Case Report

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Treatment of *Strongyloides stercoralis* Hyperinfection in a Dog

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Abstract A 10-year-old spayed female beagle referred to the Veterinary Teaching Hospital of Chungnam National University presented with acute diarrhea, depression, anorexia, and emaciation. The laboratory findings of the dog showed leukocytosis, high C-reactive protein, and low albumin levels. Fecal examinations revealed severe infection with *Strongyloides* (*S.*) *stercoralis*, with a high fecal score (6/7). Consequently, the dog was diagnosed with hyperinfection of *S. stercoralis*, and thus, was treated with fenbendazole and ivermectin after discontinuation of prednisolone treatment. The dog showed negative on the Fecal Dx® Antigen Panel (IDEXX Laboratories Inc., Westbrook, ME, USA) after treatment, and clinical signs disappeared with normal stool consistency.

Key words *Strongyloides stercoralis*, hyperinfection, prednisolone, ivermectin, dog.

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Introduction

Strongyloides (*S.*) *stercoralis* is an opportunistic intestinal threadworm parasite that infects dogs and cats (4). Most *S. stercoralis* infections in dogs are chronic and asymptomatic, but a change in immune status can lead to acute, hyperinfection, and death if unrecognized (9). The difference between acute and chronic forms depends on the severity of clinical signs and the number of *S. stercoralis* adults in the intestine (1,6,10). Indeed, chronically infected dogs are asymptomatic or self-limiting, whereas acute hyperinfected dogs are more likely to have severe gastrointestinal and respiratory alterations (1,6,10). The acute form, also known as hyperinfection or massive infection with *S. stercoralis*, has been noted most frequently in dogs with immunosuppressive statuses, such as young dogs or administration of immunosuppressive agents, especially corticosteroids (9).

The diagnosis of *S. stercoralis* infection has traditionally been based on fecal examination or the Baermann method, although more recent serological approaches such as enzyme-linked immunosorbent assay and polymerase chain reaction can be used (7). Many drugs are available for the treatment of *S. stercoralis* infections in dogs. In normal infections, ivermectin, albendazole and fenbendazole have been demonstrated to be effective (6,7,10). In hyperinfection, combination therapy of fenbendazole and ivermectin are expected to be effective (6,7,10). The present study aimed to describe a case of *S. stercoralis* hyperinfection in a dog that was successfully treated with fenbendazole and ivermectin.

Case Report

A 10-year-old spayed female beagle, weighing 9.25 kg, living outdoor with regularly taking anthelmintics, was referred with symptoms such as fever, lethargy, and exercise intolerance. Physical examination revealed no swelling or painful reactions in all joints. Body temperature (39.7°C), leukocytosis (24,790 cells/μL, reference range: 5,200-13,900), and high C-reactive protein (CRP) (18.81 mg/L, reference range: 0-2) levels were observed. To find why the dog has a fever, arthrocentesis was performed on the left carpal and right stifle joints. Protein concentration (3 g/dL, reference range: <2.5) and white blood cell counts (3.3×10^9 cells/L, reference range: $<3.0 \times 10^9$ cells/L) were increased. Non-degenerative neutrophils were predominant on cytologic examination (non-degenerative neutrophilic pleocytosis). In addition, bacterial and fungal cultures were performed on the synovial fluid, and the results were all negative. Rheumatoid arthritis and systemic lupus erythematosus were ruled out after the rheumatoid factor (RF), antinuclear antibody (ANA) tests and normal radiographic results of the joints. We diagnosed this case as type 1 immune-mediated polyarthritis based on the results of complete blood count profiles, serum chemistry profiles, arthrocentesis, and negative RF and ANA tests.

Prednisolone (Solondo®, Yuhan, Seoul, S. Korea; 1 mg/kg PO q12h) was initiated and clinical signs improved gradually. Two weeks after prednisolone administration, improvements of clinical signs and hyperthermia, and decreased level of CRP (2.11 mg/L, reference range: 0-2) were noted.

After prednisolone administration, the dog started presenting with symptoms of watery diarrhea, depression, anorexia, and emaciation. At presentation, severe weight loss and depression were the only physical alterations. Mild leukocytosis (17,630 cells/μL; reference range: 5,200-13,900), high CRP (10.87 mg/L; reference range: 0-2), and low albumin (1.7 g/dL; reference range: 2.6-4.0) levels were detected. The Giardia SNAP Kit (IDEXX Laboratories Inc., Westbrook, ME, USA) was negative. Fecal examinations revealed that the dog was severely infected with *S. stercoralis* with a high fecal score (6/7) (Fig. 1A).

