

Dioctophimosis in a community dog from a public park in the city of Curitiba-PR: a case report from the perspective of One Health

Dioctofimose em cão comunitário de um parque público da cidade de Curitiba-PR: um relato de caso a partir da ótica da Saúde Única

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Abstract

The present study describes from the holistic One Health perspective a case report of dioctophimosis in a community dog (defined as stray dogs managed by the local community) residing in a park in the city of Curitiba-PR, considering the multispecies collectives directly affected by the dynamics of this dangerous zoonosis. The work underlines the importance of the community dog program of the Rede de Proteção Animal, demonstrating the health barrier function of these dogs. Despite being a cosmopolitan zoonosis, dioctophimosis is of particular importance in regions of the developing world, including Latin America, because of large populations of stray animals and social inequalities. Public policies focused on raising awareness among the general population about this parasitic disease and its risks and the restraint of actions that determine risks of infection for humans and companion animals are fundamental to a One Health approach to prevent this zoonosis.

Keywords: environment and public health, host-parasite interactions, one health, parasites.

Resumo

No presente estudo, é descrito um relato de caso de dioctofimose em um cão comunitário (descrito como um cão em situação de rua mantido pela comunidade local) residente em um parque da cidade de Curitiba-PR, sob a perspectiva holística da Saúde Única, considerando os coletivos multiespécies que estão diretamente envolvidos e influenciados pela dinâmica desta perigosa zoonose. O trabalho aborda a importância do programa do cão comunitário da Rede de Proteção Animal, demonstrando claramente a função de barreira sanitária desses cães. Argumenta-se que apesar de ser uma zoonose praticamente cosmopolita, a dioctofimose tem importância significativa em regiões do mundo em desenvolvimento, incluindo a América Latina, devido às grandes populações de animais errantes e às desigualdades sociais comuns nesta porção do planeta. Políticas públicas que envolvam a sensibilização da população em geral sobre esta doença parasitária e seus riscos, bem como a coibição de ações que determinem riscos de infecção para humanos e animais de companhia são fundamentais para uma abordagem de Saúde Única com objetivo de prevenir esta zoonose.

Palavras-chave: meio ambiente e saúde pública, interações hospedeiro-parasita, saúde única, parasitas.

Introduction

Dioctophimosis or dioctophymatosis is a zoonotic parasitic disease caused by an agent called *Dioctophyma renale* or *Dictyophyme renale*. The popularly known "giant kidney worm" is the largest parasitic nematode of mammals worldwide. Adult females can reach up to 103 cm in length, and adult males up to 45 cm (Eiras et al., 2021; Freitas Tancredi et al., 2021; Radman et al., 2017). This parasite is known to have been affected humans and animals for millennia, based on paleoparasitological studies that identified *D. renale* eggs in deer coprolites dated to 6,540 years (Before Present) in Argentina and human coprolites dated to approximately 3,370 years (Before the Common Era) in Switzerland (Eiras et al., 2021; Fugassa et al., 2013; Le Bailly et al., 2003).

The parasite has an almost cosmopolitan incidence although no cases of dioctophimosis have been reported on the African continent (Eiras et al., 2021). However, a recent study reported



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the first case of parasitism in the abdominal cavity in a man from Guinea-Bissau treated in the Netherlands who had recently traveled through Mali, Mauretania, Libya, and Algeria. This suggests that the parasite is cosmopolitan (Boerekamps et al., 2022). The nematodes can parasitize the renal parenchyma, remain free in the abdominal cavity (and very rarely in the thoracic cavity), and may attach to organs such as the liver of various carnivores, herbivores, and omnivores, including humans (Freitas Tancredi et al., 2021; Ishizaki et al., 2010; Silveira et al., 2015). The parasite has a complex life cycle that involves the deposition of eggs in the environment through the urine of parasitized animals, ingestion of these eggs by an intermediate host, consumption of this intermediate host by several possible paratenic hosts, and different definitive and accidental hosts that may be parasitized according to the environmental and socioeconomic conditions of the location where the etiological agent is present (Eiras et al., 2021; Ishizaki et al., 2010; Nakagawa et al., 2007; Radman et al., 2017).

In the city of Curitiba in the state of Paraná, stray dogs spend most of their lives moving through densely populated and busy urban areas, residing mainly in bus terminals and city parks. Due to their free movement in public spaces, these dogs are extensively exposed to environmental diseases such as dioctophimosis (Constantino et al., 2016; Yamakawa et al., 2015). The present study reports a case of dioctophimosis in an adult dog attended by the Rede de Proteção Animal de Curitiba (RPA), classified as a community dog and resident of a public park with large areas of fresh water in the city of Curitiba-PR. The case and its implications are discussed from the One Health perspective.

