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1. Introduction

The Dioctophyma renale (Goeze, 1782) is a worldwide occurring nematode, known as giant kidney worm. It is the largest parasite nematode infecting domestic animals. Parasitism by this nematode has been described in different animal species, including in humans. Among the domestic species, it affects especially dogs, but it has been also observed in felines, swine, horses and cattle (Beaver and Theis, 1979; Kommers et al., 1999; Urquhart et al., 1998; Verocai et al., 2009). In Brazilian wild animals the parasitism was observed in coati (Nasua nasua), little grison (Galictis cuja), maned wolf (Chrysocyon brachyurus), bush dog (Speothos venaticus) and two-toed sloth (Choloepus didactylus) (Ribeiro et al., 2009). Vermis are ovipare and the female can reach more than 60 cm length and 1 cm diameter. The prepatent period for Dioctophyma is approximately 155 days and the entire life cycle can take up to two years to complete (Dyer, 1998; Measures and Anderson, 1985; Senior, 1980). Transmission of this parasite involves eggs being passed in the urine of the infected definite host. Eggs develop in the aquatic environment and are then ingested by the intermediate host, an aquatic oligochaete annelids (mud-worm), where the development of the first and second stages larva occurs. From this stage on, more than one route of transmission has been reported. In the first of them, maturation to third and fourth stages larva may occur within the annelid, which is then directly infective to mammal hosts; in the second route, an annelid containing a second stage larva may be ingested by a fish, or a frog, where the larva encysts in tissue and develops into third and fourth stages. In the third route, the infected annelid parasitic on crayfish (Cambarus spp.) may be ingested together with the crayfish by fish or frogs. As a result of these possible modes of transmission, some investigators consider fish or frogs as transporters rather than true intermediate hosts (Dyer, 1998). All routes of transmission converge on the mammal host. In the definitive hosts, the dioctophymas larva...
penetrates the duodenal wall, enters the abdominal cavity and migrates to the kidney, where it remains until the adult stage (Bowman, 1999; Dyer, 1998; Measures and Anderson, 1985; Pedrassani et al., 2009).

This way, the adult nematode is commonly found in the renal pelvis, but has been seen encysted within the abdominal cavity, the uterus, ovary, mammary gland, urethra, subcutaneous tissues of the inguinal region and mesenteric lymph nodes. In dogs, the nematode has been more frequently observed in the kidney or free in the abdominal cavity (Georgi and Georgi, 1991; Nakagawa et al., 2007). Usually, just one of the kidneys is affected, the right kidney more often than the left one, due to its anatomic proximity to the duodenum. Affected animals may demonstrate compressive atrophy of the renal parenchyma, dilation of the renal pelvis and ureteral obstruction, but the main lesion is the progressive destruction of the renal parenchyma leaving only a thin capsule containing the worm and hemorrhagic exudates inside (Nakagawa et al., 2007; Soler et al., 2008; Urquhart et al., 1998).

When just one kidney is affected, the signs of renal failure may not be evident, however hematuria can occur. If the parasite migrates to the peritoneal cavity, abdominal distention and peritonitis can be observed. Most of the times, affected dogs are asymptomatic (Birchard and Sherding, 1994).

Clinical diagnostic methods can be used to support the detection of renal parasitism. Recently, imaging techniques have proven to be useful diagnostic tools. The most commonly used of these methods are radiology (Nakagawa et al., 2007) and sonography (Soler et al., 2008). The diagnosis of dioctophymatosis can also be confirmed by the observation of the D. renale ova in the urine. Even so, in Brazil, postmortem diagnosis of D. renale parasitism is still the most frequent method of infection detection in domestic animals (Pereira et al., 2006).

Some authors recommend surgical treatment with nephrectomy, when just one kidney is affected, and nephrotyomy, when both kidneys are affected (Birchard and Sherding, 1994). Nevertheless, there are also authors that recommend performing an intravenous pyelography in order to estimate the magnitude of the residual function in the affected kidney, before opting for surgical treatment. In case of peritonitis, exploratory laparotomy is recommended to remove the parasites present in the abdominal cavity (Birchard and Sherding, 1994; Senior, 1980).

