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CASE REPORT

Companion or pet animals

Crenosoma vulpis associated eosinophilic bronchopneumopathy in a young dog in Latvia

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Abstract

A 1.5-year-old male American Staffordshire Terrier with a chronic cough was referred to the Latvia University of Life Sciences and Technologies veterinary hospital. A diagnosis of bronchopneumopathy was reached by means of radiography and CT. Nematode parasites were detected during bronchoscopy and were collected by bronchoalveolar lavage. Parasitological examination confirmed infection with *Crenosoma vulpis*. Treatment with fenbendazole at 50 mg/kg for 3 days was effective.

BACKGROUND

To the authors' knowledge, this is the first time *Crenosoma vulpis* is reported in dogs in Latvia. Lung parasites are important to include as a differential diagnosis in young dogs with cough and pulmonary lesions. This case report describes clinical signs, radiographic, CT, bronchoscopy and laboratory diagnostic findings. The results outlined in this case report will be useful for all veterinary practitioners and will update their knowledge on parasitic diseases that can cause respiratory disorders.

CASE PRESENTATION

An 18-month-old, 30.2 kg, intact male American Staffordshire terrier dog living in a house situated close to a forest and sharing the household with another dog and two cats was presented with a history of chronic coughing, gagging and irregular vomiting. The dog had been dewormed with a chewable pill (unknown trade name) 3 months before presentation. At a local veterinary clinic, radiographic examination with contrast media had been performed to rule out a foreign body in the gastrointestinal tract, and symptomatic treatment had been initiated. The dog was then referred to Latvia University of Life Sciences and Technologies veterinary hospital. On physical examination, the dog was active, alert and responsive. Vital signs were within normal limits. During tracheal palpation, a cough response was elicited. Thoracic auscultation was unremarkable. Initially, the dog was treated with doxycycline (5 mg/kg orally twice daily) and prednisolone (0.5 mg/kg orally twice daily). During the treatment, coughing and gagging decreased but did not disappear. Visual inspection of the oral cavity and the pharynx revealed a hyperaemic larynx with small erosive lesions. Diagnostic imaging was performed thereafter.

INVESTIGATIONS

Radiography and CT

Thoracic and neck radiographs were acquired in full inspiration. Radiographs revealed increased lung density and a diffuse bronchial pattern (Figures 1 and 2). CT was performed with a 16-slice multidetector CT scanner (Philips MX-16). The dog was premedicated with medetomidine (0.01 mg/kg) intramuscularly, induced with propofol (6 mg/kg) intravenously (IV) and maintained with inhalation anaesthesia (isoflurane). During the examination, the dog was positioned in sternal recumbency. High resolution CT scans were performed. Native and post-contrast (ultravist 623 mg/ml [300 mg/ml iodine], 2 ml/kg IV) scans were performed. The CT findings of a peribronchial ground glass pattern, bronchial wall thickening are shown in Figures 3 and 4. The CT confirmed the diagnosis of bronchopneumopathy, and bronchoscopy was recommended.

Bronchoscopy

Bronchoscopy was performed 2 weeks after the CT scan. The examination was performed under general anaesthesia with butorphanol (0.25 mg/kg IV), atropine sulphate (0.01 mg/kg IV), midazolam (0.3 mg/kg IV) and propofol bolus injection. Bronchoscopy showed a hyperaemic larynx and an unremarkable bronchial mucosa. A bronchoalveolar lavage was performed, and several parasites were aspirated.

Laboratory diagnostic

Blood analysis showed mild leucocytosis (white blood cells 17.1 * $10^3/\mu$l) and moderate eosinophilia (4.44 * $10^3/\mu$l). Blood

biochemistry was unremarkable. Cytological analysis of the bronchoalveolar lavage fluid showed an increased number of epithelial cells, rare macrophages and neutrophils. In the aspirated bronchial fluid, six small, white and motile nematodes were detected. They were viewed and measured under a microscope (Leica DM500). The size varied from 6 to 9 mm (average 7.6 mm). All six worms were male because bursae and spicules (Figure 5) were visualised at the end of the tail. Cuticular ridges were present in the anterior part of the body (Figures 6 and 7), the number of which varied from 19 to 20. Based on the parasite morphological traits (for adults – size and cuticular ridges in the anterior part of the body, for first stage larvae – straight and pointed tail), the location and the host, it was determined as *Crenosoma vulpis*.

