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Ultrasonographic Signs of Dioctophyma renale (GOEZE, 1972) in a Maned Wolf (Chrysocyon brachyurus)

Sinais Ultrassonográficos de Dioctophyma renale (GOEZE, 1972) em um Lobo Guará (Chrysocyon brachyurus)

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Abstract

The ultrasonographic signs of dioctophimosis in a captive maned wolf (*Chrysocyon brachyurus*) at the Federal University of Mato Grosso (UFMT) Zoo are described in this study. On ultrasonographic examination, the right kidney exhibited marked alterations in size and architecture, with small hyperechoic ring-shaped structures of similar diameter in the transverse plane, immersed in anechoic fluid beneath a hyperechoic capsule. The animal underwent total right nephrectomy and the parasite (*Dioctophyma renale*) causing the disease was identified on macroscopic examination. This nematode is recognized as the largest parasitic roundworm in domestic carnivores, primarily affecting the kidneys of these animals. The maned wolf described in this report had no prior history of renal disease, and the routine examinations were part of the zoo's preventive health program. The use of ultrasound images should be considered a screening test for lobos-guará, even asymptomatic ones, and may be useful for the identification, treatment and control of this parasitic disease, because the renal deterioration caused by *D. renale* may reduce the survival of lobos-guará in their natural habitat, leading to a decline in the population of these animals. The ultrasonographic appearance of the lesions was highly characteristic, facilitating the exclusion of other diseases and supporting the use of ultrasound for the diagnosis of dioctophymosis in this species.

Keywords: Dioctophimosis. Zoo. Wild Animals. Nematode. Renal Parasite.

Resumo

Os sinais ultrassonográficos de dioctofimose em um lobo-guará (*Chrysocyon brachyurus*) cativo do Zoológico da Universidade Federal de Mato Grosso (UFMT) são descritos neste estudo. Ao exame ultrassonográfico, o rim direito exibia alterações acentuadas de tamanho e arquitetura, com pequenas estruturas hipereocóicas em forma de anel de diâmetro semelhante no plano transverso, imersas em líquido anecoico sob uma cápsula hiper ecogênica. O animal foi submetido a nefrectomia total direita e o parasita (*Dioctophyma renale*) causador da doença foi identificado ao exame macroscópico. Este verme é conhecido como o maior nematoide parasita de carnívoros domésticos, afetando principalmente o rim destes animais. O lobo-guará aqui descrito não apresentava histórico prévio de doença renal e os exames de rotina foram realizados como parte do programa preventivo de saúde do zoológico. O uso de imagens de ultrassom deve ser considerado um teste de triagem para lobos-guará, mesmo assintomaticos, e pode ser útil para identificação, tratamento e controle dessa parasitose, já que a deterioração renal causada por *D. renale* pode reduzir a sobrevivência de lobos-guará em seu habitat natural, levando a um declínio no contingente populacional desses animais. A imagem das lesões na ultrassonografia foi muito característica, o que facilitou a exclusão de outras doenças e justificou o uso de ultrassonografia para o diagnóstico de dioctofimose nesta espécie.

Palavras-chave: Dioctofimose. Zoológico. Animais Silvestres. Nematoide. Parasita Renal.

1 Introduction

Dioctophyme renale, the causative agent of dioctophymosis, is a nematode that primarily parasitizes the kidneys of both wild and domestic carnivores. It is a parasite of zoonotic significance, frequently reported in Brazil, and is considered the largest nematode infecting domestic animals (Ketzis; Little; Wulcan, 2021; Rappeti *et al*., 2017).

The life cycle of *D. renale* is long, indirect, and complex, involving definitive hosts that excrete nematode eggs in the urine, and an aquatic intermediate host (oligochaete). Infection in carnivores mainly occurs through the ingestion of intermediate or paratenic hosts (such as frogs and fish) by predation (Tancredi *et al*., 2021).