The purpose of this study is to report a case of parasitism by D. renale, where the treatment was performed in time to allow the cure of the disease.

2. Materials and methods

A German Shepherd dog, female, not castrated, eight years old, was brought to the Pet Care Veterinary Hospital, São Paulo, Brazil, with a history of hyporexia and muscle weakness for five days. During anamnesis, the owner told that the animal lives in a place near to dam water having as contactants a horse and a dog of non-defined breed. Both dogs were fed with commercial dog food, vaccinated with anti-rabies vaccine and V10 (vaccine against Hepatitis, Distemper virus, Parvovirus type 2, Parainfluenza, Leptospirosis, Coronavirus, Adenovirus) and received profilactic treatment for ixodidiosis, with fipronil, each three months, whereas the non-defined breed already presented a picture of hemoparasitosis.

During the clinical exam the animal presented good hydration, normocoloured mucous membranes, prostration and fever. The hemogram showed leucocytosis by neutrophilia with left shift toxic granulation neutrophils, lymphopenia, eosinophilia and basophilia (Table 1). The animal’s renal function was normal with creatinine values of 0.94 mg/dl (reference value: 0.8–1.8 mg/dl) and urea of 26.6 mg/dl (reference value: 15–40 mg/dl). At the initial treatment, enrofloxacine dose of 5 mg/kg each 12 h and dipiron sodium 25 mg/kg each 8 h was prescribed. An ultrasound exam to evaluate the abdominal organs was requested, whereas the hemogram suggested an active inflammatory process.

Table 1

| Hemogram       | Patient’s values | Percentage | Reference values     |
|----------------|------------------|------------|----------------------|
| **Eritrogram** |                  |            |                      |
| Erythrocytes   | 7.44 × 1,000,000 | 6 (%)      | 6–8 (mm$^3$)         |
| Hematocrit     | 52 (%)           | 37–54 (%)  |                      |
| Hemoglobin     | 17.4 (g/dl)      | 12–18 (g/dl)|                      |
| MCV            | 69.89 (fl)       | 65–80 (fl) |                      |
| HCM            | 23.39 (pg)       | 20–30 (pg) |                      |
| CHCM           | 33–46 (g/dl)     | 30–36.5 (g/dl)|                  |
| **Leucogram**  |                  |            |                      |
| Leukocytes     | 22,800 (μl)      | 100 (%)    | 6000–15,000 (μl)     |
| Bastonets      | 456 (μl)         | 2 (%)      | 0–300 (μl)           |
| Neutrophils    | 17,328 (μl)      | 76 (%)     | 3000–11,000 (μl)     |
| Lymphocytes    | 912 (μl)         | 4 (%)      | 1500–5000 (μl)       |
| Eosinophils    | 2964 (μl)        | 13 (%)     | 0–750 (μl)           |
| Monocytes      | 228 (μl)         | 1 (%)      | 0–800 (μl)           |
| Basophil       | 912 (μl)         | 4 (%)      | 0–50 (μl)            |
| Platelets      | 291,000 (mm$^3$) |            | 150,000–500,000 (mm$^3$) |
| Plasmatic protein | 8.3 (g/dl)     |            | 5.5–8.0 (g/dl)       |
| Toxic neutrophils | ++ (g/dl)     |            | 0                     |
Two days after the initial admission, the animal returned to the clinic for accomplishing this exam. The dog presented no fever, although prostration. The exam revealed an uncharacteristic presented right kidney and on its topography a ring-like structure involved by a thin hypercogenic capsule of 5.64 cm in diameter in transversal image could be observed (Fig. 1) and left kidney with normal topography (Fig. 2). The ultrasound findings suggested parasitism by *D. renale*. Urinalysis confirmed

