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Research Article

The Prevalence of Strongyle Infections and Persistent Efficacy of Pyrantel Embonate, Ivermectin and Moxidectin in Turkish Horses

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Abstract: Strongyle infection was detected in 68% of 320 horses from 9 farms in western Turkey. Egg counts per gram of faeces (EPG) were more than 950 in half of the animals. The persistent efficacy of 3 different anthelmintics to suppress cyathostome EPG was compared on a horse farm. One group of horses was treated with moxidectin on day 0, and the 2 other groups received pyrantel embonate or ivermectin on days 0 and 70. Pyrantel embonate reduced the EPG by >90% for 2 weeks; thereafter egg counts steadily increased. Ivermectin reduced the EPG by >98% for up to 6 weeks. In contrast, one treatment with moxidectin resulted in a persistent efficacy of >98% for at least 16 weeks.

Key Words: Strongyles, horse, ivermectin, moxidectin, pyrantel embonate

Türkiye Atlarında Strongylidae Enfeksiyonlarının Yayılışı ve Pyrantel Embonate, İvermectin ve Moxidectinin Etki Süreleri

Özet: Türkiye'nin batısında yer alan dokuz at çiftliğindeki 320 atın % 68'inde Strongylidae enfeksiyonu saptanmıştır. Atların yarısında, gram dışkıdaki yumurta sayısının (EPG) 950'den yüksek olduğu belirlenmiştir. Çiftliklerden birinde üç farklı antelmentiğin Cyathostominae EPG'lerine etki süreleri karşılaştırılmıştır. Bir grup at 0. gün moxidectin ile, diğer iki grupta bulunan atlar ise 0. ve 70. günlerde pyrantel embonate ve ivermectin ile tedavi edilmişlerdir. Pyrantel embonate 2 hafta boyunca EPG değerini >% 90 oranında azaltmış, yumurta sayıları daha sonra artmaya başlamıştır. İvermectin ise EPG miktarını 6 hafta süresince >% 98 oranında azaltmıştır. Buna karşılık moxidectin ile yapılan tek tedavinin etki süresi en az 16 hafta boyunca >% 98 olmuştur.

Anahtar Sözcükler: Strongylidae, at, ivermectin, moxidectin, pyrantel embonate

Introduction

One of the important parasitic diseases of horses is strongylosis, caused by strongyle nematodes. Overall, the prevalence of strongyles is generally high worldwide (1-3). The prevention of strongylosis relies mainly on suppressive anthelmintic treatments during the grazing season. There have been numerous comparisons of the suppression of faecal egg output with different anthelmintics like pyrantel, ivermectin and moxidectin (4-8).

In Turkey 271,000 horses are kept according to the official veterinary census (9), and it is estimated that approximately 11,000 of them are thoroughbreds for horse races. In recent years several investigations have been performed to elucidate the gastrointestinal parasite fauna of equines in Turkey; however, these studies mainly focused on draught and breeding horses, donkeys or mules in rural regions (10-12). Knowledge on the parasitological situation in Turkish stud farms is rather scanty (13). In spite of missing information on both epidemiological principles as well as on the different potencies of available drugs, and just because of this lack of knowledge current helminth control practices rely on irregular, often wrongly dated and unnecessary use of anthelmintics on many of these farms. This also implies an increasing risk for the development of anthelmintic resistance in equine nematode populations.

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Therefore, the aims of the present investigation were first to determine the current prevalence of strongyle infections in horses from large farms in western Turkey and second to evaluate the persistent efficacy of 3 anthelmintic drugs, i.e. pyrantel embonate, ivermectin and moxidectin, under local conditions.