The maned wolf (*Chrysocyon brachyurus*) is the largest wild canid in South America, occurring primarily in cerrado and open grassland areas in Brazil, although it can also be found in transitional regions with forested habitats. This species is recognized as an important bioindicator of environmental balance but faces multiple threats, including habitat loss, roadkill, infectious diseases, and parasitic infections. Many individuals harbor helminths and protozoa, including parasites with zoonotic potential, which can cause severe health damage or even lead to death. Among these agents, nematodes such as *D. renale* are noteworthy, as renal infections caused by this parasite can be fatal if left untreated (Duarte *et al*., 2013; Oliveira *et al*., 2021). Due to the combination of these risk factors, the manned wolf is currently classified as "Near Threatened" by the International Union for Conservation of Nature (IUCN), which underscores the need for ongoing monitoring of both population health and the ecological conditions that affect its survival (Duarte *et al*., 2013; Oliveira *et al*., 2021).

Due to the insidious nature of the disease and the scarcity of clinical signs, diagnosis in this species is often incidental and made post-mortem. The recommended treatment for *D. renale* infection is nephrectomy, particularly in unilateral cases (Oliveira *et al*., 2021). In this context, ultrasonographic examination serves as an essential tool for the *in vivo* diagnosis of renal dioctophymosis, enabling direct visualization of the parasites in various anatomical locations within the patient (Rappeti *et al*., 2017; Tancredi *et al*., 2021). Ultrasound imaging should be considered a screening method for free-ranging maned wolves, even in asymptomatic individuals (Oliveira *et al*., 2021), as it may facilitate the identification, treatment, and control of this parasitic disease. Renal damage caused by *D. renale* can compromise the survival of maned wolves in their natural habitat, contributing to population decline (Duarte *et al*., 2013).

The aim of this study was to report a case of renal dioctophymosis in a maned wolf treated at a veterinary hospital, describing the ultrasonographic findings and discussing the relevance of imaging diagnostics for the early detection of *D. renale* infection in threatened species.

2 Case Reports

2.1 Animal and clinical context

An adult female maned wolf, approximately eight years old and housed at the Federal University of Mato Grosso (UFMT) Zoo, was referred to the Veterinary Hospital for clinical, laboratory, and imaging evaluations. The animal had no prior history of renal disease, and the routine examinations were performed as part of the zoo’s preventive health program.

2.2 Sedation protocol and pre-examination procedures

To ensure an effective and stress-free ultrasonographic evaluation, the animal was sedated via intramuscular injection of ketamine (8 mg/kg) and midazolam (0.5 mg/kg). Prior to the examination, the patient underwent an 8-hour fasting period to minimize the risk of regurgitation and enhance ultrasonographic visualization.

Physiological parameters, including heart rate, respiratory rate, and oxygen saturation, were continuously monitored throughout the procedure. The animal was positioned in dorsal recumbency on a padded examination table. The abdominal hair was clipped, and a water-soluble ultrasound gel (Sonic Plus, São Paulo, Brazil) was applied to the skin to improve image quality.

2.3 Ultrasonographic examination - diagnostic confirmation and additional tests

Ultrasonographic evaluation was performed using a MyLab™ Five Vet ultrasound system (Esaote Pie Medical™, Genoa, Italy) equipped with a multifrequency microconvex transducer (5 – 6.6 – 8 MHz). Real-time B-mode imaging was used to assess the abdominal organs, with particular attention given to the kidneys. The following parameters were analyzed: renal size and shape; corticomedullary differentiation; renal parenchymal echogenicity and echotexture; presence of abnormal structures or renal pelvic dilation; evaluation of the urinary bladder; ureters; proximal urethra; and adjacent structures.

Additional diagnostic tests were performed: a urine sample was collected via cystocentesis and analyzed for the presence of D. renale eggs; blood samples were analyzed to assess renal function (urea and creatinine levels).

