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NOTE

Surgery

Spinal epidural empyema concurrent with sequestrum in a cat: a case report

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ABSTRACT. A 5-month-old intact female mixed cat presented with repetitive paraplegia and drainage of pus from the back despite continuous antibiotic medication. Neurologic examination was consistent with below T3-L3 myelopathy. Computed tomography and magnetic resonance imaging revealed a contrast-enhanced mass in the L1-3 spinal canal, and bone fragments in the T13 and L1 spinal canal. Spinal epidural empyema was suspected, and hemilaminectomy was performed for T12-L2 on the right side and T11-12 on the left side. Bone fragments were diagnosed as sequestrum infected with *Bacteroides* sp. The cat recovered enough to ambulate next day. One month after surgery, there was no deficit in neurological function. This is the first report of spinal epidural empyema concurrent with sequestrum in a cat.

KEYWORDS: cat, empyema, neurosurgery, sequestrum, spine

Spinal epidural empyema is the formation of an abscess in the epidural space. This disease can lead to mechanical compression by the infectious mass, causing neurological dysfunction [4]. Severe or chronic mechanical compression of the spinal cord can lead to be necrosis [8]. Spinal epidural empyema is a rare disease in dogs and cats [3, 5, 6, 13, 14]; routes of infection in previous reports include hematogenous spread invading, discospondylitis, prostatitis, dermatitis, paraspinal infection following penetrating injury, urinary tract infection, pyothorax, direct inoculation [3, 14], aberrant parasites, and migration of foreign bodies [5, 6]. Clinical signs of spinal epidural empyema are fever, neck pain, and neurological signs of a transverse myelopathy [5, 14]. We encouraged a cat with repetitive and chronic spinal epidural empyema concurrent with sequestrum in the vertebral canal.

A 5-month-old 1.8 kg non-neutered female mixed cat was referred with a history of acute onset of paraplegia, which became repetitive and progressive. The cat had been brought home from outside 2 months previously and presented with paraparesis, back pain, and pus drainage from back. The cat recovered but clinical signs recurred after the treatment with antibiotics, including enrofloxacin (5 mg/kg, SC, q24 hr), amoxicillin (25 mg/kg, PO, q12 hr), orbifloxacin (5 mg/kg, PO, q24 hr), and clindamycin (10 mg/kg, PO, q12 hr). Paraplegia, and urinary and fecal incontinence occurred a week before admission. Creatine phosphokinase increased to 1,058 U/L (ref: 20–170 IU/L). Feline immunodeficiency virus antibody and feline leukaemia virus antigen tests were negative. Other hematology and serum biochemistry results were shown in Supplementary Table 1. Neurologic examination found paraplegia and upper motor neuron signs of hindlimbs. Neurologic examination suggested a T3-L3 localized myelopathy. Lack of deep pain in the hindlimbs, and back pain on palpation, were observed. No abnormalities were found in cranial nerve assessment. *Staphylococcus intermedius* was detected in bacterial culture from pus drainage from the back.

Radiographic revealed osteolysis of the dorsal vertebral arch (L1) and dorsal vertebral bodies (T12, L1, and L2), and narrowed intervertebral space (L2-3). Computed tomography (CT) and magnetic resonance imaging (MRI) were undertaken to examine the T3-L3 myelopathy. MRI was performed using a 0.4 T unit (APERTO Inspire version V5.0M; Hitachi Healthcare Systems, Osaka, Japan). Anesthesia was induced by propofol (MSD Animal Health, Tokyo, Japan) at a dose of 6.0 mg/kg and was maintained by isoflurane (MSD Animal Health). The sequences included T2-weighted images (T2WI; TR, 2,800 msec; TE, 120 msec), fluid-attenuated inversion