It was not possible to examine the dog's faeces on the same day. They were examined by flotation and Baermann technique after initiating treatment.

LEARNING POINTS/TAKE-HOME MESSAGES

- Lung parasites are important to include in the differential diagnosis in young dogs that present coughing and pulmonary lesions.
- If *Crenosoma vulpis* infection is suspected, faeces should be examined using the Baermann technique.
- Treatment with oral fenbendazole at 50 mg/kg for 3 days is effective.
- Dogs with free access to forests should be dewormed with medication effective against *C. vulpis* infection, such as fenbendazole or milbemycin oxime.

TREATMENT

After establishing a diagnosis of a *C. vulpis* infection, treatment with oral fenbendazole at 50 mg/kg for 3 days was initiated, and it was recommended to administer oral milbemycin oxime 0.5 mg/kg and praziquantel 5 mg/kg orally (Milprazon, KRKA) 3-4 weeks thereafter.

OUTCOME AND FOLLOW-UP

Clinical signs disappeared rapidly, and coughing resolved completely within 5 days. After the treatment was completed, no first stage larvae (L1) were detected in the feaces of the dog.

DISCUSSION

C vulpis is a nematode of the Metastrongylidae family that affects the respiratory system. Adult parasites are localized in the bronchioles, bronchi and trachea. The definitive hosts are a variety of wild and domestic Canidae, including dogs.[13] Three wild canids are present in Latvia: the red fox (*Vulpes vulpes*), the wolf (*Canis lupus*) and the racoon dog (*Nyctereutes procyonoides*). Infection by *C.vulpis* is more common in foxes, so this parasite is often called 'fox lungworm'. Adult parasites have also been reported in the Eurasian badger (*Meles meles*).[1] This parasite was first reported in dogs in the United Kingdom in 1992.[2] After this first report, occasional cases have been described in dogs from several European countries, such as Spain, Germany, France, Switzerland, Austria, Hungary, Netherlands, Denmark, Norway, Belgium[3] and Czech Republic.[4] Crenosomosis is thought to be more relevant in Central and Northern Europe than in Southern Europe.[5] To date, there have been no reports or clinical cases of crenosomosis in dogs in Latvia, although *C.vulpis* has been detected in wolves and foxes in the country, with a prevalence of 9.1%[6] and 11.3%, respectively.[7]

The life cycle of *C.vulpis* is indirect. Intermediate hosts include various slugs and snails, such as *Arion vulgaris*, *Limax maximus* and garden snails (*Cornu aspersum*),[5] in which *C. vulpis* larvae have been detected. The intermediate host ingests the first larval stage (L1) that is present in the environment after having been eliminated through the faeces of an infected canid. In the intermediate host, within 17 days the larvae evolve to L2 and then L3. The dog becomes infected by ingesting the infective stage (L3). After ingestion, the larvae migrate through the gastrointestinal tract, change their shell twice during migration and enter the respiratory system (the primary localization site) as stage L5 larvae. In the respiratory system, the larvae mature and become adults. Later, they reproduce, and as females are ovoviviparous, they lay L1 stage larvae.[3] The L1 larvae ascend with the mucus of the tracheobronchial tree when the dog coughs, being swallowed and, consequently, excreted with the faeces. Adult parasites can live in the definitive host for up to 10 months, and their prepatent period is 18–21 days.[8,9]

The clinical signs of crenosomosis are rather non-specific. There is also no evidence of a predisposition of sex or age for this parasitic disease.[10] However, it is believed that most dogs become infected at the age of approximately one year or slightly older.[2] The environment of residence is a proven risk factor for becoming infected by *C. vulpis*. Dogs living in rural areas have a higher risk of becoming infected than dogs living in urban areas.[10] The way of life of the animals, the presence of other definitive hosts, such as foxes, and the density of intermediate hosts in a given area must also be taken into account. Most infections occur during the winter months.[11]

