ARTICLES

Comparison of ivermectin, oxibendazole and pyrantel pamoate in suppressing fecal egg output in horses

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Abstract

Thirty resident horses at a boarding stable in Alberta were used to evaluate the relative efficacies of ivermectin, oxibendazole, and pyrantel pamoate in reducing fecal egg output in adult horses under routine management conditions during spring and early summer, and to more clearly define the duration of suppression of fecal egg production following anthelmintic treatment. Horses were blocked according to pretreatment egg counts and randomly assigned to one of three treatments: pyrantel pamoate at 6.6 mg/kg body weight; oxibendazole at 10 mg/kg body weight; or ivermectin at 200 μg/kg body weight. All treatments were administered orally as a paste on day 0. Fecal samples were collected for examination by the modified Wisconsin procedure before treatment, and then at 4–11 day intervals up to day 72.

Very few if any strongyle eggs were found in the feces of any horses up to day 35. On days 42, 50 and 57, the geometric mean egg count for the ivermectin group was significantly ($p < 0.05$) lower than that for the oxibendazole or pyrantel pamoate groups. Based on a survival curve analysis of the data, the mean number of days for recurrence of eggs in the feces was significantly longer for the ivermectin group than for the oxibendazole and pyrantel pamoate groups.

Under conditions encountered in this study, the posttreatment interval to resumption of fecal egg output in horses treated with ivermectin was eight to nine weeks, compared with five to six weeks for horses treated with oxibendazole or pyrantel pamoate.

Résumé

Comparaison de l'efficacité de l'ivermectin, de l'oxibendazole et du pamoate de pyrantel pour éliminer les oeufs dans les matières fécales chez les équins

Trente chevaux, en pension dans une écurie en Alberta, ont été évalués pour déterminer l'efficacité relative de l'ivermectin, de l'oxibendazole et du pamoate de pyrantel quant à la diminution du nombre d'oeufs éliminés dans les matières fécales chez les sujets adultes gardés dans des conditions normales de régie, au printemps et au début de l'été. Les auteurs voulaient, par cette étude, préciser plus clairement la durée de la suppression de la production d'oeufs dans les matières fécales suite au traitement anthelmintique. Les chevaux ont été assignés au hasard à l'un des trois traitements : pamoate de pyrantel 6,6 mg/kg; oxibendazole 10 mg/kg ou ivermectin 200 μg/kg. Tous les traitements ont été administrés *per os* sous forme de pâte au jour 0. Des échantillons de matières fécales ont été récoltés pour examen par la méthode Wisconsin modifiée avant traitement, puis à des intervalles de 4 et 11 jours, jusqu'au 72ième jour.

En règle générale, aucun oeuf de strongles n'était présent dans les matières fécales des chevaux jusqu'au 35ième jour. Aux jours 42, 50 et 57, la moyenne géométrique du nombre d'oeufs pour le groupe traité à l'ivermectin était plus basse de façon significative ($p < 0,05$) comparativement aux groupes traités à l'oxibendazole ou au pamoate de pyrantel. Basée sur une courbe d'analyse à partir du suivi, la moyenne du nombre de jours pour la réapparition d'oeufs dans les matières fécales était plus longue de façon significative pour le groupe traité à l'ivermectin comparativement aux groupes traités à l'oxibendazole ou au pamoate de pyrantel.

Dans les conditions rencontrées dans cette étude, l'intervalle de temps posttraitement, pour la réapparition d'élimination d'oeufs dans les matières fécales chez les chevaux traités à l'ivermectin était de 8 à 9 semaines comparativement à 5 à 6 semaines pour les chevaux traités à l'oxibendezole ou au pamoate de pyrantel.

(Traduit par Dr Thérèse Lanthier)

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Introduction

Parasite control is an important aspect of equine health management which has relied primarily on the use of anthelmintics and, to a lesser extent, pasture hygiene (1-3). Many drugs are available for control of parasites; the activity of these drugs has been reported (4). Unfortunately, little research has been conducted which directly compares the posttreatment duration of suppression of fecal egg output after treatment with various anthelmintics. This information is essential for determining appropriate intervals between treatments. The purpose of this study was to evaluate the level and duration of suppression of fecal egg output by ivermectin, oxibendazole, and pyrantel pamoate in mature horses on pasture in western Canada.

