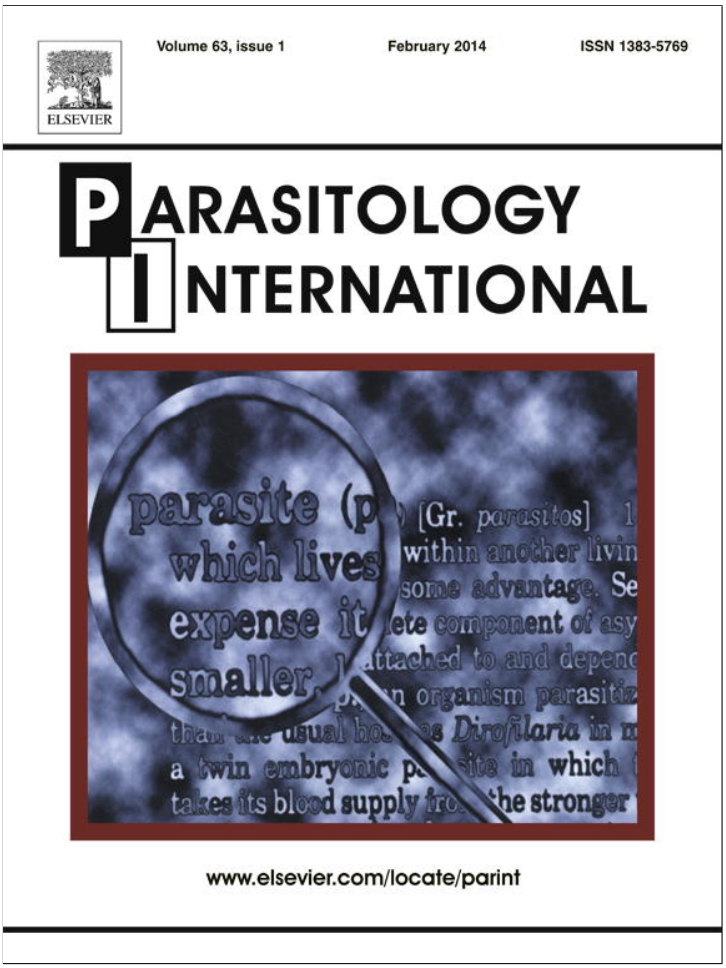

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Case report

Capillaria plica (syn. *Pearsonema plica*) infection in a dog with chronic pollakiuria: Challenges in the diagnosis and treatment

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ABSTRACT

Capillaria plica (syn. *Pearsonema plica*) is a nematode parasite of the urinary tract of canids, felids and mustelids, which can cause cystitis, pollakiuria, dysuria and hematuria. An eight-month-old female crossbred dog from Switzerland presented a six-month history of frequent urination. During the first clinical examination, *C. plica* eggs were detected in the urine sediment. Three series of treatments with fenbendazole (50 mg/kg body weight [BW]/day, orally) for 10 days each, three single day treatments with moxidectin–imidacloprid (spot-on) and one single administration of ivermectin (0.2 mg/kg BW subcutaneously) were performed within an eight-month period. None of those treatments succeeded in eliminating the *C. plica* infection or in resolving the clinical signs. An endoscopic examination of the urine bladder still revealed numerous adult viable *C. plica* worms attached to the bladder mucosa. A two-day treatment with levamisole (7.5 mg/kg BW/day intramuscularly) was subsequently performed. An endoscopic control of the urine bladder two days after this treatment and a urine analysis after two weeks confirmed the elimination of the parasites. The clinical signs disappeared within one month. Levamisole was shown to be effective against *C. plica* infection in a dog, whereas previous treatments with fenbendazole, moxidectin and ivermectin had failed.

