

## Successful Resolution of Esophageal Granulomas in a Dog Infected with *Spirocerca lupi*

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(Received 4 March 2013/Accepted 10 July 2013/Published online in J-STAGE 24 July 2013)

**ABSTRACT.** A 13-year-old female Labrador Retriever presented with chronic regurgitation. Radiography and computed tomography (CT) revealed nodules in the caudal esophagus. Upper gastrointestinal endoscopy followed by histopathological examination revealed esophageal granulomas caused by *Spirocerca lupi*. The infection was treated with milbemycin oxime. The therapy was successful, and a remarkable reduction in granulomas was observed. This case report describes the diagnostic imaging findings and treatment outcome of a dog with *S. lupi* infection in Japan.

**KEY WORDS:** esophageal granulomas, gastrointestinal endoscopy, milbemycin oxime, *Spirocerca lupi*.

doi: 10.1292/jvms.13-0116; *J. Vet. Med. Sci.* 75(12): 1629–1632, 2013

*Spirocerca lupi* (*S. lupi*) is a parasitic nematode with a tropical and subtropical distribution. This nematode has been found in many species, but it mostly affects carnivores, especially Canidae [4, 10, 12, 22]. Carnivores are infected by ingestion of beetles [1, 5]. The adult parasites live in nodules present in the esophageal wall of their hosts. With time, the parasite initiates a granulomatous reaction with esophageal granuloma formation. The nodule becomes larger and granulomatous in appearance, often developing focal necrotic areas. Secondary infection and neoplastic transformation may occur [1]. Sarcomas, such as fibrosarcoma and osteosarcoma, have been reported in dogs associated with spirocercosis [19], sometimes with metastases to several organs, such as the lungs and bronchial lymph nodes [15]. Infection may either be subclinical or more commonly. If the esophageal granuloma is big enough, regurgitation, vomiting and weight loss will develop [22]. Several anthelmintic products, such as doramectin and milbemycin oxime, have been evaluated against adult *S. lupi* infection in canine esophagus, and good efficacy was reported [1, 7, 14]. In Japan, only autopsy reports [20, 21] and epidemiologic studies [6, 16] regarding dogs infected with *S. lupi* have been reported; antemortem diagnosis and therapy for *S. lupi* infection in dogs have not yet been described. This case report describes the diagnostic

imaging findings and treatment outcome of a dog with *S. lupi* infection in Japan.

A 13-year-old, neutered female Labrador Retriever weighing 26.4 kg was referred to the Animal Medical Center at Nihon University for evaluation of a thoracic mass and intermittent regurgitation. The dog regurgitated twice or thrice each month, but was in good general condition. The dog was born in Japan and lives in Tokyo at the time of presentation, but had previously lived in India (a year before) and United Arab Emirates (4 years before). The dog was generally fed dry food. At the initial visit, a blood test revealed high C-reactive protein (CRP) level, 6.2 (reference, <1.00) mg/dl and fibrinogen level, 750 (reference, 200–400) mg/dl; however, all other parameters were within the normal range. Furthermore, no significant abnormalities were observed on general fecal examination (direct and flotation method) and abdominal ultrasonography. Radiography revealed a shadowy mass in the caudal esophagus and a moderate amount of air on the cranial portion of the mass (Fig. 1a). Computed tomography (CT) revealed dilatation of the esophageal lumen of the cranial esophagus and more than 4 masses of varying sizes in the caudal esophagus. The largest mass was 24-mm wide and showed central mineralization without any enhancement by a contrast agent (Fig. 1b). Additionally, abdominal aortic mineralization was observed between the kidney and the liver (Fig. 1c). Upper gastrointestinal endoscopic examination revealed dilatation of the cranial esophagus and several smooth rounded nodules in the caudal esophagus (Fig. 2a). Additionally, the nodules were also observed at the esophageal-cardiac junction, but were not large enough to obliterate the opening. Endoscopic ultrasonography (EUS) revealed that the pathological lesions were limited to the

