# *Halicephalobus gingivalis* encephalomyelitis in a horse

Johan T. Bröjer, Deborah A. Parsons, Keith E. Linder, Andrew S. Peregrine, Howard Dobson

**Abstract** — An 8-year-old, Arabian mare presented with acute progressive ataxia and a firm swelling over the right mandible. Radiographs revealed multiple radiolucent areas on the mandibles. The mare's neurological signs progressed, she was consequently euthanized. Postmortem examination revealed mandibular granulomatous reactions and meningoencephalitis due to the nematode *Halicephalobus gingivalis.*

**Résumé — Encéphalomyélite causée par *Halicephalobus gingivalis* chez un cheval.** Une jument arabe de 8 ans été présentée pour ataxie progressive aiguë et enflure ferme sur la mandibule droite. Le radiographie a révélé de multiples zones semi-transparentes sur la mandibule. Les signes neurologiques ont progressé et la jument a été subséquemment euthanasié. L'examen post-mortem a révélé des réactions granulomateuses de la mandibule et une méningo-encéphalite causée par le nématode *Halicephalobus gingivalis.*

*(Traduit par docteur André Blouin)*

*Can Vet J 2000;41:559–561*

An 8-year-old, Arabian mare was referred to the Ontario Veterinary College with a 24-hour history of depression, pyrexia, and a painful swelling of the right mandible. In addition, she had a 4-hour history of progressive ataxia. Approximately 6 mo prior to presentation, a draining tract in the right mandible resolved following the administration of procaine penicillin, IM, for 5 d, and lavage of the area. The horse had no other history of illness and was current on all vaccinations, including rabies, tetanus, influenza, and herpesviruses 1 and 4. Anthelmintic administration included ivermectin, PO, 2 and 7 mo previously, and a benzimidazole, PO, 5 mo prior to presentation. The mare had been treated with dexamethasone, tetracycline, and flunixin meglumine, IV, immediately prior to referral, with no significant improvement in her condition. She had been ridden 2 d prior to presentation with no abnormalities noted in her gait.

At the time of presentation, the most significant findings on physical examination were profound ataxia, left hemiparesis, and depression. The mare was in good body condition, and all vital parameters were within normal limits. A complete neurological examination was impossible, as the horse was hyperresponsive to restraint and would fall to the left when moved. Examination of the cranial nerves revealed a lack of menace response on the left side, while the pupillary light response remained intact bilaterally. Tongue tone, panniculus reflex on the left side from the cranial cervical area to the last thoracic vertebra area, anal tone, and tail tone were decreased. The right mandible had a hard swelling over the location of the aforementioned draining tract, approximately 6 cm × 15 cm in size. No heat, pain, or drainage could be appreciated.

Radiographs of the skull revealed extensive lysis throughout the length of the lower left dental arcade with mild osteosclerosis. The extent of the osteolysis of the horizontal ramus of the mandible, with minimal evidence of sclerosis, was indicative of neoplasia rather than osteomyelitis. A large osteolytic lesion surrounded the roots of the right 3rd lower premolar. Bony proliferations were noted on the pterygoid bones as well. A complete blood cell count, fibrinogen level, and biochemical profile (including serum ammonia) were analyzed. All hematological parameters were within normal limits, except for an elevation in fibrinogen (4.0 g/L, normal, 1.0 to 2.9 g/L). Attempts to obtain a cerebrospinal fluid (CSF) sample were aborted due to the unsteady nature of the mare.

Initial medical management included IV fluid therapy with lactated Ringer's solution (Baxter, Toronto, Ontario), ceftiofur sodium (4.4 mg/kg BW, IV, q12h; Excenel, Pharmacia & Upjohn Animal Health, Orangeville, Ontario), flunixin meglumine (1.1 mg/kg BW, IV, q12h; Cronyxin, Vetrepharm, London, Ontario), and dimethyl sulfoxide (1 g/kg BW, IV, q24h; Domoso, Ayerst Veterinary Laboratories, Guelph, Ontario). During the following 20 h, the mare became progressively more ataxic and began to head press continuously. Each time she attempted to urinate, she would lose balance and fall. The mare became disoriented and violent; consequently, she was euthanized.