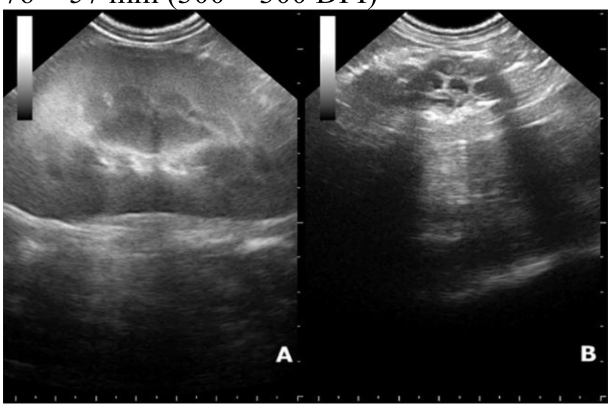
2.4 Post-examination Care

After the procedure, the animal was closely monitored until full recovery from anesthesia. Supportive care, including fluid therapy and analgesia, was provided as needed. Based on the diagnosis, the veterinary team evaluated therapeutic options, including nephrectomy or continuous monitoring, depending on the progression of clinical signs and renal function. Thus, supported by the ultrasonographic diagnosis of right renal parasitism by *D. renale*, the animal underwent laparotomy for direct nephrectomy.

3 Results and Discussion

During the ultrasonographic examination, the urinary bladder was empty, with a small amount of anechoic fluid present. Moderate cellularity and a bladder wall thickness of 0.38 cm were also observed. The left kidney showed apparent enlargement, measuring approximately 9.0 cm in length on the longitudinal plane. The renal cortex was thickened and exhibited moderately hyperechoic echogenicity compared to the hepatic parenchyma and was isoechoic to the spleen. Corticomedullary differentiation was relatively preserved, with normal renal medulla and pelvis (Figure 1A).

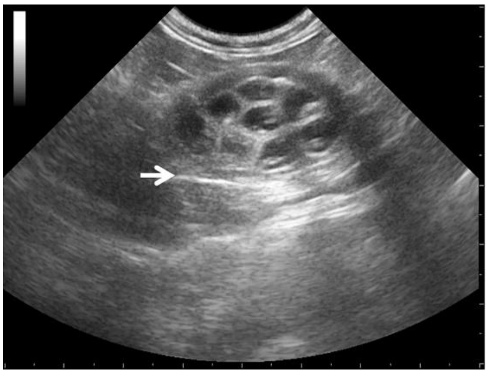
Figure 1 - Ultrasound images of the kidneys at the same depth. A) Left kidney showing cortical thickening and relative enlargement. B) At the anatomical position of the right kidney, loss of normal renal architecture is observed; similarly sized, ring-shaped hyperechoic structures can be seen, surrounded by a hyperechoic capsule. 76 × 57 mm (300 × 300 DPI)



Source: resource data.

Evaluation of the right kidney revealed significant structural alterations characterized by a thick, ring-shaped, hyperechoic tubular structure observed in both transverse and longitudinal planes (Figure 2). In the longitudinal view, the structure exhibited a thick hyperechoic outer layer and a hypoechoic inner layer, with a diameter of approximately 0.5 cm, immersed in a small amount of anechoic fluid and surrounded by a well-defined hyperechoic capsule. These ultrasonographic features are highly suggestive of D. renale infestation, with the identified structure possibly representing a renal cyst caused by the nematode. The absence of movement in the structure further supports this hypothesis.

Figure 2 - Ultrasonographic image of *Dioctophyma renale* in the transverse plane showing multiple similarly sized hyperechoic rings (arrowhead), surrounded by a hyperechoic capsule (arrow). 76 × 57 mm (300 × 300 DPI)



Source: resource data.

No significant alterations were observed in the stomach, intestines, liver, spleen, or left adrenal gland. The pancreas and right adrenal gland were not visualized, and no free abdominal fluid was identified.