Materials and Methods

Cross-sectional survey

The survey was performed on 320 horses, most of them thoroughbreds, from 8 stud farms and 1 military property in western Turkey. Parasite control of the farms was mainly based on irregular applications of anthelmintic drugs like ivermectin, doramectin, benzimidazoles, tetramisole or levamisole, and the reported deworming frequency varied between 2 and 6 per horse and year. Horses under investigation were 10 months to 18 years of age, of different sex and had not been anthelmintically treated during the previous 3 to 5 months according to the information given by the farm managers. Faecal samples were collected during summer months and examined for strongyle egg counts using a modified McMaster technique with a sensitivity of 50 eggs per gram of faeces (EPG) (14). Pooled faecal samples were cultured for larval differentiation, and where possible 100 third-stage larvae were identified (15).

Additionally, faecal samples were collected from the same horses and examined as described on 2 occasions 2 to 5 days (n = 134 animals) or 2 weeks apart (n = 59 animals) to assess the repeatability of egg counts. The correlation between the duplicate EPG was evaluated using Spearman´s rank correlation coefficient (r_s) with a statistical software package (16).

Persistence efficacy trial

The trial was carried out on a state Arabian Thoroughbred farm in the south Marmara region, Turkey. On this farm ivermectin and thiabendazole had been irregularly used in previous years. A total of 48 female horses, naturally infected with strongyles, were selected for the trial. The animals were 10 months to 2 years of age and had not been treated with anthelmintics in the previous 4 months. All animals grazed together on permanent horse pasture throughout the year. Horses were ranked on the basis of pre-treatment faecal egg counts and randomly allocated to 4 groups of 12 animals each. On day 0, 3 groups of horses were treated with pyrantel embonate (Bivantel® 40% paste, Boehringer Ingelheim, Germany; group P), ivermectin (Eqvalan® 1.87% paste, Merial or Eraquell® 1.87% paste, Virbac, Germany; group I) or moxidectin (Equest® 1.89% gel, Fort Dodge, Germany; group M) at the recommended dose rates of 19 mg/kg body weight (BW), 0.2 mg/kg BW and 0.4 mg/kg BW, respectively. Animals in group C remained untreated as controls; they were discarded from the trial after week 10. Group P and I horses were re-treated 10 weeks after the first treatment. BWs were estimated by means of a heart girth tape to calculate the appropriate dose for each horse. All treatments were given orally by one of the authors. Horses were observed for approximately 5 min after treatment to verify dose retention. No adverse reactions were recorded. Individual faecal samples were examined for strongyle egg counts and group faecal cultures were performed before treatments and then at 2-week intervals until trial week 16, when most of the young mares were sold. Additionally, 6 and 4 horses of groups P and M, respectively, were available for faecal examinations on week 25. Arithmetic mean EPG was calculated for each group on each sampling date. The percentage of faecal egg count reduction (FECR) in treated groups was calculated according to the formula

$$\text{FECR (\%)} = ((\text{mean EPG}_{\text{Day 0}} - \text{mean EPG}_{\text{Day 0+Y}}) / \text{mean EPG}_{\text{Day 0}}) \times 100,$$

With ‘Day 0+Y’ meaning the respective sampling date post-treatment. Data were analysed for statistical significance ($P < 0.01$) by the Mann-Whitney U test (7).

Results

Prevalence of strongyle infections

Patent strongyle infections were detected in 219 (68.4%) of 320 horses examined once 3 to 5 months after the last anthelmintic treatment (Figure 1). Half of the animals shed more than 950 EPG (median), and a maximum egg shedding as high as 14,300 EPG was found in 1 horse. All 9 farms harboured egg-positive horses. The within-farm prevalence and mean within-farm EPG ranged from 43% to 100% and from 185 to 2358, respectively (Table 1). Larvae of small strongyles (cyathostomes) were isolated from faecal cultures almost exclusively; Strongylus spp., Triodontophorus spp., Poteriostomum spp. and *Strongyloides westeri* larvae occurred in a few cases.

