



---

Use of Ivermectin against Several Nematodes in Naturally Infected Raccoons (*Procyon lotor*)  
Author(s): Richard E. Hill Jr., Jeff J. Zimmerman, John H. Greve, George W. Beran  
Source: *Journal of Zoo and Wildlife Medicine*, Vol. 22, No. 4 (Dec., 1991), pp. 417-420  
Published by: [American Association of Zoo Veterinarians](#)  
Stable URL: <http://www.jstor.org/stable/20095184>  
Accessed: 24/06/2011 14:21

---

Your use of the JSTOR archive indicates your acceptance of JSTOR's Terms and Conditions of Use, available at <http://www.jstor.org/page/info/about/policies/terms.jsp>. JSTOR's Terms and Conditions of Use provides, in part, that unless you have obtained prior permission, you may not download an entire issue of a journal or multiple copies of articles, and you may use content in the JSTOR archive only for your personal, non-commercial use.

Please contact the publisher regarding any further use of this work. Publisher contact information may be obtained at <http://www.jstor.org/action/showPublisher?publisherCode=aazv>.

Each copy of any part of a JSTOR transmission must contain the same copyright notice that appears on the screen or printed page of such transmission.

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact [support@jstor.org](mailto:support@jstor.org).



American Association of Zoo Veterinarians is collaborating with JSTOR to digitize, preserve and extend access to *Journal of Zoo and Wildlife Medicine*.

<http://www.jstor.org>

## USE OF IVERMECTIN AGAINST SEVERAL NEMATODES IN NATURALLY INFECTED RACCOONS (*PROCYON LOTOR*)

Richard E. Hill, Jr., D.V.M., M.S., Jeff J. Zimmerman, D.V.M., Ph.D.,  
John H. Greve, D.V.M., Ph.D., and George W. Beran, D.V.M., Ph.D.

**Abstract:** The anthelmintic effectiveness of various dosages of ivermectin administered i.m. was compared in three groups of raccoons (*Procyon lotor*) naturally infected with nematode parasites. Qualitative fecal examinations were performed before treatment and periodically after treatment using a sucrose flotation technique. Ivermectin was effective against *Placoconus lotoris*, *Capillaria putorii*, and *Physaloptera* sp. at all doses (200–2,000 µg/kg body weight) and against *C. plica* at higher doses ( $\geq 600$  µg/kg body weight). Ivermectin was incompletely effective against *Baylisascaris procyonis* and *C. procyonis* at a dose of 2,000 µg/kg body weight.

**Key words:** Ivermectin, nematodes, raccoons, *Procyon lotor*, internal parasites.

### INTRODUCTION

Internal parasites are common in free-ranging raccoons (*Procyon lotor*). *Baylisascaris procyonis*, *Capillaria procyonis*, *C. plica*, *C. putorii*, *Placoconus lotoris*, and *Physaloptera* sp. are among the many nematode species commonly reported in field surveys of raccoons.<sup>1,2,6,7,9,10</sup> *Baylisascaris procyonis*, the common large roundworm of raccoons, is of particular concern because of its potential for infection of and causing clinical disease in humans and domestic animals.<sup>4</sup> Raccoons infected with *B. procyonis* and maintained by private owners, in zoological parks, in research environs, or in wildlife rehabilitation centers pose a particular hazard because *B. procyonis* eggs may remain infectious for extended periods of time in the environment.<sup>3</sup> The effectiveness of anthelmintics in raccoons is important for both animal health and public health reasons. Ivermectin (Ivomec, Merck and Co., Rahway, New Jersey 07065, USA) has anthelmintic activity against a wide range

of parasites in a variety of species. No studies, however, have used ivermectin in raccoons. The purpose of this study was to evaluate the anthelmintic activity of ivermectin against several nematodes, including *B. procyonis*, in naturally infected raccoons.

### MATERIALS AND METHODS

**Experimental animals:** Thirteen raccoons from a commercial fur farm in central Iowa (USA) and 12 wild-caught raccoons (Boone County, Iowa, USA) were used in the experiment. Raccoons were housed individually in stainless steel cages in isolation facilities. Animals were maintained on dry dog food (Canine Maintenance Science Diet, Hills Pet Products, Topeka, Kansas 66601, USA) and given water ad libitum.

**Fecal analysis:** Fecal specimens were collected from each raccoon and examined for parasite eggs and larvae prior to treatment. For detection of parasite eggs, the modified Sheather's method<sup>8</sup> was used. Each fecal sample was mixed in a solution of concentrated sucrose, centrifuged, and examined microscopically. Fecal specimens were examined before treatment of raccoons with ivermectin and at least twice after treatment, starting on day 14. Fecal specimens were examined at weekly or biweekly intervals after some treatments. Evaluation of the efficacy of the various ivermectin dosage

---

From Biotechnology, Biologics, and Environmental Protection, Animal and Plant Health Inspection Service, U.S. Department of Agriculture, 223 South Walnut, Ames, Iowa 50010, USA (Hill); and the Departments of Veterinary Microbiology and Preventive Medicine (Hill, Zimmerman, Beran) and Veterinary Pathology (Greve), and the Veterinary Diagnostic Laboratory (Zimmerman), Iowa State University, Ames, Iowa 50011, USA.

