



NOTE

Surgery

Surgical removal of an intramedullary chopstick fragment penetrating the spinal cord in a cat

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83(11): 1670–1673, 2021

doi: 10.1292/jvms.20-0706

Received: 14 December 2020

Accepted: 26 August 2021

Advanced Epub:

14 September 2021

ABSTRACT. A 3-year-old male domestic shorthair cat presented with sudden ataxia. Neurologic examination showed complete loss of proprioception in the thoracic and pelvic limbs. Computed tomography and magnetic resonance imaging revealed a non-metallic foreign body penetrating the spinal cord. The foreign body was removed by the ventral approach to the atlanto-occipital junction. Mild improvement of proprioception was observed the day after surgery. In a follow-up two months after surgery, the owner reported a complete recovery of the patient, showing a normal gait. To the author's knowledge, this is the first case report describing successful removal of an intramedullary foreign body penetrating cervical spinal cord by ventral approach in a cat.

KEY WORDS: cat, foreign body, intramedullary, spinal cord

Feline spinal cord trauma due to ingestion or inhalation of a foreign body is rarely reported. A misplaced microchip migrating to the vertebral canal has been reported by Platt *et al.* [6] and a splinter-ingestion migrating to the extramedullary region in the cervical vertebral canal has been described by Tanaka *et al.* [10]. This report describes the successful removal of an intramedullary wooden chopstick fragment penetrating the cervical spinal cord in a cat.

A 3-year-old male domestic shorthair cat was presented to the Baeksan Feline Medical Center to evaluate the sudden onset of paralysis in all four limbs. Lethargy and progressive loss of appetite before quadriparesis were reported by the owner.

Through the initial physical and neurological examination, tetraplegia with the rigidity of the forelimbs, absence of proprioception of all four limbs, and loss of cutaneous reflex were identified. There was no neck pain. Hematologic examinations, including complete blood count, serum biochemical profile, electrolyte analysis, FeLV/FIV, proBNP, and fPLI were unremarkable. Thoracic and abdominal radiographs were normal. For further neurologic evaluation, computed tomography (CT, Aquilion Lightning 160, Canon Medical Systems, Otawara, Japan) and 1.5T magnetic resonance imaging (MRI, Signa, GE healthcare, Milwaukee, WI, USA) were performed. CT and MRI images were acquired before and after administration of contrast media (Omnipaque 300[®], GE Healthcare, Milwaukee, WI, USA; Magnevist[®], Bayer-Schering Pharmaceutical, Berlin, Germany), respectively. As a result, on a sagittal T2-weighted image, a sharply margined material with a hypointense signal was detected (Fig. 1A). The intramedullary foreign body penetrating the middle of the spinal cord was identified on dorsal and transverse T2-weighted images (Fig. 1B and 1C). Hyperintensity of the medulla oblongata, cranial to the material, and the spinal cord, caudal to the material, was identified on sagittal, dorsal, and transverse T2-weighted images (Fig. 1A–C). The paraspinal muscles, spinal cord parenchyma, and meninge surrounding the foreign body showed contrast enhancement, suggesting a mild inflammatory response to the foreign body on post-contrast transverse T1-weighted images (Fig. 1D). On a transverse GRE T2-weighted image, a hypointense signal of the spinal cord was identified, indicating hemorrhage of the spinal cord parenchyma (Fig. 1E).

The size of the foreign body varied from 2 mm to 2.5 mm thickness with a length of 2 cm. Air was observed between the oropharynx and the rectus capitis anterior muscles on post-contrast sagittal CT images (Fig. 2A). Volume-rendering of the CT image confirmed the existence of the foreign body (Fig. 2B). Surgery was performed 2 days after CT and MRI images were obtained. Meanwhile, the owner brought a chopstick with a broken edge found in the kitchen. Considering the information provided by the owner and image findings, the foreign body was assumed to be a chopstick fragment.

