New Studies Associate Equine Tapeworm Infection with Colic

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Key Points

- Recent studies reported at the 2007 International Conference of the World Association for the Advancement of Veterinary Parasitology provide new information on the clinical relevance of equine tapeworm infection, including enteric pathology that potentially results in colic.

- In a European study, ileocecal lesions including necrotizing enteritis and neuronal degeneration were identified in 35 horses with active tapeworm infection. More than 70% of the ileocecal lesions were classified as either moderate (grade 2) or severe (grade 3), indicating that advanced tapeworm-induced pathology existed in most infected horses.

- All 6 horses with heavy tapeworm burdens (n >100) had severe, grade 3 ileocecal lesions. Seven horses (20%) with light (n <30) or moderate (n = 30-100) tapeworm burdens also had grade 3 lesions, indicating that even horses with low-intensity infections are at risk of severe necrotic enteritis.

- Neuronal degeneration was most severe in grade 3 cases, affecting ganglions in the myenteric and submucosal plexi of the gut wall and providing neuropathologic evidence of the association between equine tapeworm infection and increased incidence of colic.

- In a second study, prevalence of tapeworm infection in 157 horses was randomly evaluated at necropsy during a 12-month period. Anoplocephala perfoliata was identified in 27% of the horses, exceeding what fecal testing would indicate in many herds. Horses <2 years of age, perhaps due to immunologic susceptibility, were at greater risk of tapeworm infection than adult horses. The geometric mean A. perfoliata burden was 15, although some horses were infected with as many as 476 tapeworms.

- There was no significant difference in seasonal prevalence of tapeworm infection in either juvenile or adult horses, indicating that a year-round treatment program for tapeworms would have a benefit in endemic herds.
Until recently, diagnosis and control of tapeworm infection in horses never acquired the urgency associated with that for cyathostomins and other nematodes. At one time, equine tapeworm infection was considered all but inconsequential due to the absence of clinical signs, inability to induce experimental infection, and the difficulty in diagnosing infection in the living animal. However, beginning in 1990s, it became apparent that *A. perfoliata*, the most common equine tapeworm, is not the innocent bystander it was once thought to be, in the words of one expert.\(^1\)

**Evidence clearly shows that equine tapeworms:**

- Have a high prevalence worldwide and in many areas of the U. S., including >95% seroprevalence in the upper Midwest in a recent survey,\(^2,4\) creating the potential for increased risk of clinical disease.
- Induce demonstrable equine gastrointestinal (GI) pathology centered on the critical nexus at the ileocecal junction.\(^5,7\)
- Are correlated with risk of ileal impaction, spasmodic colic, and cecal intussusceptions and rupture.\(^8,10\)

There has been a renewed interest in equine tapeworm infection, driven by the association between the tapeworm burden and colic, and by colic’s role as the single most important cause of equine mortality.\(^11\) This report describes results of recent studies that shed light on the pathology and clinical relevance of tapeworm infection in horses, and establish tapeworms as an important equine parasite.

**Topics include:**

- Identification of necrotizing enteritis and submucosal neuronal degeneration in the large intestine as components of tapeworm pathology that can affect enteric function.
- The relationship between worm burden and the lesions mentioned above, including the adverse effects of even low levels of tapeworm infection.
- How seasonality and the horse’s age affect infection intensity.

**Diagnosis and its clinical implications**

Active tapeworm infection is difficult to diagnose. The significance of this limitation is that it contributes to underestimating the true prevalence of tapeworm infection in a herd, which in turn encourages negligence in tapeworm control. In most cases, the clinician or horse owner will simply resort to routine deworming instead of performing a diagnostic test that can confirm active infection. Some horse owners mistakenly assume that broad-spectrum dewormers such as macrocyclic lactones (avermectins) or benzimidazoles will control tapeworms, unaware that neither of these anthelmintic classes has a cesticidal (anti-tapeworm) effect. In tapeworm endemic areas, a positive diagnosis is a useful adjunct to empirical treatment that can help guide a control strategy.

There are two approaches to tapeworm diagnosis, (1) coprologic (fecal) testing using a centrifugation/flotation technique, and (2) serologic testing using an ELISA format to detect tapeworm antibodies as evidence of prior exposure. Although coprologic diagnosis has the advantage of not requiring specialized equipment, it is labor intensive and is generally conceded to be a hit-or-miss affair. This is partly due to the irregular shedding of tapeworm proglottids (segments) in the feces and frequent failure of the proglottid to rupture and release its eggs. Tapeworm eggs have a characteristic morphology and can be readily visualized microscopically, but they are smaller than cyathostomin eggs and tend to sink rather than float when placed in solution.