![Fig. 1. Ultrasound image of the right kidney of a German Shepherd, parasited by *Dioctophyma renale* (arrows). Transversal image on the left and longitudinal on the right side.](image1)

![Fig. 2. Ultrasound image of the left kidney with normal topography in a German Shepherd.](image2)

![Fig. 3. Ova of *Dioctophyma renale* in urinary sediment of a German Shepherd.](image3)

![Fig. 4. Kidney of a German Shepherd, surgically removed, with *Dioctophyma renale* inside.](image4)
the diagnosis by the presence of parasite ova in the urine (Fig. 3). Treatment was surgical. The patient’s right kidney was removed (Fig. 4). This kidney was enlarged due to the presence of 3 parasites inside the renal capsule, with lengths of 52 cm, 53 cm and 57 cm respectively. The kidney’s parenchyma was totally destroyed and only the renal capsule with the nematodes and hemorrhagic exudates inside could be found (Figs. 5–7). The animal presented excellent surgical recovery and was released one week after surgery.

3. Discussion and conclusion

In almost all cases, parasitism by *D. renale* in domestic dogs is a necropsy finding. The diagnosis is made difficult by the nonspecificity of the clinical signs, specially in renal unilateral manifestation (Kommers et al., 1999). In this report, the animal presented signs of fever and prostration. The hemogram evinced neutrophilia with left shift, toxic granulation in neutrophils and lymphopenia, suggesting aggressive inflammatory lesion, probably due to destruction of the renal parenchyma by parasites. Parasitism with tissue invasion often induces to eosinophilia and/or basophilia (Latimer et al., 2003; Schultze, 2000; Thrall, 2007), as we can observe here.

The ultrasound may be helpful as a diagnostic method for suggesting the presence of the parasite in the renal parenchyma, with the image of multiple ring-like structures in approximately 8 mm diameter and a thin outer hyperechoic layer and hypoechoic core (Oliveira et al., 2005). In this report, the ultrasound exam was important to elucidate the case. The right kidney’s topography image displayed a rounded multitubular structure, involved by a thin hyperecogenic capsule suggesting parasitism by *D. renale* in the kidney.

The conclusive diagnosis was confirmed after urinaryysis, where the parasite eggs could be seen in the animal’s urine. This method has been recommended for concluding the diagnosis (Birchard and Sherding, 1994). However, it is important to remark, that the eggs will only appear in the urine sediment, if a gravid parasite female is in the kidney causing the infection (Soler et al., 2008). This patient was submitted to nephrectomy and 3 parasites were found inside the right kidney. The dog’s clinical signs were associated to the parasitic infection, since the patient’s recovery was excellent with significant improvement of the clinical condition after removal of the affected kidney. For the same reason, additional blood tests were not performed. The animal was released after removing the cutaneous surgical wound stitches. In this case, the prognosis was favorable, due to the unilateral parasite localization. Sometimes, the *D. renale* finds itself free in the abdominal cavity causing a process of peritonitis, or even parasitizing both kidneys of one animal. In such cases it is necessary to perform an exploratory laparotomy or nephrectomy to remove the parasites (Birchard and Sherding, 1994).

The infection in mammals is related to animals used to eat raw fish, frogs or to drink water contaminated with the mud-worm infected by *D. renale* in its larval form. These are also the ways domestic dogs get infected. A study...
carried out in Rio Grande do Sul, Brazil, showed that parasitism appears more often in street dogs having less selective eating habits. Nevertheless, in this report, the animal could have been infected by any of the two ways mentioned, as although living within household, it had access to dam water (Kommers et al., 1999; Soler et al., 2008; Urquhart et al., 1998).

In a recent retrospective study of the disease of 16 cases of infection by *D. renale* in dogs, all diagnosis of parasitism was based on necropsy findings (Kommers et al., 1999). For that reason, this case shows the importance of associating the clinical history, anamnesis and complementary exams in order to obtain a precise diagnosis and treatment of a rarely diagnosed disease in domiciliary pet animals.

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