The patient was premedicated with butorphanol (0.5 mg/kg, Myungmoon Pharm., Seoul, Korea) and ampicillin-sulbactam (20 mg/kg, Whanin Pharmaceutical, Seoul, Korea) before induction with alfaxalone (4 mg/kg, Jurox, Rutherford, Australia). Inhalation anesthesia was maintained with isoflurane (Isoflurane; Choongwae Pharmaceutical, Seoul, Korea) with oxygen after intubation. A constant rate infusion (5 ml/kg/hr) of 0.9% normal saline was administered intraoperatively.

In ventral recumbency, in addition to the endotracheal tube, a gastric tube was inserted to identify the esophagus better and

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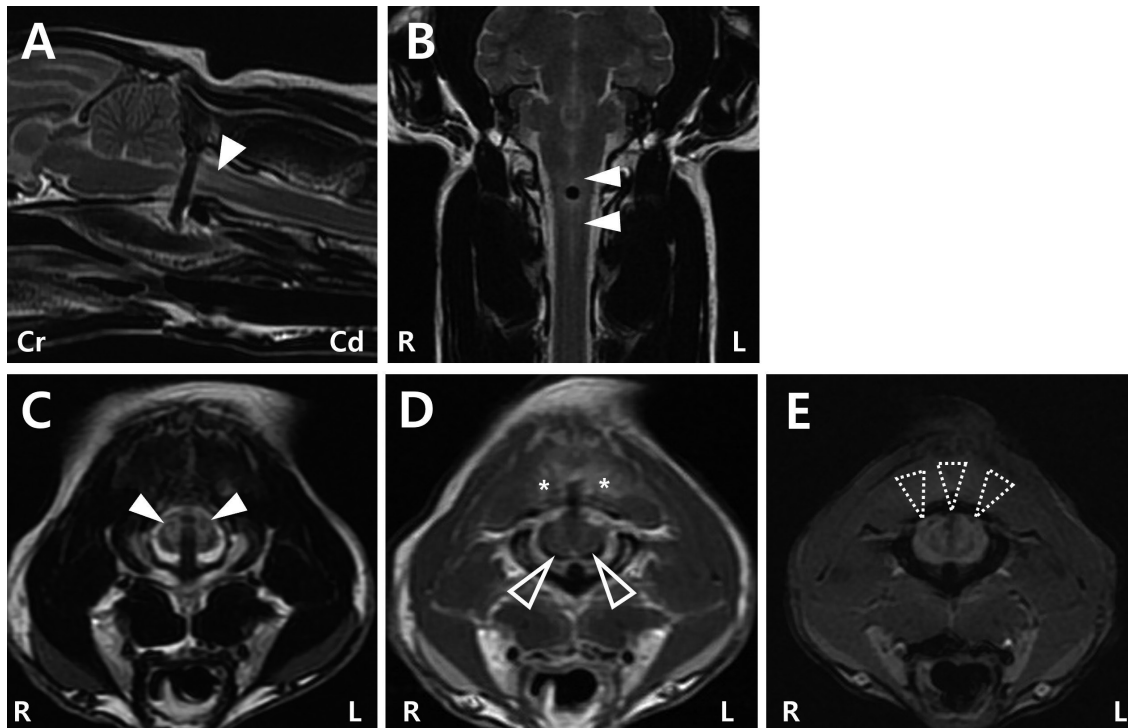


Fig. 1. Magnetic resonance findings of the atlanto-occipital junction region. A sharply margined material with a hypointense signal on a sagittal T2-weighted image (A); Dorsal and transverse T2-weighted images showing penetration of the middle of the spinal cord by the intramedullary foreign body (B, C); Hyperintensity of the medulla oblongata, cranial to the material, and the spinal cord, caudal to the material, on sagittal, dorsal, and transverse T2-weighted images (A, B, C, respectively) (closed arrowheads); Contrast enhancement of the paraspinal muscles (asterisks), and the meninge (open arrowheads) surrounding the foreign body on transverse T1-weighted, post-contrast image (D); Hypointense signal of the spinal cord in the dorsal white matter region (dashed arrowheads) on transverse GRE T2-weighted image (E). (Cr: cranial, Cd: caudal, R: right, L: left. GRE, gradient recalled echo sequence).

