



## Short Communication

**FIRST CASE OF *STRONGYLOIDES STERCORALIS* INFECTION IN A DOG  
IN THE REPUBLIC OF MACEDONIA**

Aleksandar Cvetkovikj<sup>1</sup>, Ljubica Rashikj<sup>1</sup>, Irena Celeska<sup>2</sup>, Elena Atanaskova Petrov<sup>2</sup>,  
Branko Angjelovski<sup>1</sup>, Iskra Cvetkovikj<sup>1</sup>, Maja Jurhar Pavlova<sup>3</sup>, Jovana Stefanovska<sup>1</sup>

<sup>1</sup>Veterinary Institute, Faculty of Veterinary Medicine, Ss. Cyril and Methodius  
University in Skopje, Lazar Pop-Trajkov 5-7, 1000 Skopje, Republic of Macedonia

<sup>2</sup>University Veterinary Hospital, Faculty of Veterinary Medicine,  
Ss. Cyril and Methodius University in Skopje, Lazar Pop-Trajkov 5-7, 1000 Skopje,  
Republic of Macedonia

<sup>3</sup>Institute for Microbiology and Parasitology, Medical Faculty, Ss. Cyril and Methodius  
University in Skopje, 50 Divizija 6, 1000 Skopje, Republic of Macedonia

Received 5 June 2017; Received in revised form 24 July 2017; Accepted 14 September 2017

**ABSTRACT**

A six-month-old Pomeranian male dog was referred due to a month long history of unformed, soft faeces and mild weight loss. Stool analyses by direct faecal smear, Zinc sulphate flotation and the Baermann concentration method revealed an infection with *Strongyloides stercoralis*. The dog was initially treated once with a combination drug of praziquantel, pyrantel and febantel (½ Drontal® Plus Tablets for puppies and small dogs; Bayer; i.e. 31.5 mg/kg bodyweight of febantel). The treatment was repeated after 12 days with the same dosage for 3 consecutive days. The stool analyses performed 14 days and 3 months after the second treatment were negative for *S. stercoralis* larvae. The results suggest that a repeated treatment with Drontal® Plus Tablets is effective against *S. stercoralis* in dogs and has no adverse effects.

**Key words:** canine strongyloidosis, febantel, larvae, treatment

**INTRODUCTION**

The intestinal threadworm *Strongyloides stercoralis* is a soil-transmitted, potentially zoonotic nematode with worldwide distribution (1). It is a slender hair-like worm around 2 mm long that parasitizes the proximal small intestine of dogs, wild canids, non-human primates and humans, mostly in tropical and sub-tropical countries (1, 2, 3). It has a free living form (males and females in soil) and a female-only parasitic form. The females

are parthenogenetic and lay eggs. The hatched first-stage larvae (L1) contaminate the environment through the faeces. In the environment, L1 moult to infective third-stage larvae (L3) that can infect a host primarily by penetration of the skin and rarely by ingestion (4). The transmammary route of infection is also described, but it is controversial and can occur if the bitch gets infected in late gestation and during lactation (5, 6). The infective L3 migrate to the lungs, then are coughed out, swallowed and reach the small intestine within 4-5 days (1, 6). Autoinfection can occur if the L1 develop to infective L3 before leaving the host's digestive tract, and is often associated with immunosuppression. Immunocompromised dogs may also develop a severe hyperinfection (L3 that migrate throughout the body) that is related to the acute form of the disease (1, 4). The prepatent period is 5-21 days (1).

The infection with *S. stercoralis* may be asymptomatic and self-limiting, or cause an acute

*Corresponding author:* Dr. Aleksandar Cvetkovikj, PhD  
*E-mail address:* acvetkovic@fvm.ukim.edu.mk  
*Present address:* Veterinary Institute, Faculty of Veterinary Medicine,  
Ss. Cyril and Methodius University in Skopje, Lazar Pop-Trajkov 5-7,  
1000 Skopje, Republic of Macedonia  
*Phone:* +389 2 3240 740; *Fax:* +389 2 3114 619

**Copyright:** © 2017 Cvetkovikj A. This is an open-access article published under the terms of the Creative Commons Attribution License which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

**Competing Interests:** The authors have declared that no competing interests exist.

**Available Online First:** 14 December 2017  
<https://doi.org/10.1515/macvetrev-2017-0032>

or chronic disease. The clinical signs are more commonly seen in young dogs and puppies, especially in kennels and shelters. High worm burden results in watery diarrhoea and bronchopneumonia and can be life threatening (1, 3, 4).