1. Introduction

Capillaria plica (syn. *Pearsonema plica*) is a worldwide distributed nematode parasite of the urinary tract of canids, felids and mustelids [1]. In Europe, it is a frequent parasite of red foxes (*Vulpes vulpes*) with prevalences of 23.5% in The Netherlands [2], 78% in Germany [3], 93.3% in Lithuania [4], 53% in Norway [5], 80.5% in Denmark [6], 52% in Hungary [7] and 59% in Switzerland and Lichtenstein [8]. Foxes serve as reservoir hosts and are considered important factors in the epidemiology and spread of the parasite to companion and hunting dogs as well as to domestic cats [3]. Prevalence data in dogs and cats are scarce and many reports refer to isolated cases [9–13]. However, the parasite was demonstrated in 1 to 2.7% of cats of different regions in Germany [14]. Under certain environmental and housing conditions, the prevalence may be high. Senior et al. reported *C. plica* infections in 76% and 69% of a total of 127 mature dogs from two breeding kennels in the United States [15]. *C. plica* worms are threadlike, 16–53 mm long and affect mainly the urinary bladder. Adults attach to the mucosa of the urinary bladder, but may be occasionally localized in the ureters and renal pelvis. Dogs and cats acquire the infection by ingestion of earthworms (intermediate hosts) containing the infectious larval stages. These stages reach the urinary organs probably by the lymph–bloodstream, mature and begin passing eggs (55–67 × 26–29 μm, barrel-shaped, with slightly pitted shell and two opercules with polar plugs) with the urine 58–63 days after the infection. In the environment, the first-stage larvae (L1) develop within the eggs. These eggs have to be ingested by earthworms (annelids) to allow L1 to become infectious for the definitive host. *C. plica* infections may cause cystitis, pollakiuria, dysuria and hematuria. However some infected dogs and cats are asymptomatic. [1,16]. A *C. plica* infection should be suspected in cases of proteinuria, hematuria and increased numbers of epithelial cells in the urine sediment, or based on ultrasound or X-ray images. However, a definitive diagnosis can only be achieved by endoscopic procedures or, more commonly, by the detection of eggs in the urine sediment. The therapy of choice is unknown, but single treatment reports include fenbendazole [1,9,13,16,17], albendazole [1,15,18], levamisole [19] and ivermectin [1,11].

2. Case report

An eight-month-old female crossbred Lagotto Romagnolo–Poodle from Zurich, Switzerland, presented a six-month history of pollakiuria. A clinical assessment including an abdominal ultrasound examination and a urine analysis were performed. No ultrasonographic abnormalities were noticed. The urine had a density of 1040 g/l, pH 8 and proteinuria. In the sediment, *C. plica* eggs accompanied by erythrocytes, leucocytes and epithelial cells were observed. A treatment with fenbendazole

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(Panacur®) 50 mg/kg BW/day for 10 days was administered. Immediately after completion of the treatment, *C. plica* eggs could not be detected in the urine sediment. Two and a half months later, the dog suffered from a painful abdomen, vomiting, and pollakiuria. Urine analyses revealed again the presence of *C. plica* eggs, leucocytes, bacteria, and proteinuria. Two further treatments with fenbendazole (50 mg/kg BW/day) for 10 days each, with an interval of 10 days followed. Urine control immediately after completion of the second course revealed no eggs. However, two months later, *C. plica* eggs were again observed (Fig. 1) and the frequent urination syndrome persisted. Subsequently, three single-day treatments with moxidectin–imidacloprid spot-on (Advocate®), with two-week intervals were administered, accompanied by flavoxate (Urispas®) (10 mg/kg BW twice daily) to relax the bladder muscles. After completing the treatment, *C. plica* eggs were still present in the urine sediment and the clinical signs did not improve. Subsequently, a single-day administration of ivermectin (0.2 mg/kg BW subcutaneously) and cephalexin (20 mg/kg BW/12 h) and prednisolone (1 mg/kg BW) for 10 days was performed. Two urine analyses two and four weeks after the ivermectin administration again revealed *C. plica* eggs and the clinical signs were even more severe. For this reason flavoxate and ephedrine (Caniphedrin®) (1 mg/kg BW) (to stimulate the tonicity of the uretral sphincter) were administered. A new ultrasonographic examination revealed hyperechogenicity and thickening of the bladder wall. An endoscopic examination of the urine bladder was performed, and numerous adult viable *C. plica* worms attached to the mucosa were detected (Fig. 2 and Supplementary file1). The mucosa around the parasite attachment sites was reddish, and the urine presented abundant particulate matter. A treatment with levamisole (7.5 mg/kg BW/day intramuscularly) for two days was performed. As no anthelmintics containing this drug were registered for dogs in Switzerland, a product containing levamisole (Levamisole 10, Produlab Pharma, Raamsdonksveer, Holland), commercialized for the treatment of lungworms in hedgehogs had to be used. The treatment was well tolerated and an endoscopic control of the urine bladder two days after the treatment confirmed the elimination of the parasites. Urine analysis two weeks later was negative for *C. plica* eggs. The clinical signs disappeared within one month.

