis of the worldwide distribution concern hazards in both human health and veterinary medicine. Although the final host is the cat, *T. gondii* infects all mammals including man (Edwards and Dubey, 2013) causing mild to fatal congenital complications (Saleh *et al*, 2016). The commonest sources of human infection are ingestion of tissue cysts in raw meat or of food or water contaminated with oocysts shed by felids and transplacental transmission (Pfaff *et al*, 2014). *T. gondii* has been shown to alter behavior of infected rodents in ways through to increase the rodent's chances of being preyed upon by cats (Berdoy *et al*, 2000). The live cycle of *T. gondii* can be broadly summarized into two components: a sexual component occurs only within cats and an asexual component that can occur within virtually all warm blooded animals. *T. gondii* is considered to have three stages of infection; the tachyzoite stage of rapid division, the bradyzoite stage of slow division within tissue cysts, and the oocyst environmental stage. When an oocysts or tissue cyst in ingested by a human or other warm-blooded animal, the resilient cyst wall is dissolved by proteolytic enzymes in the stomach and small intestine, freeing sporozoites from within the oocyst. The parasites differentiate into tachyzoites, the motile and quickly multiplying cellular stage of *T. gondii* tissue cysts in tissues such as brain and muscle tissue, form approximately 7-10 days after initial infection, (Robert and Darde, 2012). Infection often

asymptomatic, immunocompetent individuals may present with fever, lymphadenopathy, muscle aches, and headache. Congenitally infected children may suffer impaired vision and mental retardation. Immunosuppressed patients may have central nervous system disease (encephalitis). The exposure to *T. gondii* is known risk factor for the development of schizophrenia, presumably through a direct pathological effect of the parasite on brain and behavior (Severance *et al*, 2012).

The present study investigated seropositivity for *Toxoplasma gondii* in commensal rodents *Rattus norvegicus* and *Rattus rattus* trapped from rural area, Abu-El-Nomros center, Giza Governorate, Egypt.

Materials and Methods

Wire box traps were deodorized by cleaning with hot water and soap before used. Traps were baited, distributed in selected houses at sunset at Abu-El-Nomros center, Giza Governorate, Egypt. Traps collected next morning and transported to the laboratory (WHO, 1970). In laboratory they were caged individually and each animal was identified to species and them given water and a suitable diet. The studies were done from October 2015 to July 2016. Animals were anaesthetized with diethyl ether and blood sample will be collected from heart and centrifuged for serum. Of 125 serum samples will be tested for the anti-*Toxoplasma* IgG antibodies, by using commercially available enzyme-linked immuno-sorbent assay (ELISA). The levels of antibody were determined by reading the optical density (O.D.) at 450 nm by ELISA reader. The ratio between the O.D. value of the sample and the Cut-off were calculated. Data subjected to analysis for variance and the method of least significant differences (L.S.D.), the method of Duncan (1955) was used.

Results

The results are shown in tables (1, 2 and 3).

Table1: *T. gondii* among rodent species collected from Abu-El-nomros center, Giza Governorate.

Rattus	Sex	No tested Rats	Weight of rats		Mature rats			Immature rats		
			Range	Mean	rats	-ve IgG	+ve IgG	rats	-ve IgG	+ve IgG
norvegicus	Males	46	84-512	289	44	43	1	2	1	1
	Females	33	76-454	276	30	29	1	3	3	0
	Total	79	-	-	74	72	2	5	4	1
rattus	Males	23	40-187	112	15	14	1	8	8	0
	Females	23	40-160	101	16	16	0	7	6	1
	Total	46	-	-	31	30	1	15	14	1

Table 2: Correlation between *R. norvegicus* and *R. rattus* infected with *Toxoplasma gondii*

Species	No.	Mean	SD	Levene's Test
R. norvegicus	n=79	0.03787	0.19236	F=0.090
R rattus	n=46	0.04348	0.20618	P>0.05

Table 3: Correlation between males and females of *R norvegicus* and *R. rattus* infected with *Toxoplasma gondii*.

