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Treatment of *Baylisascaris procyonis* infections in dogs with milbemycin oxime

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Abstract

An examination was made as to the ability of Sentinel® Flavor Tabs® (milbemycin oxime/lufenuron) to treat *Baylisascaris procyonis* infections in dogs. The study was designed as a critical trial and included five naturally infected dogs and two dogs that were experimentally infected. Another dog from a prior clinical trial that was treated with Sentinel Flavor Tabs as part of the original FDA submission package for intestinal nematode infections was also included with the treated dogs. Of the five naturally infected dogs treated as part of the critical trial, three were cleared of their infections. These five dogs passed a total of 52 worms after treatment; one dog retained 23 worms and the other retained 1 worm at necropsy 7 days after treatment. Two of five experimentally infected Beagle dogs that had been given mice that had been fed 200 infectious eggs, developed patent infections with the parasite. These dogs were treated, and one of the dogs passed one worm and the other passed two worms after treatment with no worms being detected at necropsy 7 days after treatment. The one dog that was treated with milbemycin oxime as part of the FDA submission was clear of worms at necropsy. Overall, the mean efficacy of Sentinel Flavor Tabs was found to be 91.0%. Of the eight dogs that were treated, six were totally cleared of their infections, a cure rate of 75%. The two dogs that did not clear their infections had very large numbers of adult *B. procyonis* within their intestinal tracts at the time of treatment, one dog had 40 worms (23 remaining) and the other had 26 worms (1 remaining). It is suggested that the treatment of dogs with monthly Sentinel Flavor Tabs could markedly reduce the chance of infected dogs contaminating the environment. Also, additional monthly treatments are highly likely to clear dogs of any worms not killed with the initial treatment.

Keywords: *Baylisascaris*; Milbemycin; Dog; Efficacy; Zoonosis

1. Introduction

Baylisascaris procyonis is a very common parasite of raccoons (*Procyon lotor*) throughout North America (Kazacos, 2001; Evans, 2002). This parasite was also introduced into Europe along with its raccoon

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host (Gey, 1998). The worm has also been introduced into Japan with raccoons (Sato et al., 2003). The larvae of this nematode are capable of causing severe zoonotic disease in people who ingest infective eggs, and a number of such cases have occurred (Rowley et al., 2000). Infections can also cause ocular lesions have been reported in the US (Mets et al., 2003) and in Europe (Kuchle et al., 1993). Throughout its range, this parasite has caused outbreaks of neurologic disease in many different species of birds and mammals that unfortunately ingested the infective eggs of this parasite (Kazacos, 2001).

Raccoons have been treated with several different drugs that are known to have effects against ascaridoid nematodes. Kazacos (2001) reported that he has cleared raccoons of their infections with piperazine citrate (120–240 mg/kg), pyrantel pamoate = embonate (6–10 mg/kg) and fenbendazole given at 50–100 mg/kg for 3–5 days. Raccoons in Germany were successfully treated with pyrantel embonate = pamoate (20 mg base/kg), ivermectin (1 mg/kg), moxidectin (1 mg/kg), albendazole (50 mg/kg daily for 3 days), fenbendazole (50 mg/kg daily for 3 days) and flubendazole (22 mg/kg daily for 3 days) with all raccoons being negative for worms on necropsy 7 days after treatment (Bauer and Gey, 1995). Intramuscular ivermectin given to raccoons at 2 mg/kg caused 11 of 12 animals to have negative fecal examinations after treatment (Hill et al., 1991).

The eggs of *Baylisascaris*, presumably of *B. procyonis* of raccoons, are being found more and more commonly in the feces of dogs. Kazacos (2001) listed 28 cases of dogs that were shedding the eggs of *Baylisascaris* in their feces. Of these 28 dogs, 23 were necropsied and found to harbor anywhere between 1 and 13 worms within their small intestine. These dogs came from Iowa, Minnesota, Michigan, and Indiana. We have continued to come across a number of additional dogs in Michigan that have been positive for *B. procyonis*, and we suspect that the worms are present in dogs throughout the range of the raccoon. It has been shown that it is possible to experimentally infect dogs with adults of the raccoon roundworm; in studies in Japan, one of three dogs was infected through the feeding of infective eggs (six worms were recovered from this dog) and three of four dogs were infected through the feeding of third-stage larvae (four to five worms were recovered from each of these dogs). Young raccoons become infected by ingesting eggs and older raccoons become infected by eating infected rodents (Kazacos, 2001), and it seems highly likely that a similar pattern of infection may occur in the case of dogs.

The concern of having patent infections in dogs is that dogs are indiscriminate defecators compared to raccoons. Raccoons tend to defecate in specific sites, called latrines, where their fecal matter concentrates, and accordingly where there are high concentrations of contaminating *Baylisascaris* eggs (Page et al., 1999). The domestic dog, on the other hand, often will defecate throughout its neighborhood or within backyards. This means that the eggs of *B. procyonis* could become widely distributed like the eggs of *Toxocara canis.* Levels of larval toxocariasis in the US have been found by serology to be sometimes as high as 30% in some populations (Ellis et al., 1986). The larvae of *T. canis* do not grow within the non-canine host; thus, there are often no signs associated with infections unless relatively large numbers of larvae are ingested or the larvae migrate to an especially vulnerable site such as the retina of the eye. The larvae of *B. procyonis,* on the other hand, grow within the host and cause marked pathology with associated signs as evidenced by the large numbers of animals that have died due to these infections.

During the past 12 years, we have discovered the eggs of *B. procyonis* in at least 17 dogs that were naturally infected with this parasite. Although fecal examinations have been performed on hundreds of dogs during this time, it is still very worrisome that this number of dogs are presenting with these eggs in their feces. The dangerous zoonotic potential of this parasite and the indiscriminate defecation patterns of canine hosts make this a very marked threat to public safety. There is every reason to believe that more and more dogs will become infected with this parasite, and it is even possible that the parasite might become ‘canine adapted’ where it will more easily be able to infect dogs in the future.

The experimental work described below was performed to ascertain the efficacy of milbemycin oxime in Sentinel Flavor Tabs, to treat existing infections of *B. procyonis* in dogs. The study was designed as a series of critical trials where each dog served as its own control. This method was chosen because of the relative infrequency by which these