Materials and methods

The study was conducted at a boarding stable during the spring and early summer months, using thirty horses ranging in age from four to 15 years. Prior to the initiation of the study, most of the horses in the stable had been treated with ivermectin or pyrantel pamoate at twelve week intervals. Horses were housed individually in box stalls during the evening and were turned out to a common permanent pasture of approximately 10 acres during the day. On day -7, a fecal sample was obtained from each horse in the study and the number of strongyle-type (strongyle) eggs per 5 g of feces was determined by the modified Wisconsin method (5). Egg counts were expressed as the number of eggs per gram (epg). Eggs of other equine parasites (e.g. *Parascaris equorum*) were not observed in samples from horses included in the trial, and fecal larval cultures were not performed to differentiate eggs of small strongyles from those of large strongyles. The horses were ranked in descending order on the basis of strongyle egg count, and sequentially stratified into 10 groups of three. Three treatments were randomly allocated to the horses in each group. Group 1 contained 10 horses and each horse was given pyrantel pamoate (Strongid P, rogar/STB, London, Ontario) orally as a paste at 6.6 mg of pyrantel base per kg of body weight. Group 2 contained 10 horses and each horse was given oxibendazole (Anthelcide Eq, Norden Laboratories, Mississauga, Ontario) orally as a paste at 10 mg of oxibendazole per kg of body weight. Group 3 contained 10 horses and each horse was given ivermectin (Eqvalan Paste, MSD Agvet, Kirkland, Quebec) orally as a paste at 200 μg of ivermectin per kg of body weight. All treatments were administered on day 0. A girth tape, calibrated to correlate girth circumference to weight, was used to estimate the body weight for each horse prior to treatment. A fecal sample was obtained from each horse before treatment on day 0, and every 4-11 days thereafter until day 72 for fecal egg counting, according to the procedures established on day -7.

Individual egg counts within treatments were highly variable; therefore, data were transformed to the $\log_e (x + 1)$, and the geometric mean strongyle egg count was computed for each sampling time. Examination of the residuals indicated the distribution of the transformed data was nonnormal, and Friedman's nonparametric test for a randomized complete-block design was used to detect differences among the treatment groups (6). Differences were declared significant when $p < 0.05$.

An analysis was conducted to estimate the time from treatment to the first appearance of strongyle eggs in the feces. Survival curves were estimated using the product limit method and were compared using the log rank test and by the Wilcoxin rank test (6). Statistical significance was declared when $p < 0.05$.

Four horses were permanently removed from the stable at some point during the study and were unavailable for sampling after that time. One horse from group 1 was removed from the stable after day 50. One horse from group 2 was removed after day 22 and another after day 28. One horse from group 3 was removed after day 50. Data for these horses are included in all calculations and analyses for as long as the horses were present for sampling. Occasional samples were not available for testing during the trial.

Results

Geometric mean strongyle egg counts, ranges of actual values, and the proportion of samples from each treatment group found to contain strongyle eggs at each sampling time are presented in Table 1. With the exception of three horses in group 2, and two horses in group 3, the same horses were positive for nematode eggs in their feces on samplings taken on days -7 and 0.

All horses treated with pyrantel pamoate (group 1) had reduced strongyle egg counts (< 1 epg) from day 7 through day 35. For the majority of the group, egg counts began to increase slightly between day 35 and day 42. The geometric mean egg count approached or exceeded the pretreatment value at all sampling after day 42. Feces of all horses treated with pyrantel pamoate were negative for strongyle eggs on one sampling date (day 22).

Findings for horses treated with oxibendazole (group 2) were similar to those treated with pyrantel pamoate. From day 7 to day 35, individual egg counts in this group of horses were < 1 epg, and a moderate increase was noted from day 42 to day 72. Feces of horses treated with oxibendazole were negative for strongyle eggs on days 18 and 22.

Treatment of horses with ivermectin (group 3) reduced individual strongyle egg counts of 0 or < 1 epg from day 7 through day 50. The geometric mean count reached the pretreatment level by day 72. Feces of all horses treated with ivermectin were negative for strongyle eggs on days 7, 18, 22, 28 and 42.

Comparisons of the geometric mean egg count revealed significant ($p < 0.05$) differences among treatments on days 42, 50 and 57. At each of these sampling times, the geometric mean fecal egg count for the ivermectin group was significantly lower than for the pyrantel pamoate or oxibendazole groups.

Survival curve analysis indicated treatment differences for the number of days until recurrence of eggs in the feces. The mean interval was calculated to be 35.5 days for the pyrantel pamoate group, 33.3 days for the oxibendazole group, and 52.5 days for the ivermectin group. Results of the log rank and

Table 1. Geometric mean strongyle-type egg counts, range of actual values, and proportion of horses shedding eggs in the feces before and after treatment

Sampling day	Pyrantel pamoate		Oxibendazole		Ivermectin	
	Geometric mean epg	#pos #sampled	Geometric mean epg	#pos #sampled	Geometric mean epg	#pos #sampled
−7	6.04[a] (0–900)*	6/10	6.38[a] (0–260)	6/10	7.25[a] (0–259)	6/10
0	9.08[a] (0–271)	6/10	16.80[a] (0–296)	9/10	6.33[a] (0–1066)	6/10
7	0.03[a] (0–0.4)	1/10	0.08[a] (0–1)	1/9	0.00[a] (0)	0/10
18	0.02[a] (0–0.2)	1/10	0.00[a] (0)	0/10	0.00[a] (0)	0/10
22	0.00[a] (0)	0/10	0.00[a] (0)	0/10	0.00[a] (0)	0/10
28	0.07[a] (0–0.4)	2/10	0.02[a] (0–0.2)	1/9	0.00[a] (0)	0/10
35	0.18[a] (0–2)	2/10	0.35[a] (0–0.6)	5/8	0.09[a] (0–0.6)	3/10
42	1.90[a] (0–41)	9/10	1.97[a] (0.2–44)	8/8	0.00[b] (0)	0/10
50	4.77[a] (0–178)	9/10	3.04[a] (0–85)	6/8	0.06[b] (0–0.2)	3/10
57	5.63[a] (0–206)	8/9	5.86[a] (0–134)	6/7	0.54[b] (0–7)	2/8
64	6.95[a] (0–187)	8/9	6.50[a] (0.2–70)	7/7	3.56[a] (0–589)	5/9
72	6.29[a] (0–156)	8/9	4.20[a] (0–76)	6/8	7.22[a] (0–750)	6/9