Crenosoma vulpis does not cause serious life-threatening lesions in dogs. However, it should be noted that crenosomosis is a chronic disease, and the dog's quality of life is negatively affected. Clinical signs are related to the parasite intensity. Specifically, heavier infections are associated with more pronounced and severe clinical signs. Typical signs include coughing, gagging and tachypnoea.[2,4] In the case of a light infection, the cough is dry, but when the dog suffers a more severe infection, the cough becomes productive.[2]

Adult parasites cause inflammation in the bronchi and bronchioles that manifest as bronchitis or bronchiolitis and, in more severe cases, bronchopneumonia. Histological examination reveals hyperplasia of the bronchial glands,[4] and inflammatory cells and debris are observed in the lumen,[8] resulting in obstruction of the bronchioles and bronchi. Mast cell infiltrations were observed. The most commonly detected cells are eosinophils, plasma cells, macrophages and lymphocytes.[8]

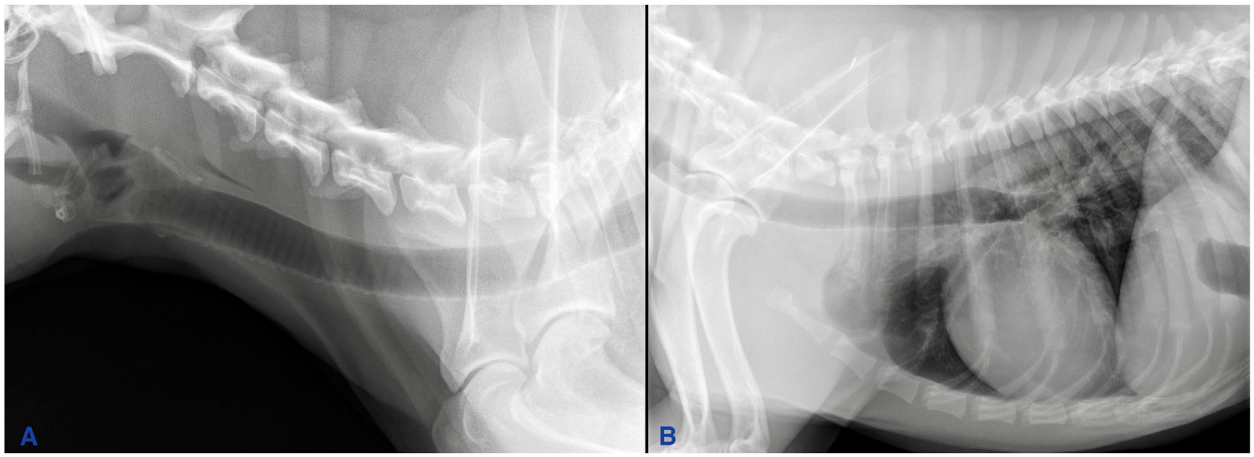

FIGURE 1 Neck region (a) and thoracic radiograph (b) lateral view. Moderate bronchial pattern