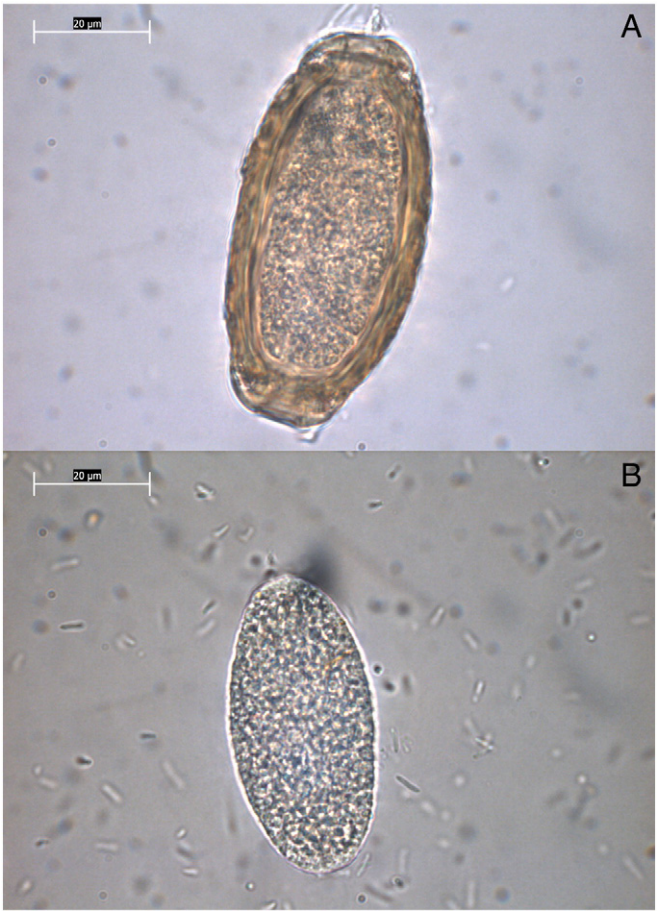

Fig. 1. A: Typical barrel-shaped *Capillaria plica* egg, showing a slightly pitted shell and two opercules with polar plugs. B: Immature or atypical egg of *C. plica*. Note the absence of the shell and the rudimentary polar plugs.

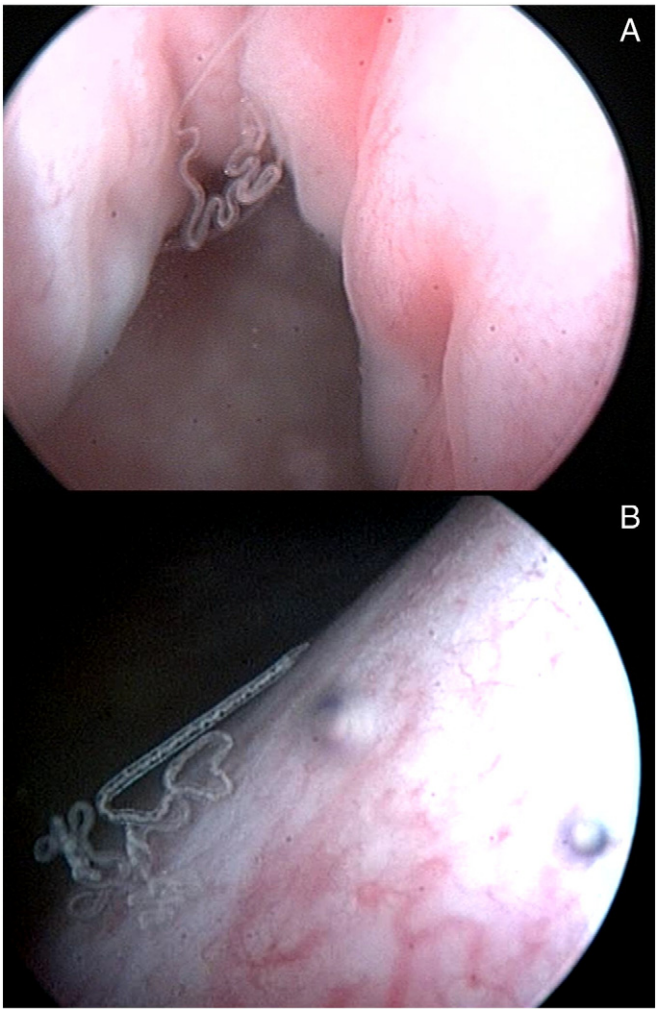

Fig. 2. A and B: Adult *Capillaria plica* worms attached to the mucosa of the urinary bladder (photographs taken during the endoscopic examination).

