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Special Focus on Parasitology

Editorial

The appropriate antiparasitic treatment: Coping with emerging threats from old adversaries

Conventional strategies for equine helminth control involve prophylactic anthelmintic treatments administered at scheduled intervals or applied at tactical times during the year [1]. In recent years, however, increasing emphasis has been placed on the use of diagnostic surveillance to generate information on the types of parasites present and the level of helminth egg excretion, and to evaluate treatment efficacy [2]. As a result of such recommendations, efforts have been made to develop novel species-specific diagnostic tools that detect the presence of particular species of interest. This issue of the *Equine Veterinary Journal* hosts two articles that focus on the diagnosis of 2 important equine pathogens; *Parascaris* spp. [3] and *Strongylus vulgaris* [4]. For both parasites, an obvious question to ask is: "What is the treatment of choice when a given parasitic infection is detected?" While there is some scientific information available to help answer this question, there is a real paucity of underpinning evidence, and often treatment decisions are based on the practitioner's experience. Here we provide our considerations for treating a horse with: 1) a sizeable *Parascaris* spp. burden diagnosed by ultrasonography, or 2) *S. vulgaris* infection diagnosed with coproculture or serology.

Parascaris spp.

As outlined in the research article presented in this issue [3], recent anthelmintic treatment is a risk factor for verminous impactions of the small intestine and there is a need to define the optimal clinical approach for a foal with ultrasonographic evidence of a large *Parascaris* spp. burden. There are no published studies that have directly evaluated the immediate or long-term consequences of deworming foals that harbour large ascarid burdens, so this challenge is not easily answered. However, some information can be derived from the literature. For example, 2 publications encompassing a total of 34 clinical cases determined that the majority of ascarid impactions were associated with the administration of anthelmintics with a 'paralytic' mode of action, i.e. pyrantel pamoate or ivermectin [5,6]. In contrast, a benzimidazole anthelmintic was administered in only one case. While this could merely reflect the frequency of the anthelmintic classes used, one interpretation is that benzimidazole therapy might be associated with a lower risk of impaction [7]. There is some logic to this hypothesis because benzimidazoles do not paralyse worms; rather they disrupt cellular metabolism. Thus, if benzimidazoles cause worms to die more slowly, a more gradual removal of worms ensues and the risk of impaction is reduced. Although this seems like a reasonable explanation, more research is needed to test this hypothesis. Another important factor to consider is the expected efficacy of the available anthelmintics. Ivermectin-resistant *Parascaris* populations are commonly reported in managed horses worldwide [8], whereas resistance to pyrantel or benzimidazoles has only been identified in a few studies [8]. However, the prevalence of resistance in *Parascaris* spp. has not been well studied; thus there is a need to perform region-wide studies for all 3 major drug classes to determine the prevalences of resistance in this parasite.

Taken together, the relatively limited available evidence suggests that a benzimidazole drug may be the drug of choice for foals when there is evidence, or a suspicion, of a large ascarid burden. The literature does not offer recommendations regarding dosage or, in relevant locales, choice of benzimidazole. Also, there is no published evidence to suggest that clinicians should use a higher or lower dosage of benzimidazole than the labelled recommendation. Some veterinarians elect to treat first with a half dose of a given anthelmintic and then follow up with a full dose about one week later. However, the potential consequences of such an approach have not been investigated. A 5-day regimen of fenbendazole given at a 10 mg/kg bwt has been shown to treat migrating ascarid larvae effectively in the lungs [9], and may offer some clinical benefits to heavily exposed foals. Some veterinarians recommend administering mineral oil via nasogastric tube to facilitate the passage of dead or dying worms. However, there is no scientific evidence for the clinical benefits of this procedure and the passing of a nasogastric tube can be stressful to a foal. It is also unknown whether a mineral oil-coated alimentary tract absorbs and metabolises anthelmintics as expected or whether mineral oil might interfere directly with the anthelmintic. Certainly, it is recommended that foals presenting with evidence of a large ascarid burden be kept under observation for the first 24–48 h following treatment.

