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Short communication

Traumatic brain abscess due to Streptococcus equi subspecies zooepidemicus in a Foal

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Abstract

Bacterial infection of the equine central nervous system is rare. This report describes the clinical features, computed tomography (CT) findings, and postmortem results of a 3-month-old female Quarter Horse with an intracranial abscess. Clinical signs included seizures, depression, and bilateral blindness. CT imaging demonstrated a large space-occupying lesion in the left cerebral hemisphere, associated with a frontal bone fracture. Necropsy and histopathology confirmed the presence of an abscess secondary to head trauma. Bacterial culture identified *Streptococcus equi* subsp. *zooepidemicus* as the causative agent. Brain abscess should be considered a differential diagnosis in foals presenting with seizures and other acute neurological abnormalities

Keywords

Abscess, computed tomography, Streptococcus equi subsp. zooepidemicus

Introduction

Several reports have described the clinical course of intracranial abscesses in horses; however, most of these cases have involved adult animals (Cornelisse et al., 2001; Spoormakers et al., 2003; Audigié et al., 2004; Smith et al., 2004; Hanche-Olsen et al., 2012; Schott II et al., 2020). Neurological deficits such as abnormal mentation, blindness, and multiple cranial nerve deficits, when coupled with a relevant history, suggest the presence of an intracranial lesion affecting the cerebral hemisphere and brainstem. However, clinical signs typically become apparent only once the lesion is sufficiently large to impair cerebral function (Divers, 2006). In most horses, a thorough physical and neurological examination can determine the location and severity of brain injury (Feary et al., 2007). Computed tomography (CT) and magnetic resonance imaging are recommended for detecting structural abnormalities within the brain and skull (Spoormakers et al., 2003; Audigié et al., 2004; Lacombe, 2015). Additionally, cerebrospinal fluid (CSF) analysis can provide valuable diagnostic information (Feary et al., 2007).

Streptococci are a common group of bacteria responsible for brain infections in domestic animals, including horses (Ribeiro et al., 2023). Streptococcus equi subsp. zooepidemicus (S. zooepidemicus) is a versatile bacterium commonly found in the microbiota of the oral cavity, pharynx, and respiratory tract of domestic animals, including horses (Walter, 2017). While usually harmless, S. zooepidemicus can be associated with opportunistic infections in domestic animals, particularly horses (Rasmussen et al., 2013). In humans, there are reports of zoonotic infections

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such as bacteremia, meningitis, endocarditis, and arthritis (Friederichs et al., 2009; Franceschi et al., 2024). This represents a One Health concern given the close relationship between humans and horses (Kim et al., 2022) and the risk of pathogen transmission from horses to humans (Pelkonen et al., 2013).

Treatment of abscesses is often challenging and carries a high mortality rate (Broux et al., 2019). Diagnosis via CT, followed by craniotomy for surgical debridement or drainage combined with long-term antibiotic therapy, has been described as a successful therapeutic approach (Cornelisse et al., 2001; Broux et al., 2019; Schott II et al., 2020).

This report describes the clinical features, CT findings, and postmortem results of a 3-month-old female Quarter Horse diagnosed with an intracranial abscess caused by S. zooepidemicus following head trauma.

Case description

A 3-month-old female Quarter Horse was referred for evaluation of seizures and apparent blindness. The foal had experienced generalized seizures at 35, 50, and 80 days of life. According to the owner, the animal had suffered head trauma a few days before the first seizure. The last seizure occurred 2 days before presentation, after which the foal remained unconscious and in lateral recumbency with continuous paddling movements (Video, Supplementary Material).

On admission, the foal was in status epilepticus, presenting a comatose mental state, absence of response to external stimuli, and bilateral loss of menace response. Multiple abrasions were observed across the body. Increased muscle tone and exaggerated reflexes were evident in all limbs. Ophthalmoscopic examination of the fundus could not be performed due to marked eyelid edema. The foal was afebrile, and no abnormalities were detected in the musculoskeletal, cardiorespiratory, gastrointestinal, or urogenital systems.