[a,b]Means in same row with different superscripts are significantly different ($p<0.05$)
*Values in parentheses are the ranges of actual egg counts

Wilcoxin rank tests were in agreement in that the mean number of days to recurrence of eggs in the feces was found to be significantly ($p<0.05$) greater for the ivermectin group than for the oxibendazole or pyrantel pamoate groups.

Discussion

In this study, ivermectin was found to be more effective than oxibendazole or pyrantel pamoate in suppressing strongylid fecal egg output in mature horses on pasture. From day 42 to day 57 after treatment, the mean number of eggs in feces of horses treated with pyrantel pamoate or oxibendazole was significantly greater than the mean for horses treated with ivermectin.

It is recognized that the majority of strongylid eggs passed in the feces of horses are those of small strongyles and that the prepatent period of small strongyles is six to eight weeks or longer (7–9). Few, if any, nematode ova were detected for at least eight weeks in fecal samples from horses treated with ivermectin. In contrast, nematode ova were detected in feces of the majority of horses by the sixth week after treatment with oxibendazole or pyrantel pamoate. This finding indicates that ivermectin provided better control of small strongyle larvae than did oxibendazole or pyrantel pamoate. These results are consistent with those of previously published studies in which the posttreatment fecal egg counts in ivermectin-treated horses remained negative or very low for at least eight weeks and where counts increased by six weeks posttreatment in pyrantel or benzimidazole-treated horses (9–11). The treatment differences in mean number of days until recurrence of eggs in the feces are similar to those reported in a U.K. study where the posttreatment interval was significantly longer for ivermectin than for pyrantel or fenbendazole (12).

Although evaluation of, or recommendations for, pasture and stable management practices is beyond the scope of this trial, it has been proposed that levels of parasitism may be substantially reduced in grazing horses by integration of good pasture management, good sanitation practices, and correct use of effective anthelmintic therapy to control shedding of eggs (2,3,9). Recently conducted studies have demonstrated that the strategic use of anthelmintics, early in the grazing season, can eliminate the spring-summer rise in fecal egg counts (13,14). This can reduce the seasonal rise in pasture infectivity later in the grazing season. It is important, however, that attention be paid in the choice of the anthelmintic. Factors such as the spectrum of activity and the posttreatment interval to resumption of fecal egg output must be considered to ensure adequate parasite control.

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Abstract

Prediction of the halothane (Hal) genotypes by means of linked marker loci (Phi, Po2, Pgd) in Quebec Landrace pigs

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Flow cytometry was investigated for detection of bovine viral diarrhea virus (BVDV) in peripheral blood mononuclear leukocytes of persistently infected cattle. The mononuclear leukocytes were purified by sedimentation in a gradient of Ficoll-Paque, fixed, permeabilized, and then labelled by indirect immunofluorescence using biotinylated immunoglobulins from a porcine antiserum to BVDV. Flow cytometric analysis of blood samples obtained from persistently infected cattle revealed virus in 3.0–21.0% (mean ± SD, 11.2% ± 6.4%) of the mononuclear leukocytes. Fluorescent cells were not observed in controls. Flow cytometric detection of BVDV in blood cells of persistently infected bovines is a rapid and objective technique which does not require cell culture facilities.

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Abstract

Flow cytometric detection of bovine viral diarrhea virus in peripheral blood leukocytes of persistently infected cattle

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Quebec Landrace pigs (n = 896) were halothane tested and blood samples were taken for the determination of Phi, Po2 and Pgd phenotypes. The prevalence of the halothane positive pigs was 5.3%. The frequencies of the favorable alleles Phi^A, $Po2^S$ and Pdg^A were respectively 29,2%, 39.6% and 64.4%. The highest linkage disequilibrium was found between Hal-Phi (0.0606) followed by Hal-Pgd (0.0428) and Hal-Po2 (−0.0308). Alleles Phi^B, Pgd^B and $Po2^F$ were associated respectively with 97%, 81% and 74% of Hal^n haplotypes. It was concluded that selection to increase the favorable marker loci Phi^A and Pgd^A would reduce the Hal^n frequency in Quebec Landrace pigs.

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