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recovery (FLAIR; TR, 6,900 msec; TE, 120 msec), T1-weighted images (T1WI; TR, 300 msec; TE, 14.3 msec), and postcontrast T1WI. CT was also performed using a multidetector 16-slice scanner (Activion16; Canon Medical Systems Corp., Otawara, Japan). CT revealed a fracture of the dorsal vertebral arch in the first lumbar vertebra, and osteolysis in the L1 ventral vertebral canal with rough margins (Fig. 1A). A subcutaneous soft tissue mass was also found infiltrating into a spinal canal, contrast-enhanced along the margins following intravenous contrast administration with 2 mL/kg of non-ionic contrast medium (Omnipaque, GE Helthcare, Chicago, IL, USA), and a soft tissue mass in the dorsal epidural space compressing the dural sac ventrally were also observed (Fig. 1B, 1C). Hyperdense isolated bone fragments in the extradural soft tissue mass were also observed (Fig. 1A, 1D). MRI showed extradural compression of the spinal cord at the level of T11 to L2 (Fig. 2A). This hyperintensity of the T2WI lesion infiltrating from the subcutaneous region to the vertebral canal (Fig. 2B) was enhanced following intravenous contrast administration of gadoteridol (0.2 mL/kg intravenous administration; ProHance, Eisai Corp., Tokyo, Japan) (Fig. 2C, 2D). The Cerebrospinal fluid (CSF) collected by the lumbar puncture was provided for protein concentrations and bacterial culture. The protein concentrations were 302 mg/dL, which correspond to inflammation in the intradural cavity. Bacterial culture results were negative in CSF. Spinal epidural empyema was suspected, based on these findings, and emergent surgical intervention was performed the same day.

The cat was placed in sternal recumbence, and hemilaminectomy was performed for T12-L2 on the right side and for T11-12 on the left side, and abscessectomy. Fentanyl (Daiichi Sankyo Co., Tokyo, Japan) was administered 5 µg/kg followed by a constant rate infusion 5–20 µg/kg/hr. A large amount of white abscess tissue and bone fragments were found within the epidural cavity (Fig. 3). The epidural space was washed by 0.9% normal saline. Abscess and bone fragments were removed surgically and parts of them were taken for microbial culture and histopathology with abnormal tissue suctioned copiously. Bone fragments were found pathologically to be sequestrum (Fig. 4), and *Bacteroides* sp. was detected in bacterial culture from the abscess. Postoperative management consisted of antimicrobial therapy with doses of 20 mg/kg cefazolin intravenously for 1 week, and followed by 10 mg/kg clindamycin orally based on the result of bacterial culture examination every 12 hr for 4 weeks. Buprenorphine (Otsuka Pharmaceutical, Tokyo, Japan; 10 µg/kg) was administered intravenously for 3 days. The cat became ambulatory on the next day and was discharged 4 days after the surgery. At 4-week recheck, the cat was ambulatory with normal proprioception. CT and MRI were performed to check for any neurological lesion in spinal canal, and no revealed that any compressive lesions were found.

The aim of treatment for spinal epidural empyema is to relieve the epidural abscess pressure and then finally eliminate the abscess and causative bacteria through surgery and antimicrobial therapy. Treatment guidelines for canine and feline spinal epidural empyema have not been established, although continuous medication and dorsal laminectomy or unilateral laminectomy are commonly performed