Sedimentation/flotation methods tend to capture only a small sample that often has few if any eggs. All of these factors conspire to make fecal analysis an unreliable diagnostic method that allows most tapeworm eggs to go undetected. Not surprisingly, sensitivity of coprologic methods has been found to be low, variously determined to be from 22.5 to 37.5 percent\(^12\) or 61%\(^13\) depending on the study and methodology. Furthermore, although the probability of a positive diagnosis increases with infection intensity, fecal testing is a poor indicator of the actual tapeworm burden in the individual horse and in the...
herd overall since only a representative minority of horses in larger groups are generally tested.\textsuperscript{12,13}

A serologic test using ELISA methods was developed in Europe at the University of Liverpool to detect tapeworm antibodies,\textsuperscript{14} but this test is not commercially available in the U.S. An equine tapeworm ELISA test has been developed at the University of Tennessee and is available from the College of Veterinary Medicine Clinical Immunology Service.\textsuperscript{15,16} Although more expensive than fecal testing, serologic diagnosis is more convenient and suitable for evaluating large numbers of samples. The U.K. test has been shown to have a 68% sensitivity (ability to identify positive individuals) and a 95% specificity (ability to exclude negative individuals). ELISA identifies prior exposure, not active infection, a disadvantage compared to fecal testing. However, because antibody levels decay in a linear fashion, ELISA optical density values have been correlated with tapeworm infection intensity.\textsuperscript{14} More recently, an experimental polymerase chain reaction (PCR) test developed in Europe for detection of \textit{A. perfoliata} in fecal samples has been shown to be a valid molecular alternative to coprological and serological methods.\textsuperscript{17,18}

\section*{Necrotizing enteritis and neuronal degeneration are features of tapeworm pathology}

A university research group in Europe has developed a scoring system for assessing severity of ileocecal gross pathology and histopathology in horses with confirmed \textit{A. perfoliata} infection.\textsuperscript{19} The investigators correlated lesions severity with tapeworm burdens in studies of horses necropsied at an abattoir.\textsuperscript{19,20} Using this approach in a recent study of 35 horses, tapeworm burdens at the ileocecal junction were determined as light (n <30), medium (n = 30-100), or heavy (n >100) and correlated with an ileocecal lesion grade and associated histopathology.\textsuperscript{20} As illustrated in Figure 1, ileocecal lesions were scored according to the severity of the gross pathology as follows:

- Grade 1 (mild) – Characterized by mild edema, hyperplasia, hemorrhagic foci and mucosal inflammation at the site of tapeworm attachment.
- Grade 2 (moderate) – Characterized by edema, inflammation, and focal pseudomembranous enteritis with fibrin membranes at the tapeworm attachment site. Histopathology consisted of a non-specific chronic enteritis with infiltration of eosinophils affecting the lamina propria and submucosa, and neuronal degeneration in the submucosa and myoenteric plexi.
- Grade 3 (severe) – Characterized by regional necrotizing enteritis at the site of tapeworm attachment, and reduced distensibility of the ileocecal valve. Histopathology consisted of a fibro-necrotic enteritis affecting all mucosal layers, and neuronal degeneration in the submucosa and myoenteric plexi.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure1.png}
\caption{Gross ileocecal lesions (left-hand views) and corresponding histopathology (right-hand views) in cases of equine tapeworm infection are classified according to the severity grade, which correlated in a non-linear manner with the parasite burden. A Grade 1 lesion shows edema, hyperplasia, and scattered hemorrhagic foci at the site of attachment. Histopathology reveals a well-defined area of mucosal inflammation. A Grade 2 lesion shows more extensive focal inflammation and edema combined with pseudomembranous enteritis with fibrin membranes around the tapeworm attachment points. Histopathology shows a nonspecific chronic enteritis with infiltration of eosinophils affecting the lamina propria and submucosa. A Grade 3 lesion has a more extensive regional necrotic enteritis in the area of tapeworm attachment and much reduced distensibility of the ileocecal valve. Histopathology shows a fibro-necrotic enteritis affecting all layers of the mucosal sample. (Photo used with permission of D. Marciat, Virbac SA).}
\end{figure}
Table 1 shows the distribution of ileocecal lesion grades among the 35 horses evaluated and the percentage of each grade with light, medium, or heavy tapeworm burdens. All 6 horses with heavy tapeworm burdens (>100) had severe, grade 3 ileocecal lesions, a statistically significant (p<0.01) correlation that conformed to earlier findings by the same research group as well as other investigators. However, 7 horses (20%) with light (<30) or moderate (30-100) tapeworm burdens also had grade 3 lesions, indicating a non-linear relationship between the number of tapeworms at the ileocecal junction and occurrence of severe pathology at that site. In other words, even horses with low-intensity tapeworm infections are at risk of severe, regional necrotic enteritis.

Grade 2 and 3 ileocecal lesions included neuronal degeneration (Figure 2), which tended to be more severe in grade 3 cases. Ganglions in the myoenteric (Auerbach) and submucosal (Meissner) plexi of the gut wall were affected. Neuronal degradation involving both plexi could be expected to compromise excitatory or inhibitory enteric motor activity at the highly innervated ileocecal junction. In addition, *A. perfoliata* as well as other cestodes contain acetylcholinesterase, an enzyme involved in the synthesis of neurotransmitters that terminate neural transmission. Thus, the histochemistry of tapeworms as well as their effect on ganglions at the ileocecal junction may be significant factors contributing to neural impulse deficit or other enteric neuromuscular dysfunction. These findings provide neuropathologic evidence of the association between equine tapeworm infection and increased incidence of colic.