**Table 1.** Number of raccoons positive before and negative after treatment with various i.m. dosages of ivermectin against nematodes.<sup>a</sup>

Ivermectin dosage ( $\mu\text{g}/\text{kg}$ body weight)	n	Nematodes											
		<i>Baylisascaris procyonis</i>		<i>Capillaria plica</i>		<i>C. procyonis</i>		<i>C. putorii</i>		<i>Physaloptera</i> sp.		<i>Placoconus lotoris</i>	
		Be-fore	After	Be-fore	After	Be-fore	After	Be-fore	After	Be-fore	After	Be-fore	After
Group 1	7												
200		1	1	6	5 <sup>b</sup>	6	1 <sup>c</sup>	5	5	6	6	4	4
400				3	2	6	1						
600				1	1	5	3						
Group 2	6												
800		1	1	1	1	5	1	2	2	3	3	3	3
Group 3	12												
2,000		10	9	4	4	8	5 <sup>c</sup>	4	4	1	1	3	3

<sup>a</sup> Fecal assay for nematode eggs was performed 14 days after treatment.

<sup>b</sup> Two animals negative on day 14 were positive on subsequent assay.

<sup>c</sup> One animal negative on day 14 was positive on subsequent assay.

regimens was based on clearance of eggs in fecal specimens collected on the 14th day after treatment.

**Treatment regimens:** Raccoons were divided into three treatment groups. Each group received different levels of ivermectin delivered i.m. Raccoons in group 1 ( $n = 7$ ) received three treatments at dosages of 200, 400, and 600  $\mu\text{g}/\text{kg}$  body weight. The interval between the first and second treatment was 44 days, and the interval between the second and third treatment was 28 days. Raccoons in group 2 ( $n = 6$ ) received 800  $\mu\text{g}/\text{kg}$  body weight, and animals in group 3 ( $n = 12$ ) received 2,000  $\mu\text{g}/\text{kg}$  body weight.

## RESULTS

Prior to treatment, eggs of several species of helminths were identified in fecal samples from the 25 raccoons: *B. procyonis* (from 12 animals), *C. plica* (11), *C. procyonis* (19), *C. putorii* (11), *Physaloptera* sp.(10), and *Placoconus lotoris* (10). Results of fecal examinations on the day of treatment and 14 days after treatment are presented in Table 1. Adverse reactions were not observed following administration of ivermectin in any raccoons at any of the treatment levels.

Ivermectin was effective at eliminating *C.*

*putorii*, *Physaloptera* sp., and *Placoconus lotoris* at all dosage levels, based on the absence of eggs in the feces. Ivermectin was ineffective against *C. plica* at 200 and 400  $\mu\text{g}/\text{kg}$  body weight, but was effective at doses  $\geq 600$   $\mu\text{g}/\text{kg}$  body weight. Ivermectin was ineffective against *C. procyonis* at doses of 200 and 400  $\mu\text{g}/\text{kg}$  body weight, and even at 2,000  $\mu\text{g}/\text{kg}$  body weight, the infection persisted in 50% of the raccoons. Ivermectin appeared to be effective against *B. procyonis* at the lower dosage levels, but even at the highest dosage level, eggs continued to be shed in the feces of one animal.

## DISCUSSION

The anthelmintic activity of ivermectin varied among the nematode species in these raccoons and included both parasite elimination and suppression of egg production as judged by fecal egg counts. Ivermectin was highly effective in clearing infections of *C. putorii*, *Physaloptera* sp., and *Placoconus lotoris*. Ivermectin was less effective against *B. procyonis*, *C. procyonis*, and *C. plica*.

Of the nematodes only partially affected by ivermectin, *B. procyonis* may be the most important because of public health implications. *Baylisascaris procyonis* eggs can re-

main infectious for years in the environment.<sup>3</sup> Like those of other ascarids, *B. procyonis* eggs in the environment are resistant to common disinfectants and may be best inactivated with flame.<sup>4,5</sup>

Although 92% of the raccoons in this study were cleared of *B. procyonis* infection, there were too few animals to make definitive conclusions regarding the effectiveness of ivermectin against this parasite. The continued shedding of *B. procyonis* eggs in one raccoon that received the highest dosage suggests that animals need to be monitored carefully posttreatment for *B. procyonis* infection, and measures to prevent human exposure must be maintained.