A complete blood count revealed neutrophilia (7060 cells/µL; reference range, 2700–6700 cells/µL) without leukocytosis (9800 cells/µL; reference range, 5200–13,900 cells/µL) and hyperfibrinogenemia (600 mg/dL; reference range, 100–400 mg/dL). Serum biochemistry showed increased activities of creatine kinase (4715 U/L; reference range, 2.4–23.4 U/L), aspartate aminotransferase (411 U/L; reference range, 226–366 U/L), and alkaline phosphatase (685 U/L; reference range, 143–395 U/L). Serum glucose, total protein, albumin, globulin, urea, and creatinine values were within normal limits. Urinalysis revealed no abnormalities. Cerebrospinal fluid (CSF) collected from the atlanto-occipital space showed a normal nucleated cell count (2 cells/µL) and a protein concentration of 66 mg/dL. CSF culture was also negative.

The history of cranial trauma combined with the leukogram findings raised suspicion of a bacterial infection. The foal was treated with ceftiofur, dexamethasone, diazepam, midazolam, and phenobarbital for 3 days, without clinical improvement.

CT scans with 2-mm slice thickness revealed an amorphous intracranial structure with well-defined, slightly hyperdense margins (HU = 39) and a slightly hypodense core (HU = 20.38) compared with the surrounding brain parenchyma (HU = 30.72), consistent with a brain abscess. The mass measured approximately 6 cm in diameter and was located in the left parietal, temporal, and occipital lobes, producing a marked mass effect on adjacent structures. A discrete hypodense halo (HU = 19) was observed around the lesion, consistent with perilesional edema (Figure 1A). Three-dimensional reconstructed CT images revealed discontinuity of the frontoparietal bone (Figure 1B).

Given the absence of systemic or local signs of infection, head trauma was considered the most likely source of brain infection and subsequent abscess formation.

The neurological signs did not improve despite treatment, and surgical intervention was not considered feasible due to the size of the abscess. Consequently, the foal was euthanized at the owner's request.

During postmortem examination, brain material was aseptically collected for bacterial culture after removal of the skull and opening of the dura mater (Figure 1E). Necropsy confirmed the presence of an abscess in the left cerebral hemisphere, with compression and destruction of both white and gray matter (Figures 2A, 2B, and 1D), consistent with the extent of the lesion described by CT. In addition, cranial fractures of the parietal, temporal, and occipital bones (Figure 1C) and multifocal subdural hematomas were identified.

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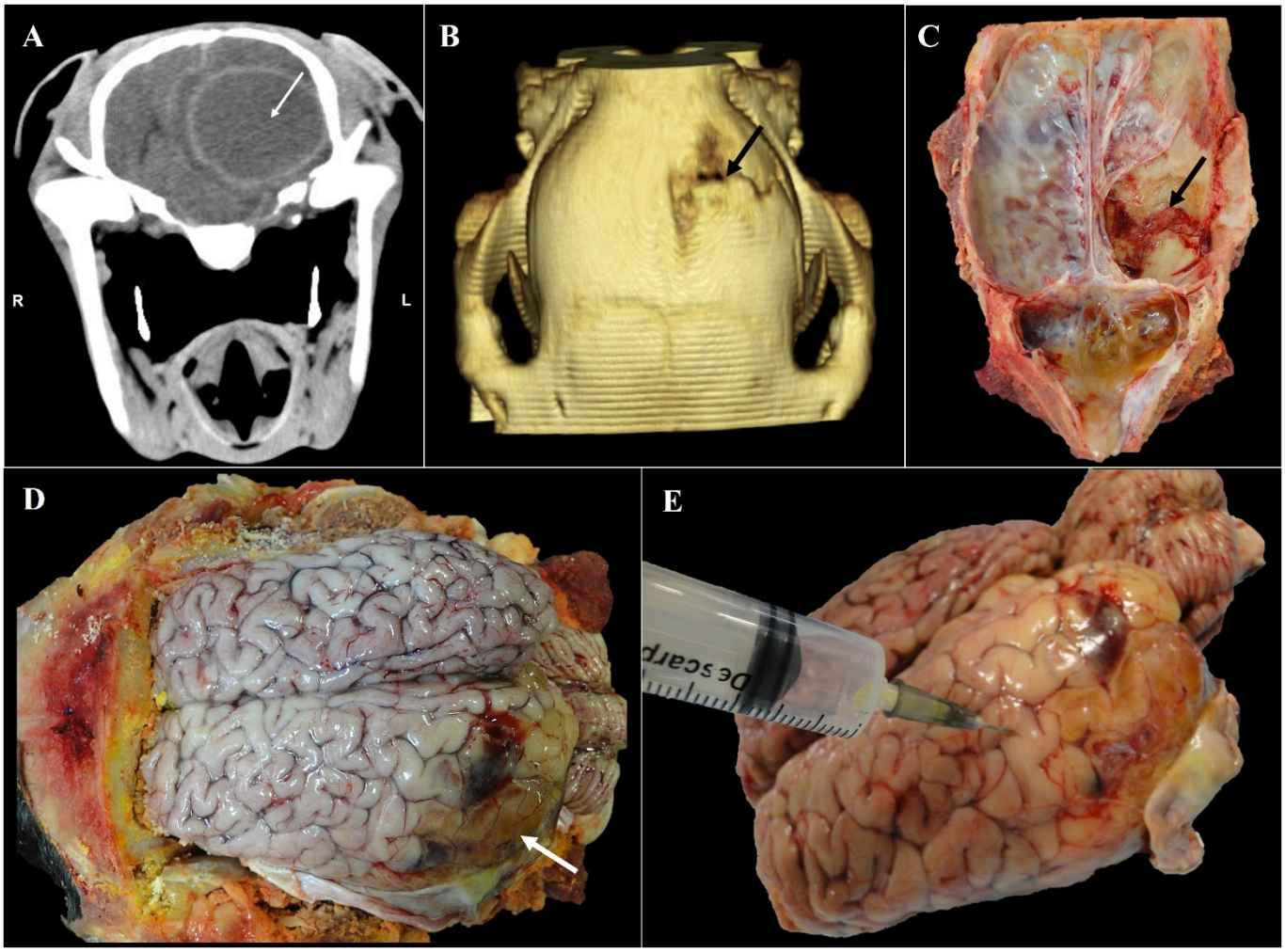