An immediate postmortem CSF sample was obtained from the atlanto-occipital space, and submitted for cytological examination and microbial culture. The fluid had a mildly elevated protein content of 0.89 g/L (normal < 0.7 g/L) and a markedly elevated nucleated cell count of 2.03 × $10^9$/L (normal 0 to 0.005 × $10^9$/L).

Department of Clinical Studies (Bröjer, Parsons, Dobson), Department of Pathobiology (Linder, Peregrine), Ontario Veterinary College, University of Guelph, Guelph, Ontario N1G 2W1.

Address correspondence to Dr. Parsons.

Reprints will not be available from the author.

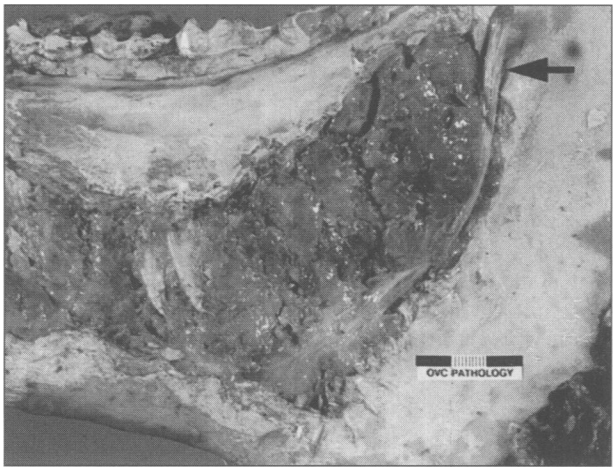


**Figure 1.** Proliferative soft tissue mass present within the right mandible (the medial cortex has been removed). The roots of a cheek tooth are visible centrally in the mass, as is the mandibular nerve (arrow).

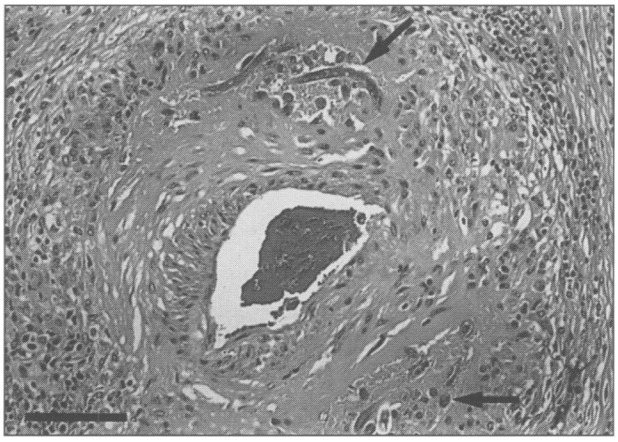

**Figure 2.** Numerous longitudinal and transverse sections of nematodes (arrows) are present in the tunica media of an artery within the mandibular mass. Macrophages and lymphocytes are present within the tunica adventitia; bar = 100 μm.

The nucleated cells in the CSF werae primarily well-preserved neutrophils and a few eosinophils. The CSF glucose concentration was mildly decreased (32% of blood glucose concentration; normal 35% to 70%), while the creatinine kinase level was markedly increased (61 U/L, normal 0 to 8 U/L). These findings indicated neural tissue damage, necrosis, and a possible septic process.

At postmortem examination, an extensive mass of homogeneous, pink, firm tissue was located throughout the entire central portion of the right mandible (Figure 1). In the left mandible, similar tissue extended caudally into the ventral ramus. These masses invested the roots of the cheek teeth and mandibular nerves, bilaterally, and were associated with loss of mandibular bone. A complete transverse pathological fracture of the mandible was located caudal to the symphysis. The hard swelling of the right mandible resulted from remodeling of bone around a tooth root abscess centered on the 3rd premolar.

Lesions were restricted to the mandible and brain both grossly and histologically; however, the spinal cord was not evaluated. Gross lesions of the brain were limited to cloudy areas of the cerebral meninges. Impression smears of the mandibular tissue, stained with Wright's stain, contained numerous nematode life-cycle stages, including eggs, larvae, and adults, some of which contained eggs. Fluid from the suppurative focus involving the 3rd premolar had a mixed population of rod- and coccus-shaped bacteria, as well as degenerate neutrophils. Impression smears of the meninges contained activated stromal cells, occasional foamy macrophages with intracytoplasmic bacterial cocci, a few granulocytes, and mature and immature nematodes. *Actinobacillus equuli* was cultured from the suppurative focus in the right mandible. However, no bacterial growth was obtained from the CSF or multiple meningeal swabs.