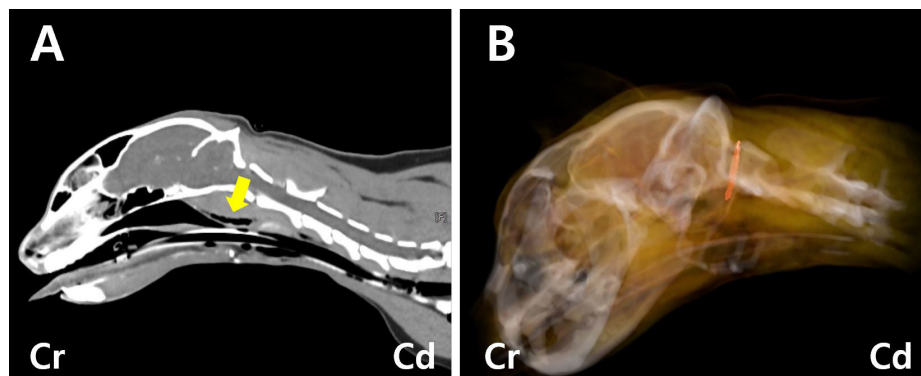


Fig. 2. Air (yellow arrow) observed between the oropharynx and the rectus capitis anterior muscles on post-contrast sagittal CT image (A); Volume-rendering of CT image (B). (Cr: cranial, Cd: caudal).

prevent accidental esophageal injury during the approach. The platysma muscle was transected in line with the skin incision. The deep cervical fascia was identified and divided along the anteromedial border of the sternocleidomastoid muscle. A finger was then used for blunt dissection between the carotid sheath laterally, and the trachea and esophagus medially, down to the longus coli muscle. After incision of the median fascia of the longus coli muscle, the ventral side of the foreign body was exposed (Fig. 3A) and grasped with DeBakey forceps. After the removal of the foreign body by gentle traction, some fluid came out from the lesion. Microbial culture of the fluid yielded negative results. The surgical field was flushed with a sterile normal saline solution several times. Subsequently, the platysma muscle was sutured, followed by routine closure of the subcutaneous tissue and skin. Recovery from anesthesia was unremarkable. The foreign body was found to be a chopstick fragment, as expected (Fig. 3B).

Postoperative medical treatment consisted of intravenous administration of ampicillin-sulbactam (20 mg/kg, Whanin Pharmaceutical)

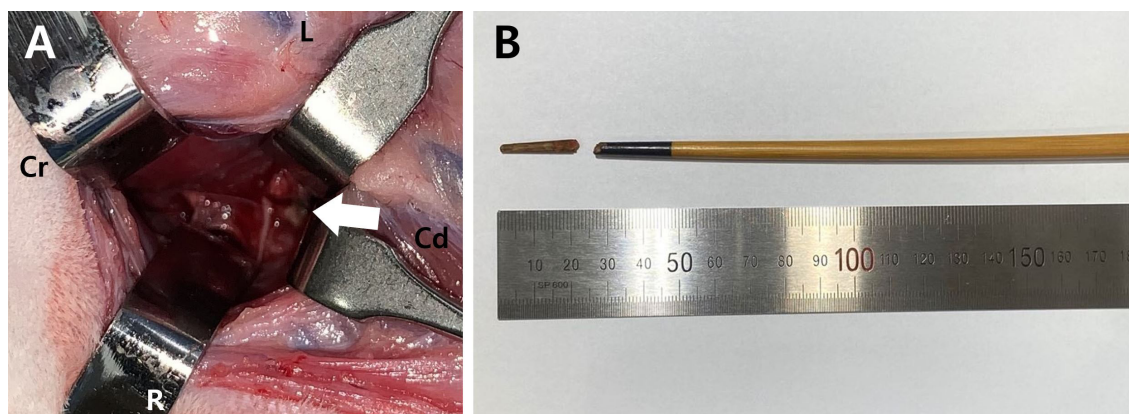


Fig. 3. Ventral side of the foreign body (arrow) (A); Wooden chopstick fragment narrowing toward the end (B). (Cr: cranial, Cd: caudal, R: right, L: left).

for 7 days, which was continued orally for 7 days after bacterial culture results. Mild improvement of proprioception in both the forelimbs and hindlimbs was observed the day after surgery. On day 2, proprioception of the four limbs completely recovered. However, ataxia of all 4 limbs persisted. The patient was discharged on day 7. At the time of stitch-out on day 14, the patient could bear its weight with some aid. During routine follow-up three weeks after the surgery, the patient could walk unstably. The owner reported, subsequently, that the patient had complete recovery of gait and jumping two months after the surgery.