Case Report

In March 2023, a mixed-breed, neutered female dog, approximately 5 years old, and classified as a community dog residing principally at the Parque Náutico de Curitiba presented neurological signs with paralysis of the jaw, face, and limbs and urinary incontinence that lasted for three days. The patient was referred to a private veterinary clinic where vital parameters were recorded as normal on physical examination. However, on clinical examination, the patient presented facial hemiparesis, mandibular rigidity, paralysis of all four limbs, tachypnea, muffled lung auscultation with stridor, and sinus arrhythmia.

Based on the neurological signs and history, the patient was diagnosed with tetanus. Coincidentally, during the abdominal ultrasound examination, the animal was also diagnosed with dioctophimosis because of the observation of a large parasite in the right kidney.

The ultrasound revealed that the right kidney had a structure compatible with *D. renale*, with the corticomedullary definition completely lost and measuring 5.96 cm in diameter (Figures 1 and 2). The left kidney had a preserved shape and regular contour; however, cortical echogenicity was increased, with decreased corticomedullary definition, whereas the renal pelvis was moderately dilated, measuring 6.75 cm in diameter. The diagnostic analysis revealed an overload of the left kidney, with ultrasound signs of chronic kidney disease. The ultrasound findings were consistent with a higher prevalence of parasitism occurring in the right kidney and, consequently, compensatory hypertrophy of the left kidney.

The animal was accommodated and treated for tetanus until it no longer showed neurological symptoms. Subsequently, a nephrectomy of the kidney affected by the parasite was performed. At the end of the treatment and upon significant regression of neurological signs, the patient was referred to the Centro de Referência para Animais em Risco (CRAR), the municipal adoption center in the city of Curitiba-PR. The CRAR is managed by the Rede de Proteção Animal de Curitiba (RPA). In addition to being an adoption center, it is an important physical and social rehabilitation home for dogs and cats cared for by the RPA.

The patient underwent a fresh battery of exams carried out by the veterinary clinic (Clínica veterinária), contracted by CRAR. No notable changes were identified in the blood cell counts. In contrast, the biochemical analysis of the blood serum revealed an increase of 60.83 mg/dL in urea was identified (the reference values provided by the clinic were 15 to 40 mg/dL). This change is consistent with the diagnosis of dioctophimosis due to the destruction of the renal parenchyma and consequent deficiency in the filtration capacity of the remaining kidney.

The animal underwent the surgical procedure of nephrectomy of the right kidney, which resulted in the removal and identification of a single parasite measuring over than 30 cm (Figures 3 and 4).



Figure 1. Ultrasonographic image of the right kidney indicating parasitism by *Dioctophyma renale*.



Figure 2. Second ultrasonographic image of the right kidney indicating parasitism by *Dioctophyma renale*.

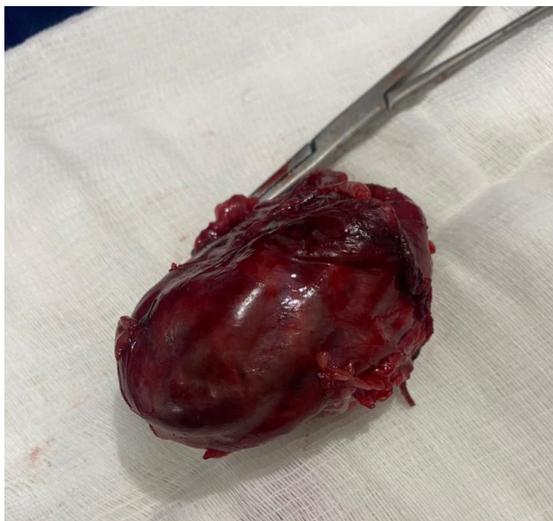


Figure 3. Right kidney capsule containing *Dioctophyma renale*.



Figure 4. *Dioctophyma renale* parasite removed from the right kidney, leaving only the renal capsule.

The patient fully recovered from the procedure and had no further urinary complications. After several days of postoperative recovery at CRAR, the animal was adopted.

Discussion

Dioctophimosis has a complex life cycle. It needs several months to reach its adult form within the definitive or accidental host. Its perpetuation requires specific environmental factors such as the presence of fresh water, a competent intermediate host, and definitive and accidental hosts that differ according to the environmental and even socioeconomic context (Anderson, 2000; Norouzi et al., 2017).