Histopathological evaluation of the mandibular mass revealed proliferative granulomatous tissue containing innumerable cross sections of eggs, larvae, and adult nematodes. Nematodes were present multifocally in the walls of medium-sized arteries (Figure 2). Affected vessels were surrounded by macrophages and lymphocytes, and, in more advanced lesions, vessels were replaced by discrete granulomas containing remnants of the internal elastic lamina. Neither nematodes nor inflammatory infiltrates were present in sections of both trigeminal nerves (taken at the level of the trigeminal ganglion) or the right mandibular nerve (taken from the mandibular foramen and from the mandibular body within the mass). Changes in the brain were consistent with lymphohistiocytic meningoencephalitis. Lesions were most prominent in the thalamus, internal capsules, and midbrain, where numerous nematodes, including free eggs, were associated with focal malacia and prominent perivascular cuffing by mixed mononuclear cells. Nematodes were occasionally seen in the tunica media of the small arteries and in the meninges. The nematodes from this horse were cultured and identified morphologically as *Halicephalobus gingivalis* (1). These authors also documented that *Micronema deletrix, H. deletrix,* and *H. gingivalis* are synonymous, with *H. gingivalis* being the correct nomenclature (1).

*Halicephalobus gingivalis* is a free-living nematode that has the potential to be pathogenic. The nematode has thus far been reported to infect both horses (1) and humans (2). In common with other reports, only female nematodes were identified in the horse described here, suggesting that the organism multiplies by parthenogenesis (1,3,4).

At least 31 cases of *H. gingivalis* infection have been described in horses in the literature. These cases were reviewed recently by Anderson et al (1) and included infections involving the brain, kidney, maxilla, mandible, humerus, femur, stomach, adrenal gland, lymph nodes, spinal cord, lungs, and eye. This report also indicated that cases of *H. gingivalis* have a wide geographic distribution, including Japan, North America, Columbia, Egypt, and several countries in Europe (1). The *H. gingivalis* infection previously diagnosed in a horse in Canada was from a carcass in an Alberta slaughter facility (5). The antemortem clinical signs and origin of the horse were not known. In the horse reported here, there was no history of travel outside Ontario. Consequently, this is

the first case of *H. gingivalis* reported in a horse in Ontario and the first in Canada that was known to reside only in Canada. There has been a prior report of a fatal infection in a Canadian child that was thought to have become infected through skin lacerations that were contaminated with feces (6). The fatal nature of *H. gingivalis* appears to be associated with infection of the central nervous system (CNS) in both horses and humans (2,4,7).

The mechanism and circumstances that enable *H. gingivalis* to establish infection and reproduce in the host are unknown. In 2 of the 3 documented human cases, it has been suggested that the nematodes entered via contaminated skin lesions (2,6). The 3rd case had no apparent route of entry (7). In horses, there may be various routes of entry, although an oral or nasal route seems likely. Since the mandibular swelling in the present case preceded clinical signs of CNS dysfunction by several months, it is possible that the draining tract may have been the point of entry for the nematode. The parasite may have proliferated in the decaying tissue around the tooth root. This route of infection is consistent with several other reports of *H. gingivalis* infection that involved structures in the head, including the sinuses, nasal cavity, maxillae, and mandibulae. In each of these cases, the route of entry was presumed to be via lesions in the oral mucous membranes (1). Two described cases with preputial involvement support the theory that the nematode requires mucous membranes or mucocutaneous junctions for tissue invasion (4). Since *H. gingivalis* is a free-living nematode in the soil, the oral mucosa could be exposed to the parasite through contaminated feed, and the preputium exposed by direct contact with soil when the horse is recumbent.