<table>
<thead>
<tr>
<th>Ileocecal lesion grade</th>
<th>No. /total (% of total)</th>
<th>Light (&lt;30)</th>
<th>Medium (30-100)</th>
<th>Heavy (&gt;100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – Mild</td>
<td>14/35 (40%)</td>
<td>14 (100%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2 – Moderate</td>
<td>8/35 (23%)</td>
<td>6 (75%)</td>
<td>2 (25%)</td>
<td>0</td>
</tr>
<tr>
<td>3 – Severe</td>
<td>13/35 (37%)</td>
<td>4 (31%)</td>
<td>3 (23%)</td>
<td>6 (46%)</td>
</tr>
</tbody>
</table>

**Figure 2** – An example of neuronal degeneration in a ganglion of the enteric nervous system in a horse with equine tapeworm infection. Ganglions in the submucosal (Meissner) and myoenteric (Auerbach) plexi of the gut wall were involved, potentially affecting gastrointestinal movement and secretion. Neuronal degeneration was a feature of grade 2 and grade 3 ileocecal lesions. (Photo used with permission of D. Marciat, Virbac SA).
Tapeworm prevalence is affected by the host’s age but not by seasonality

To assess prevalence of tapeworm infection and age predisposition, the same European research group performed necropsies on a sizeable and varied population (n = 157) of juvenile and adult horses. Necropsies were evenly distributed among the four seasons of the year, which enabled a determination of seasonal fluctuations in incidence of equine tapeworm infection.

The prevalence of tapeworm infection by Anoplocephala species and age of the horse is shown in Table 2. Several findings were noteworthy:

- Although A. perfoliata is by far the predominant equine tapeworm in horses worldwide, A. magna was identified in 14% of the population evaluated versus 27% for A. perfoliata. (In contrast, in the U. S. A. perfoliata is diagnosed almost exclusively3,25)
- Juvenile horses <2 years of age had a higher prevalence of tapeworm infection than adult horses >2 years. In the case of A. magna, the difference was statistically significant (p<0.05), 17% in juvenile horses versus 4% in adults.
- The geometric mean tapeworm burden was 15 for A. perfoliata and 4.2 for A. magna.

However, some individuals had much higher numbers of tapeworms, up to 476 for A. perfoliata and 137 for A. magna.
- There was no appreciable difference in seasonal prevalence of tapeworm infection in either juvenile or adult horses.

The study indicated that prevalence of tapeworm infection in a random equine population is approximately one in four animals in the case of A. perfoliata, exceeding what coprological diagnosis would indicate in many herds. Data also indicated that the juvenile horse, perhaps due to immunologic susceptibility, is at greater risk of tapeworm infection than the adult, a result corroborated in serologic studies by other investigators.26 Additionally, A. magna should not be ignored as a potential equine parasite. Perhaps counter-intuitively, tapeworm infection is not restricted to warmer seasons, but appears to be prevalent throughout the year. This outcome was consistent with a U. S. seroprevalence study showing the high exposure rates in states that experience the full range of seasonal climate variation (for example, a 95.8% prevalence in states in the upper Midwest and a 62.3% seroprevalence in New England states).4 These data suggest that a year-round treatment program for tapeworms would have a benefit in endemic herds.

### Table 2 – Prevalence of tapeworm infection in juvenile and adult horses at necropsy24

<table>
<thead>
<tr>
<th>Tapeworm species</th>
<th>GM tapeworm burden (range)</th>
<th>Juvenile (&lt;2 yrs, n = 69)</th>
<th>Adult (&gt;2 yrs, n = 53)</th>
<th>All horses* (n = 157)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. perfoliata</td>
<td>15 (1-476)</td>
<td>21 (30%)</td>
<td>11 (21%)</td>
<td>43 (27%)</td>
</tr>
<tr>
<td>A. magna</td>
<td>4.2 (1-137)</td>
<td>12 (17%)a</td>
<td>2 (4%)b</td>
<td>22 (14%)</td>
</tr>
</tbody>
</table>

GM = geometric mean.
*35 horses were of unknown age.
* Columns with different superscripts were significantly different (p<0.05).
Clinical perspective

Tapeworm infection is far from a benign form of parasitism in horses, and should not be viewed as such. Epidemiological data indicate that tapeworm infection is widespread in North America regardless of the season. Experimental evidence has demonstrated that severe lesions can occur at the ileocecal junction where tapeworm attachment occurs, even in cases where the worm burden is light. Because of this enteric pathology, tapeworm infection should be considered in herds where episodes of colic occur in clusters or on a repeated basis. Tapeworm diagnostic testing has its limitations, but can confirm active infection (by fecal testing) or recent exposure (by serologic testing). Tapeworm infection can occur year-round in most moderate climates, and tends to be more prevalent in horses less than 2 years of age.

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References