Based on the ultrasonographic findings suggestive of *Dioctophyma renale* in the right kidney, ultrasound-guided cystocentesis was indicated for urine sample collection and potential identification of parasite eggs. However, the bladder was empty due to spontaneous micturition during restraint. Biochemical analyses showed no abnormalities in renal markers.

Based on the ultrasonographic diagnosis indicating the presence of *Dioctophyma renale* in the right kidney, the animal underwent laparotomy and nephrectomy of the affected kidney. During the surgical procedure, cystocentesis was performed, and urinary sediment analysis revealed double-operculated eggs with a thick, rough shell, consistent with *Dioctophyma renale* eggs. The nephrectomy revealed marked renal asymmetry, with the right kidney displaying a rounded structure, a thick fibrous capsule, and an irregular surface. Inside the capsule, an adult female *Dioctophyma renale* nematode was identified, confirming the ultrasonographic diagnosis and parasitic infection.

D. renale has a worldwide distribution (Bowman, 2006) and is commonly found during post-mortem examinations of various wild animals, such as the ring-tailed coati (Milanelo *et al*., 2009), sloth (Rocha; Serra; Grechi, 1965), capuchin monkey (Ishzaki *et al*., 2010), small grison (Zabott *et al*., 2012), crab-eating fox (Ribeiro; Veroai; Tavares, 2009), and maned wolf (Duarte *et al*., 2013; Kumar; Vercruysse; Vandesteene, 1972; Oliveira *et al*., 2021). Other mammals, including cattle, horses, pigs, and cats, are also parasitized, though to a lesser extent (Tancredi *et al*., 2021).

Forced habitat migration due to climatic factors and human interference has led to increased interaction between wild and domestic animals, spreading infections and rendering both more vulnerable to parasitic diseases (Butti *et al*., 2018). The ecological impact of dioctophimosis affects not only endangered animals but also humans, as it is a neglected zoonosis associated with public health issues, especially for people living in poverty and with inadequate sanitation. This situation is known to be a reality in many parts of the world, including South America. Therefore, the study and reporting of new cases of dioctophimosis contribute to clarifying its life cycle in different habitats and underscore the benefits of early diagnosis.

D. renale is frequently found in the right kidney and rarely in both kidneys, with reports also describing anatomically unusual locations (Rappeti *et al*., 2017; Tancredi *et al*., 2021). The lateral predisposition for the right kidney may be related to its anatomical proximity to the duodenum, facilitating larval migration through the abdominal cavity to the definitive host's kidney (Flórez; Russo; Uribe, 2018; Oliveira *et al*., 2021). This influences the clinical profile of the disease, which varies according to the number of specimens per host and the presence of ectopic locations (Butti *et al*., 2018).

The worms can cause severe and irreversible damage to the renal parenchyma, destroying both the cortex and medulla (Flórez; Russo; Uribe, 2018). The poor prognosis associated with these lesions may lead to euthanasia of domestic and wild animals, some of which are threatened with extinction. In humans, documented cases include fatal outcomes and renal carcinoma (Butti *et al*., 2018; Oliveira *et al*., 2021). Nevertheless, some infected individuals may remain asymptomatic (Oliveira *et al*., 2021) or present nonspecific clinical signs such as abdominal pain, fever, lethargy, hematuria, polyuria, pollakiuria, anemia, abdominal effusion, proteinuria, and stranguria due to urethral obstruction caused by the parasite (Stainki, 2011).

The in vivo diagnosis of renal dioctophymosis is commonly incidental, achieved through abdominal ultrasonography, exploratory celiotomy, detection of characteristic eggs in urine, and molecular techniques (Butti *et al*., 2018). Parasitism by *Dioctophyme renale* in maned wolves has been reported; however, in most cases, it is restricted to findings during necropsy without clinical correlations or antemortem diagnoses (Oliveira *et al*., 2021). On the other hand, inherent difficulties in the clinical evaluation of wild animals such as the maned wolf likely contribute to this parasitosis going unnoticed, even under captive conditions. This underscores the necessity of routine examinations for early detection of the nematode, including ultrasound or urinary sediment analysis, which are particularly useful for identification. Other imaging modalities such as renal endoscopy, videolaparoscopy, and excretory urography are uncommon in these cases and are even more restricted in wild animals, being limited to a few specialized centers nationwide.