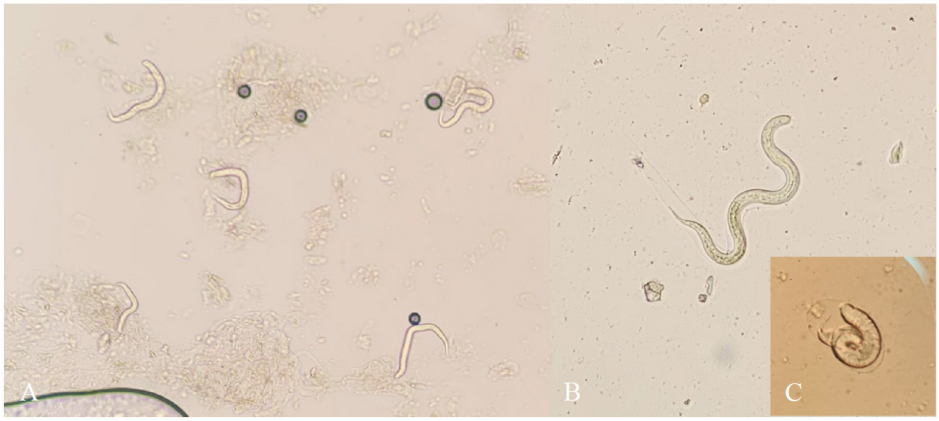

Fig. 1. Identification of the first stage larvae of *Strongyloides stercoralis* by direct fecal smear of a ten year old spayed female Beagle dog. A low magnification (A). A higher magnification of (A), Larvae of *S. stercoralis* containing a prominent genital primordium and non-kinked tail (B). *S. stercoralis* eggs containing first stage of larvae (C).

The dog was hospitalized and treated with fenbendazole (PanCom®, ELT Science, Cheongju, S. Korea; 50 mg/kg PO q12h), and discontinued taking prednisolone the dog had taken for a month. Lactated Ringer's solution was administered to correct the dehydration and electrolyte abnormalities. Metronidazole (Flasinyl, HKinnoN, Seoul, S. Korea; 15 mg/kg PO q12h), L-glutamine (Gibco®, UK; 0.5 g/kg PO q8-24h), maropitant citrate (Cerenia®, Zoetis, NJ, USA; 1 mg/kg SC q24h), and esomeprazole (Nexium, AstraZeneca, Seoul, S. Korea; 1 mg/kg PO q12h) were added to the prescription. During hospitalization, fresh fecal samples were collected daily and analyzed by direct fecal smears. After seven days, fecal direct smears revealed a small amount of live *S. stercoralis* larvae, and treatment with ivermectin (Ivomec®, Boehringer Ingelheim, Ontario, Canada; 0.2 mg/kg SC every 4 days) was started. *S. stercoralis* infection recovered on day 14 by Fecal Dx® Antigen Panel (IDEXX Laboratories Inc., Westbrook, ME, USA) through 14 days of fenbendazole (PanCom®, ELT Science, Cheongju, S. Korea) and 2 times of ivermectin treatment. No eggs or larvae of the parasite were observed during fecal examination.

Discussion

The clinical signs of *S. stercoralis* infection are often asymptomatic and self-limiting (1,2,5). Long-term corticosteroid administration is considered a risk factor associated with severe forms of hyperinfection (1). In this case, the dog may be infected with *S. stercoralis* in immunosuppression condition due prednisolone (1 mg/kg PO q12h for 1 month) treatment.

The first-stage larvae were easily detected as clearly seen genital primordium and non-kinked tail, which allowed us to differentiate *S. stercoralis* from other nematode larvae in dogs (7). In this case, we performed a direct fecal smear and found the first-stage larvae with clearly visible genital primordium and non-kinked tail. Based on these results, the patient was diagnosed with *S. stercoralis* infection.

The treatment choice for *S. stercoralis* infection is known to be fenbendazole, albendazole, and ivermectin (6,10). For common infections, fenbendazole treatment alone is sufficient. However, fenbendazole and ivermectin need to be added in cases of *S. stercoralis* hyperinfection. Ivermectin is a prototype of avermectin antiparasiticide. Its action is to stimulate the release of GABA, thus, causing the paralysis of the parasite and eventually death (8). A recent report tried ivermectin as a treatment for *S. stercoralis* infection in dogs for several reasons, such as it is the first-choice drug for humans and has an affordable economic impact (8). The dosage of ivermectin is the same as that used for the treatment of chronic *S. stercoralis* infection in humans (8). The effectiveness of ivermectin has been demonstrated in several reports that it is 100% effective for L1, L2, and adults of *S. stercoralis* in dogs. However, it was not effective for tissue-dwelling L3 (3,8). In immunosuppressed dogs, ivermectin can be added to the treatment because the number of tissue-dwelling L3 is low (3,8). In this case, the negative result of *S. stercoralis* infection was achieved after the addition of ivermectin because fenbendazole treatment alone was not effective. These results indicate that combination therapy with fenbendazole and ivermectin may be necessary for the successful treatment of *S. stercoralis* hyperinfection (1).

In conclusion, the present study describes a case of *S. stercoralis* hyperinfection in a dog that was successfully treated with fenbendazole and ivermectin.

Conflicts of Interest

The authors have no conflicting interests.

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