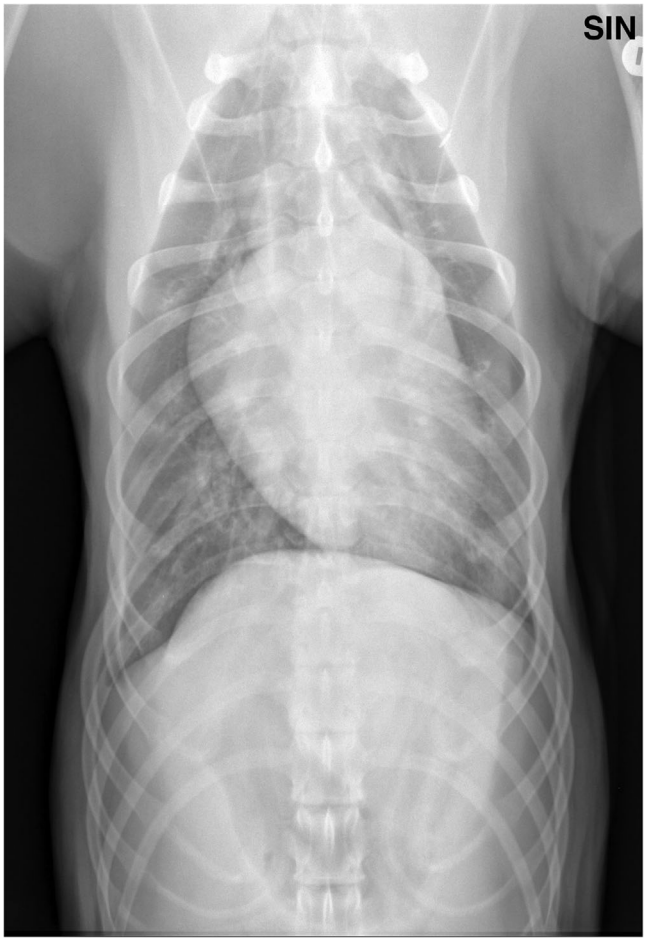

FIGURE 2 Thoracic radiograph ventrodorsal view. Moderate bronchial pattern

Diagnosis of *C. vulpis* involves the examination of faeces. *C vulpis* can be detected by the Baermann and also flotation method. When the flotation method is used, flotation solution choice is important. The most common used flotation solution is sodium chloride, but for *C. vulpis* larvae diagnostic, this fluid is ineffective and use of zinc sulphate is recommended.[13] The Baermann technique is the most often used, and it is also considered the most effective method of detecting *C. vulpis*.[12] It is inexpensive and easy to perform but is rarely used in veterinary clinics and practice. There are also cases where this method shows false negative results because larval shedding may be intermittent.[12] To avoid this, it is recommended to examine multiple samples collected at least three times within a period of 7 days.[12] Other methods have also been described, such as FLOTAC, which is most commonly used to determine the burden of parasites.[13] Flotation or centrifugal flotation with zinc sulphate solution can also be used.[13] The classic saline solution is not suitable because its density is lower than the larval density, and it is not able to lift them up. Like L1 stage larvae, adults are also easily differentiated. They are 5–10mm long with a characteristic anterior part of the body—they have 18–26 cuticular ridges.[12] Adult parasites are detected by bronchoalveolar lavage. The recovered nematodes must then be examined microscopically and their morphological characteristics determined. This was done in the case presented in this report.

There are only a few clinical reports of *C. vulpis* infection in dogs. Husnik and colleagues describes a clinical case of *C. vulpis* infection in a dog in the Czech Republic. In that case, a 1-year-old dog had a history of chronic coughing and gagging. Previously, the dog had been treated with antibiotics and prednisolone and had temporary improvement in clinical signs; however, the dog had increased lung sounds, monocytosis and peribronchial cuffing and a bronchial lung pattern on thoracic radiographs. The tracheal mucosa was hyperaemic, and mucopurulent exudate in the lower bronchi and nematode parasites were detected during bronchoscopic examination.[4] The case described by Husnik and colleagues and our clinical case share some common findings: chronic coughing, gagging and moderate improvement after antibiotic and prednisolone treatment; however, that case did not result in the complete resolution of clinical signs. Caron and colleagues described *C. vulpis* infection in two young dogs in Belgium. Both animals were less than 2 years of age and had previously been dewormed. Clinically, they were observed to have a cough that had been previously treated with antibiotics but without success. In both dogs, radiographic examination revealed a diffuse bronchointerstitial lung pattern. Lung parasites were detected during bronchoscopy.[3] As it is seen in previous reports and in our clinical case, dogs with *C. vulpis* infection present with chronic coughing and gagging that does not respond to antibiotic treatment. CT can be useful in the