The diagnosis of the infection is commonly based on detection of L1 in the faeces with methods such as the Zinc sulphate flotation solution method and the Baermann funnel concentration method (1, 7). The recovered L1 are distinguishable by the morphology of the oesophagus (made up of corpus, isthmus and muscular bulb) and other features. For successful treatment of the infection, ivermectin, albendazole and fenbendazole are expected to be effective (1, 8, 9, 10).

This study describes the first *S. stercoralis* case in a dog in the Republic of Macedonia and a successful treatment of the infection with a commercial combination drug of praziquantel, pyrantel and febantel.

#### CASE HISTORY, DIAGNOSIS AND TREATMENT

A six-month-old Pomeranian male dog, weighing 1.8 kg, was referred to the University Veterinary Hospital at the Faculty of Veterinary Medicine in Skopje in March 2017 with a history of unformed, soft faeces during the last month

and mild weight loss. The dog was imported from Russia a week before the admittance to the Hospital. The dog was afebrile, with unchanged appetite and normal activity. Blood tests showed only mild anaemia ( $4.69 \times 10^{12}/l$ ). A fresh faecal sample was collected, divided in 1 gram portions and analysed by direct faecal smear, Zinc sulphate flotation and the Baermann method (1, 7, 8, 10). The coprological analyses revealed nematode larvae (14 L1 per gram of faeces) with distinct rhabditiform oesophagus and length 200-300  $\mu m$ . The oesophagus was well defined and obvious with length < 25% of the length of the larvae. All recovered larvae had straight, blunt pointed tails (Fig. 1). Based on the size of the larvae, morphology of the oesophagus and the tail, the L1 were identified as *S. stercoralis* (2, 11).

After identification of the larvae, the dog was initially treated once with a combination drug of praziquantel, pyrantel and febantel ( $\frac{1}{2}$  Drontal® Plus Tablets for puppies and small dogs; Bayer; 1 tablet contains 22.7 mg praziquantel, 22.7 mg pyrantel base as pyrantel pamoate and 113.4 mg febantel). A clinical examination 12 days after the treatment revealed that the dog had gained weight (0.2 kg) and had normal and formed faeces. At the same time, a fresh faecal sample was collected again and the coprological analyses (all 3, as specified earlier) revealed 6 *S. stercoralis* L1 per gram of feces. The treatment was repeated for 3 consecutive days, and 14 days after the second treatment the



**Figure 1.** First-stage larva (L1) of *Strongyloides stercoralis* with well-defined rhabditiform oesophagus (E) and straight tail (T), 250x magnification

3 coprological analyses of 2 consecutive faecal samples were negative for *S. stercoralis* larvae. To confirm that the treatment was effective, we tested 3 consecutive faecal samples using the Baermann method, 3 months after the second treatment. All tested samples were negative for *S. stercoralis* larvae.

As a precautionary measure, the dog owner and the rest of the family members (three persons in total) were coprologically tested for *S. stercoralis* larvae (by all 3 methods in parallel with the dog's second and third test). All tested samples (2 samples from each person; 6 in total) were negative.

## DISCUSSION

This study reports the first observation of canine strongyloidosis in the Republic of Macedonia. The dog had mild, non-specific clinical signs and the disease was diagnosed by coprological analyses. The recovered nematode larvae were identified as L1 *S. stercoralis*. The dog was successfully treated by a repeated treatment with Drontal® Plus Tablets.