Rattus	Sex	Mean	SD	Levene's Test
norvegicus	♂(n=46)	0.04348	0.174	F=0.360
	♀ (n=33)	0.03030	0.206	P>0.05
rattus	♂ (n=23)	0.04348	0.209	F= 0.00
	♀ (n=23)	0.04348	0.209	

Discussion

In the present study, *R. norvegicus* and *R. rsttus* from Abu-El-Nomros center showed anti-toxoplasmal antibodies 3 (3.8%) and 2 (4.3%). Of 46 males *R. norvegicus* 2 (4.3%) and of 33 female rats 1(3%) were seropositive. Of 23 male and female *R. rattus* one (4.3%) was seropositive. This result showed no significant between *R. norvegicus* and *R. rattus* (F=0.090 & P>0.05) and between sexes of both species (F=0.360 & P>0.05 for *R. norvegicus* and F= 0.00 for *R. rattus*). El-Shazly *et al*. (1991) in Dakahlia Egypt examined four species of commensal rodents (*R. norvegicus*, *R. rattus*, *Mus musculus* and *Acomys cahirinus*) trapped from different

localities and reported that *R. norvegicus*, 32/200 (16%), *R. rattus*, 29/228 (12.7%) *M. musculus*, 2.87 (2.3%) and *A. cahirinus*, 5/69 (7.2%) were IHA-positive.

Abroad, Asai *et al*. (1988) in Japan reported IHA-seropositivity in 27(11.5%) *R. norvegicus*. Dubey *et al*. (2006) in Grenada, west India reported positivity in 238 *R. norvegicus*, which tissue samples of hearts and brains were microscopically examined and were 2 (0.8%) of 238 were seropositive. Yin *et al*. (2010) in southern China reported *T. gondii* in female *R. norvegicus* and *R. flavipectus*, seropositivity was (3.4% & 3.0%) respectively.

Dabritz *et al*. (2008) in Morro Bay (California among 523 wild rodents reported seropositivity in 17% (88/523), which were 26% (85/328) *Peromyscus sp.* and 8% (3/37) *Spermophillus beecheyi*. Fourteen percent (23/161) of rodents and 15% (16/109) of rodents from sites adjacent to riparian habitats had antibodies to *T. gondii*, compared to 19% (49/253) of rodents captured in habitats not associated with water, this difference was not significant.

Jittapalapong *et al*. (2011) showed that overall 21 of 461(4.6%) rodents had diagnostic significant to *T. gondii* during rodents captured from either forested or anthropized areas in Thailand. Vujanic *et al*. (2011) reported that *Toxoplasma gondii* infection was examined in 144 *R. norvegicus* and 12 *M. musculus* captured in three locations in Belgrade city characterized by poor housing and degraded environment. In rats, specific IgG antibodies were detected by modified agglutination test in 22 (27.5%) of the 80 blood samples available.

Ahmad *et al*. (2012) in Pakistan found seropositive *T. gondii* (58.57%) in *R. rattus* followed by *M. musculus* (36.66%) and lowest was in man (11.33%). Costa *et al*. (2012) in Brazil reported antibodies to *T. gondii* in 13 (38.2%) of *R. rattus* in Femandode Noronha which is an archipelago of 21 Islands and islets in Atlantic Ocean, State of Pemambuco,. Mosallanejad *et al*. (2012) reported that wild rats were infected with *T. gondii* due to ingestion of food or water contaminated with oocysts with an important role in zoonotic *T. gondii* transmission. Rats captured among Ahvaz district, southern Iran indicated that thirty-one of the 127 serum samples (24.41%) had antibodies against *T. gondii*, prevalence was higher in females (24.66%) than males (24.07%).

