Surgical extraction of an intraocular infection of *Parelaphostrongylus tenuis* in a horse

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**Case Description**—A 4-year-old Hanoverian gelding was evaluated because of a mobile worm-like structure in the right eye.

**Clinical Findings**—Opthalmologic examination of the right eye revealed a white, thin, coiled, mobile parasite, which was presumed to be a nematode, located in the ventral portion of the anterior chamber of the eye; there also were vitreal strands located temporally and inferiorly near the margin of the pupil. Results of ophthalmologic examination of the left eye were unremarkable.

**Treatment and Outcome**—The horse was treated with a neomycin-polymyxin B-dexamethasone ophthalmic solution applied topically (1 drop, q 8 h) to the right eye and penicillin V potassium (22,000 U/kg [10,000 U/lb], IV, q 6 h). The horse was anesthetized. A stab incision was made in the cornea, and a viscoelastic agent was infused around the parasite. The parasite was extracted via the incision by use of an iris hook and tying forceps. The horse had an uncomplicated recovery from the procedure and retained vision in the right eye. Gross and microscopic examination was used to identify the parasite as an adult metastrongylid nematode consistent with a fully developed male *Parelaphostrongylus tenuis.*

**Clinical Relevance**—To the authors’ knowledge, this is the first report of intraocular paretaphostrongylosis in a horse. This report provided evidence that vision could be retained after treatment for intraocular *P tenuis* infection in a horse. (*J Am Vet Med Assoc* 2010;237:196–199)

A 4-year-old 541-kg (1,190-lb) Hanoverian gelding was evaluated in June 2008 at the University of Wisconsin-Madison Veterinary Medical Teaching Hospital because of a mobile worm-like structure in the right eye. The horse was maintained in a pasture in southwestern Wisconsin and had a history that included travel to states adjacent to Wisconsin. The owner first noticed the structure approximately 2 weeks before ophthalmologic examination at the veterinary medical teaching hospital. The owner did not detect any change in vision or attitude of the horse. The horse had been treated with ivermectin and fenbendazole (dosages unknown) 10 and 30 days, respectively, before the ophthalmologic examination. Three days before the ophthalmologic examination, the referring veterinarian prescribed treatment with flunixin meglumine (1 mg/kg [0.45 mg/lb], PO, q 24 h).

Ophthalmologic examination performed on day 1 revealed typical direct and consensual pupillary light reflexes, a typical dazzle reflex, and a typical menace response in both eyes. Examination of the right eye revealed a white, thin, coiled, mobile parasite, which was presumed to be a nematode, in the ventral portion of the anterior chamber (Figure 1). Flare or cells were not detected in the anterior chamber of the right eye, and the eye was unremarkable in appearance except for several coalescing vitreal strands located temporally and inferiorly near the margin of the pupil. Retinal examination findings were unremarkable. Findings of the ophthalmologic examination of the left eye were unremarkable. The horse was hospitalized, and the right eye was treated topically with a neomycin-polymyxin B-dexamethasone ophthalmic solution (1 drop, q 8 h).

On day 2, treatment with penicillin V potassium (22,000 U/kg [10,000 U/lb], IV, q 6 h) was initiated. The horse was sedated with xylazine hydrochloride (1 mg/kg, IV). Anesthesia was induced by administration of ketamine hydrochloride (2.2 mg/kg [1 mg/lb], IV) and diazepam (0.1 mg/kg [0.045 mg/lb], IV). Anesthesia was maintained by administration of a solution that contained a mixture of guaifenesin (20 g), ketamine (400 mg), and xylazine (200 mg) in 1 L of lactated Ringer’s solution as a constant rate infusion (10 mL/min, IV).

The horse was positioned in left lateral recumbency. The right eye was aseptically prepared for surgery. A 19-gauge vitrectomy knife was used to make an oblique stab incision through the right inferonasal region of the cornea near the corneal limbus directly over the location of the parasite. A small amount of 1% sodium hyaluronate (viscoelastic substance) was infused into
Spicule length typical of the nematode were 190 to 200 µm in length. The fully cuticularized spicules of the nematode were 190 to 200 µm in length, approximately equal in size, and symmetric in form.

the anterior chamber of the eye to envelop the parasite, impede the parasite's mobility, facilitate extraction of the parasite, and prevent iatrogenic damage to the corneal endothelium. An iris hook and straight non-toothed tying forceps were used to remove the parasite without causing it damage. Most of the viscoelastic substance was removed during extraction of the parasite. Thus, irrigation of the anterior chamber of the eye was unnecessary. The corneal incision was closed with 8-0 polyglactin 910. Butorphanol tartrate (0.03 mg/kg [0.014 mg/lb], IV) and penicillin V potassium (22,000 U/kg, IV) were administered during surgery. The horse had an uncomplicated recovery from anesthesia. The parasite was stored in neutral-buffered 10% formalin solution of 70% ethanol for archiving at the US National Parasite Collection.

