Research Note

Braz. J. Vet. Parasitol., Jaboticabal, v. 23, n. 4, p. 522-525, oct.-dec. 2014
ISSN 0103-846X (Print) / ISSN 1984-2961 (Electronic)
Doi: http://dx.doi.org/10.1590/S1984-29612014074

Toxocara cati (Nematoda: Ascarididae) in *Didelphis albiventris* (Marsupialia: Didelphidae) from Brazil: a case of pseudoparasitism

Toxocara cati (Nematoda: Ascarididae) em *Didelphis albiventris* (Marsupialia: Didelphidae) do Brasil: um caso de pseudoparasitismo

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Received February 12, 2014
Accepted August 12, 2014

Abstract

Eggs of *Toxocara cati* were found in the feces of *Didelphis albiventris* from a peridomestic urban environment in Brazil. Negative fecal tests following short-term captivity of the opossums, as well as the absence of ascaridids during necropsy, suggest the occurrence of pseudoparasitism. Implications of the findings for the epidemiology of toxocariasis are discussed.

Keywords: Opossum, pseudoparasitism, *Toxocara cati*.

Resumo

Ovos de *Toxocara cati* foram encontrados nas fezes de *Didelphis albiventris* oriundos de um ambiente peridomiciliar urbano no Brasil. A negatividade dos exames de fezes após um curto período de cativeiro dos gambás e a ausência de nematódeos ascaridídeos durante a necropsia sugerem a ocorrência de pseudoparasitismo. As implicações dos achados para a epidemiologia da toxocarose são discutidas.

Palavras-chave: Gambás, pseudoparasitismo, *Toxocara cati*.

Anthropogenic environmental changes have led to the overlap of habitats and increased contact between wildlife and domestic animals, which can result in the transmission of helminth species from these hosts (spillover), a phenomenon widely discussed in recent times (reviewed by DASZAK et al., 2000; THOMPSON, 2013). However, studies on the possible involvement of wild animals in the life cycle of parasites from domestic animals are comparatively scarce (THOMPSON, 2013).

Among the wildlife animals affected by human-caused environmental changes is the white-eared opossum, *Didelphis albiventris* Lund, 1840, a marsupial with a high potential for adaptation to urban areas (CÁCERES, 2002; SOUSA et al., 2012). In these areas, there is considerable overlap of the habitat of these didelphids and domestic animals, such as cats and dogs. Although not well known, the possibility of parasite transmission between felines and marsupials is real. Moreover, the fact that opossums act as reservoir hosts of pathogens that are of medical and veterinary importance (THATCHER, 2006) should be considered as a warning.

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In this case report, during the coproparasitological analysis of two young specimens of *D. albiventris* (males, weighing about 400 g), immature eggs of *Toxocara cati* (SCHRANK, 1788), an ascaridid parasite of felids with a worldwide distribution, were found, characterizing cases of pseudoparasitism.

The opossums, captured in December 2013 on the premises of the Institute of Biological Sciences, Federal University of Minas Gerais, Belo Horizonte, Minas Gerais, Brazil, were individually kept in cages containing food and water *ad libitum* for three days. All feces obtained during the captivity period were evaluated daily. Initially, the search for proglottids of cestodes and larger-sized nematodes that were possibly eliminated in the feces was performed macroscopically, and the fecal aliquots were processed using the spontaneous sedimentation method and analyzed by light microscopy. In parallel, samples of feces from cats (n = 12) obtained in the same habitat where opossums were caught were examined by the same parasitological method. The eggs of the helminths found were submitted to morphometric analysis with the aid of a micrometer eyepiece. Images of the eggs were captured with the aid of a microscope (Leica DM500) coupled with a digital camera (Leica ICC50 HD). Following the captivity period, one animal was euthanized and necropsied for the presence of parasites, and the other animal was freed in a forest fragment.

