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Observations in Horses on the Effects of Ivermectin Treatment on Strongyle Egg Production and Larval Development

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ABSTRACT: Two field tests were completed on naturally infected horses ($N = 8$ treated and 2 nontreated) using a single dose of ivermectin liquid or paste formulation at the therapeutic dose rate (200 μg/kg body weight) per os to evaluate the effect of treatment on counts of strongyle eggs and larvae per gram of feces. Drug activity for each test was monitored by egg and larval counts at posttreatment intervals of 4 hr for 36 or 60 hr and thereafter at longer intervals. Fecal cultures indicated that only small strongyle larvae were present. Horses ($N = 4$), treated with the ivermectin liquid, had negative egg counts at 50 or 60 hr in the 2 tests. Larval counts were negative by 28 or 56 hr. Paste-treated horses ($N = 4$) had egg count values of 10 at 50 hr in 1 test and 0 at 72 hr in the other test. Larval counts were 0 at 32 and 48 hr in the 2 tests. Effect of ivermectin on larval development was also evidenced by presence of second-stage larvae and sluggish third-stage larvae during the posttreatment period. The egg count observations indicate that horses should be isolated for at least 3 days after treatment with ivermectin to minimize chances of contamination of pasture with small strongyle eggs. However, the isolation or quarantine period may be even shorter because development of infective larvae ceased during the 24–48-hr posttreatment interval.

KEY WORDS: ivermectin, horses, small strongyle, egg, larvae, counts.

Owners and operators of horse farms with good parasite control programs are particularly concerned about worm infections in transient horses because of potential pollution of pastures with feces containing eggs of internal parasites. Therefore, these horses are routinely isolated and treated with antiparasitic compounds upon arrival at the farm. The question arises as to how soon after treatment with ivermectin can transient horses be commingled with other animals on a good parasite control program so there is minimal chance of contamination of pastures with strongyle eggs. One study indicated that passage of strongyle eggs in feces of ponies is nil 4 days after treatment with ivermectin (DiPietro et al., 1990).

The current research was done with ivermectin to determine the earliest time interval after treatment that minimal strongyle contamination of pasture may occur and whether the liquid or paste formulation produces this effect quicker.

Materials and Methods

Test horses and time of tests

Two field tests (A and B) were completed in 10 horses ($N = 5$/test). Most of the horses had been on the farm for several years and were on the same parasite control program of almost exclusive use of ivermectin at approximately 8-wk intervals during recent years. Parasite infections were naturally acquired. Adult female mixed grade or Thoroughbred horses were used.

The horses were kept in individual box stalls during the tests and were fed mixed timothy hay ad libitum. An exception was that predominantly red clover was fed the first 12 hr in Test B. It was replaced with timothy because it apparently caused some diarrhea, particularly in the nontreated control horse. Test A was completed 18–20 January 1991 and Test B between 26 August and 18 November 1991.

Drug formulation and administration

For each of the 2 tests, 4 horses were treated once with ivermectin (2 with the liquid formulation and 2 with the paste formulation) and 1 horse was nontreated. Commercial preparations of ivermectin (Eqvalan; Merck, Rahway, New Jersey) liquid (1.0%) and paste (1.8%) were administered per os into the back of the mouth, at the therapeutic dose rate of 200 μg/kg of body weight. Individual dose rates were calculated and the drug was measured into small (6 or 12 cc) plastic syringes for administration. Before treatment, the mouth of each horse was examined to ensure no cuds of feed were present. After each treatment, the horses were observed for approximately 3 or 4 min to verify dose retention.

Parasitologic procedures

Rectal fecal samples for determinations of egg and larval counts were collected at the time of treatment. Also, they were taken every 4 hr posttreatment for 36 hr, with an additional collection at 50 hr in Test A and every 4 hr posttreatment until 60 hr, with single collections at 72 and 104 hr, and at 1, 2, 4, 6, 8, 10, and 12 wk in Test B.