On day 3, findings of an ophthalmologic examination were unremarkable, except for the corneal sutures, and revealed no complications related to the surgical procedure or as a result of the infection by the parasite. The horse was discharged on day 3 with instructions for the owner to administer flunixin meglumine (1 mg/kg, PO, on day 4) and to topically apply neomycin-polymyxin B-dexamethasone ophthalmic solution (1 drop, q 8 h for 7 days) to the right eye.

Approximately 2 months after the surgery, the referring veterinarian performed an ophthalmologic examination on the right eye of the horse. The examination revealed a healthy eye. Additionally, the horse appeared to have normal vision. However, a small scar remained at the site of the corneal incision. Approximately 6 months after surgery, the owner reported no postoperative complications for the horse. The horse continued to retain vision in the right eye.

On the basis of microscopic examination, the parasite was classified as a fully developed adult male bursate nematode included in the taxon Metastrongyloidea. The parasite was initially cleared in glycerine and later in a phenol-alcohol solution. The parasite was 44 to 45 mm in length. The fully cuticularized spicules of the nematode were 190 to 200 µm in length, approximately equal in size, and symmetric in form.

The gubernaculum was 63 µm in length. The reduced copulatory bursa was similar to that of other nematodes included in the taxon Metastrongyloidea and the genus *Parelaphostrongylus* (Figure 2). Further examination revealed that the morphological characteristics of the nematode were consistent with *Parelaphostrongylus tenuis*. The nematode parasite was submitted in a solution of 70% ethanol for archiving at the US National Parasite Collection.

**Discussion**

Among the elaphostrongyline metastrongyloid nematodes found in North America, there are 3 species of *Parelaphostrongylus*; all 3 are extrapulmonary parasites of definitive ungulate hosts, which include cervids and bovids. Among these 3 parasites, *P. tenuis* is relatively large; males are typically up to 62 mm (range, 31 to 62 mm) in length, are anatomically equipped with spicules that typically exceed 200 µm (range, 202 to 249 µm) in length, and have a gubernaculum > 100 µm (range, 89 to 137 µm) in length. In contrast, specimens of *Parelaphostrongylus andersoni* found in white-tailed deer (*Odocoileus virginianus*) are 22 mm in length and have spicules that do not reach > 115 µm in length. Mature males of *Parelaphostrongylus odocoilei* found in Dall’s sheep (*Ovis dalli*) are up to 36 mm in length, but they are slightly smaller in black-tailed deer (*Odocoileus hemionus columbianus*). Spicule length typical of
**P odocoilei** may approach that observed in **P tenuis**, but they do not reach >165 µm in length. Additionally, the parasite in the horse reported here should not be classified as **P odocoilei** because the geographic range for **P odocoilei** is restricted to northwestern North America. The only other elaphrostrongyline of consideration in the horse of the present report is **Elaphostrongylus rangiferi**. However, records indicate that these parasites, which were previously introduced in cervids, remain geographically restricted to Newfoundland. For typical **E rangiferi**, total body length would be similar to that of **P tenuis** but these species would be distinguishable on the basis of structural differences of the spicules and gubernaculum. The parasite in the present report was identified as **P tenuis** on the basis of structural characteristics of the preserved specimen, compared with the characteristics of parasites in another description, and in conjunction with the geographic location of the horse (ie, Wisconsin).

A commercially available antemortem diagnostic procedure for **P tenuis** does not exist for hosts other than cervids. An ELISA can be used to reliably detect serum anti-excretory–secretory antigen antibodies from third-stage larvae in white-tailed deer and elk (**Cervus elaphus**) within 2 weeks after infection. However, necropsy and recovery of adult **P tenuis** remain the only diagnostic tools for identifying infections in noncervid hosts. In the event that parasites are recovered that cannot be identified on the basis of morphological methods, classification should be possible by use of various molecular diagnostic techniques. **Parelaphostrongylus tenuis** (meningeal worm) is considered to be a common (prevalence of up to 86%) neurotropic parasite in white-tailed deer in parts of the United States, including eastern to central North America. The life cycle of **P tenuis** has been described elsewhere. In white-tailed deer, the adult stage of **P tenuis** resides in the subarachnoid space and venous sinuses of the brain. Females lay eggs that enter the circulation and are carried to the lungs where they become lodged in alveolar capillaries. The first-stage (dorsal-spined) larvae develop within the eggs, hatch, and penetrate the pulmonary parenchyma to enter the alveoli and migrate along the trachea in an orad direction. The larvae are expectorated from the trachea into the pharynx, swallowed, and excreted in the feces. Then, the first-stage larvae penetrate the foot of a gastropod, which is the obligatory intermediate host. Within the gastropod, the first-stage larva develops into a third-stage larva. Infection with **P tenuis** results when an infected gastropod is ingested by ungulates during grazing activities. The third-stage larva is released into the abomasum or stomach of the host and migrates through the host tissues to the CNS. In white-tailed deer, the larvae migrate cranially to the gray matter of the spinal cord and into the brain where they mature into adult parasites.