The literature describes a freshwater oligochaeta *Lumbriculus variegatus* as the intermediate host in the parasite's life cycle in the northern hemisphere. In contrast, in the southern hemisphere, this species is not the main intermediate host, and additional, yet undetermined, species of oligochaeta may be involved in the cycle (Lemos et al., 2010; Measures, 2001). The intermediate host is crucial due to its role in carrying out development up to the third larval level (L3) after ingestion of fertile *D. renale* eggs released by the adult female through the urine of a parasitized animal (Kommers et al., 1999; Measures, 2001). The definitive host is parasitized when consuming water along with the oligochaeta carrying L3 or through the consumption of paratenic hosts that had previously consumed the oligochaeta and had the infective larva encysted in their soft tissues (Freitas Tancredi et al., 2021; Nakagawa et al., 2007).

In North America, the American Mink (*Mustela vison*) is considered a typical definitive host. However, it is not the only because the parasite exhibits the ability to adapt to new hosts and infect several carnivores, herbivores, and omnivores (Eiras et al., 2021). In South America and especially in Brazil, the most common definitive host is the domestic dog (*Canis lupus familiaris*) mainly because of the large populations of semidomesticated and nondomesticated dogs in this country, leading to elevated levels of exposure to environments in which *Dioctophyma renale* perpetuates its life cycle (Lemos et al., 2010; Silveira et al., 2015). Feral, abandoned, or semidomestic cats can also become infected accidentally when consuming food and water from contaminated sources (Verocai et al., 2009).

Numerous paratenic hosts exist, including fish, frogs, turtles, toads, crayfish, and ducks (Eiras et al., 2021). Over time, such hosts have developed adaptive capabilities to increasingly anthropogenic aquatic environments such as sewage systems, rice crops, drainage systems, water treatment plants, and artificial and natural lakes with large human circulation (Radman et al., 2017). Paratenic hosts have considerable epidemiological importance, especially in Latin America, as they are highly related to cases of canine dioctophimosis due to the large number of dogs in free circulation preying on these animals (Nakagawa et al., 2007; Sousa et al., 2011). In the definitive host, L3 ingested through the intermediate or paratenic host penetrates the duodenal wall, enters the abdominal cavity, and migrates to the kidney where it settles and develops into its fourth-level larval form (L4), subsequently entering its adult phase and beginning the consumption of renal parenchyma (Measures, 2001; Sousa et al., 2011; Spratt & Singleton, 2008).

Because it is a zoonotic parasitism, dioctophimosis is a challenge in contexts that involve multispecies collectives in swampy areas, where the etiological agent manifests and can perpetuate its cycle. The One Health perspective can be applied extremely congruently to analyze the epidemiological scenario where human and nonhuman animals are inserted, tracing a complex dynamic that involves the aquatic environment and enabling a range of paths by which individuals can be infected with the parasite (Capella et al., 2018; Eiras et al., 2021; Kommers et al., 1999).

The Parque Náutico (Figure 5) is one of several freely accessible public leisure facilities in the city of Curitiba and the surrounding region. It is part of the Iguaçu Municipal Natural Park complex, which includes the Curitiba Municipal Zoo and the Cajuru Olympic Park. It has a total area of 2,300,000 m² and an infrastructure comprising an outdoor gym, island in the middle of the lagoon, canoeing, sailing, and rowing center with olympic lanes for practicing sports, timing tower, garden with apiary production, commerce street vendors, food trucks, parking, walking trails, public bathrooms, and Curitiba Municipal Guard (CMG) station (Curitiba, 2023).



Figure 5. Parque Náutico's area delimited in red.

In addition to the ample anthropic actions represented in water sports practices and the constant human flow, the park also hosts a group of community dogs kept onsite by the RPA, the CMG, and members of the civil society represented through dog keepers. The canine pack resident at the Parque Náutico comprised seven individuals. However, the size of the pack fluctuates due to possible deaths, adoptions, and unintentional insertion of new individuals. Except for a single animal, all dogs were neutered by the RPA. The RPA team of veterinarians also vaccinates them annually with the canine polyvalent vaccine (V8) and anti-rabies vaccine and periodically controls endoparasites and ectoparasites by administering flea protection and vermifugation. Dog keepers

are crucial animal health surveillance agents, informing the RPA about any health problems with the dogs, the arrivals of new dogs, and conflicts between the dogs and the community. They also provide food based on commercial feed, beds and shelter for all dogs.

The park's biodiversity is among the factors that can directly affect the incidence of dioctophimosis. Species present in the park such as teals, fish, wild ducks, agoutis, nutria, caviés, terrapins, and capybaras can serve as paratenic hosts, considering that community and other stray dogs may prey on these animals (Capella et al., 2018; Mascarenhas et al., 2021). In addition to the community dogs, pet dogs out for walks without the use of a leash may also prey on these animals and expose themselves to dioctophimosis, therefore, educating dog owners about responsible ownership is crucial and may prevent cases of the disease (Capella et al., 2018; Domingues et al., 2015).