The fecal samples were processed for worm egg and larval counts within approximately 1 hr of collection. A modified Stoll method was used to determine egg

Table 1. Data (means) on strongyle eggs per gram of feces in horses in 2 tests (A and B) of activity of ivermectin (200 μg/kg) liquid or paste formulations administered per os.

Time post-treatment	Strongyle eggs per gram of feces					
	Test A			Test B		
	Ivermectin			Ivermectin		
	Liquid ($N = 2$)	Paste ($N = 2$)	Nontreated ($N = 1$)	Liquid ($N = 2$)	Paste ($N = 2$)	Nontreated ($N = 1$)
Hours						
0	425	230	230	2,555	2,290	2,180
4	275	255	250	4,350	2,165	3,080
8	235	240	410	4,665	3,875	1,500
12	300	295	350	3,475	800	2,080
16	340	310	270	4,285	1,900	1,350
20	220	310	740	2,100	870	1,230
24	145	335	610	1,690	1,420	1,070
28	60	185	200	1,180	210	470
32	30	55	320	1,180	210	760
36	5	45	290	ND	185	220
40	ND	ND	ND	735	85	170
44	ND	ND	ND	430	40	220
48	ND	ND	ND	55	40	220
50/52	0	10	260	35	10	140
56	ND	ND	ND	25	0	180
60	ND	ND	ND	0	10	20
72	ND	ND	ND	0	0	70
104	ND	ND	ND	0	0	20
Weeks						
1	ND	ND	ND	0	0	230
2	ND	ND	ND	0	0	750
4	ND	ND	ND	0	0	380
6	ND	ND	ND	0	0	350
8	ND	ND	ND	5	5	560
10	ND	ND	ND	35	20	510
12	ND	ND	ND	280	35	610

ND = not determined.

counts expressed as eggs per gram of feces (epg) (Lyons et al., 1976). The larval counts, expressed as larvae per gram of feces, were derived from individual 50 g fecal cultures by a previously described method (Drudge et al., 1979).

Results

Observations on strongyle egg (Table 1) and larval (Table 2) counts (means), before and after treatment with ivermectin, are summarized for the tests. Only small strongyle larvae were found in larval counts. Small strongyle egg and larval values were relatively equal for the animals at the beginning of each test.

Liquid formulation

Strongyle egg counts (means) rapidly declined in treated horses about 24 hr after treatment. Negative counts were found at 50 hr in Test A and at 60 hr in Test B. Reappearance of positive egg counts occurred at 8 wk after treatment in Test B.

Third-stage larvae (L_3) were sluggish from 16 through 24 hr and absent by 28 hr in Test A. Second-stage larvae (L_2) were found at 4 hr and 16 through 32 hr. For Test B, negative larval (L_3) counts were found at 48 hr through 6 wk, with the exception of 52 hr. Sluggish L_3 were observed at 16–52 hr, except at 48 hr. First appearance of L_2 was at 12 hr and, except at 52 hr, were found through 56 hr. At 8 wk, larval (L_3) counts were again positive.

Paste formulation

The egg counts (means) were quickly reduced after about 24 hr, but a mean epg of 10 was recorded at 50 hr in Test A. In Test B, zero counts

Table 2. Data (means) on small strongyle larvae per gram of feces in horses in 2 tests (A and B) of activity of ivermectin (200 μg/kg) liquid or paste formulations administered per os.