Canine strongyloidosis is frequent in kennels and shelters, with prevalence from 0 to over 50% in younger dogs (1, 9). There are numerous reports about the presence of the infection throughout the world, even in colder climates (3, 12). However, this is the first description of *S. stercoralis* in Macedonia, and this case was an imported dog from Russia where the infection is sporadically reported (13). Due to the non-specific clinical signs, the disease is undoubtedly underreported by veterinarians, and the prevalence therefore underestimated since parasitological laboratories regularly perform only standard faecal flotation methods which are known to have low sensitivity for detection of nematode larvae (1, 11, 12). In our case, we found larvae with all the test methods (direct smear, flotation and Baermann), but the definitive identification was made by examining larvae recovered using the Baermann funnel concentration method. This method is considered as one of the most reliable copro-parasitological method for detection of *S. stercoralis* larvae (14).

The selection of Drontal® Plus Tablets as a treatment of choice was based on its broad spectrum anti-parasitic activity and the current availability. Although fenbendazole is the drug of choice for treatment of canine strongyloidosis (2, 9), we still do not have a commercially registered fenbendazole for veterinary use in Macedonia. The only alternative is febantel, a

pro-benzimidazole that is metabolized to fenbendazole and oxfendazole which have the parasitocidal effect (15). Febantel is not available as a single formulation, and is commonly found in combined products with praziquantel and pyrantel (15). Our initial treatment was a single administration of ½ Drontal® Plus Tablets for puppies and small dogs which equals to 31.5 mg/kg bodyweight of febantel. The single treatment proved ineffective, and for complete elimination of the parasite, we repeated the treatment after 12 days with the same dosage for 3 consecutive days. Our treatment regime supports the findings of Itoh et al. (16) that, in order to be effective against *Strongyloides* sp. larvae, febantel needs to be administered at least at 15 mg/kg body weight for 3 consecutive days. Considering the migratory route, the prepatent period and the egg output that may last for 11 weeks (1), we performed a follow-up faecal examination of the dog 3 months after the second treatment. All samples tested negative, which further confirms the efficacy of the treatment regime.

The most concerning fact about canine strongyloidosis is the zoonotic potential of *S. stercoralis* (1). The infections may be shared between dogs and people (15), especially in areas with inappropriate sanitary conditions. Considering the potential danger for human infection, we also tested the owners of the dog for *S. stercoralis* and all samples from all individuals were negative. Nevertheless, as infected dogs pose a significant public health risk, the owners were advised to properly remove the dog's faeces to avoid environmental contamination and possible spread of the infection.

## CONCLUSION

The results of this study suggest that a repeated treatment with a commercial combination drug of praziquantel, pyrantel and febantel (Drontal® Plus Tablets) is effective against *S. stercoralis* in dogs and has no adverse effects.

This report should raise awareness among the veterinary practitioners about canine strongyloidosis, and that any case of diarrhoea or soft stools, especially in younger dogs, should be considered for *S. stercoralis* infection. There are no data about the prevalence of canine strongyloidosis in the Republic of Macedonia, and further studies should be carried out to evaluate the unknown epidemiological status of the disease.

**CONFLICT OF INTEREST**

The authors declare that they have no potential conflict of interest with respect to the authorship and/or publication of this article.