Strongylus vulgaris

Historically, *S. vulgaris* was the most important parasitic helminth of horses, and the report in this issue of EVJ documents the continued pathogenic potential of this parasite in managed horses [4]. Faecal egg counts do not reveal the presence of this parasite specifically, as it produces an egg similar to those of other equine strongyle species. Definitive testing therefore requires coprocultures and examination of third stage larvae, although polymerase chain reaction and a serum enzyme-linked immunosorbent assay have been developed for research purposes [10,11]. If increased testing for *S. vulgaris* is to be recommended, it is relevant to ask: what would be the most appropriate therapeutic option when a horse tests positive? All available evidence suggests that *S. vulgaris* has yet to develop resistance to any of the currently available anthelmintic formulations. In fact, this is a main explanation as to why this parasite has become 'rare' in most managed equine populations. This susceptibility pattern indicates that any registered anthelmintic could be used to treat the parasite, but each has relevant properties to consider. Pyrantel salts, for example, only have efficacy against intestinal stages, and, hence, do not kill migrating larvae. Given the lengthy migratory phase of several months for *S. vulgaris*, it would be preferable to use an anthelmintic with larvicidal properties, i.e. a macrocyclic lactone. Efficacy levels against *S. vulgaris* larvae in the cranial mesenteric artery have been assumed to be similar for ivermectin and moxidectin, although one study reported higher efficacy for moxidectin [12]. A recent investigation suggested that early fifth stage larvae, present in the arterial lumen, responded poorly to ivermectin treatment, although good efficacy against fourth stage larvae was observed [13]. Fenbendazole has also been reported to have good activity against migrating larvae of *S. vulgaris* at 10 mg/kg bwt when given over at least 3 days [14], and probably remains a valid larvicidal treatment option for this parasite.

A question often asked by veterinarians is whether adverse reactions might occur when treating a horse harbouring a large burden of arterial larvae. One, often-expressed concern is whether treatment can lead to, or exaggerate production of, thromboemboli, due to decay of dead worms in the arterial lumen. There are no published studies to support this hypothesis. On the contrary, it has been described that arterial larvae remain viable for at least 14 days following ivermectin treatment, and that they are eventually killed/eliminated by a cellular host immune response occurring over a period of several weeks [15]. Some practitioners have elected to supplement anthelmintic treatment with corticosteroids to dampen a presumed local inflammatory response following treatment; however, there is no scientific basis to support this procedure. In fact, it is possible that corticosteroids might counteract the aforementioned host immune response that kills/degrades the larvae.

Considerations for treatment of a horse with parasite-induced colic

It should be emphasised that the considerations presented above strictly apply to situations in which an asymptomatic horse tests positive for the given parasite. Management of an active colic case of suspected parasitic aetiology comes with a different set of considerations, largely dependent on the clinical presentation. Typically, therapeutic interventions will focus on pain management and normalising fluid and electrolyte balances, while attempting to determine whether surgery is required. Possible anthelmintic interventions, however, are not a priority in the emergency situation.

Some cases of small intestinal ascarid impaction can be approached with medical treatment if the case does not have gastric reflux, and is generally manageable. In such situations, anthelmintic treatment, perhaps with a benzimidazole, could be considered as a crucial component of the treatment plan, along with appropriate pain medication, spasmolytics, fluid therapy and regular evaluation for gastric reflux. Surgical intervention is indicated in cases where medical treatment does not resolve the impaction. Published evidence indicates that surgery involving enterotomy carries a poor prognosis [5,6]. In contrast, a recent retrospective study reported survival of >1 year in 60% of foals in which impaction was managed by manual evacuation of worms into the caecum, rather than by enterotomy [16]. To balance these data, the success will depend significantly on the worm burden, the time frame before deciding the intervention and the local surgical/hospital structure.

The situation is quite different for *S. vulgaris*-associated colic cases, as these typically involve intestinal ischaemia and infarction, which leads to peritonitis [4]. Here, the extent of intestinal tissue damage and the severity of accompanying peritonitis largely determine the prognosis. Anthelmintic intervention is unlikely to exert any positive effects in this context as intestinal infarction may require exploratory laparotomy and resection of the affected portion of the intestine. Anthelmintic therapy in the form of ivermectin or moxidectin should be considered once the patient has been treated successfully and stabilised.

Closing remarks

The considerations given here only pertain to treatment of individual horses diagnosed with *Parascaris* spp. or *S. vulgaris* infection. Obviously, control of these parasites at the herd level requires a different set of considerations, in particular, integrated management plans involving diagnostic procedures that target all potential helminth species present and best practice grazing practices. These issues are not within the scope of this editorial. However, interested readers are referred to the parasite control guidelines recently published by the American Association of Equine Practitioners [2]. Further, details on the current levels of anthelmintic resistance found in equine parasites worldwide have been summarised in recent publications [8,17,18].

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