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Original article

Parascaris and cyathostome nematodes in foals: parasite in transit or real infection?

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Abstract

Faecal egg counts were performed in 187 foals of a large Polish stud farm between February and September 2007. Eggs of *Parascaris equorum* were present in faeces of 7% and those of cyathostomins in 13% of the foals aged less than 194 days. Information dealing with age of foals and/or efficiency of ivermectin treatment as well as the nematode parasite prepatent periods, it can be conducted that most of the infections recorded on the basis of faecal egg counts were false-infections in animals up to the age of six months, probably due to the ingestion of infected faeces of their dam or some other horses.

Key words: nematode, *Parascaris equorum,* Cyathostominae, foal, coprophagy, parasite in transit

Introduction

Foals are especially susceptible to digestive tract infections with nematodes (Thamsborg et al. 1998). The infections with threadworms (*Strongyloides westerii*) are detected first, due to short, 4-7 days prepatent period and lactogenic way of infection. Subsequently, coccidia (*Eimeria leuckarti*) (Beelitz et al. 1994) may occur in foals, and then, roundworm (*Parascaris equorum*) and cyathostomins (Cyathostominae) and much later on, strongylins (Strongylinae) infections. The prepatent period gives a first indication on the age at which a foal could be first excreting eggs of parasites or re-excreting after an efficient treatment. The strongylins have the longest prepatent period (6.5 to 11 months depending on *Strongylus* species) (Anderson 2000); the prepatent period of cyathostomins extends from three to four months (Anderson 2000) and that of *Parascaris equorum* from 72 to 110 days (Lyons et al. 1976, Clayton and Duncan 1979, Craig et al. 2007).

Excreted eggs of several species of nematodes may be reingested due to coprophagy and remain infective (in pigs and chicken *Ascaris* and *Trichuris*: Olsen et al. (2001) and in foals *P. equorum*: Lyons et al. (1996). The presence of strongylids (Strongylidae) eggs in faeces has been also recorded in young foals (Russell 1948, Lyons and Tolliver 2004). Coprophagy may perturbate interpretations on first infection date or reinfection speed (Lyons et al. 1996, Lyons and Tolliver 2004) or anthelmintic efficacy evaluation. Coprophagy occurred, according to Crowell-Davis and Houpt (1985), up to 19 weeks old foals, its frequency being greatest during the first eight weeks. Nearly 85% of the foals reared partly indoors had a coprophagous behaviour. Foals usually ate the faeces of their mother but were observed to eat their own and those of other horses (Crowell-Davis and Houpt 1985).

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This study intended to detect the prevalence of actual infections with *Parascaris* and strongylids of foals. Since relatively long indoors period is observed, and may favor coprophagous behaviour, false-infection due to the ingestion and transit of infected faeces from other animals may also be recorded. Based on information dealing with prepatent periods and absence of resistance to drugs, we will sort infections into real or false-infections.

Materials and Methods

The research was conducted in February, April, July, August and September of 2007, and included 17, 48, 54, 16 and 52 foals, respectively, from one large stud farm in south-west Poland in Silesia region. The weather is characterized by a temperate climate with cold winters and hot summers, with an annual average temperature of 8ºC; annual rainfall is 600 mm. Thoroughbred mares are bearing of foals from the beginning of January each years. The foals are nursed by the mares in the individual horse boxes until they reach 5-6 months and have access to pastures from May to October. Each year the deworming scheme is as follows: a first distribution of anthelmintics (1% ivermectin – paste form) is given when foals are 90 days old and the subsequent treatments are conducted every 2-3 months, until the foals reach one year of age. They may be dewormed earlier when infection is suspected.

Faecal samples were collected early morning from each foal per rectum and examined in the laboratory on the same day using the McMaster method with a flotation solution (sucrose) with specific gravity=1.28 (MAFF, 1986). One egg counted corresponded to 50 EPG (eggs per gram of faeces). Due to the various birth dates of foals and the deworming scheme with ivermectin, conducted in the stud farm, the presence of nematode eggs in the faeces of each foal were analyzed individually in the respective months. From the faecal samples, gathered in the last three months from 17 infected foals, the individual larval cultures were done according to Henriksen and Korsholme (1983).The faecal cultures contain: 10 g of faeces, 8 ml of water and 3 g of vermiculite were incubated at room temperature for 10-12 days. The larvae were extracted with baermman funnel, counted and differentiated on their morphological features, into cyathostomins (Cyathostominae) or strongylins (Strongylinae).

Efficacy of ivermectin was tested in foals aged more than the minimum prepatent period recorded in literature (60 or 90 days for *P. equorum* or cyathostomins, respectively) in order to obtain a sample of possibly infected animals. The foals were then either treated or remained untreated. A statistical Bootstreat program based on resampling (1000) was used to assess mean efficacy and confidence interval at P=0.05 based on EPG in treated foals versus untreated group of animals (Cabaret and Antoine, 2008; software available at http://wcentre.tours.inra.fr/sfpar/stat.htm).

False-infections were identified: i) when positive EPG were found in the foals aged less than the prepatent period ii) or when treated, if the post treatment period was shorter than the prepatent period. This suggests that ivermectin is efficient in removing worms.

Results

Efficacy of ivermectin

The efficacy against *P. equorum* was 99% in 82 foals (confidence interval: 88-100) and againts cyathostomins was 90% in 71 foals (confidence interval: 64-100).

Low prevalence of infection/false-infection

P. equorum as well as strongylids (Strongylidae) were found in the foals examined. The larval cultures showed that strongylids belonged to cyathostomins (Cyathostominae).