The resistance of *C. procyonis* to ivermectin appears to be high. At each dosage level, a decrease in the fecal burden was noted by day 14 after treatment, but in 40–100% of the animals per group, eggs continued to be shed after treatment. One animal was negative on days 14 and 20 post-treatment after receiving 200  $\mu\text{g}/\text{kg}$  body weight, but was shedding *C. procyonis* eggs on day 27. Another *C. procyonis*-infected animal was negative by fecal assay on day 14 and positive on day 18 after receiving 2,000  $\mu\text{g}/\text{kg}$  body weight. Three of five animals in group 1 were cleared of eggs at the 600  $\mu\text{g}/\text{kg}$  body weight level, whereas only one of five animals in group 2 receiving 800  $\mu\text{g}/\text{kg}$  body weight was cleared of the infection. Even at the 2,000  $\mu\text{g}/\text{kg}$  body weight dosage, only five of eight animals were cleared of *C. procyonis* eggs at day 14, and one of these animals was again positive by fecal assay on day 18. The results observed in group 1 suggested that the number of treatments at lower dosages was a factor in clearing *C. procyonis* infections. However, a similar effect was observed with a single treatment at a dosage of 2,000  $\mu\text{g}/\text{kg}$  body weight in group 3. The observed egg shedding pattern could have been due to incomplete elimination of adult parasites or suppression of egg production.

A similar pattern was observed in animals infected with *C. plica* at the 200  $\mu\text{g}/\text{kg}$

body weight dosage. Two raccoons that were negative by fecal assay on days 14 and 20 were again shedding eggs by day 41, indicating that only egg production may be suppressed at this dosage. Only at levels of  $\geq 600$   $\mu\text{g}/\text{kg}$  body weight was permanent elimination of *C. plica* egg shedding accomplished, suggesting that adult parasites had been eliminated.

Ivermectin can be used safely in raccoons. The ease of accurate dosage administration is a strong advantage of this drug. There were no apparent adverse reactions following i.m. administration, even at what may be considered very high dosages. Ivermectin was most effective against the largest number of nematode species at a dosage of 2,000  $\mu\text{g}/\text{kg}$  body weight; therefore, this dosage is recommended for treatment of raccoons. Because of the recommencement of egg shedding in a number of instances, fecal assays should be repeated at timely intervals. Ivermectin, particularly in rotation with other anthelmintics, should be useful in a parasite control program for raccoons.

#### LITERATURE CITED

1. Bafundo, K. W., W. E. Wilhelm, and M. L. Kennedy. 1980. Geographic variation in helminth parasites from the digestive tract of Tennessee raccoons, *Procyon lotor*. *J. Parasitol.* 66: 134–139.
2. Cole, R. A., and W. L. Shoop. 1987. Helminths of the raccoon (*Procyon lotor*) in western Kentucky. *J. Parasitol.* 73: 762–768.
3. Kazacos, K. R. 1986. Raccoon ascarids as a cause of larva migrans. *Parasitol. Today* 2: 253–255.
4. Kazacos, K. R., and W. M. Boyce. 1989. *Baylisascaris* larva migrans. *J. Am. Vet. Med. Assoc.* 195: 894–903.
5. Pegg, E. J. 1977. A new approach to the control of *Toxocara canis* and other parasitic ova on concrete-floored kennel runs. *Br. Vet. J.* 133: 427–431.
6. Robel, R. J., N. A. Barnes, and S. J. Upton. 1989. Gastrointestinal helminths and protozoa from two raccoon populations in Kansas. *J. Parasitol.* 75: 1000–1003.
7. Schaffer, G. D., W. R. Davidson, V. F. Nettles, and E. A. Roller. 1981. I. Helminth parasites of translocated raccoons (*Procyon lotor*) in the southeastern United States. *J. Wildl. Dis.* 17: 217–227.
8. Sloss, M. W., and R. L. Kemp. 1978. Veterinary

Clinical Parasitology, 5th ed. Iowa State Univ. Press, Ames, Iowa.

9. Smith, R. A., M. L. Kennedy, and W. E. Wilhelm. 1985. Helminth parasites of the raccoon (*Procyon lotor*) from Tennessee and Kentucky. *J. Parasitol.* 71: 599–603.

10. Snyder, D. E., and P. R. Fitzgerald. 1985. Helminth parasites from Illinois raccoons (*Procyon lotor*). *J. Parasitol.* 71: 274–278.

*Received for publication 20 May 1991.*

### **CALL FOR PAPERS FOR A SPECIAL ISSUE ON WILDLIFE MEDICINE**

The *Journal of Zoo and Wildlife Medicine* is planning a special March 1993 issue on wildlife medicine. Manuscripts on research findings or case reports for this issue should be related to the diseases, clinical medicine, surgery, toxicology and pharmacology, chemical restraint, anatomy, physiology, reproduction, nutrition, parasitology, etc., of free-living wild animals. Drs. David Jessup and James W. Carpenter will be coordinating this special issue. Manuscripts should be submitted by 15 July 1992 to Dr. James W. Carpenter, Editor, *Journal of Zoo and Wildlife Medicine*, Department of Clinical Sciences, College of Veterinary Medicine, Kansas State University, Manhattan, Kansas 66506, USA.