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Determination of the Efficacy of Pyrantel Pamoate at the Therapeutic Dose Rate Against the Tapeworm *Anoplocephala perfoliata* in Equids Using a Modification of the Critical Test Method

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ABSTRACT

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A total of 59 equids (54 horses and five Shetland ponies) were treated with pyrantel pamoate once, at the dose rate of ~6.6 mg base kg^{-1}, during the period November 1985–January 1988. The drug was administered as a paste formulation (51 equids) intraorally or as a suspension formulation by stomach tube (eight equids). The purpose of treatment was to evaluate the activity of pyrantel pamoate (at the therapeutic dose rate) for removal of the tapeworm, *Anoplocephala perfoliata*, by a modified (24-h) critical test. The presence or absence of tapeworms was not determined for the equids before treatment.

Twenty-three (39%) of the 59 treated equids were found to be infected with *A. perfoliata* (from one to 180 specimens per infected equid) at necropsy. Removals varied from 67 to 100% (average 88%) for the 18 infected equids treated with the paste formulation. For the five infected equids treated with the suspension, removals were 58–100% (average 75%). The combined average removal of *A. perfoliata* for both formulations was 87%. Two abnormal (triradiate) specimens of *A. perfoliata* were recovered; one from each of two different equids.

INTRODUCTION

Possible detrimental effects of the tapeworm, *Anoplocephala perfoliata*, in equids have recently been reviewed (Drudge and Lyons, 1986). No parasiticide is commercially labeled for the removal of tapeworms from equids in the U.S.A.

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Pyrantel pamoate, a product marketed as a nematocide in equids, has been shown to have some activity against *A. perfoliata* at the therapeutic dose rate of 6.6 mg base kg^{-1} (Lyons et al., 1974; Slocombe, 1979), but better activity at twice that rate (Slocombe, 1979; Lyons et al., 1986).

The purpose of the present tests was to obtain more data on the efficacy of pyrantel pamoate at the therapeutic dose rate against *A. perfoliata* in equids.

MATERIALS AND METHODS

For the tests, 59 cull equids (either donated or raised at the University of Kentucky research farm) were used during the period November 1985–January 1988. They included 39 Thoroughbreds (males = 14 yearlings and five others 2–10 years old; females = three yearlings and 15 others 7–30 years old; geldings = one 3-year-old and one 6-year-old), three Standardbreds (a weanling male, a yearling female and a 20-year-old gelding), 12 mixed-bred horses (males = four yearlings, one 2-year-old and one 13-year-old; females = two yearlings and four others 9–22 years old) and five Shetland ponies (males = three yearlings; females = one 8-year-old and one aged). Actual ages were available for 52 of the equids and, for the other seven, ages were estimated by dental characteristics.

Weights of the equids were obtained by girth tape measurement, visually, or by weighing on portable scales; most of the weights being determined by the former two methods.

Pyrantel pamoate paste (Strongid Paste, Pfizer, Terre Haute, IN) or suspension (Strongid Suspension, Pfizer, Terre Haute, IN) was administered once intraorally or by stomach tube, respectively, at the therapeutic dose rate of $\sim$6.6 mg base kg^{-1}. The paste formulation was given to 51 of the equids (32 Thoroughbreds, 12 mixed-bred horses, two Standardbreds and the five ponies) and the suspension to eight (seven Thoroughbreds and one Standardbred). The paste formulation was given to the larger equids ($\sim \geqslant$454 kg), directly from the commercial syringe after the appropriate dose was dialed. For the smaller equids ($\sim <$454 kg), the exact dose was measured into plastic syringes and administered. For the suspension, the appropriate volume was measured into a glass or plastic graduated cylinder and administered via stomach tube, followed by $\sim$300 ml water rinse.

The method of evaluating the activity of pyrantel pamoate against *A. perfoliata* was not the standard critical test (Moskey and Harwood, 1941), but a modified critical test (Lyons et al., 1986) which involved killing the equids at $\sim$24 h after treatment. Feces were not collected post-treatment for examination for *A. perfoliata*. The evaluation was determined by counting the total number of *A. perfoliata* specimens found at necropsy in the small and large intestine. Normally, *A. perfoliata* lives in the cecum, although it can be present occasionally in the small intestine and uncommonly in the ventral colon.

Therefore, tapeworm specimens found in the small intestine and cecum were considered as not removed and those recovered from the ventral colon, dorsal colon, small colon and rectum were considered removed by the drug. For eight infected equids, the mucosa of the ileal–cecal area was examined at necropsy under a 3× magnifying glass and under a 30× dissecting microscope for residual scolices that may have remained after possible separation from the rest of the tapeworm by the effect of treatment. Examination of the equids' feces for tapeworm proglottids or eggs was not carried out either before or after treatment.

The equids were also examined at necropsy for ascarids (*Parascaris equorum*), which were identified and counted.

Statistical analysis was carried out using standard deviations (Snedecor and Cochran, 1980).

Methods for the examination of equids at necropsy for tapeworms and ascarids were the same as used previously (Lyons et al., 1986).

RESULTS AND DISCUSSION

For the 59 equids treated with pyrantel pamoate at the therapeutic dose rate, 23 (39%) harbored *A. perfoliata* at necropsy. Data on the infected horses are presented in Table 1.