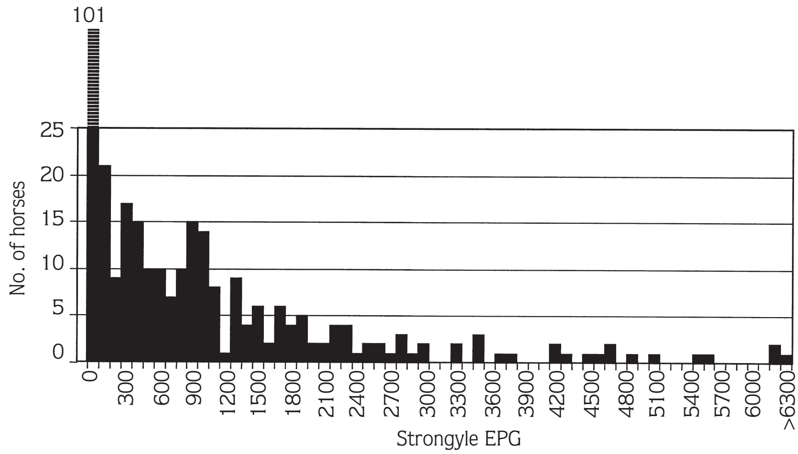

Figure 1. Frequency distribution of strongyle EPG in 320 horses of different age and sex from 9 farms in western Turkey (last anthelmintic treatments 3-5 months prior to examination).

Table 1. Within-farm prevalence of strongyle infections and mean within-farm EPG in 9 horse farms in western Turkey (last anthelmintic treatments 3-5 months prior to examination).

Farm	Within-farm prevalence (%)	Mean within-farm EPG
A	100	1946 (± 1142)[A]
B	57	489 (± 767)
C	43	403 (± 1010)
D	79	661 (± 634)
E	45	185 (± 426)
F	58	817 (± 1226)
G	67	2358 (± 4040)
H	69	1881 (± 2192)
I	58	238 (± 292)

[A]Standard deviation in parentheses.

Duplicate EPG were strongly correlated with each other if the sampling interval was 2 to 5 days. However, the correlation between 2 egg counts taken 2 weeks apart was low and not significant (Figure 2).

Persistence of faecal egg count suppression

Table 2 and Figure 3 show the course of mean egg counts and the percentage of efficacy throughout the trial period, respectively. All horses shed high levels of strongyle eggs at the start of the trial, indicating a considerable infection risk on this farm. In all cases before and after treatments only cyathostome larvae were found in faecal cultures. The egg output of untreated control animals varied slightly during the trial. Pyrantel embonate significantly suppressed the EPG by 90% to 95% 2 weeks after first and second treatment. However, mean egg counts steadily increased and from 8 weeks post-treatment had nearly reached the level on day 0. Ivermectin significantly reduced the EPG by >98% for up to 6 weeks; from 8 weeks post-treatment mean egg counts exceeded 200 EPG. In contrast, strongyle egg output was negative or very low on all sampling dates after moxidectin treatment, resulting in a significantly persistent efficacy of >98% for at least 16 weeks. In addition, 4 horses of group M available in week 25 still showed low egg counts.

Discussion

The results of the present survey clearly demonstrate that strongyle infections are highly prevalent in stud farms in western Turkey. This is in line with previous reports from both Turkey (10-13) and other countries (2,3), which indicate prevalence rates varying between 62.7% and 100%. High mean EPG levels were observed in several premises; however, generally most animals passed low egg counts and high counts concerned only a few animals on a farm (Table 1; Figure 1). The skewed frequency distribution of EPG in horses exactly corresponds with the well-known fact that both worm