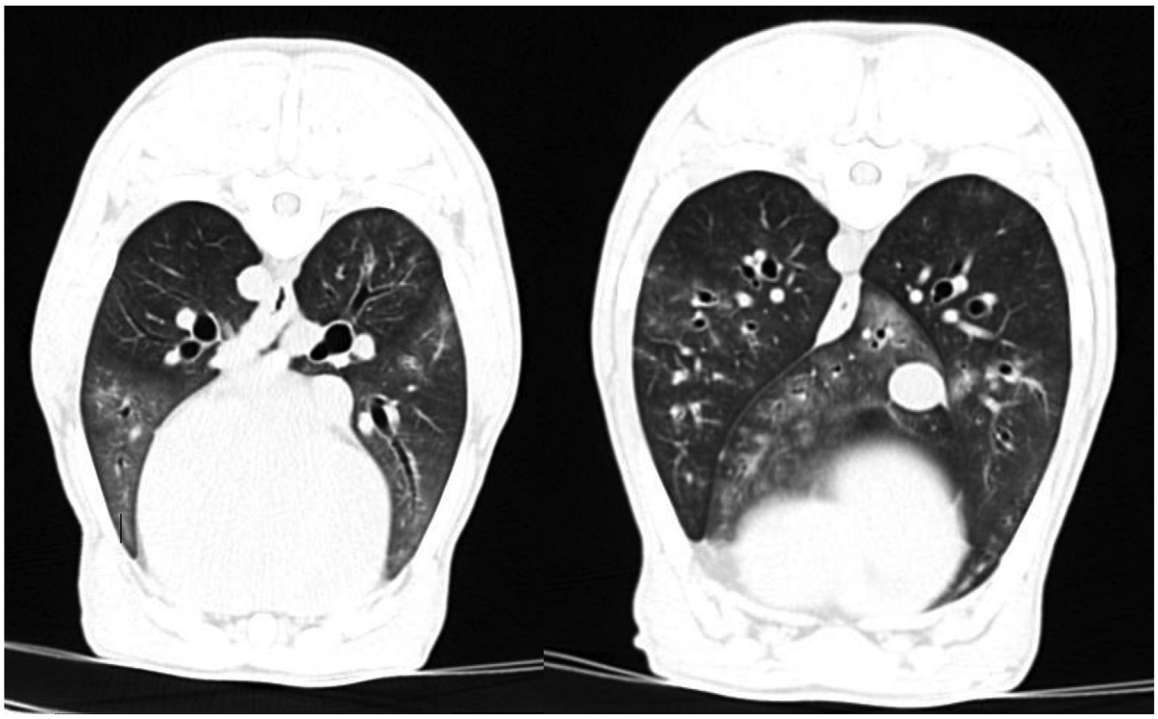

FIGURE 3 Computed tomography, axial view. Peribronchial ground glass pattern, bronchial wall thickening