Treatment is limited to radical therapies such as unilateral total nephrectomy, when feasible, or euthanasia in cases incompatible with life, although the use of antiparasitic drugs has been reported in isolated cases (Butti *et al*., 2018; Oliveira *et al*., 2021). Minimally invasive diagnostic and therapeutic techniques, commonly used in humans and domestic animals, have been refined for use in wildlife to reduce surgical trauma, postoperative recovery time, and pain management (Feranti *et al*., 2014). This is especially important as these animals require frequent monitoring for early disease diagnosis and follow-up, yet their handling is limited and stressful, particularly for free-ranging individuals.

In the case of the maned wolf described here, the ultrasonographic image of the parasite demonstrated features similar to those reported in the literature, showing ring-shaped structures approximately 0.5 cm in diameter, immersed in a small amount of anechoic fluid, observed in the transverse plane. In the longitudinal plane, the parasite appeared with alternating hyperechoic and hypoechoic bands, consistent with the description by Ketzis, Little and Wulcan (2021) and with the absence of free parasites in other body cavities. Additionally, the animal's left kidney exhibited an increased size compared to previous studies on the species, which reported lengths up to 8.0 cm for this organ (Guimarães *et al*., 2013). Furthermore, the renal cortex was hyperechoic relative to the hepatic parenchyma and isoechoic to the spleen, a pattern that differs from that described by Guimarães *et al*. (2013) for the species, where the renal cortex displayed more homogeneous echogenicity.

In the aforementioned studies, the ultrasonographic image of the parasite showed the presence of multiple rings with double-layered walls in the transverse scan (Soler *et al*., 2008). Although the increased renal size may be attributed to compensatory hypertrophy of the contralateral kidney (Bichard; Sherding, 1994), the echogenicity changes observed in the present study could not be fully explained. This is due to the fact that biochemical evaluation revealed no significant alterations in renal function, and the only relevant finding in urinalysis was the presence of *D. renale* eggs.

When considering the complications arising from nephrectomy for the treatment of dioctophymosis, few studies provide detailed reports on cases in wild animals, due to management difficulties both inside and outside captivity. Nevertheless, the technique is described in domestic animals and tends to be effective, with good to guarded prognoses in wild canids such as the crab-eating fox (*Cerdocyon thous*), the Pampas fox (*Lycalopex gymnocercus*), and the maned wolf described here (Cardoso *et al*., 2023; Piccoli *et al*., 2017). It is important to emphasize that rapid placement of animals treated for *D. renale* into captivity, zoos, or wildlife rehabilitation centers is essential to assess surgical recovery and monitor their quality of life.

It is also noteworthy that *D. renale* has been described as a significant cause of death in captive canids housed in zoos and reserves (Oliveira *et al*., 2021), environments where animals are more susceptible to parasitic infections due to stress, management conditions, and the quality of water provided. Therefore, prevention of dioctophymosis involves periodic screening measures utilizing complementary diagnostic methods, including imaging, clinical, and laboratory examinations. Surgical management techniques and postoperative care following nephrectomy in maned wolves remain under-studied and under-applied, as do more advanced imaging diagnostics, with ultrasonography being the preferred method for routine evaluations and early diagnosis of *D. renale* in this species.

4 Conclusion

The ultrasonographic confirmation of *D. renale* in a maned wolf was essential for guiding treatment. The animal underwent a total right nephrectomy, and the parasite was identified during macroscopic examination. The ultrasonographic imaging of the lesions was highly characteristic, facilitating the exclusion of other diseases and justifying the use of ultrasound for diagnosing dioctophymosis in this species.

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