Emerging Problems in Infectious Diseases

Serosurvey for *Toxoplasma gondii* in dogs in Maiduguri, Borno State, Nigeria

Joshua Kamani¹, Aliyu U. Mani², Hussaini A. Kumshe², Goni I. Dogo¹, James P. Yidawi³, Dauda K. Pauline¹, Henry E. Nnabuife¹, Peter Joan¹ and Godwin O. Egwu²

¹Parasitology Division, National Veterinary Research Institute PMB 01 Vom, Plateau State, Nigeria
²Department of Veterinary Medicine, University of Maiduguri. PMB 1069 Maiduguri Borno State, Nigeria
³Mohamet Lawan Colleges of Agriculture, PMB 1427 Maiduguri, Borno State, Nigeria

Abstract

The seroprevalence of *Toxoplasma gondii* (*T. gondii*) antibodies in dogs in Maiduguri, the capital of Borno State, Nigeria, was determined using the Latex Agglutination Test (LAT). Antibodies (LAT titer > 1:64) to *T. gondii* were found in 42 (25%) of the animals examined. Antibody titers in positive dogs ranged from 1:64 (15 dogs) to 1:2048 (3 dogs). There was a significant statistical difference (P < 0.05) between age groups of dogs, the prevalence being higher in dogs ≥ 3 years (χ² = 13.73 P = 0.0002, OR 2.80 CI95% 1.28-6.13 P = 0.008). Pure Alsatians and their crosses were less likely to be seropositive (OR cross breed 0.28 CI95% 0.13-0.61 P = 0.001, OR Alsatian 0.16 CI95% 0.04-0.58 P = 0.002). The high prevalence of *T. gondii* infection that we found in dogs suggests a need for a larger survey to determine the national prevalence and identify possible risk factors in different agro-climatic zones. Such a study will help in formulating nation-wide control measures for toxoplasmosis.

Key words: *Toxoplasma gondii*, seroprevalence, dogs, Borno State, Nigeria

*J Infect Dev Ctries* 2010; 4(1):016-018.

(Received 11 August 2009 -- Accepted 13 November 2009)

Copyright © 2010 Kamani et al. This is an open-access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Introduction

Infection with the protozoan *Toxoplasma gondii* is one of the most common parasitic infections of man and other warm-blooded animals [1-3]. The main route of infection is through the ingestion of oocysts excreted in the feces of cats, which are the definitive host. Infections can also occur by ingestion of cysts in the muscles and tissues of intermediate hosts [4]. As they are definitive hosts, free-roaming cats can be used as sentinels for the environmental spread of *T. gondii* in densely built urban areas [5]. Although dogs do not produce *T. gondii* oocysts like cats, outdoor dogs can become infected by oocysts from soil contaminated with *T. gondii* and mechanically transmit oocysts [6]. Further, the fur of dogs that have come in contact with cat faeces may be a vector for transmission of oocysts to humans [7]. Although primary toxoplasmosis in dogs is rare, the prevalence of *T. gondii* antibodies in canine populations can be an indicator of environmental contamination and the risk of toxoplasmosis to humans [8-11].

Recently there has been increased interest in keeping dogs in major Nigerian cities, for security, as pets, or to hunt for game popularly known as bush meat. Some people breed and sell dogs for income while in some areas they form a good source of animal protein for people. The level of management and care depends largely on the intended use and the social or economic status of the owners. Exotic breeds, especially Alsatians, are owned by more affluent people and security agencies such as the police; exotic cross-breeds are owned by the middle class; and low-income earners generally have mongrels which are used for hunting. The exotic breeds and their crosses are usually housed and well cared for unlike the mongrels that roam freely. Recent surveys of *T. gondii* antibodies in dogs have shown country variations with 8% in Taiwan, 9% in Thailand, and 89% in Brazil [9,11-12]. No data concerning the prevalence of *T. gondii* in dogs in Maiduguri, Borno State, Nigeria, are available.

The aim of our study was to determine the seroprevalence of *T. gondii* in dogs in Maiduguri, Borno State, Nigeria, using the Latex agglutination test. This is the first serological survey for *T. gondii* antibodies in dogs in a Nigerian city.
Materials and methods

The location of Borno state, the study area, has been described elsewhere [10]. A hundred and sixty-eight dogs were randomly selected from different parts of the city and 5 ml of blood were collected by venipuncture. Blood was allowed to clot, then it was centrifuged, and the serum collected into cryovials and labeled. Sera was stored at −20 °C until further examination. Data such as age, breed, sex, and access to outdoor environment were noted. Dogs were classified as mongrel, Alsatian cross or pure Alsatian.