3. Discussion

In the present case, the diagnosis was first achieved by the detection of parasite eggs in the urine and confirmed afterwards by endoscopic examination of the urinary bladder. The differential diagnosis included *Dioctophyma renale*, another nematode that may affect the urinary system in dogs but is rare in Central Europe. The eggs of this parasite can be morphologically differentiated from those of *C. plica* by microscopic examination. The eggs of *D. renale* are brownish-yellow, thick shelled, oval (60–84 µm × 39–52 µm), and the surface appears to be pitted except at the poles [1]. Immature *C. plica* eggs or eggs of atypical morphology, as were regularly found in the present case (Fig. 1), may closely resemble eggs of *D. renale*. Adult *D. renale*, however, are much larger (30–100 cm) than *C. plica* (16–53 mm), occur mainly in the renal pelvis and only extraordinarily in the urine bladder.

The occurrence of reinfections during the observed period cannot be totally ruled out but seems very unlikely since the dog was held exclusively indoors and the owner denied the possibility of earthworm uptake during walks. However, there is anecdotic information from the breeder, of massive ingestion of red slugs (probably *Arion rufus*, that is very abundant in the region) before the dog was acquired by its present owner. It is not known whether red slugs can also act as intermediate hosts of *C. plica*, but this observation suggests that the dog had the opportunity to eat earthworms in the past and could have been already infected when it was sold. No data about other dogs from the same breeder were available.

There are no drugs labeled for the treatment of *C. plica* in dogs and cats, and reports of successful therapies are based only on isolated cases. A successful treatment with fenbendazole was reported in a dog [9], and in a cat [13]. However, fenbendazole treatment failed in another dog that was subsequently successfully treated with ivermectin [11]. These authors reported that eggs could not be detected in the urine sediment after completing the treatment, but no long-term follow-up information is given. In the present case, eggs were not found immediately after the fenbendazole treatment, but egg shedding reappeared later. Our findings suggest that the treatments with fenbendazole, moxidectin–imidacloprid and ivermectin were not effective in eliminating the *C. plica* infection. As large scale trials on the therapy of *C. plica* infection in dogs are missing, we first based our treatment choice on isolated reported cases. However, we can assume that the pharmacokinetic behavior and the bioavailability in the urinary bladder of the drugs used in this study could have influenced the efficacy of the therapy. For example, fenbendazole is scarcely excreted in the urine as intact drug or active metabolites, and effective plasma levels in dogs are only reached after repeated administrations of this drug, mainly due to its poor hydrophilicity [20,21]. Macrocyclic lactones such as ivermectin and moxidectin present a good absorption and distribution in canine tissues, but these drugs and their metabolites are mostly (>90%) excreted with the bile and feces, and only 0.5–2% are excreted with urine, allowing only a limited contact with parasites in the urinary system such as *C. plica*, what might affect their final efficacy [22,23]. On the other hand, imidazothiazole compounds such as levamisole, might have some advantage over other drugs to treat susceptible parasites of the urinary tract as they achieve particularly high concentrations in kidney and urine after administration, and their metabolites are mainly excreted with the urine (94%) after liver processing [20,24,25]. In the present case, a two-day treatment with levamisole (7.5 mg/kg BW/day intramuscularly), was effective in eliminating the *C. plica* infection, whereas treatments with other drugs were not successful.

The high prevalence of *C. plica* observed in foxes in Europe and the colonization of urban areas by foxes may enhance the infection risk of domestic dogs and cats with this parasite species, therefore *C. plica* infection should be taken into account in the differential diagnosis of urinary disorders in dogs and cats.

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.parint.2013.09.002.

Conflict of interest

The authors declare that there is no conflict of interest.

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