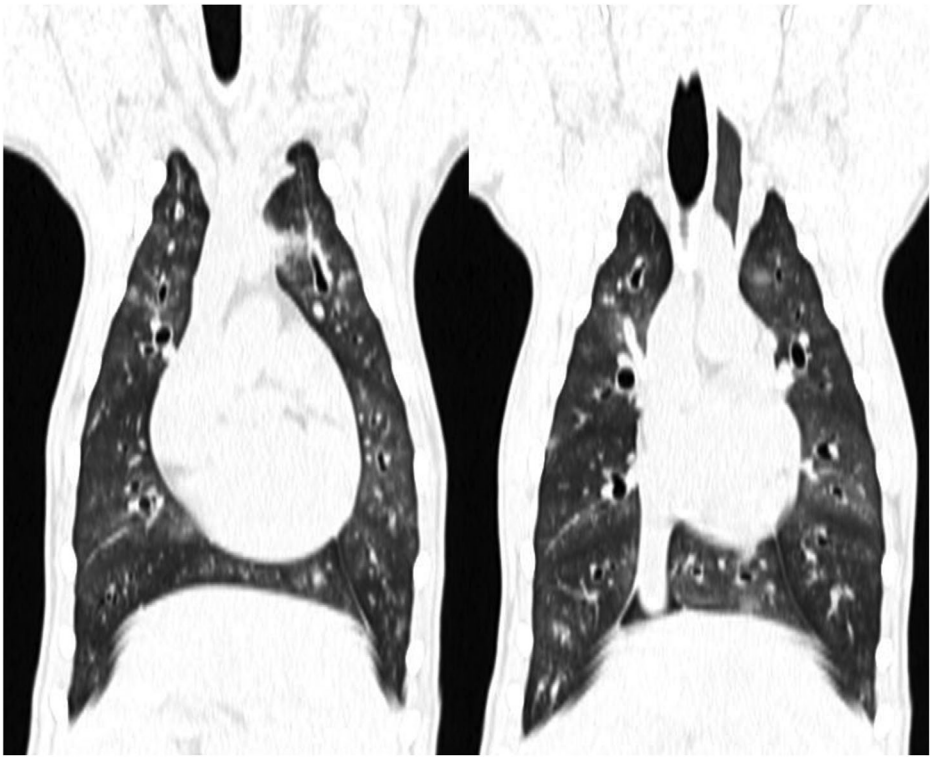

FIGURE 4 Computed tomography, dorsal view. Peribronchial ground glass pattern, bronchial wall thickening

detection of lung lesions. In cases of *C. vulpis* infection, findings include bronchial wall thickening, peribronchial ground glass pattern, pulmonary parenchymal consolidation and bronchiectasis.[14]

There are multiple drugs available for the treatment of *C. vulpis* infection. Treatment with fenbendazole (50 mg/kg, 3–7 days) gives positive results.[10,15] In a study where dogs were experimentally infected with this nematode, treatment with milbemycin oxime (0.5 mg/kg) and praziquantel (5 mg/kg) (Milbemax), showed 98.7% efficacy.[8] Matos and colleagues described that treatment with 10 % imidacloprid + 2.5 % moxidectin spot-on did not give the desired result, and L1 of *C. vulpis* were still present in the dog faeces.[2] Treatment with ivermectin (200 μg/kg) has been reported to be effective in naturally infected silver foxes.[16] In our clinical case, treatment with fenbendazole was chosen because of its proven effectiveness against *C.vulpis*. Milbemycin oxime (0.5 mg/kg) and praziquantel (5 mg/kg) (Milprazon, KRKA) administered

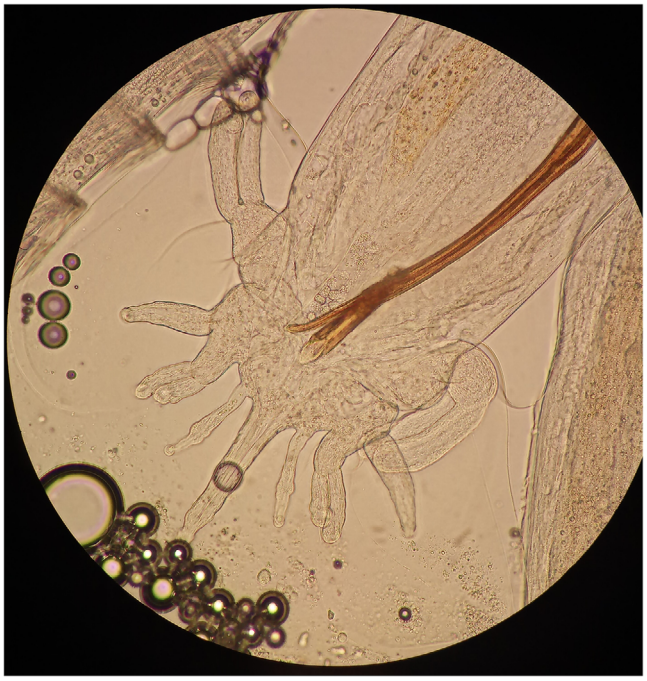

FIGURE 5 Bursa and spicules at the caudal part of an adult male of *Cremasoma vulpis* (400x)