Serology

The presence of *T. gondii* antibodies was analyzed by the Latex Agglutination Test (LAT) kit (TOXOREAGENT - Mast Diagnostics, Mast House, Derby Road, Bootle, L20 1EA, UK) according to the manufacturer’s instructions. The cut-off titer was taken as 1:64 according to the manufacturer's instructions, and an end point titer was established for positive samples.

| Variable          | n   | P     | Relative Distribution (%) | LAT Positive | Prevalence (%) | OR (CI95%) |
|-------------------|-----|-------|---------------------------|--------------|----------------|------------|
| **Gender**        |     |       |                           |              |                |            |
| Male              | 60  | 36    | 10                        | 17           | 1.00           |            |
| Female            | 108 | 64    | 32                        | 30           | 2.10           |            |
| (0.95-4.66)       |     | 0.06  |                           |              |                |            |
| **Age group (years)** |   |       |                           |              |                |            |
| 6 mo-1yr          | 23  | 14    | 4                         | 17           | 1.00           |            |
| >1≤3              | 104 | 62    | 21                        | 20           | 1.2            |            |
| (0.37-3.91)       | 0.75|       |                           |              |                |            |
| >3 (1.28-6.13)    | 41  | 24    | 17*                       | 42           | 2.80           |            |
| **Breed**         |     |       |                           |              |                |            |
| Mongrel           | 62  | 37    | 26                        | 42           | 1.00           |            |
| Alsatian Cross    | 77  | 46    | 13*                       | 17           | 0.28           |            |
| (0.13-0.61)       |     | 0.001 |                           |              |                |            |
| Pure Alsatian     | 29  | 17    | 3*                        | 10           | 0.16           |            |
| (0.04-0.58)       |     | 0.002 |                           |              |                |            |
| **Habitat**       |     |       |                           |              |                |            |
| Indoor with limited access to outside | 32  | 19    | 4                         | 12           | 1.00           |            |
| Free access to outside | 136 | 81    | 38*                       | 28           | 2.71           |            |
| (0.89-8.27)       |     | 0.07  |                           |              |                |            |
| **Total**         | 168 | 100   | 42                        | 25           |                |            |

* Values with asterisk are statistically significant.

Data analysis

Chi-square and Fisher’s exact tests were used to compare seroprevalence values relative to gender, age, breed as well as access to outdoor environment. Odds ratios (OR) at confidence intervals (CI95%) were used to determine possible factors of exposure. Analyses were done with Statistix 8, and MedCal statistical softwares, with a probability (p) value < 0.05 as statistically significant.

Results

A seroprevalence of 25% (42/168) was recorded in dog samples examined by LAT at a cut-off titer of 1:64 (Table 1). The prevalence in females (30%; 32/108) was higher than in males (17%; 10/60) but the difference was not statistically significant. Positive titers ranged from 1:64 (15 dogs) to 1:2048 (3 dogs). Prevalence increased significantly with age ($\chi^2 = 13.73$, P =0.0002) and dogs ≥ 3 years were significantly more likely to be seropositive than those ≤ 1 year. Mongrels had significantly higher (P < 0.05) prevalence (41.9%) than Alsatian crosses (16.9%) and pure Alsatians (10.3%). The risk of infection was significantly lower in pure Alsatians.
and Alsatian cross-breeds than in mongrels. The prevalence of anti *T. gondii* antibodies was higher (28%) in dogs that have free access to the outdoors than those confined indoors (11.8%) and they were 2.7 times more likely to be exposed to *T. gondii* (Table 1).

**Discussion**

Because of the great importance of *T. gondii* as a zoonotic agent, public health organisations, such as the World Health Organisation, have repeatedly advised the collection of accurate epidemiological data on this parasite [2]. For our serological survey for *T. gondii* antibodies in dogs in Maiduguri, the capital of Borno state, Nigeria, we used the LAT which is widely available and has been evaluated as a screening test [11-13].

We recorded a seroprevalence of 25% which is much lower than the 89% recently reported in Brazil [11] but higher than the 8% reported in Taiwan [10] and 9% in Thailand [9]. In our study, the sex of dogs was not significantly associated with seroprevalence, but age and breed were significantly associated and this has been discussed by several other investigators [2,5-8,17,20]. Age is directly related to the rate of exposure to the sources of *T. gondii* infection. From our experience, quality of care by the owners is related to the breed of a dog. Pure Alsatians are expensive and usually owned by more affluent people for security purposes. Some people breed and sell them to individuals or government agencies. These dogs are usually provided with good food and kenneling and have limited access to outside environment, which limits their exposure to *T. gondii* in the soil and in animals such as rodents which may be preyed upon for food. Mongrels, in contrast, generally receive little attention from their owners and are commonly exposed to risk factors for *T. gondii*. The highest antibody titers we found were (three at 1:2048) in adult (> 1 year to > 3 years) mongrels with free access (stray) to the outdoor environment, which, as previously reported, is a risk factor [17-20]. This suggests recent infection or ingestion of a high infectious dose of *T. gondii*.

In conclusion, our study has shown *T. gondii* infections in domestic dogs are prevalent in northeastern Nigeria. Taking into account the risk factors we identified, control measures should include restricting access to the outdoors and feeding the animals to prevent them from preying on animals that might be intermediate hosts. These measures should lower the rate of exposure in dogs and may consequently prevent infection in people.