Infection with *P. equorum* concerned only 7% of the foals examined. Eggs were detected, for the first time, in 56 day old foal in April (Table 1). After that, the eggs of *P. equorum* were detected in the faeces of 100 to 176 day old foals. The number of excreted eggs of *P. equorum* reached up to 6200 EPG in one of the foal examined. Eggs of this parasite were found again in the faeces of foals after 7-9 days after deworming (Table 1). Thus the false-infection should concern less than 5% of the foals.

Eggs of strongylids (EPG) were found in 13% of the foals. Eggs were detected in the faeces of 26-37, 81-91 and from 103 day old foals (Table 2). These eggs were all identified to cyathostomins after faecal cultures. The percentage of cyathostomins eggs development in faecal cultures was from 5.2 to 52.6% (Table 3). It should be noted that in case of false-infection (through coprophagy), some of the ingested eggs were able to develop into infective larvae. Similarly, as in case of *P. equorum,* the eggs of cyathostomins were often found in ivermectin dewormed foals, even 7-9 days after administration of the drug (Table 2).

Table 1. *Parascaris equorum* eggs in faeces of foals.

Month (infected/examined) %	Age of foals (in days)	EPG	Number of days after treatment with ivermectin	False-infection based on	
				prepatent period	positive EPG when effective treatment is shorter than 60 days before sampling
April (3/48) 6.3%	56	50	9	Yes	Yes
	100	2150	76	No	No
	101	350	94	No	No
July (3/54) 5.6%	107	50	56	No	Yes
	108	700	46	No	Yes
	113	50	46	No	Yes
August (4/16) 25%	106	450	55	No	Yes
	117	750	55	No	Yes
	127	50	80	No	No
	133	350	76	No	No
September (3/52) 5.8%	149	50	7	No	Yes
	173	6200	78	No	No
	176	50	7	No	Yes

Table 2. Cyathostomins eggs in faeces of foals.

Month (infected/examined) %	Age of foals (in days)	EPG	Number of days after treatment with ivermectin	False-infection based on	
				prepatent period	positive EPG when effective treatment is shorter than 60 days before sampling
February (1/17) 5.9%	34	50	Untreated	Yes	–
April (5/48) 10.4%	26	50	Untreated	Yes	–
	27	50	Untreated	Yes	–
	30	50	Untreated	Yes	–
	37	550	Untreated	Yes	–
	100	200	76	No	Yes
July (13/54) 24.1%	81	100	19	Yes	Yes
	83	350	34	Yes	Yes
	91	600	Untreated	Yes	–
	98	250	8	No	Yes
	103	50	8	No	Yes
	105	50	Untreated	No	–
	108	100	46	No	Yes
	108	100	71	No	Yes
	114	50	8	No	Yes
	119	50	19	No	Yes
	154	50	34	No	Yes
	181	50	8	No	Yes
	186	150	34	No	Yes
August (1/16) 6.3%	106	100	55	No	Yes
September (3/52) 5.8%	173	50	78	No	Yes
	179	650	70	No	Yes
	193	50	7	No	Yes

Table 3. The percentage of the development of eggs into larvae in relation to suspected false-infections after treatment with ivermectin.

Month	Age of foals (in days)	EPG	Number of cyathostomins larvae/g in faecal culture	The percentage of egg development into larvae (%)
July	81*	100	16	16
	83*	350	26	7.4
	91*	600	66	11
	98	250	13	5.2
	103	50	15	30
	105	50	11	22
	108	100	45	45
	108	100	51	51
	114	50	16	32
	119	50	21	42
	154	50	19	38
	181	50	16	32
	186	150	39	26
August	106	100	53	53
September	173	50	26	52
	179	650	342	52.6
	193	50	13	26

* false-infection also based on pre-patent period

Discussion

False-infections are easy to detect when the age of the foal is much shorter than the pepatent period. We detected eggs of roundworm *(P. equorum)* in 56 days old foal, as previously recorded by Gawor (1996) and Lyons and Tolliver (2004), which were possibly acquired through coprophagy. The infections of roundworm detected in older foals in present study, it may correspond to actual infections. On the other hand the occurrence of eggs *P. equorum* in faeces short after treatment might be related also to coprophagy, in case that ivermectin is still effective against this nematode in our conditions.

The occurrence of eggs of cyathostomins in foals between 26th and 37th day of life was probably resulting from coprophagy as also recorded by Gawor (1995), or Lyons and Tolliver (2004). On the other hand, the eggs found in the feces of foals older than 90 days might have also been an effect of patent infection. When recent treatments with ivermectin were provided, due to the fact that cyathostomins resistance to this drug has not yet been recorded (Kaplan 2002), it may be concluded that eggs demonstrated in foal faeces are probably also the result of coprophagy. However, the ivermectin treatment ensures an incomplete removal of luminal specimens (fourth stage larva), some of which mature and begin laying eggs by about four weeks after the treatment (Lyons et al. 2009): this may explain the 90% efficacy. These eggs were cultivated and sufficient percentage of them developed into infective larvae (Table 3), indicating that coprophagy will not probably reduce the available contamination of the environment, as already shown in other intestinal nematodes (Olsen et al. 2001).

The false-infections are frequent in foals up to the age of six months (*P. equorum* and cyathostomins, 5% and 13% of foals, respectively). These rates are possibly overestimated, since some of our evaluations were performed on the basis of a 100% efficacy of the drug, although the drug was apparently efficient at 90%. The false-infections should be taken into account for diagnostic of nematode infection or evaluation of anthelmintic treatments in foals.

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