Figure 1. Traumatic brain abscess in a foal. A) Computed tomography (CT) axial image showing a large space-occupying abscess in the left cerebral hemisphere, causing a rightward midline shift and marked asymmetry between the cerebral hemispheres. A surrounding hyperdense capsule is visible (R = right; L = left). B) Three-dimensional reconstructed CT image highlighting a cranial fracture (arrow). C) Frontal bone fracture (arrow) on the left ventral aspect of the calvarium. D) Gross view of a yellow–red space-occupying mass markedly enlarging the left parietal, occipital, and temporal lobes, more evident on the dorsal and lateral aspects of the left cerebral hemisphere (arrow). E) Aseptic collection of material from the lesion for bacterial culture.

Brain tissue was simultaneously cultured on sheep blood agar (5% defibrinated ovine blood; Oxoid™, Hampshire, UK) and MacConkey agar (Oxoid™, Hampshire, UK), incubated aerobically at 37 °C for 72 h. After 18–24 h, small (0.5 mm), beta-hemolytic, translucent colonies compatible with *Streptococcus* spp. were isolated. Phenotypic characterization included Gram staining, catalase testing, and biochemical assays such as sugar fermentation (lactose, maltose, sorbitol, trehalose) and aesculin hydrolysis (Quinn et al., 1991, 2002). Gram staining revealed gram-positive cocci arranged in long chains, consistent with *Streptococcus* morphology. The isolate was catalase negative, a typical reaction distinguishing streptococci from catalase-positive staphylococci. Further biochemical testing (Api 20 Strep™, bioMérieux SA, Lyon, France) showed positive reactions for lactose, maltose, and sorbitol, and negative reactions for trehalose and aesculin, identifying the isolate as *Streptococcus equi* subsp. *zooepidemicus* (Quinn et al., 1994, 2002).

Histopathological examination of the left cerebral hemisphere revealed chronic inflammatory infiltration composed of neutrophils, macrophages, and lymphoplasmacytic cells, circumscribed by a thick fibrous capsule (Figure 2C). The abscess was surrounded by a broad zone of Gitter cells, gliosis, vacuolization, and necrosis. Degenerated neurons, edema, and severe vascular congestion were also observed.