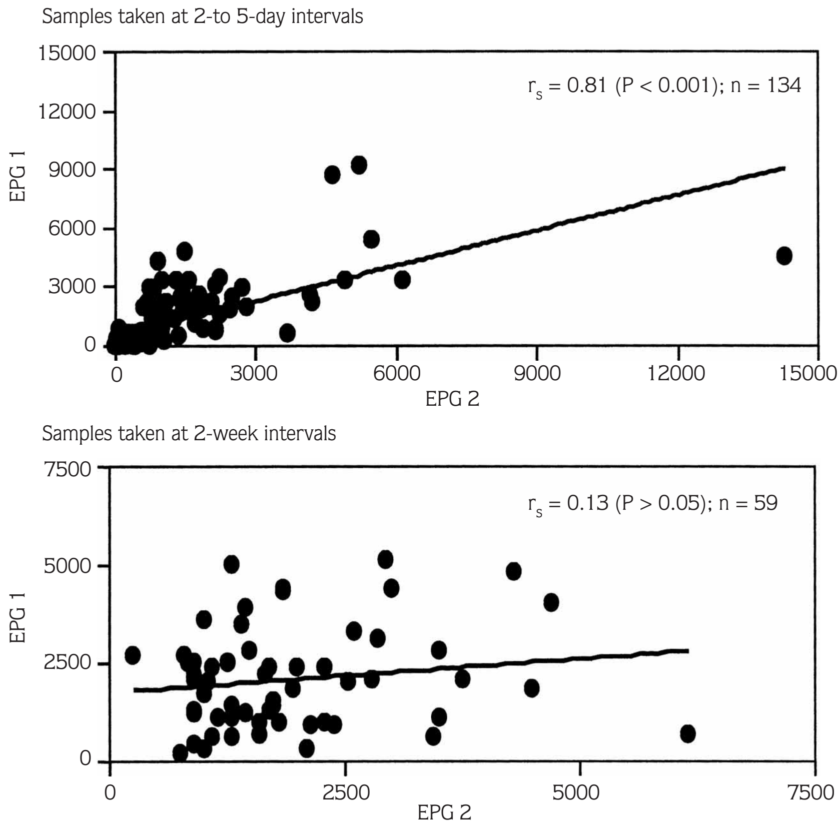

Figure 2. Correlation of 2 consecutive strongyle EPG of the same horses for 2 sampling intervals (2 to 5 days; 2 weeks).

Table 2:. Arithmetic mean strongyle EPG and numbers of positive animals in groups of young horses untreated (C) or treated with moxidectin (M), ivermectin (I) and pyrantel embonate (P). Groups grazed together on permanent pasture.

Group	No. of horses	Mean EPG (number of positive horses) in week									
		0[A]	2	4	6	8	10[B]	12	14	16	25[C]
C	12	1721 (12)	1500 (12)	2417 (12)	1254 (12)	2238 (12)	2804 (12)	nc	nc	nc	nc
P	12	2105 (12)	105 (10)	336 (8)	341 (12)	1650 (12)	1568 (12)	155 (9)	68 (7)	259 (10)	3300
I	12	1521 (12)	4 (1)	15 (1)	17 (1)	221 (9)	696 (9)	0 (0)	0 (0)	0 (0)	nc
M	12	2283 (12)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (1)	0 (0)	27 (2)	25

[A]First treatment of groups P, I and M.
[B]Second treatment of groups P and I; discarding group C from the trial.
[C]Calculated for 6 and 4 horses of groups P and M, respectively; other horses had been sold.
nc = not calculated.

