Pathology in Practice

Figure 1—Photographs of a transverse section of the T18 vertebral body (A) with a magnified image of that vertebral body (B) and a sagittal section of the left forelimb (C) of a 12-year-old Pony of the Americas mare that was evaluated because of a 2-week history of weight loss and a 1-week history of inappetence, lethargy, intermittent fever, and grunting coupled with generalized signs of pain when moving backward. One month prior, the pony had mild lameness of the left forelimb (attributable to cellulitis), which resolved with treatment. Three days after the initial evaluation, the pony was euthanized because of its deteriorating condition. In panel A, there is mottled red-tan-brown discoloration of the vertebral body (arrowhead) and hypaxial musculature and red-tan discoloration of the extradural adipose tissue (arrow). The spinal canal is labeled (asterisk). In panel B, bony tissue (arrowhead) is visible radiating from the cortex of the vertebral body (arrow). In panel C, there is abundant, red-tan, friable material within the tendon sheaths and in the radiocarpal and intercarpal joint spaces of the left forelimb. In all panels, bar = 1 cm.
Histopathologic and Microbiological Findings

Tissue samples from numerous tissues including the carpal joint, thoracic vertebrae, brain, spinal cord, sciatric nerve, heart, lungs, liver, kidneys, spleen, adrenal glands, skin, uterus, lymph nodes, and large and small intestines were routinely processed for microscopic examination. The vertebral periosteum was expanded by radiating trabeculae of woven bone extending at right angles from the vertebral body, consistent with the formation of reactive periosteal bone (Figure 2). Variably mature fibroplasia was present between trabeculae of the exostotic bone, admixed with large groups of degenerating neutrophils, which occasionally surrounded colonies of gram-negative, rod-shaped bacteria. Trabeculae of exostotic bone closest to the vertebral cortex were undergoing remodeling by osteoclasts, indicative of a long-term process. In many areas, the fibroplasia ran parallel to the trabeculae, suggesting that those areas were a component of the inflammatory process, not just residual periosteum. Multifocal to coalescing marrow spaces in the vertebral body contained many viable and degenerating neutrophils and colonies of similar bacteria. Vertebral myeloid hyperplasia was also observed in lesser affected regions. The dura of the thoracic spinal cord was covered by a dense plaque of fibrin with myriad degenerating neutrophils and mild, multifocal hemorrhage. In the spinal cord, some axonal spaces in the dorsal, lateral, and ventral funiculi were empty and rare myelin degeneration and phagocytosis (digestion chambers) was present; rare swollen axons (spheroids) were also evident. Spinal nerves of affected cord segments were surrounded by inflammation and fibroplasia, with small numbers of digestion chambers. Abundant fibrin, hemorrhage, and viable and degenerating leukocytes (neutrophils and macrophages) were present in the carpal joint space.

The synovial membranes of the radiocarpal and intercarpal joints were hypertrophic and hyperplastic, forming papillary projections into the joint space; many lymphocytes, plasma cells, macrophages, neovascularization, and immature fibroplasia were detected in the subintima. Mild, acute, interstitial pneumonia, severe splenic and lymph node lymphoid depletion, and systemic congestion also were present. Other microscopic findings included congestion of intertubular renal and cardiac blood vessels and scattered foci of mild, acute myocardial and cerebral leptomeningeal hemorrhage. No relevant microscopic findings were observed in tissues samples from the uterus, intestines, liver, adrenal glands, sciatric nerve, or skin. Bacterial culture of a sample of the red-brown mass ventral to the T13 through T18 vertebrae yielded heavy, pure growth of *Klebsiella pneumoniae*.

Morphologic Diagnosis and Case Summary

Morphologic diagnosis: chronic, suppurative, thoracic vertebral osteomyelitis and periostitis; suppurative spinal pachymeningitis and epidural steatitis, with axonal degeneration; and chronic carpal tenosynovitis and arthritis in the left forelimb.

Case summary: vertebral osteomyelitis and paravertebral abscess (*K pneumonia* infection), carpal tenosynovitis, and arthritis in a pony.