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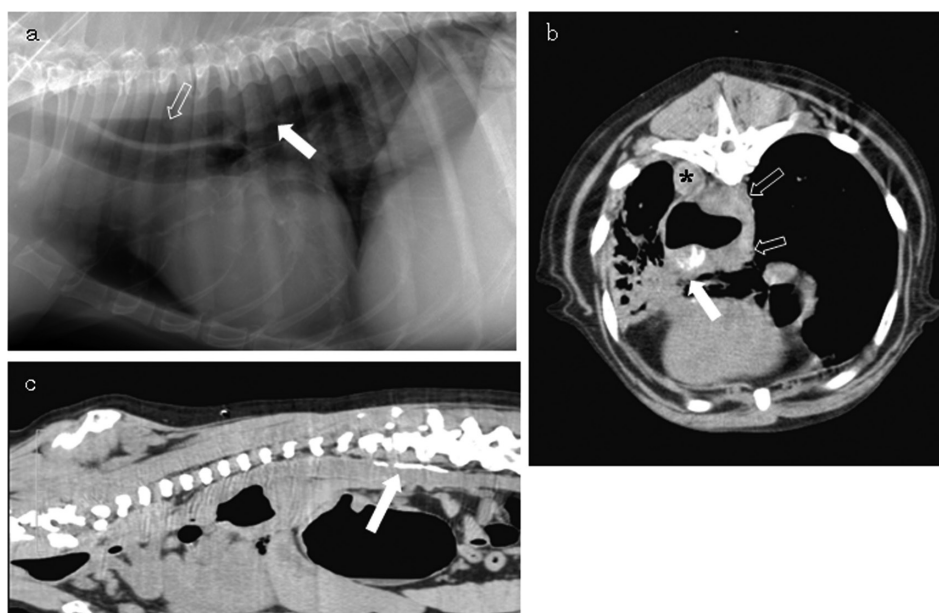


Fig. 1. Diagnostic imaging reveals masses and aortic mineralization caused by *S. lupi* infection in a dog. (a) Right lateral thoracic radiograph. Soft tissue mass (white-filled arrow) and a moderate amount of air (unfilled arrow) were observed. (b) Transverse thoracic computed tomography (CT) image using a soft tissue window. Nodules were observed in the caudal esophagus (unfilled arrows). An *S. lupi*-associated mass shows central mineralization (white-filled arrow) and invasion of the air-filled esophagus. The aorta is indicated by an asterisk (\*). (c) The aorta shows advanced mineralization of its lateral wall (white-filled arrow).

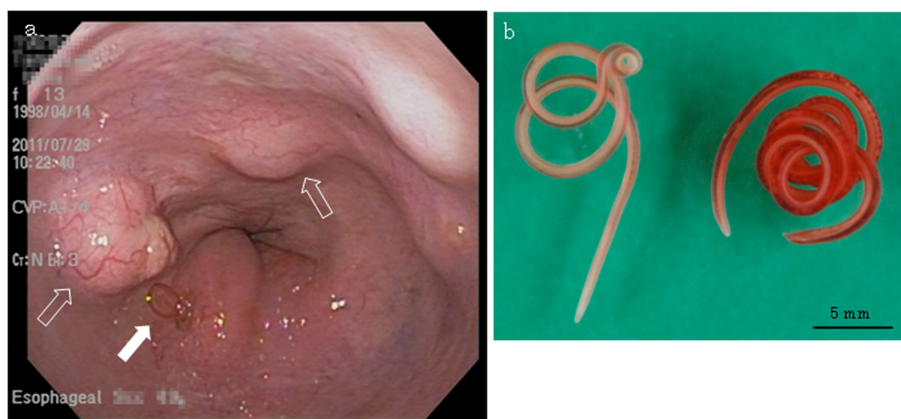


Fig. 2. Gross pathological findings of *S. lupi* isolated from the esophageal nodules. (a) Endoscopic appearance of the esophagus in a dog with spirocercosis. Few smooth rounded nodules were observed in the caudal esophagus (unfilled arrows). (b) The male (left) and female (right) parasites of *S. lupi*. The male parasite was light red, and female parasite was bright red in color.