The route of the cerebral infection in this horse is consistent with hematogenous spread, as suggested in the literature (1). Parasites were located in an embolic (associated with blood vessels) pattern in the brain. The novel observation of parasites infiltrating the arterial walls suggests a mechanism by which parasites gain access to the vascular system. Rames et al (8) described a case of ocular *H. gingivalis* infection and suggested that the nematodes migrated from the eye to the brain via optic nerve tracts. In the present case, a mechanism of local extension via the trigeminal nerves was considered; however, bilateral histological evaluation of these nerves failed to provide evidence of nematode migration. Finally, it has been suggested that the nervous system dysfunction that is frequently seen in infected horses may be attributed to a hypersensitivity reaction to dying parasites (9). However, the mare described here had not been treated with an anthelmintic close to the time of development of neurological signs. Therefore, the presence of viable nematodes or bacteria in the brain would appear to have been directly associated with the clinical signs.

The history of anthelmintic use in this mare, consisting of ivermectin administration at 2 and 7 mo prior to presentation, brings into question the actual timing of the infection with reference to the mandibular draining tract. It is possible that the nematode only recently invaded the mandible of this horse, localizing there as an opportunistic pathogen. Another possibility, which may explain the apparent anthelmintic failure, is that the nematode was protected from high concentrations of drug by sequestration in bone or granulation tissue. Finally, lack of sensitivity of the nematode to ivermectin is a possibility.

Recommendations for treatment of infection with *H. gingivalis* at this time are unclear, due to the lack of knowledge regarding the route of entry of the organism and its susceptibility to anthelmintic drugs. In cases that were treated with ivermectin or benzimidazoles, the horses have failed to survive (4,10–12). However, all these cases were in the terminal stages of the disease. In one case, in which the infection was limited to the prepuce, the successful treatment included a combination of ivermectin and diethylcarbamazine (4).

In conclusion, *H. gingivalis* infection should be considered as a differential diagnosis for osseous granulomatous lesions in horses in Canada. Once the diagnosis of *H. gingivalis* infection is made, a poor prognosis for recovery should be given. When diagnosis is made prior to the development of nervous signs, treatment may be attempted, but the potential for rapid neurological deterioration should be acknowledged. CVJ

## References


1. Anderson RC, Linder KE, Peregrine AS. *Halicephalobus gingivalis* (Stefanski, 1954) from a fatal infection in a horse in Ontario, Canada with comments on the validity of *H. deletrix* and a review of the genus. Parasite 1998;5:255–261.
2. Gardiner CH, Koh DS, Cardella TA. *Micronema* in man: third fatal infection. Am J Trop Med Hyg 1981;30:586–589.
3. Simpson RM, Hodgin EC, Cho DY. *Micronema deletrix*-induced granulomatous osteoarthritis in a lame horse. J Comp Pathol 1988;99:347–351.
4. Dunn DG, Gardiner CH, Dralle KR, Thilsted JP. Nodular granulomatous posthitis caused by *Halicephalobus* (syn *Micronema*) sp. in a horse. Vet Pathol 1993;30:207–208.
5. Chalmers GA, Kennedy MJ, Martin WB, Ettrich WF. *Micronema deletrix* in the kidney of a horse. Can Vet J 1990;31:451–452.
6. Hoogstraten J, Young WG. Meningo-encephalomyelitis due to the saprophagous nematode, *Micronema deletrix*. Can J Neurol Sci 1975;2:121–126.
7. Shadduck JA, Ubelaker J, Telford VQ. *Micronema deletrix* meningoencephalitis in an adult man. Am J Clin Pathol 1979;72:640–643.
8. Rames DS, Miller DK, Barthel R, et al. Ocular *Halicephalobus* (syn, *Micronema*) *deletrix* in a horse. Vet Pathol 1995;32:540–542.
9. Ruggles AJ, Beech J, Gillette DM, Midla LT, Reef VB, Freeman DE. Disseminated *Halicephalobus deletrix* infection in a horse. J Am Vet Med Assoc 1993;203:550–552.
10. Keg PR, Mirck MH, Dik KJ, Vos JH. *Micronema deletrix* infection of a Shetland pony stallion. Equine Vet J 1984;16:471–475.
11. Trostle SS, Wilson DG, Steinberg H, Dzata G, Dubielzig RR. Antemortem diagnosis and attempted treatment of (*Halicephalobus*) *Micronema deletrix* infection in a horse. Can Vet J 1993;34: 117–118.
12. Johnson KH, Johnson DW. Granulomas associated with *Micronema deletrix* in the maxillae of a horse. J Am Vet Med Assoc 1966; 149:155–159.