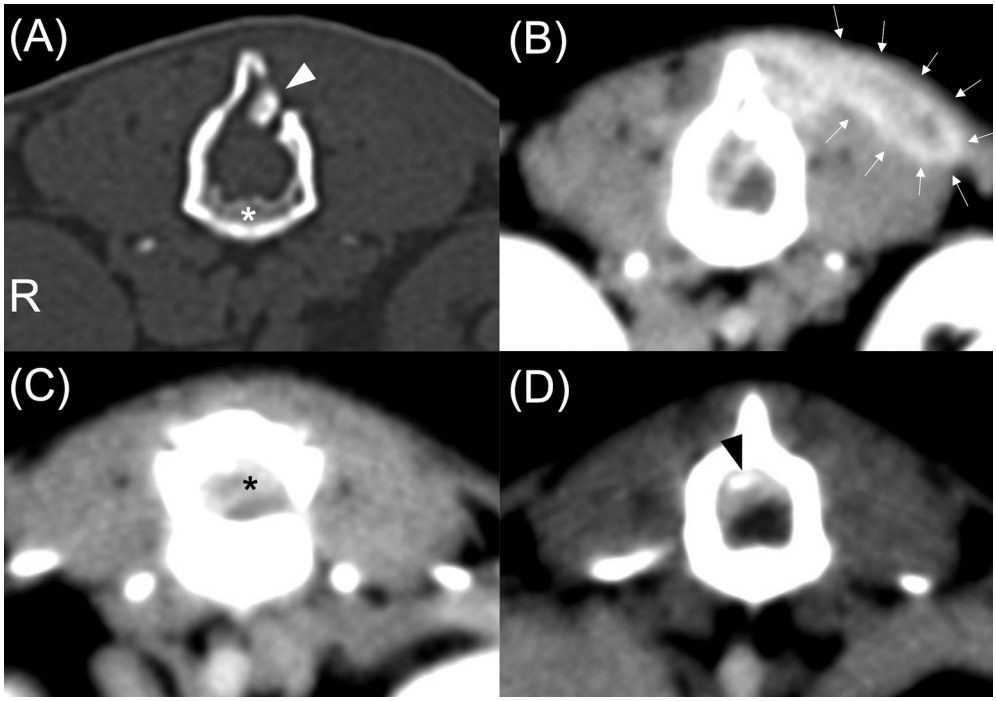

Fig. 1. Transverse CT images of the thoracolumbar spine of the cat. (**A**) Pre-contrast transverse image at the level of L1 reconstructed with a bone algorithm (window level: 400 Hounsfield units [HU], window width: 3,000 HU). A fracture of the vertebral arch (white arrowhead) and osteolysis of ventral vertebral body were in spinal canal with rough margins (white asterisk) were found. Post-contrast (**B**, **C**) transverse images reconstructed with a soft tissue algorithm (window level: 50 HU, window width: 300 HU). The images at the level of L1, and L2 respectively. There was an enlarged soft tissue structure with a thick strongly enhanced rim infiltrating from the subcutaneous region into the spinal canal (white arrow), displacing the spinal cord to the left ventral direction (black asterisk). (**D**) Post-contrast transverse image at the level of T13 reconstructed with a soft tissue algorithm. There was an isolated bone fragment in the soft tissue structure, with a thick strongly enhanced rim in the epidural space (black arrowhead).

for spinal epidural empyema. [5, 6, 12, 17]. In the present case, surgical intervention was applied since long-term antimicrobial therapy was not effective. Some bone fragments were removed as well as the abscess. These bone fragments were diagnosed histopathologically as sequestrum. Pus drainage and neurological dysfunction were not observed postoperatively. Some cases with repetitive and chronic infectious disease due to sequestrum have been reported in humans [1, 15, 19]. Mu *et al*. reported a patient with abscess formed in the past affecting a limb after fifteen years, and surgery was necessary to remove his affected osteoid and necrotic tissues [15]. Hernon *et al.* reported a feline case presenting with continuous lameness and remaining bone fragments diagnosed postoperatively as sequestrum [7]. This sequestrum of the medial palmar sesamoid in the fourth digit might be related to a long-term episode of infection, and surgical removal of the sequestrum would lead to complete recovery. These studies have shown that any remaining foreign body, including sequestrums, increases the risk of persistent infection.

Mechanisms for sequestration have been documented in various reports [9, 10, 12]. Any remaining abscess due to chronic osteomyelitis can cause further bone necrosis, regarded as sequestration because of increased pressure in the bone marrow and absence of blood supply. Because the segments involved are devitalized and have no blood supply, antibiotics have not been reported as penetrating these floating islands of infected bone and eradicating the infection [1, 2]. Antimicrobial therapy alone rarely proved effective, as has been reported in human and cats. In the present case, the chronic and repetitive episode might be related to the bone fragments found on CT and intraoperative findings. Surgical debridement with removal of the infected bone is important in therapy for chronic infection.