muscle layer or submucosa and were not found to infiltrate the mucosa. Two worms were found in the surface of the nodules (Fig. 2a). The worms (1 male and 1 female), which appeared coiled, were extracted using endoscopic biopsy forceps. The male worm was slightly red and measured approximately 6.1 cm in size. The female worm was bright red and measured approximately 10.2 cm in size (Fig. 2b). Thereafter, stool examination using the formol-ether con-

centration technique (MGL method) revealed the presence of eggs. Finally, the worms were identified as *S. lupi* based on the morphological characteristics of the adult parasites and the eggs, their measurements and their habitats, which have been reported previously [17, 21]. The biopsy samples of the nodules were obtained by means of endoscopic biopsy forceps. A histopathological examination of the nodules revealed esophageal granulomas with chronic inflammation

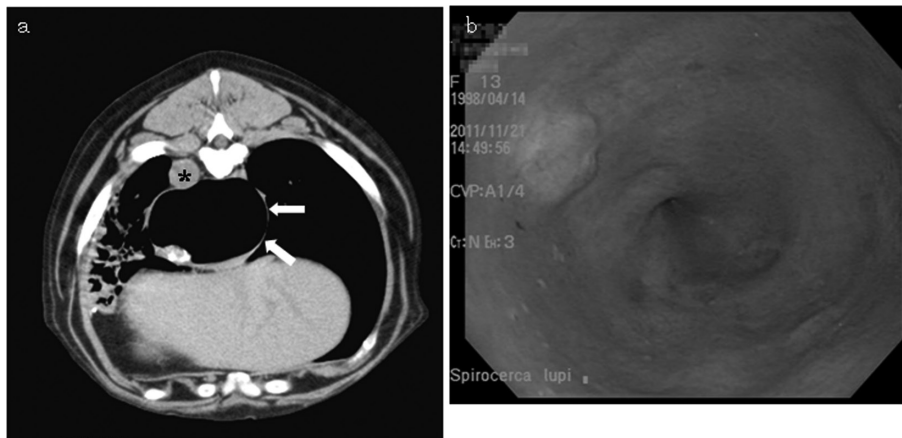


Fig. 3. Post-therapeutic images in esophageal findings. (a) Transverse thoracic CT image using a soft tissue window. The esophageal granulomas had remarkably reduced; however, no change in the central mineralization of the granulomas was observed. The esophagus is shown by white-filled arrows. The aorta is indicated by an asterisk (\*). (b) Endoscopic examination after therapy. A remarkable reduction in the granulomas was observed.

of many plasmacytes and lymphocytes. For the treatment of spirocercosis, the dog was administered 0.5 mg/kg PO of milbemycin oxime on days 0, 7 and 28 and then monthly (a total of 6 times). The CRP value was decreased to 0.05 mg/dl 45 days after the initial administration. Fecal examinations conducted using the MGL method 161 days after the therapy did not reveal eggs in the feces. Regurgitation also gradually resolved. A computed tomography (CT) examination performed 161 days after the initial administration showed that the esophageal granulomas were remarkably reduced; however, no change was observed in the central mineralization of the granulomas (Fig. 3a). In addition, the abdominal aortic mineralization and dilation of the esophageal lumen showed no changes. Similar to the CT result, upper gastrointestinal endoscopic examination revealed a remarkable reduction in the granulomas (Fig. 3b).