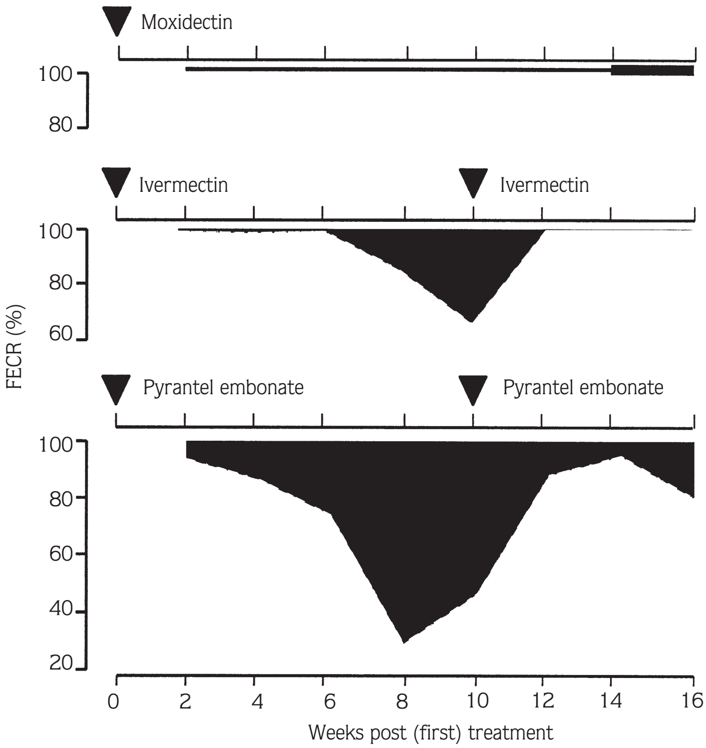

Figure 3. Time course of mean faecal egg count reduction (FECR) percentage in groups of young horses treated orally with moxidectin, ivermectin and pyrantel embonate. Groups grazed together on permanent pasture.

burdens and EPG are overdispersed, e.g., in ruminants (17). The question of overdispersion is relevant to the identification and possible selection of animals for genetic resistance to nematodes. Faecal egg counts were shown to be an appropriately phenotypic criterion to identify in sheep those animals that are genetically superior in terms of resistance to trichostrongyle infection (18). The usefulness of a method to assess the parasite resistance of a host in breeding studies depends, in part, on its repeatability. The repeatability of a parameter such as EPG is the correlation between repeated measurements on the same animal, and repeatability analysis is a simple way to determine whether quantitative genetic analysis will be profitable. Similar to previous observations on trichostrongyle egg shedding in sheep (19) the repeatability of EPG in horses was high when samples were collected at short intervals of 2 to 5 days but fell to an insignificant level when the interval was longer (Figure 2). Therefore, it may be of interest to elucidate in future the question of whether differences in susceptibility to nematodes also exist in equines and in this case faecal egg counts are useful tools to look for 'strongyle resistant' horses.

In the second part of our investigation the 3 anthelmintic drugs (paste formulations for use in equines) resulted in a high reduction in patent strongyle infections. However, strong differences were observed in their persistence to suppress the egg output for a period of time. Four to six weeks after administration of pyrantel embonate, which is effective against adult strongyles only (20), the egg counts were increasing again. These results correspond with previous reports (4,6,21). Ivermectin reduced the EPG by >98% for up to 6 weeks, and 8 weeks post-treatment increasing egg counts were seen in our trial. This confirms data from others (4,6,8); in some studies ivermectin covered a period of even 10 to 12 weeks (5,7,22). Moxidectin resulted in a >98% suppression of strongyle egg counts for at least 16 weeks. This relatively new anthelmintic was first evaluated in horses in Turkey as an off-label used injectable formulation and the efficacy was 100% at a dose rate of 0.3 mg/kg BW (23). It suppressed the strongyle egg output by 99% for 8 weeks (7), >90% for 12 weeks (6,8,24) and 95% for 25 weeks (25).

In agreement with many previous studies our data clearly demonstrate that pyrantel embonate, ivermectin and moxidectin differ in their persistent effect. The different potency of these (and other) drugs is of practical importance: anthelmintic control programmes in stud farms should be based on the so-called 'egg reappearance period' (ERP) of the respective compound. The ERP is that period after anthelmintic treatment in which mean egg counts do not exceed a specific level of, e.g., 200 EPG. An exceeding of this level indicates the necessity for re-treatment.

In conclusion, considering the high prevalence rates of strongyle infections in Turkish stud farms, anthelmintics with longer persistent efficacy should be used to minimise the risk of reinfections due to strongyles.

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