For definitive diagnosis of spinal epidural empyema, diagnostic imaging observations of abscess in the epidural space and histopathologic examination are crucial, as well as clinical signs and clinicopathologic findings. MRI is a noninvasive, highly sensitive, and specific imaging modality that can delineate the size and location of the abscess. Its sensitivity to spinal epidural empyema is 91%, easily distinguishing spinal epidural empyema from spinal cord diseases in humans [8]. Spinal epidural empyema tends to have low or intermediate intensity with the loss of cortical margins on T1-weighted images, and high intensity on T2-weighted images. Fluid pus is related to an area of low signal intensity on T1-weighted images, but a boundary of the abscess is enhanced after administration of Gd-contrast medium, representing granulation tissue [11, 18]. In dogs and cats, the epidural empyema with compression of spinal cord are well circumscribed and appear hyperintense on T2-weighted MRI images, and mildly hyperintense or hypointense on T1-weighted images. Contrast enhancement was either diffusely homogeneous, heterogeneous, or ring-like and was moderate to strong [6, 14]. The use of noncontrast CT examination also successfully revealed bone abnormality and a loss of low-attenuating epidural fat. Osteolysis of vertebral body in the spinal canal as confirmed by CT was also found in a cat with chronic spinal epidural abscess [14], and chronic epidural abscess may lead to progressive osteolysis of vertebra. Intravenous contrast CT may have permitted delineation of the subcutaneous abscesses, and of soft tissue structure with a thick strongly enhanced rim in the vertebral canal of dogs and cats [13, 16, 17, 20].

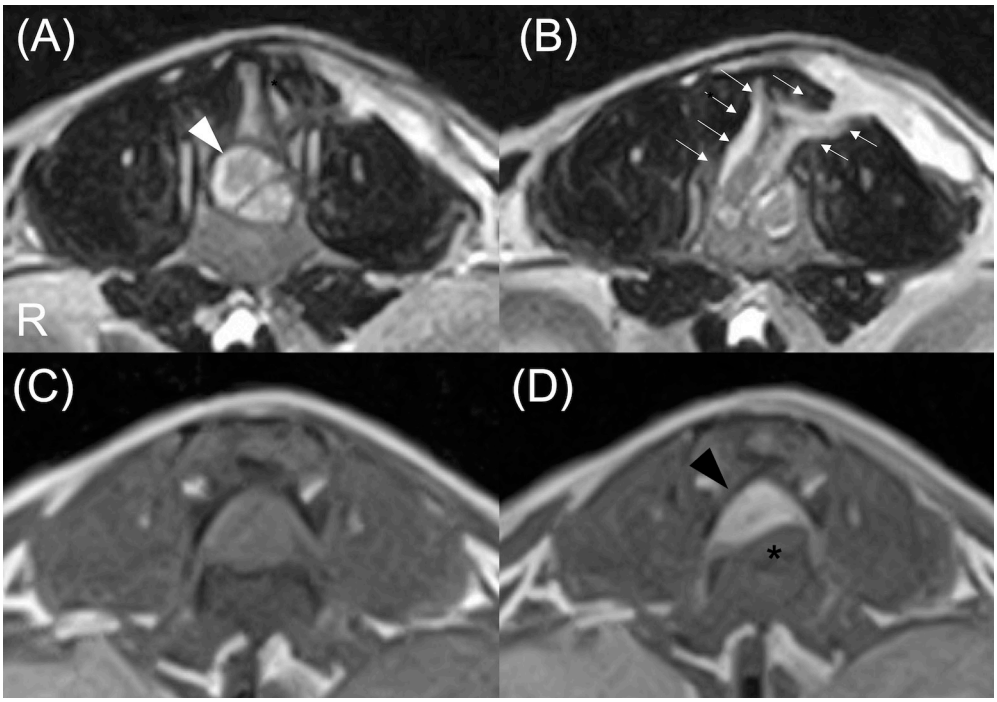

Fig. 2. Transverse MRI images of the thoracolumbar spine of the cat. (**A**) T2WI transverse image at the level of L1. Extradural compression from the dorsolateral was found (white arrowhead). (**B**) T2WI transverse image at the level of L1. Hyper/iso-intesnse irregular lesion infiltrating from the subcutaneous region into the spinal canal was compressing the spinal cord ventrally (white arrow). (**C**, **D**) Pre/Post-contrast transverse image at the level of intervertebral disc of L1-L2. Extradural compression from the dorsolateral homogenous contrast enhanced lesion was found (black arrowhead). A black asterisk indicated the compressed spinal cord (A–D).