	Small strongyle larvae per gram of feces*					
	Test A			Test B		
	Ivermectin			Ivermectin		
Time post-treatment	Liquid (N = 2)	Paste (N = 2)	Nontreated (N = 1)	Liquid (N = 2)	Paste (N = 2)	Nontreated (N = 1)
Hours						
0	168	142 (1)	210 (10)	920	1,590	1,060
4	283 (5)	133†	80	3,920	950	1,020
8	215	497 (1)	210	750	1,150	640
12	397	135	160 (10)	268 (46)	81† (15)	550
16	14† (15)	280	25	17† (33)	50† (5)	135
20	16† (7)	36† (2)	240	15† (11)	34† (14)	290 (25)
24	2† (2)	0 (15)	220	2† (102)	27† (33)	50 (5)
28	0 (3)	2† (1)	35	8† (10)	28† (8)	180
32	0 (1)	0 (9)	370 (10)	2† (16)	6† (4)	ND
36	0	0 (1)	240	4† (12)	18† (5)	215
40	ND	ND	ND	2† (11)	3 (5)	105
44	ND	ND	ND	1† (2)	3†	125
48	ND	ND	ND	0 (2)	0	165
50/52	0	0 (1)	240	2†	0	80
56	ND	ND	ND	0 (1)	0	70
60	ND	ND	ND	0	0	30
72	ND	ND	ND	0	0	40
104	ND	ND	ND	0	0	15
Weeks						
1	ND	ND	ND	0	0	160 (10)
2	ND	ND	ND	0	0	535
4	ND	ND	ND	0	0	370
6	ND	ND	ND	0	1	425
8	ND	ND	ND	3	4	565
10	ND	ND	ND	26	39	405
12	ND	ND	ND	203	23	560

* Values in parentheses are for second-stage larvae.
† Most were sluggish.
ND = not determined.

were observed at 56 hr and thereafter, except at 60 hr, through 6 wk. Positive egg counts returned at 8 wk.

Larval (L_3) counts (means) were negative after 28 hr in Test A. Sluggish L_3 in Test A were seen at 4, 20, and 28 hr. L_2 were found at 0, 8, 20–36, and 50 hr. In Test B, zero counts were first observed at 48 hr. L_3 were sluggish at 12 through 44 hr, except at 40 hr. L_2 were observed at 12–40 hr. Reappearance of positive larval counts was at 6 wk.

Both formulations

Egg and larval counts after treatment for the treated paired horses were similar in Test A. For Test B, 1 liquid-treated and 1 paste-treated horse had negative counts much sooner (32 and 24 hr, respectively) than the other pair (60 and 72 hr, respectively).

Nontreated control horses

The egg and larval counts were essentially uniform throughout Test A. These values in Test B began a dramatic decline by 8 hr but began rebounding by 1 wk.

Discussion

The strongyle egg and larval data indicate a general similarity in the activities of the 2 formulations, even though it had been reported (Asquith et al., 1987) that the liquid formulation of ivermectin reaches peak blood plasma concen-

trations 9–10 hr faster than the paste formulation in horses.

There was a similar pattern for the posttreatment decreases in the egg and larval counts in the present tests. Larval counts declined more rapidly than the egg counts. Also, a prominent characteristic of larval counts was the appearance of L_2 and sluggishly moving L_3 within a few hours after treatment, with a shift to a predominance of L_2. The reduced mobility of the larvae (L_3) and the increase in numbers of L_2 are attributed to the effect of ivermectin. Even though eggs and larvae persisted for several hours after treatment, infectivity of larvae soon after treatment was not ascertained and may be questionable.

In Test B, the diet of clover during the first 12 hr may have caused diarrhea, particularly in the nontreated control horse. This probably caused a dramatic decrease in egg and larval counts in this horse. A subsequent increase in these counts occurred after replacing clover with timothy hay.

It is apparent that, based on egg count data only, a 3-day isolation period of transient horses after ivermectin treatment should minimize strongyle transmission. However, larval count data indicate detrimental effect on larvae a few hours after treatment and, except for 1 of 8 horses, complete development of L_3 ceased before 48 hr posttreatment. The exceptional horse had a low larval count at 52 hr.

Until more research is completed, it would seem prudent to isolate transient horses 2–3 days after ivermectin treatment before turning them out to pasture. As previously mentioned, another study on posttreatment strongyle egg production suggested a 4-day isolation period after treatment with a paste formulation of ivermectin (DiPietro et al., 1990, and pers. comm., 1991).

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