**REFERENCES**

- Thamsborg, S.M., Ketzis, J., Horii, Y., Matthews, J.B. (2017). Strongyloides spp. infections of veterinary importance. *Parasitology* 144, 274–284. <https://doi.org/10.1017/S0031182016001116> PMID:27374886
- Taylor, M.A., Coop, R.L., Wall, R.L. (2016). Parasites of dogs and cats. In: *Veterinary Parasitology*, 4th ed. (pp. 599-677). Chichester: Wiley-Blackwell.
- Dillard, K.J., Saari, S.A., Anttila, M. (2007). Strongyloides stercoralis infection in a Finnish kennel. *Acta Vet Scand.* 49, 37. <https://doi.org/10.1186/1751-0147-49-37> PMID:18076758 PMCID:PMC2225404
- Cervone, M., Giannelli, A., Otranto, D., Perrucci, S. (2016). Strongyloides stercoralis hyperinfection in an immunosuppressed dog from France. *Rev Vet Clin.* 51, 55–59. <https://doi.org/10.1016/j.anicom.2016.05.001>
- Shoop, W.L., Michael, B.F., Eary, C.H., Haines, H.W. (2002). Transmammary transmission of Strongyloides stercoralis in dogs. *J Parasitol.* 88, 536–539. [https://doi.org/10.1645/0022-3395\(2002\)088\[0536:T-TOSSI\]2.0.CO;2](https://doi.org/10.1645/0022-3395(2002)088[0536:T-TOSSI]2.0.CO;2)
- Bowman, D.D. (2007). Parasites of dogs. In: D.G. Baker (Ed.), *Flynn's Parasites of Laboratory Animals*, 2nd ed. (pp. 509-577). Oxford: Blackwell Publishing. <https://doi.org/10.1002/9780470344552.ch17>
- Buonfrate, D., Paradies, P., Iarussi, F., Formenti, F., Perandin, F., Otranto, D., Bisoffi, Z. (2017). Serological and molecular tests for the diagnosis of Strongyloides stercoralis infection in dogs. *Parasitol Res.* 116 (7): 2027-2029. <https://doi.org/10.1007/s00436-017-5468-0> PMID:28493000
- Umur, Ş., Meral, Y., Bölükbaş, C.S., Gürler, A.T., Açıci, M. (2017). First clinical Strongyloides stercoralis case in a dog in Turkey. *Turk J Vet Anim Sci.* 41, 312–315. <https://doi.org/10.3906/vet-1606-2>
- Itoh, N., Kanai, K., Hori, Y., Nakao, R., Hoshi, F., Higuchi, S. (2009). Fenbendazole treatment of dogs with naturally acquired Strongyloides stercoralis infection. *Vet Rec.* 164, 559–560. <https://doi.org/10.1136/vr.164.18.559> PMID:19411688
- Yang, M., Gebeyehu, E.B., Jung, S.J., Kwon, O.D., Kwak, D. (2013). Treatment of naturally acquired Strongyloides stercoralis infection in a dog with ivermectin. *J Anim Plant Sci.* 23, 337–339.
- Zajac, A.M., Conboy, G.A. (2012). Fecal examination for the diagnosis of parasitism. In: *Veterinary Clinical Parasitology*. 8th ed. (pp. 3-169). Chichester: Wiley-Blackwell.
- Eydal, M., Skirnisson, K. (2016). Strongyloides stercoralis found in imported dogs, household dogs and kennel dogs in Iceland. *Icel Agric Sci.* 29, 39–51. <https://doi.org/10.16886/IAS.2016.04>
- Moskvina, T.V., Ermolenko, A.V. (2016). Helminth infections in domestic dogs from Russia. *Vet World* 9, 1248–1258. <https://doi.org/10.14202/vetworld.2016.1248-1258> PMID:27956777 PMCID:PMC5146306
- Buonfrate, D., Formenti, F., Perandin, F., Bisoffi, Z. (2015). Novel approaches to the diagnosis of Strongyloides stercoralis infection. *Clin Microbiol Infect.* 21, 543–552. <https://doi.org/10.1016/j.cmi.2015.04.001> PMID:25887711
- Bowman, D.D. (2014). *Georgis' parasitology for veterinarians*. 10th ed. (pp. 192-194; p. 302). St. Louis: Saunders.
- Itoh, N., Muraoka, N., Kawamata, J., Aoki, M., Itagaki, T. (2008). Treatment with febantel combination drug for canine Strongyloides sp. infection. *J Japan Vet Med Assoc.* 61, 453–458. (In Japanese with English abstract). <https://doi.org/10.12935/jvma1951.61.453>

Please cite this article in press as: Cvetkovikj A., Rashikj Lj., Celeska I., Atanaskova Petrov E., Angjelovski B., Cvetkovikj I., Jurhar Pavlova M., Stefanovska J. First case of Strongyloides stercoralis infection in a dog in the Republic of Macedonia. *Mac Vet Rev* 2018; 41 (1): i-iv. <https://doi.org/10.1515/macvetrev-2017-0032>