Fournier *et al*. (2013) reported a zoonotic *T. gondii* among wild of vertebrates. Siqueira *et al*. (2013) in Brazil found antibodies *Toxoplasma gondii* in 6.7% (15/223) of marsupials and 5, 7% (10/174) of rodents, without association between positivity in marsupias and/or rodents and sex, age, or areas of collection in the Atlantic Forest. Rendon-Franco *et al*. (2014) in Mexico reported *T. gondii* transmission between rodents and members of felids and found an important role of rodents in the sylvatic cycle of *T. gondii* prevalence 7% (3/44) and 33% (4/12) in *Sigmodon hispidus* and *Liomys irroratus*, respectively.

Gennari *et al*. (2015) in southeastern Brazil reported seropositivity in 151 rodents and 48 marsupils in the Atlantic Forest, Sao Paulo State. The anti-*T. gondii* antibodies were in 8.6% (13/151) of rodents and 10.4% (5/48) of marsupials. Normaznah *et al*. (2015) in Malaysia showed that *T. gondii* antibodies were 5.9% (31/526) of rodents from various locations, but were commonest in commensal, *R. exulans* (9/64, 14.0%), *R. argentiventer* (2/8, 25%), *R. rattus diardii* (10/166, 6.0%), and *R. tiomanicus* (6/215, 2.7%). Of forest rodents positivity was in *Maxomys rajah* (1/9, 11.1%) and *R. bowersi* (1/12, 8.3%). Gotteland *et al*. (2014) reported that toxoplasmosis infected rodents was prevalent in rural areas but its spatial distribution was poorly known. In particular, it is unclear if areas of high density of cats, the only hosts excreting *T. gondii*, constitute foci of high prevalence. Commensal rats were more infected to *T. gondii* than non-commensal species. However, the major determinant of the risk of infection was the distance to the

nearest farm, which explained the risk in all species or non–commensal species only.

Generally speaking, there are seven means of acquiring toxoplasmosis in humans (Tenter *et al*, 2000): 1- Through vertical transmission from an infected mother to her fetus congenital infection (Congenital). 2- Ingestion of infectious oocysts from the environment (usually from soil contaminated with feline feces), 3- Cleaning cat litter boxes. 4- Drinking unpasteurized goat milk or equine milk. 5- Ingestion of tissue cysts in meat from an infected animal, 6-Eating unwashed raw vegetables or fruits. 7- Via blood transfusion or organ transplantation from an infected donor, (Acquired infection). 8- Also, accidentally by needle-stick injuries as well as handling specimens that may contain viable organisms to the laboratory for examination (Herwaldt, 2001).

On the other hand, the endemicity of zoonotic toxoplasmosis was reported not only in Egypt (Shaapan, 2016), but also in many countries Worldwide as Jordan (Morsy and Michael, 1980), Libya (Kassem and Morsy, 1991), Saudi Arabia (Alanazi, 2013), Turkey (Yağcı Yücel *et al*, 2014), Kuwait (El-Azazy *et al*, 2015), Yemen (Mahdy *et al*, 2017), Italy (Formenti *et al*, 2017). Harfoush and Tahoon (2010) in rodents infested Egyptian farm, *Toxoplasma*-IHAT was detected in locally bred domestic ducks, free-range chickens, turkey and domestic rabbits. Besides, Elsheikha *et al*. (2009) reported that *T. gondii* infection had a prominent influence on the association between oxidative stress biomarkers and immune-suppression status in seropositive blood donors as well as cerebral toxoplasmosis was reported (Prandota *et al*, 2014)

Conclusion

Generally speaking, toxoplasmosis is real public health zoonotic parasite of wide geographical and zoological distribution.

The outcome results showed that Giza Governorate was featured by the presence of high population density of rats and mice. Serological survey for *T. gondii* in the commensal rodents, *R. norvegicus* and *Rattus rattus* proved high positivity. Therefore, the intimate association of rodents with human plays potential danger as disseminators as serious pathogens problems. This must be taken into consideration from the medical and veterinary point of view.

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