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The Use of Ivermectin in the Treatment and Prevention of Infection with *Parelaphostrongylus tenuis* (Dougherty) (Nematoda: Metastrongyloidea) in White-tailed Deer (*Odocoileus virginianus* Zimmermann)

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The availability of ivermectin, an avermectin with exceptional potency and spectrum of activity against many parasite nematodes and arthopods, has stimulated interest in its application in the treatment and prevention of parasitic problems common to free-ranging species of wildlife. Preliminary studies indicated that dosages of 0.2 and 0.4 mg/kg of ivermectin administered subcutaneously was effective in preventing infection of *Parelaphostrongylus tenuis*, the neurotropic parasite of white-tailed deer in eastern North America (Olsen, 1982, The efficacy of ivermectin (MK-933) for treatment and prevention of infection of *Parelaphostrongylus tenuis* (Metastrongyloidea) in cervids, M.S. Thesis, Oklahoma State University, Stillwater, Oklahoma, 23 pp.). Dosages of 0.2 and 0.4 mg/kg ivermectin given 24 hr after deer were exposed to infective larvae of *P. tenuis* prevented infection in both white-tailed deer and fallow deer (*Dama dama*). These dosages did not affect adult worms residing in the meninges of experimentally infected white-tailed deer.

The present study was designed to determine the effect of ivermectin (0.1 mg/kg subcutaneously in a propylene glycol/glycerol vehicle) on experimentally initiated infections with *P. tenuis* and to determine the effect of this dosage on eliminating adult worms and/or larvae in white-tailed deer with patent infections.

In the first study, four groups of white-tailed deer (two deer per group) were exposed to 75 larvae each and were either untreated or were treated with 0.1 mg/kg ivermectin at 1 ($n = 2$), 10 ($n = 2$), or 30 ($n = 2$) days after exposure. The fourth group served as untreated controls. Procedures for experimental exposure of deer have been described previously (Anderson, 1963, Can. J. Zool. 41: 775–792). Only deer treated at 1 day following exposure failed to develop patent infection as determined at necropsy 180 days after exposure. Apparently the larvae, which move to the spinal nerves by 6 days postexposure and reside in the white matter or the lateral horns of the gray matter of the lumbar region of the spinal cord by 10 days postexposure (Anderson, 1965, Pathol. Vet. 2: 360–379; Anderson and Strelive, 1967, Can. J. Zool. 45: 285–289), are not affected by ivermectin whereas those larvae still penetrating the abomasum are readily killed. These results may be due to the apparent inability of the ivermectins to cross the blood-brain barrier except at very high dosages.

In the second study, five deer were exposed to 75 larvae of *P. tenuis*. After patent infections were established, four deer were treated with 0.1 mg/kg ivermectin and one was left untreated as a control. Efficacy was established from the output of larvae in feces, sequential necropsies at 6 ($n = 1$), 12 ($n = 1$), and 35 ($n = 1$) days

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after treatment, histopathology (H&E stain) and adult worm recovery. The number of larvae per gram of feces was determined by placing 1 g of fresh feces in a Baermann funnel. The contents of the funnel were collected in water after 6 hr, allowed to settle, and were resuspended in 100 ml of water and a thoroughly mixed 10-ml aliquot was removed and placed in a gridded petri dish. An estimated total number of larvae per gram of feces (LPG) was calculated. Recovery of adult worms from the cranial dura mater was as described previously (Prestwood and Smith, 1969, J. Parasitol. 5: 720–725). Table 1 shows that the output of larvae in both treated and untreated deer varied greatly between observation periods. Variations in the untreated control ranged from 800 to 4,400 larvae per gram of feces. All treated deer that were not killed earlier had reductions in output of larvae that reached 0 LPG by 10 days after treatment. Larvae reappeared in the feces of all surviving deer by 28 days after treatment. Histologic examination of lung tissue from the treated deer killed 6 days after treatment revealed eggs and larvae in blood vessels with accompanying inflammatory changes. No eggs or larvae were observed in the tissues examined from the deer killed 12 days after treatment although evidence of previous capsule formation presumably associated with eggs or larvae was common. Few eggs and larvae were observed in the lungs of the deer killed 35 days after treatment. These findings, along with the observed reduction in larvae shed in the feces, indicated that ivermectin was effective against first-stage larvae in the lungs and perhaps on egg production and/or viability. This effect is similar to the effect of ivermectin on microfilariae of *Dirofilaria immitis* in dogs (Blair and Campbell, 1979, Am. J. Vet. Res. 40: 1031–1032). All deer examined at necropsy had live adult worms in the cranial dura mater ($\bar{x}$ = 6.2, SD = 2.6).

TABLE 1. Number of first stage larvae of *Parelaphostrongylus tenuis* per gram of feces recovered from experimentally infected white-tailed deer treated with 0.1 mg/kg ivermectin.

Days postinfection	Deer 1	Deer 2	Deer 3	Deer 4	Deer 5 (untreated)
2	1,000	8,000	1,200	2,000	3,200
0	1,200	800	1,200	1,200	800
2	1,200	7,600	400	800	4,000
4	6,000	11,200	2,000	1,200	3,600
6	10,800	1,200	0	0	800
8	10,800[a]	5,600	2,800	400	3,600
10		0	400	0	4,400
12		0[b]	400	0	4,400
14			0	0	2,000
21			400	0	2,000
28			400	400	4,400
35			400[c]	400	2,000

[a] Killed at 8 days posttreatment.
[b] Killed at 12 days posttreatment.
[c] Killed at 35 days posttreatment.

The results of this study indicated that at a dosage of 0.1 mg/kg, ivermectin does not have a practical application for the elimination or prevention of *P. tenuis* infections in white-tailed deer. Routine use of this product may, however, prove advantageous in temporarily reducing the number of larvae shed in the feces of infected deer, thus minimizing environmental contamination with first-stage larvae.

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