Comments

Osteomyelitis is defined as an inflammatory process of the bone and bone marrow that results in bone destruction and is caused by infectious microorganisms.1 In the veteri-
nary medical literature, vertebral osteomyelitis has been described in various species, including dogs, cats, calves, lambs, and foals, but is less frequent in adult horses.\(^1\) Vertebreal osteomyelitis most often results from hematogenous seeding from a primary site of infection, traumatic injury, or contiguous spread from an infection in adjacent soft tissue; however, iatrogenic inoculation during spinal surgery can also serve as a source of infection in applicable species.\(^2\)

A small number of reports\(^3\) of vertebral osteomyelitis or paravertebral abscesses in adult horses have described clinical signs including fever, signs of neck or back pain, muscle twitching, generalized stiffness, shuffling gait, progressive ataxia, limb weakness, muscle atrophy, and intermittent fever. Many affected horses have been described as having difficulty rising from recumbency and a history of prolonged or persistent recumbency.\(^4\) An inflammatory leukogram along with hyperfibrinogenemia was detected in the pony described in the present report as well as previously reported cases.\(^5\) Moderate to severe elevations in serum fibrinogen concentrations (>900 mg/dL) have been used as a diagnostic indicator of phlegy or epiphysyal osteomyelitis in foals.\(^6\) Evaluation of CSF samples from horses with vertebral osteomyelitis may reveal no abnormal characteristics; however, a small number of affected horses have had high total protein concentration and WBC count.\(^7\) Although bacteriologic culture of blood is highly recommended for people suspected of having vertebral osteomyelitis, in a study\(^8\) of 5 horses with vertebral osteomyelitis, 2 underwent bacteriologic culture of blood, which yielded no growth.

Plain radiography can be used as an initial diagnostic screening method in humans with vertebral osteomyelitis and may help rule out other causes of clinical signs.\(^9\) However, radiographic changes can take weeks to months to become detectable, thereby delaying diagnosis.\(^10\) Although not routinely feasible in adult horses, MRI and CT is used in people and small animals to help differentiate causes of neurologic deficits and identify evidence of vertebral osteomyelitis.\(^11\)

Ultrasonography may serve as an adjunctive imaging technique in horses with vertebral osteomyelitis.

Treatment for vertebral osteomyelitis includes long-term administration of broad-spectrum antimicrobial and anti-inflammatory medications, surgical exploration and debridement of affected bone, or drainage of accessible abscesses (eg, cervical vertebral body).\(^12\) Penicillin and trimethoprim-sulfamethoxazole have been used in horses with vertebral osteomyelitis, but other antimicrobials, selected ideally on the basis of bacterial culture and antimicrobial susceptibility results, may be viable options.\(^13\) Of 10 adult horses described previously (including the case described in the present report),\(^11\) 3 survived after medical or surgical treatment and had no reported long-term neurologic deficits.

The exact pathogenesis of the vertebral osteomyelitis in the pony described in the present report was unknown, but bacteremia originating from the chronic forelimb infection initially observed 1 month prior was suspected. Interestingly, the median time between onset of symptoms to diagnosis was 1.8 months in a retrospective study\(^11\) of vertebral osteomyelitis in 233 humans, and that interval can range from 6 weeks to 7 months, exemplifying the subacute nature of the illness, the insidious progression of disease, and the fact that clinicians are unaccustomed to consider vertebral osteomyelitis as a differential diagnosis because of the rarity of this disease process.\(^11\) The presence of bacteremia in the pony of the present report was supported by the suppurative interstitial pneumonia, lymphoid depletion, and systemic congestion. However, in horses, hematogenous spread of bacteria is typically limited to foals with septi-cemia. Thus, although not confirmed, immunosuppression with lymphoid depletion was possible in this case. In addition, multiple joints were affected grossly, to varying degrees, which may have been secondary to bacteremia. No evidence of traumatic injury to the vertebrae, hypaxial musculature, or regional subcutis was evident, ruling out traumatic injury as a source of vertebral infection. In previously described equine cases, the suspected nidus of infection included injection and abscesses in the paravertebral area, lungs, or mediastinum.\(^11\)

In the case described in the present report, clinical signs likely resulted from the proliferative bone along the ventral surface of the vertebral bodies and development of a large diffuse abscess that expanded the underlying retroperitoneal and retropleural soft tissues, resulting in compression of the associated spinal cord. Further damage to the thoracic portion of the spinal cord resulted from a combination of compression from the space-occupying inflammatory exudate in the spinal canal and injury associated with the cytokine and vascular components of inflammation.\(^11\) Vertebral osteomyelitis should be considered as a differential diagnosis in horses with signs of back pain, fever, abnormal gait, and evidence of a systemic inflammatory process.

### References