Meningeal worm infection in white-tailed deer generally results in a subclinical condition; however, migration through the CNS in atypical hosts results in a variety of clinical neurologic abnormalities. Infection in atypical hosts, such as bovids and camels, has been reported. In hosts other than white-tailed deer, parasites develop (to varying degrees) in extrapulmonary sites, including the CNS, without becoming a patent infection. Nonpatent infections of these hosts cannot be diagnosed by techniques such as fecal flotation or Baermann funnel methods. Nonpatent infections in atypical hosts have been acquired by domestic or free-ranging ungulates that share a common range with white-tailed deer, including game farms or zoos, and where ingestion of gastropod intermediate hosts provides a source of infective larvae for transmission. The horse of the present report had no history of exposure, and it was not housed in environmental conditions that would typically indicate a readily identifiable route for infection by **P tenuis**. The horse was pastured only with other horses, and the hay that was fed to the affected horse had been purchased from a farm that raised only cattle and horses. However, because **P tenuis**–infected white-tailed deer are quite prevalent throughout the range distribution, it is conceivable that infected gastropods may have been in the pasture or perhaps were even trapped in the hay during the baling process. The detection of vitreal changes in the right eye of the horse reported here indicates that this larva likely gained access to the anterior chamber of the eye via migration from the posterior segment.

To our knowledge, only 1 report of a confirmed infection in an equine host by a protostrongylid nematode (presumed to be **P tenuis**) exists. A 6-month-old Arabian was examined after an acute onset of clinical neurologic abnormalities (ie, abnormal gait and head tilt). Numerous eggs and nematode larvae were identified microscopically within the cerebellum during histologic examination. Thus, our report appears to be the first in which there was a confirmed intraocular infection of a horse by **P tenuis**. Furthermore, our report is the first to provide a description of an affected eye that retained vision after infection.

The first report of a presumed intraocular **P tenuis** infection was in a 10-month-old female eland (**Taurotragus oryx**) with progressive, unilateral uveitis of 5 weeks' duration that was nonresponsive to aggressive medical treatment. Unilateral enucleation was performed to alleviate patient discomfort. Histologic examination of that eye revealed marked uveitis and choroiditis, and multiple sections of nematode larvae were detected in the posterior segment near the retina and choroid of the eye. On the basis of morphological characteristics, the nematode was presumably classified as **P tenuis**; however, this was never definitively confirmed. Clinical manifestation of the intraocular **P tenuis** infection in that eland is quite dissimilar, compared with that of the horse reported here. We believe that the noninflamed appearance of the horse's eye was attributable to infection by an intact, viable nematode. Furthermore, it may be concluded that if the nematode were to have died in an intraocular location, then a dramatic panuveitis possibly would have ensued.

Although the intraocular infection by the nematode in the horse reported here is unusual, ocular lesions caused by migration of species of neurotropic metastongyloid nematodes have been reported as a sequela in a number of instances. The most commonly reported are caused by **Angiostrongylus cantonensis** in humans. **Angiostrongylus cantonensis** is a parasite of...
rats that migrates through the brain after ingestion of a gastropod intermediate host and eventually infects the vascular system of the rat lungs as an adult parasite. In 16% of humans infected with this parasite, ocular lesions, which often include young adult nematodes, have been detected in both the anterior and posterior chambers of the eye. In a report of 3 affected humans from Thailand, 1 live parasite was found in the anterior chamber, vitreous body, or subretinal space of the eye in each person. To our knowledge, *A. cantonensis* infections in dogs from Southeast Asia and Australia have not been associated with ocular sites. *Angiostrongylus cantonensis* is endemic in the rat population of the southern United States. Therefore, similar cases might be reported in this region. In Europe, infections with *Angiostrongylus vasorum* in the eyes of dogs have been reported to consist of developing stages of the parasite. In another report, a parasite was removed from the anterior chamber of the eye of a cat in Vancouver, BC, Canada, but it could not be classified to a genus. Because of the reported efficacy against the neurotropic stages of *A. cantonensis* in rats, some protection from infection might be provided to cats and dogs through monthly topical administration of moxidectin.

Infection with *P. tenuis* appears to be extremely rare in horses. However, *P. tenuis* infection should be considered when an intraocular parasite is identified in a horse, regardless of concurrent clinical signs (or lack thereof) of neurologic disease.

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**References**