There seem to be two possible migration routes in which foreign bodies could enter the central nervous system or vertebral canal. The first might be by the entrance through the skin and the soft tissue such as muscles or fascia to the vertebrae. Previously, intra-spinal placement of microchips was reported in the veterinary literature [6, 9]. The second pathway, more frequently found in companion animals, might be by accidental inhalation or ingestion and migration through some point of the alimentary canal. In previous studies, grass awn, wooden sticks, and sewing needle migration to the CNS or cervical spinal cord have been reported [2, 3, 5, 7]. In this case, the highly suggestive route taken by the foreign body was from the oropharynx to the atlanto-occipital junction, bypassing the esophagus. There were several reasons to support this pathway. First, there was no evidence of trauma on the dorsal skin surface, and the shape of the foreign body narrowed toward the dorsal side. Air, which seems to enter during migration of the foreign body, was observed only between the soft palate and the ventral side of the foreign body.

Spinal cord trauma caused by foreign material ingestion in cats is extremely rare. To the best of the authors' knowledge, although the migration of a foreign body to the cervical vertebral canal between the dura mater and the spinal cord in a cat has been reported [10], migration with penetration of the spinal cord parenchyma, as reported in this case, has not been described previously.

Neurological signs related to foreign bodies in the vertebral canal can result from direct penetration of the spinal cord by a foreign material or any space-occupying lesions, such as hemorrhage or granuloma formation secondary to the foreign material [1, 8, 9]. In particular, these foreign bodies are likely to migrate from the gastrointestinal tract, and inflammatory reactions by infection can lead to significant clinical signs [5]. Neurological signs may vary from neck pain to quadriplegia, depending on many factors, such as location or size of the foreign body.

Owing to the radiolucency of non-metallic foreign bodies, diagnosis of foreign bodies, such as wooden material, is challenging using conventional radiography. Therefore, advanced imaging devices such as CT or MRI might directly visualize non-metallic foreign bodies, assess the extent of spinal cord pathology, and evaluate the secondary changes in the surrounding tissues [5, 9, 11, 13]. Generally, metallic foreign bodies are known to cause hardening of beams and hypoattenuation of artifacts in the tissues around foreign materials, as observed in CT scans [4]. However, in the case reported here, no artifacts were identified in association with metallic structures in the tissues around the foreign body. In previous reports, there have been several cases describing wooden foreign bodies diagnosed by MRI [11–13]. However, depending on the composition of the surrounding tissues, the foreign body size, and the presence of an inflammatory response, wooden foreign bodies may not always be directly visible [11, 12].

In a previous study, a foreign body located in the cervical vertebral canal was removed via the dorsal approach [6, 10]. However, in the case reported here, considering the shape of the foreign body narrowing toward the dorsal side, a ventral approach was undertaken to minimize additional damage to the spinal cord parenchyma during removal of the foreign body. To preserve the neurovascular structure, such as the carotid artery, laryngeal nerve, internal jugular vein, and vagosympathetic trunk, which are crucial for survival [5], special care was taken during the surgery. No major postoperative complications were observed.

In conclusion, the current report is the first to describe the successful removal of an intramedullary wooden chopstick fragment penetrating the spinal cord in the atlanto-occipital junction using a ventral approach. Based on the prognosis of this case, removal of foreign material in the spinal canal is indicated in patients with clinical signs. Advanced imaging is recommended for appropriate preparation of surgical plans and the prevention of additional damage to the spinal cord during the procedure.

CONFLICT OF INTEREST. Nothing to declare.

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