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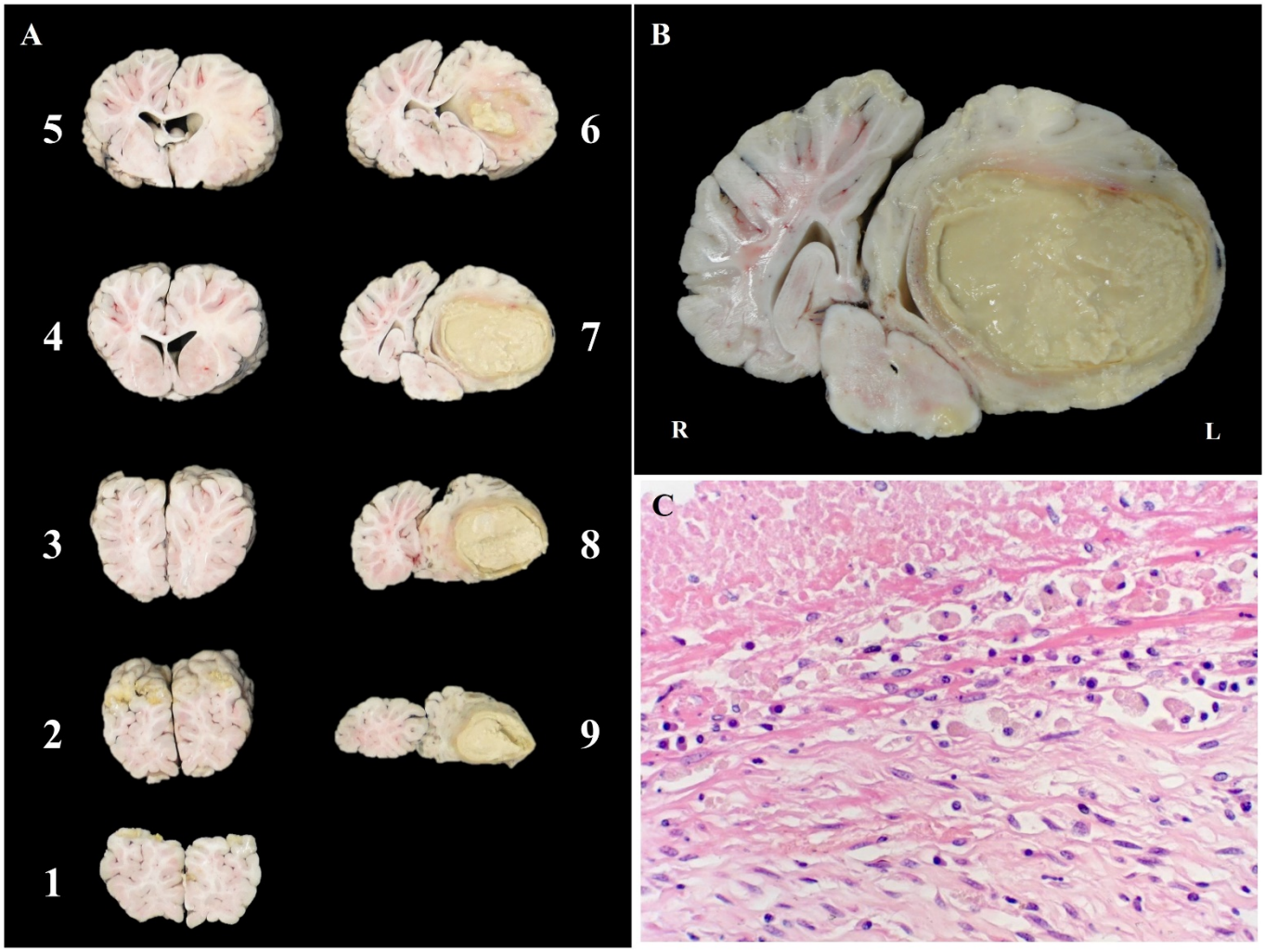

Figure 2. Traumatic brain abscess in a foal. A) Gross view of the brain showing the extent of the lesion involving portions of the left parietal, occipital, and temporal lobes. The lesion produces a mass effect, midline shift, and involvement of the hippocampus, thalamus, mesencephalon (7), and telencephalic cortex. Numbers 1–9 indicate serial sections of the brain in a rostral-to-caudal orientation. B) Close-up of the abscess in the left cerebral hemisphere (corresponding to Figure 2A), measuring 5–6 cm in diameter. The lesion causes compression and destruction of both white and gray matter, with displacement of the mesencephalon and midline (R = right; L = left). C) Histopathological section of the left cerebral hemisphere showing mixed inflammatory infiltration circumscribed by a thick fibrous capsule. Hematoxylin and eosin (HE), 400×.