The majority of reports regarding *S. lupi* infection in dogs are from Israel [12], Greece [13], India [18], the southern United States [3] and South Africa [10]. Epidemiological investigations in Japan have identified *S. lupi* infection in 0.8% (2/255) and 1.6% (3/192) of autopsies performed in feral dogs collected from Kyoto and Shizuoka, respectively [6, 16]. Furthermore, *S. lupi* infection has been detected during the performance of an autopsy in domestic dogs in Hyogo and Fukushima, respectively [20, 21]. Recently, epidemiological investigations in Japan have identified *S. lupi* infection in 1.9% (1/54) of Japanese raccoons (*Nyctereutes procyonoides*) collected from 1991 to 1992 in the Chubu mountain area [17]. The dog discussed in the present study may have ingested paratenic hosts or coprophagic beetles in the foreign countries where it had recently lived. Alternatively, the dog could have also contracted the infection in Japan, since *S. lupi* can reach the esophageal wall from the larval ingestion stage in approximately 100 days. However, when and how the dog was infected remains unknown. Since veterinarians are less aware of *S. lupi* infection in Japan, at-

tention must be paid to animals imported from foreign countries or companion animals that had lived in epidemic area.

*S. lupi* eggs can be difficult to identify by direct and flotation methods of fecal examination [5]. In the present study, the eggs could not be identified using general fecal examination methods. However, the *S. lupi* eggs were identified using the MGL method, which is not the standard stool examination test used in clinical practice. This method should be aggressively applied in cases of esophageal masses at veterinary hospitals. A previous study reported no evidence of subsequent shedding of the eggs in feces from 31 to 133 days after the commencement of milbemycin oxime treatment [7]. Fecal examinations using the MGL method were not performed for a long period (161 days) after the therapy. It is therefore possible that the eggs had disappeared earlier than 161 days after the initiation of treatment.

In the majority of dogs infected with *S. lupi*, radiography often reveals a mass in the caudal esophagus in addition to the presence of air cranially to the mass [4]. Similar radiographic findings were observed in the present study.

CT examination is also a useful tool for the diagnosis of canine spirocercosis. CT examination is used for evaluating the extent of the lesion; identifying pleural, mediastinal and pulmonary pathology; and assessing aortic mineralization, aortic aneurysms and small pulmonary nodules [22]. In the present case, CT revealed aortic mineralization and the extent of the lesion.

Endoscopy is more sensitive than radiography in the diagnosis of an *S. lupi* infection, which may have only progressed to a small nodule in the esophagus [22]. A previous study showed 100% sensitivity of endoscopy, 80% sensitivity of fecal flotation and 53% sensitivity of radiography in the diagnosis of an esophageal mass [12]. The present study also demonstrated that endoscopy is useful for the diagnosis of *S. lupi*.

Early infection typically presents with one or several

smooth rounded nodules. However, over time, the nodules may enlarge and become rough, ulcerated, lobulated, frequently pedunculated, cauliflower-like masses [22]. Because the nodules found in this case were smooth and rounded, the *S. lupi* infection in this dog might have been in its early stages.

Several drugs have been used for the treatment of spirocercosis [2, 11]. Recently, the efficacy of doramectin has been reported [1, 9, 10]; however, the drug has to be injected into the patient, which is inconvenient. Additionally, the drug is prohibited in Collies and related breeds, because of its toxicity related to the multidrug resistance protein 1 (*MDR1*) gene mutation [7]. Milbemycin oxime is orally administered, relatively inexpensive and efficacious against the larval forms situated in or migrating from the aorta [7, 8]. Therefore, milbemycin oxime was administered using the protocol described by Kelly *et al.* [7]. The treatment was successful against almost all granulomas in the present case. However, the central mineralization in a mass and the abdominal aorta remained; moreover, few esophageal granulomas had not completely disappeared. The existence of the parasites in the nodules or aorta lesions could not be determined. Furthermore, it is important to note that the esophageal granuloma caused by *S. lupi* may be translated into sarcomas [18]. Further follow-up studies are warranted to determine the completion of the therapy for *S. lupi* infections.

In summary, this is the report of *S. lupi* infection diagnosed using endoscopy in a dog living in Japan. The dog was successfully treated with milbemycin oxime. Further studies of similar cases are required to clarify the treatment regimen of *S. lupi* infected dogs.

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