Feces of both specimens of *D. albiventris* showed nonembryonated ascaridid eggs (Figure 1a) measuring 68 ± 3 (62-77) µm by 61 ± 3 (56-67) µm (n = 120) and presenting morphological features compatible with *T. cati* (UGA et al., 2000; FAHRION et al., 2011). Moreover, the eggs of *Aspidodera raillieti* Travassos, 1913 [68 ± 3 (63-77) µm by 48 ± 2 (43-53) µm, n = 40] (Figure 1b) and *Cruzia tentaculata* (Rudolphi, 1819) [116 ± 5 (103-127) µm by 61 ± 2 (55-67) µm, n = 30] (Figure 1c), which are nematode species that were previously reported in *D. albiventris* from Brazil (QUINTÃO E SILVA & COSTA, 1999), were also observed. Although a quantitative analysis has not been performed, the first evaluated samples of fecal sediment showed numerous eggs of *T. cati* (about 20 eggs/slide). However, a clear reduction up to negativity occurred after three days of captivity of the marsupials, while the presence of eggs of the other two nematode species remained constant. During necropsy of one specimen of *D. albiventris* (negative for the presence of eggs of *C. tentaculata* in coproscopy) adult nematodes identified as *A. raillieti* and *Strongyloides* sp. were found in the intestine; however, the presence of *T. cati* or another ascaridid was not verified. The formation of larvae of *T. cati* within the eggs after keeping the sediment samples at room temperature suggests the possible viability of this parasite stage following its passage through the gastrointestinal tract of *D. albiventris*. In stool samples from domestic cats, 11/12 (92%) had eggs of *T. cati* measuring 71 ± 3 (63-77) mm by 62 ± 3 (55-68) mm (n = 50).

Toxocara cati is a species of roundworm that is found in domestic and wildlife felids and presents a cosmopolitan distribution; the ingestion of mature eggs by other vertebrates (paratenic hosts), including humans, has been related to the occurrence of visceral and ocular larva migrans (DESPOMMIER, 2003; STRUBE et al., 2013; MACPHERSON, 2013). The diagnosis of infection of cats by *T. cati* or soil contamination with eggs of this ascaridid [which are very similar to *Toxocara canis* (WERNER, 1782), a parasite species found in dogs], although difficult and time consuming, may be performed by morphometric analysis (UGA et al., 2000; FAHRION et al., 2011; MACPHERSON, 2013; present study) or, more recently, with the aid of polymerase chain reaction (PCR)-based molecular characterization (FAHRION et al., 2011; DURANT et al., 2012; KHADEMVATAN et al., 2013).

Although the finding of immature eggs of *Toxocara* in the feces of marsupials is reported here for the first time, the contact of opossums with mature eggs of *T. canis* was reported in serological tests in Oceania (SWEATMAN, 1962). In the present report, the presence of a large population of free-living cats observed in the environment where the marsupials were captured, which is associated with a high percentage of feline stool samples that are positive for eggs of *T. cati*, may be related to the finding of eggs of this parasite in the feces of *D. albiventris*. Moreover, stray dogs, potential hosts of *T. canis*, were not observed in the area in which the marsupials were captured. The possibility of interspecific coprophagy, as represented by the ingestion of feline feces by *D. albiventris*, could justify the finding of large numbers of eggs of *T. cati* in the feces of both opossums. Indeed, the feces of carnivores can attract opossums, and the occurrence of coprophagy of the feces of these predators by *Didelphis virginiana* (Kerr, 1792) was suggested in the USA (GIPSON et al., 2003; LIVINGSTON et al., 2005). Furthermore, the coprophagic behavior is related to the finding of eggs of *T. cati* in dog feces (FAHRION et al., 2011). On the other hand, *D. albiventris* is an omnivorous species (CÁCERES, 2002), and the possibility of ingestion of items related to their usual diet (e.g. arthropods and vegetables) contaminated by cat feces containing the eggs of *T. cati* cannot be ruled out, although the massive amount of eggs of this parasite that were initially observed in the analyzed samples makes this hypothesis unlikely.

Some species of mammals, particularly rodents, play a known role in the epidemiology of toxocariasis. Since they are paratenic hosts of the parasite, these vertebrates may contribute to the dispersion of immature eggs of *Toxocara* spp. (DUBINSKY et al., 1995; DESPOMMIER, 2003; ANTOLOVÁ et al., 2013; MACPHERSON, 2013); this phenomenon is reported in marsupials for the first time in this report. Given that felines have a habit of burying their stool in the soil, the dispersion of eggs of *T. cati* may be comparatively more difficult (OVERGAAUW, 1997). In that respect, marsupials may contribute to the dispersion processes of the parasite, and this can acquire epidemiological