Fishing in the park is not particularly common, and the public authorities discourage it because of the presence of a water treatment plant directly attached to the lake and the need to preserve aquatic species present at the site. The authors herein underline that this activity should also be prohibited due to the risk factor for the development of human dioctophimosis. Fishing is especially dangerous for those who may practice it and not properly cook the fish before consumption. This risk extends to domestic animals that accompany these fishermen who may offer raw fish and/or offal to them (Radman et al., 2017; Russo et al., 2014).

Although the community dogs are neutered and receive support from their keepers and the CMG in relation to food, fresh water, and shelter, they do not have any type of spatial restrictions, move freely around the park and exhibit pack behavior, hunt wild and synanthropic animals, and ingest water from natural sources. By understanding that the freshwater oligochaeta is key to the maintenance and perpetuation of the zoonotic cycle of the disease, it can be theorized that in addition to predation on paratenic hosts, dogs are subject to becoming infected directly through ingestion of lake water and other sources that may be contaminated with the intermediate host. Hence, community dogs in this location are doubly exposed to the risk of contracting this disease (Lemos et al., 2010; Measures, 2001; Spratt & Singleton, 2008).

Importantly, the maintenance of stray dogs that roam freely in the bus terminals and parks of the city of Curitiba is not encouraged by the RPA. The work carried out by RPA's veterinarians with community dogs aims to seek a more dignified level of animal welfare and provide health support so that the probability of disease transmission between them and to the human population is considerably reduced. The government does not encourage the abandonment of these dogs and understands that ideally, animals should not roam freely around public spaces. It also understands that it cannot fail to provide care for these dogs that have a close bond with the community and can be potential disseminators of zoonotic diseases (Almeida, 2017; Constantino et al., 2016).

Community dogs are agents within the context of population management of stray dogs in the city of Curitiba. They form social groups that can prevent other dogs from entering their territory and the "vacuum effect" from occurring when a population of community animals is removed from a territory (Almeida, 2017; Baquero & Ferreira, 2019). These dogs also function as a health barrier, serving as sentinel animals for zoonotic diseases that may affect the human population living and circulating in the places where these dogs are housed (Cabezón et al., 2010; Robertson et al., 2000; Salb et al., 2008). This is demonstrated in the work by Constantino et al. (2016), who investigated the seroprevalence of visceral leishmaniasis, toxoplasmosis, and chagas disease in community dogs in Curitiba. The sentinel function of these animals is continually explored by the RPA. In partnership with the Curitiba Zoonosis Surveillance Unit, the RPA carries out an annual investigation into the seroprevalence of visceral leishmaniasis in all dogs registered as community dogs in the municipality. When dogs inhabit locations with specific hydrographic characteristics, monitoring dioctophimosis by public authorities becomes prudent due to the risk to human health and to other resident and visiting animals (Mascarenhas & Müller, 2015; Radman et al., 2017). Therefore, we affirm that the efforts for sanitary maintenance and the epidemiological surveillance of community dogs are paramount in the context of One Health.

Conclusion

Community dogs are important sentinels for various zoonotic agents that may be circulating in a given area. As discussed in this work, one of the etiological agents to be considered in the scope of the health barrier role of these dogs is *Dioctophyma renale*, as it represents a health risk

for people who seek leisure and water sports, as well as for animals that circulate and inhabit the places where the parasite conducts its life cycle. The implementation of a community dog program represents an innovative public policy by the city of Curitiba and serves as an example for other municipalities looking for alternatives to growing community canine populations with a high potential for transmitting zoonotic and nonzoonotic diseases. Decision-makers and the population must be aware of this parasite and its risks to humans, wildlife, and domestic animals. The movement of dogs under guardianship by people without the use of a leash must be prohibited, as this practice represents a danger to the local fauna that could be preyed upon and a danger of infection of these dogs by various parasites, including dioctophimosis. Possibly, campaigns could be created to raise awareness among the population about the risks of fishing and consuming raw fish, as well as the practice of swimming in areas in which the parasite is present. These and other possible actions by the management bodies would be in line with the purpose of a health barrier for community dogs. We verified the presence of a zoonotic etiological agent in a busy park in the city of Curitiba through the community dog.

Ethics statement

All procedures were consented by the animal owner.

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Conflict of interests

VCAA, VMM, AWCS, DF - No conflict of interest.

Authors' contributions

VCAA, DF - Development of methodology; preparation, writing and editing the manuscript.
VMM, AWCS - Review and Editing manuscript

Availability of complementary results

For more information on the Rede de Proteção Animal (RPA) work, access the following link: <https://protecaoanimal.curitiba.pr.gov.br/>

The study was carried out at the Rede de Proteção Animal de Curitiba's headquarters. Rua Carlos Calvacanti, Passeio Público, no number, Curitiba, PR, Brazil.

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