Discussion

Only a few reports of brain abscesses in foals are available (Audigié et al., 2004; Hanche-Olsen et al., 2012; Broux et al., 2019). In adult horses, cerebral abscesses are most often associated with previous cranial trauma or secondary bacterial invasion. In foals, they usually result from disseminated *S. equi* infection (Divers, 2006). This differs from the present case, in which direct extension through cranial trauma represented the portal of entry for the bacteria, as the other three routes of entry into the central nervous system described by Miller and Porter (2021)—hematogenous trafficking, leukocytic trafficking, and retrograde axonal transport—were not supported by the necropsy and histopathological findings.

Affected animals typically exhibit focal neurological signs that reflect the localization of the abscess within the central nervous system (Bell & Smart, 1992). In this foal, depression, blindness, and seizures could be explained by CT and pathological findings. Similar neurological signs, particularly impaired vision, depression, and seizures, have been consistently reported in association with brain abscesses in horses (Spoormakers et al., 2003; Broux et al., 2019).

Diagnosis of a cerebral abscess requires careful evaluation of the clinical history (previous trauma or bacterial infection) together with asymmetric localizing signs of brain dysfunction (Divers, 2006). CSF findings may remain within normal limits when the abscess is well encapsulated, as observed in this case (Divers, 2006). A complete neurological examination is essential for lesion localization; however, CT is often indispensable for definitive diagnosis and treatment planning in equine patients (Hanche-Olsen et al., 2012). In the present case, 3D reconstructed CT

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images provided detailed and accurate anatomical information about the cranial fracture. Conversely, some authors have reported the use of CT only as a diagnostic aid (Janicek et al., 2006; Hanche-Olsen et al., 2012).

Antibiotic therapy should involve bactericidal drugs capable of crossing the blood–brain barrier (Schott II et al., 2020). Third-generation cephalosporins are recommended as first-line agents, given the pathogens most frequently isolated from cerebral abscesses in horses (Cornelisse et al., 2001). Inflammation and edema surrounding the abscess are common, which may explain the temporary improvement sometimes observed with glucocorticoid therapy (Divers, 2006). In the present case, treatment with ceftiofur, dexamethasone, and anticonvulsants was initiated before CT diagnosis of the abscess but did not result in clinical improvement.

Although brain abscesses in horses may be successfully managed with combined medical and surgical treatment (Cornelisse et al., 2001; Broux et al., 2019; Schott II et al., 2020), the prognosis is generally poor when medical therapy is used alone (Schott II et al., 2020). In the present case, surgical intervention was not considered feasible owing to the size of the abscess and the patient's clinical status. Successful treatment of a brain abscess has been reported in a foal presenting after a single seizure and with a smaller, localized lesion (Cornelisse et al., 2001). By contrast, in the present case the foal was presented 50 days after the initial head trauma and had already experienced three episodes of convulsions. This considerable delay likely had a negative impact on the prognosis, as head trauma should be regarded as an emergency. Earlier antibiotic administration might have limited bacterial infection and prevented or slowed abscess formation and progression.

Finally, the lack of isolate characterization by mass spectrometry or molecular methods represents a limitation of this study in confirming the diagnosis of *S. zooepidemicus*.

Conclusion

The present case emphasizes the need for prompt veterinary evaluation of head trauma in foals and underlines the importance of including brain abscesses in the differential diagnosis of neurological disorders, particularly when the clinical history and presenting signs are suggestive. The identification of S. zooepidemicus as the causative agent following encephalitic trauma illustrates the opportunistic nature of this commensal bacterium, which commonly inhabits the mucous membranes and respiratory tract of horses. Furthermore, this report highlights the relevance to human health due to the zoonotic potential of S. zooepidemicus and the close interaction between humans and horses.

Ethical approval

All procedures were routinely conducted according to the ethical principles of veterinary medicine practice.

Author contributions

Conceptualization: (Dr. Palumbo, Dr. Cavalcante, Dr. Cagnini, Dr. Amorim and Dr. Secorum); Formal analysis and investigation: (Dr. Cagnini, Dr. Rocha, Dr. Cavalcante, Dr. Amorim, Dr. Machado, Dr. Ribeiro, and Dr. Secorun); Writing - original draft: (Dr. Cavalcanti, Dr. Palumbo); Writing – review and editing: (Dr. Cagnini, Dr. Ribeiro, Dr. Rocha, Dr. Palumbo); Supervision: (Dr. Secorun, Dr. Amorim, and Dr. Rocha).

Conflict of interest

The authors declare no competing interests.

Data availability

Not applicable.

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