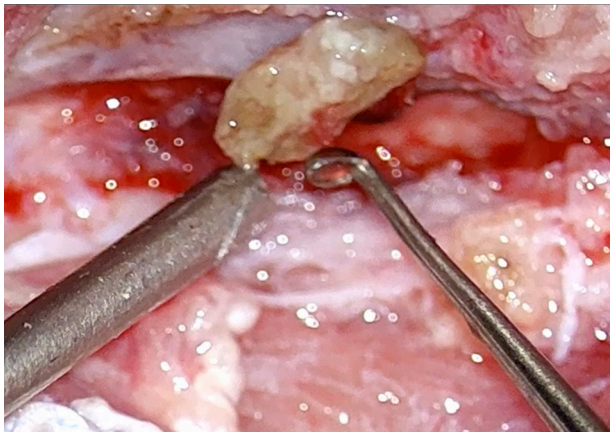

Fig. 3. Interoperative photograph. The bone fragment was found within the epidural cavity.

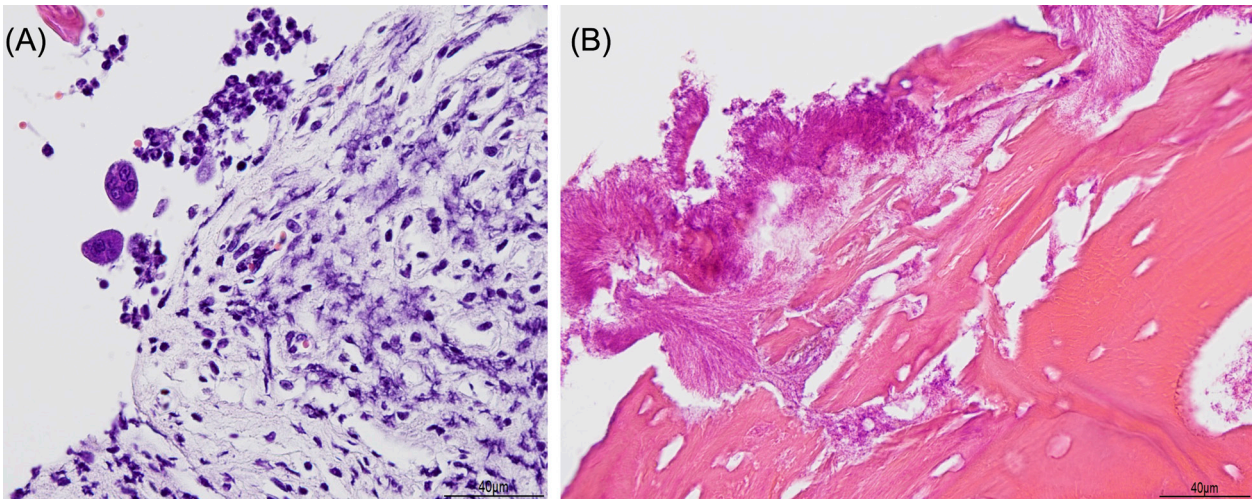

Fig. 4. Hematoxylin and eosin staining of abscess and bone fragment, respectively (A, B). (**A**) Granulation tissue with various inflammation cells including neutrophils and multinucleated giant cells were found, indicating acute osteomyelitis. (**B**) Bacterial colonies infiltrate into the necrotic bones with erosion. This bone fragments were diagnosed as sequestrum histopathologically.

In conclusion, spinal epidural empyema should be included in the differential diagnosis when young cat presents acute progressive neurological deficit. When presenting repetitive clinical course, continuous and repetitive condition might be involved with sequestrum. Rapid diagnosis and surgical intervention are also needed, and potentially useful for improving outcome in cats.

CONFLICT OF INTEREST. The authors declare no potential conflicts of interest in the research, authorship, and/or publication of this article.

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