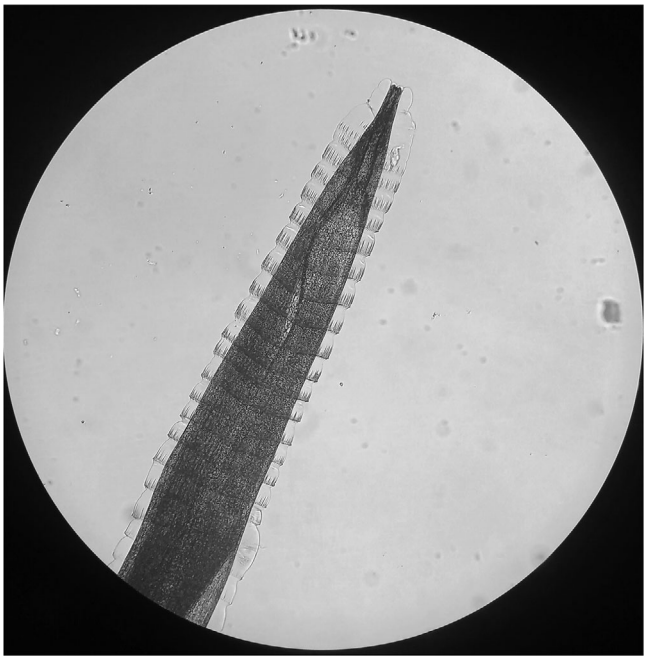

FIGURE 6 Anterior part of an adult nematode of *Crenosoma vulpis* with 19 cuticular ridges (100x)

orally 3–4 weeks after fenbendazole treatment was administered orally for prophylactic deworming. According to the Milprazon (KRKA) drug label, this active principle is effective treatment of mixed infections by adult cestodes and nematodes, included *C. vulpis*, although the only effective ingredient against *C. vulpis* is milbemycin oxime. Since our patient's coughing resolved completely within 5 days after fenbendazole treatment, and no larvae were detected in a feaces, we consider more fitting to recommend specific treatment with this active ingredient against crenosomosis in dogs rather than with Milprazon, since the latter is indicated for a wider range of helminths, including nematodes and cestodes.

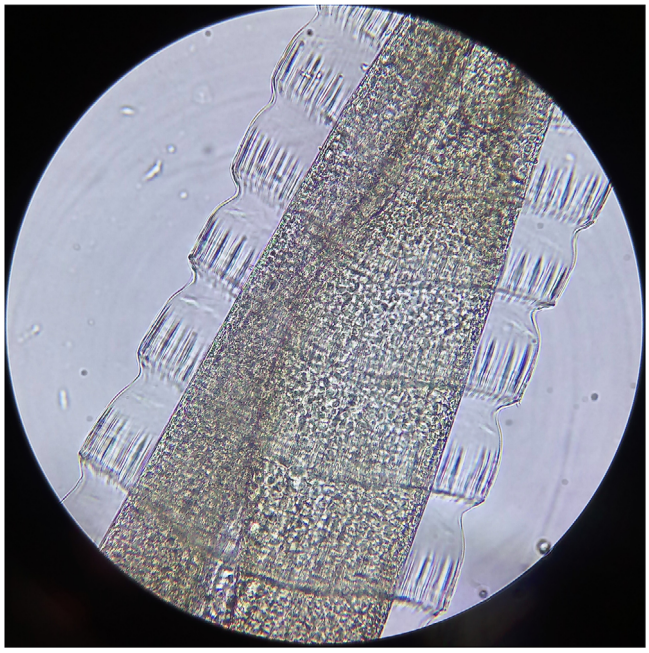

FIGURE 7 *Crenosoma vulpis* cuticular ridges in the front of the body (400x)

C. vulpis infection is typical in dogs at a young age and should be considered especially in dogs living in rural areas where these pets are more likely to ingest intermediate hosts. Lung parasites should be included in the algorithm of the diagnostic work-up for coughing and gagging in young dogs, even if they have been dewormed previously.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

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