The removal of *A. perfoliata* varied in the paste-treated equids from 67 to 100% (average 88%) and in the suspension-treated equids from 58 to 100%

TABLE 1

Data for *A. perfoliata* recovered from 23 equids treated with pyrantel pamoate paste (intraorally) or suspension (via stomach tube) at 6.6 mg base kg^{-1}

No. of equids	Range (mean)				Clearance	
	No. of specimens			Percent removal	100%	⩾90%
	Remaining[1]	Removed[2]	Total			
Paste formulation						
18	0-33	1-164	1-180	67-100	8	12[3]
	(4.8)	(34.4)	(39.2)	(88)	-	-
Suspension formulation						
5	0-11	1-18	1-26	58-100	2	3[4]
	(3.0)	(8.8)	(11.8)	(75)	-	-

[1]In cecum.
[2]In large and small colon and rectum.
[3]67%.
[4]60%.

(average 75%). For each infected animal, the total number of *A. perfoliata* present was from 1 to 180 specimens. The highest number of specimens (33) remaining in the cecum was in a paste-treated equid with a removal of 78%. Specimens of *A. perfoliata* were not found in the small intestine of any equid at necropsy.

Whether the somewhat lower average (%) removal of *A. perfoliata* in the suspension-treated equids vs. the paste-treated equids represents actual less effective activity for the former formulation is unknown. Possibly, the number ($n=5$) of equids treated with the suspension formulation was too low for a true indication of activity. No remaining scolices were found by the magnification methods of examination of the ileal–cecal area of the eight infected equids examined.

The overall good removal activity of the therapeutic dose rate of pyrantel pamoate against *A. perfoliata* (87%) in the present tests was similar to that (93%) shown recently for the 2× (13.2 mg base kg^{-1}) dose rate of the paste formulation (Lyons et al., 1986). Clearance of *A. perfoliata* was $\geqslant 90\%$ for 67 and 83% of equids treated with pyrantel pamoate paste at the therapeutic and 2× dose rates, respectively. However, there was no statistically significant difference between paste-treated equids at these two dose rates relative to percent removal or to clearance ($\geqslant 90\%$). Inconsistent removal was evident for the therapeutic dose rate, as found previously for the 2× dose rate (Lyons et al., 1986). In previous standard critical tests, removal of *A. perfoliata* by pyrantel pamoate suspension at the therapeutic dose rate of 6.6 mg base kg^{-1} (Lyons et al., 1974) was 0, 0, 67, 100 and 100% for five horses. Administration was by stomach tube for four horses and by feed for one horse. Also, in another locality (Slocombe, 1979), removal for one horse was 15% following administration by stomach tube. Although there is somewhat inconsistent removal of *A. perfoliata* by pyrantel pamoate, this compound, at the therapeutic dose rate, has an advantage in a worming program of providing cestocidal activity in addition to nematocidal activity.

The overall prevalence (39%) of *A. perfoliata* was lower than that (54, 53 and 60%) found for 945 dead Thoroughbreds in Kentucky recently (Lyons et al., 1983, 1984, 1987). However, in the present study, 50% of the Thoroughbreds were infected with *A. perfoliata*.

Two triradiate specimens of *A. perfoliata* were found; one specimen in each of two equids. These were the only two such types of *A. perfoliata* found among several thousands of specimens examined here during the last few years. However, one triradiate *A. perfoliata* was found here in an equid in the early 1950s (Drudge and Leland, 1954).

Nine equids were infected with 1–122 (0–7 immature specimens and 0–122 mature specimens) of *P. equorum*. Removal of ascarids for paste-treated equids (seven animals) was 88% (one animal) and 100% (six animals) and for suspension-treated equids (two animals) was 100%. These findings verified the

excellent removal of *P. equorum* by pyrantel pamoate at the therapeutic dose rate (Lyons et al., 1974).

The usefulness of the quick (24-h) or modified critical test method for evaluation of the activity of pyrantel pamoate and possibly other parasiticides, against *A. perfoliata* and *P. equorum* was demonstrated again in the present tests and lends support for data published previously (Lyons et al., 1986). Various aspects of the modified critical test for evaluation of the activity of pyrantel pamoate against *A. perfoliata* were discussed extensively earlier (Lyons et al., 1986). Briefly, this test is advantageous in that it probably allows recovery of more intact tapeworms, removed by the drug, than if a standard critical test (where feces is collected usually for several days after treatment) was used. Use of the latter test involves waiting until specimens are passed in the feces of a treated horse and the chances of fragmentation or deterioration of the tapeworms is greater. This may explain the overall lower activity found previously (Lyons et al., 1974) at the therapeutic dose rate for pyrantel pamoate, i.e., some specimens may not have been found in feces during 5–7 days post-treatment collection, which would be interpreted as a lower than actual percent removal. One aspect of the modified critical test may seem questionable regarding validity because specimens of *A. perfoliata* found at necropsy in the ventral colon are considered removed by the drug. However, most specimens recovered from this organ were off color or brownish, as shown previously in colored photographs (Lyons et al., 1986). The 24-h critical test method has been used previously by researchers in evaluating the activity of toluene against ascarids and bots (Todd and Brown, 1952).

Toxicosis was not evident in any treated equid.

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