**References**

1. Dubey JP, Beattie CP (1988) Toxoplasmosis of Animals and Man. CRC Press, Boca Raton, FL, pp. 1-220.
2. Tenter AM, Heckeroth AR, Weiss LM (2000) *Toxoplasma gondii*: from animals to humans: International Journal for Parasitology 30: 1217-1258.
3. Hill D, Sreekumar C, Dubey JP (2002) *Toxoplasma gondii*. In: Friend M, Brand CJ (Eds.), Field Manual of Wildlife Zoonosis. USGS National Wildlife Health Center, Madison, WI, pp. 357-382.
4. Ettinger SJ, Feldman EC (2005) Protozoal and miscellaneous infections. In: Lappin MR (Ed.), Textbook of Veterinary Internal Medicine: Disease of the Dog and Cat, sixth ed. W.B. Saunders Co., Philadelphia, p. 639.
5. Meireles LR, Galisteo Jr. AJ, Pompeu E, Andrade Jr. HF (2004) *Toxoplasma gondii* spreading in an urban area evaluated by seroprevalence in free-living cats and dogs. Tropical Medicine & International Health 9: 876-881.
6. Lee JY, Lee SE, Lee EG, Song KH (2008) Nested PCR-based detection of *Toxoplasma gondii* in German shepherd dogs and stray cats in South Korea. Research in Veterinary Science 85: 125-127.
7. Frenkel JK, Hassanean KM, Hassanean RS, Brown E, Thulliez P, Quintero-Nunez R (1995) Transmission of *Toxoplasma gondii* in Panama City, Panama: a five-year prospective cohort study of children, cats, rodents, birds, and soil. Am J Trop Med Hyg 53: 458-468.
8. Garcia JL, Navarro IT, Ogawa L, Oliveira RC (1999) Seroprevalência do *Toxoplasma gondii* em suínos, bovinos, ovinos e equinos, e sua correlação com características geográficas do Brasil. Revista de Saúde Pública 33: 321.
9. Jittapalah Sathaporn, Burin Nimsupan, Nongnuch Pinyopanuwat, Wissanuwa Chimnoi, Hidenori Kabeya and Soichi Murayama (2007) Seroprevalence of *Toxoplasma gondii* antibodies in stray cats and dogs in the Bangkok metropolitan area, Thailand. Veterinary Parasitology 145: 1-2, 138-141.
10. Kamani J, Mani AU, Egwu GO, Kumshe HA (2009) Seroprevalence of human infection with *Toxoplasma gondii* and the associated risk factors, in Maiduguri, Borno state, Nigeria. Annals of Tropical Disease & Parasitology 103: 317-321.
11. Lindsay DS, Dubey JP, Blagburn BL (1997) Mechanical transmission of *Toxoplasma gondii* oocysts by dogs. Vet. Parasitol 73: 27-33.
12. Dah-Sheng Lin (1998) Seroprevalences to *Toxoplasma gondii* in privately-owned dogs in Taiwan. Preventive Veterinary Medicine 35: 21-27.
13. Santos TR, Costa AJ, Toniollo GH, Luvizotto MCR, Benetti AH, Santos RR, Matta DH, Lopes WDZ, Oliveira JA, Oliveira GP (2009) Prevalence of anti-*Toxoplasma gondii* antibodies in dairy cattle, dogs, and humans from the Jauru micro-region, Mato Grosso state, Brazil Veterinary Parasitology 161: 324-326.
14. Tsuobata N, Hiraoka K, Sawada Y, Watanabe T, Ohshima S (1977) Studies on latex agglutination test for Toxoplasmosis. Jpn J Parasitol 26: 286-290.
15. Balfour, AH, Fleck DG, Hughes PA, Sharp D (1982) Comparative study of three tests (dye test, indirect
haemagglutination, latex agglutination test) for the detection of antibodies to Toxoplasma gondii in human sera. J Clin Pathol 35: 228-232.
16. Hollimann RE (1990) Investigation of HIV positive patients for Toxoplasmosis using the latex agglutination test. Serodiagn Immunother Inf Dis 4: 249-253.
17. Ali CN, Harris JA, Watkins JD, Adesiyun AA (2003) Seroepidemiology of Toxoplasma gondii in dogs in Trinidad and Tobago. Vet Parasitol 113: 179-187
18. Fan CK, Tsai YJ, Chung WC, Chang JS, Chao PH (1998) Seroepidemiology of Toxoplasma gondii infection among dogs in Taipei, Taiwan. Kaohsiung J Med Sci 14: 387-391.
19. Riemann HP, Kaneko JJ, Haghighi S, Behymer DE, Franti CE, Ruppannet R (1978) The prevalence of antibodies against Toxoplasma gondii among hospitalized animals and stray dogs. Can J Comp Med. 42: 407–413
20. Dubey JP (1985) Toxoplasmosis in dogs. Canine Pract 12: 7-28.

Corresponding Author
J. Kamani
Parasitology Division, NVRI PMB 01 Vom, Plateau State, Nigeria
Phone: +2347035517715
Fax: +234 73281452
Email: shapumani@yahoo.com

Conflict of Interest: No conflict of interest is declared.