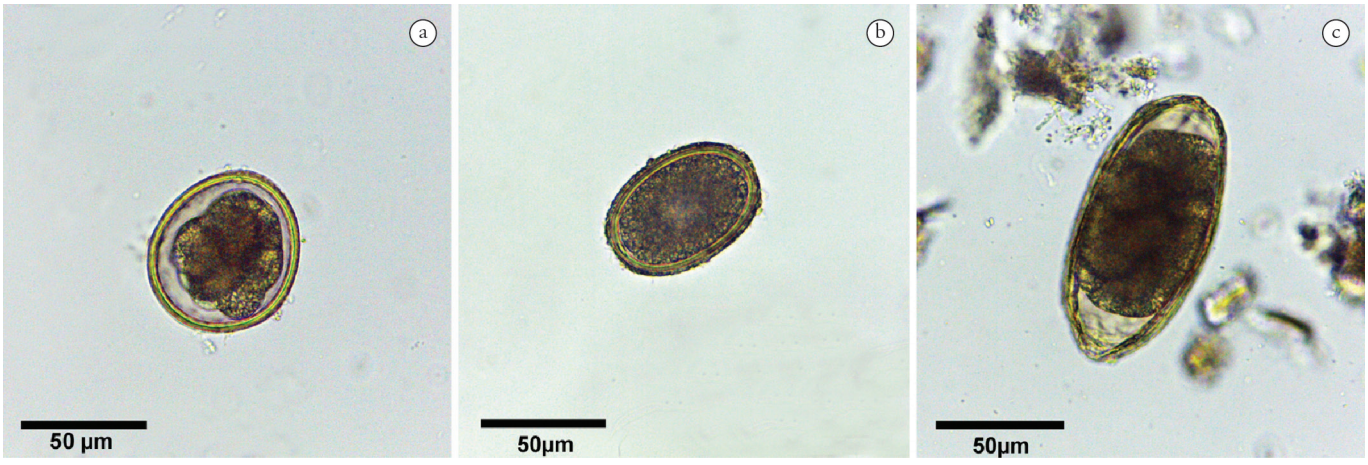

Figure 1. Eggs of nematodes found in the feces of *Didelphis albiventris* in Brazil. (a) *Toxocara cati*, (b) *Aspidodera raillieti*, (c) *Cruzia tentaculata*.

importance. Thus, the potential involvement of *D. albiventris* as a transport host for the eggs of *T. cati* is probably related to its feeding behavior; this might be a mechanism responsible for the distribution of this ascaridid in the urban enviroment.

The possible contact of *D. albiventris* with an environment contaminated with the infective eggs of *T. cati* also points to the possible involvement of these didelphids and other Neotropical marsupials as paratenic hosts of this ascaridid, although additional studies are needed. In fact, studies involving the identification of potential paratenic hosts of *Toxocara* spp. in Brazil are scarce, and there are reports that are based on serological studies of rats (CHIEFFI et al., 1981) and sheep (SANTARÉM et al., 2011; RASSIER et al., 2013). Interestingly, the eggs of some helminths, including *Toxocara* spp., require a relatively long time (at least 2 weeks) for embryonation. In these cases, depending on the developmental stage of the eggs (immature or mature) ingested, two situations, not mutually exclusive, can occur. If the host ingests immature eggs, it may develop a simple pseudoparasitism, during which the direct passage of eggs along the gastrointestinal tract of the animal is verified, as observed in the present study. On the other hand, when the host ingests mature infective eggs, the hatching and tissular larval migration are verified in this so named paratenic host.

According to Thompson (2013), the absence or inadequate care of domestic animals may be related to the increased risk of spillover, which is perhaps more applicable to cats due to the fact that the habitats of these animals range beyond the peridomestic environment; in addition, there is a growing number of free-living cats in large urban centers. Infection of wild animals present in forest fragments by parasites commonly found in domestic cats, as demonstrated for the protozoan *Toxoplasma gondii* (NICOLLE AND MANCEAUX, 1908) (THOMPSON, 2013), can possibly also occur with other parasites [e.g. *T. cati*, *Platynosomum illiciens* (Braun, 1901) (= *P. fastosum*)]. On the other hand, the movement of species such as *D. albiventris* between urban and wild areas may favor the introduction and dissemination of *T. cati* in these environments.

The diagnosis of cases of pseudoparasitism in animals, both wildlife and domestic, is an issue rarely reported in the scientific literature. This event, which has possibly been underestimated, may result in the erroneous identification of relationships of parasitism. Thus, we must keep in mind that during the execution of coproparasitological studies, the eggs of parasites found might originate from previously ingested prey, or they may result from various eating habits, as shown here. Detailed morphological and morphometric analyses of parasite developmental stages may be useful in detecting pseudoparasitism cases.

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