Atlantoaxial epidural abscess secondary to grass awn migration in a dog

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Summary
A two-year-old female Lucerne Hound was presented with a one-week history of signs of progressive neck pain, inappetence, apathy, and an elevated rectal temperature. Findings of magnetic resonance imaging (MRI) were consistent with a foreign body abscess in the epidural space at the level of the first and second cervical vertebrae. A left-sided dorso-lateral atlantoaxial approach was performed, revealing an epidural abscess containing a grass awn. The clinical signs resolved within three days of surgery and the dog made a full recovery. This case report shows that grass awns can migrate to the atlantoaxial region in dogs and MRI findings lead to a suspicion of caudo-cranial migration within the spinal canal.

Introduction
Spinal epidural abscesses are rarely reported in the veterinary literature and present a diagnostic challenge in practice (1–12). Clinical signs are often nonspecific and neurological deficits may initially be absent. The nonspecific signs of this rare clinical entity may delay diagnosis and consequently also delay appropriate therapy. Spinal epidural abscesses may, depending on anatomical localization, progress to irreversible neurological deficits or life-threatening sepsis, making early recognition of this condition essential to a more favourable outcome (13). This case report describes the acute onset of signs of cervical pain in a dog due to an atlantoaxial epidural abscess secondary to the migration of a grass awn.

Case History
A 15 kg, two-year-old, spayed female Lucerne Hound was referred to the Veterinary University Clinic of Bern University for the complaint of an acute onset and rapid progression of signs of neck pain; these were noted particularly on ventroflexion of the neck and when the owner pulled on the dog’s collar. The dog’s appetite had decreased and it had become progressively lethargic. The referring veterinarian had performed a complete blood count, serum biochemical profile, and radiographs of the thorax, abdomen and cervical spine. These revealed a mild hyperproteinemia (83.0 g/l; reference range: 54.0–82.0) and hyperglobulinaemia (57.0 g/l; reference range: 23.0–52.0) but no changes were observed on radiographs. The dog was treated with marbofloxacin (4 mg/kg IV q 24 h) and intravenous infusion with balanced isotonic electrolyte solution (2 ml/kg/h IV) for two days without substantial clinical improvement.

Clinical examination revealed the dog to be lethargic with a rectal temperature of 39.8°C. Muscle fasciculation was evident in the cervical and shoulder muscles, and cervical ventroflexion elicited an obvious pain response. The cranial and spinal reflexes, and postural reactions were unremarkable. Other aspects of the physical and neurological examination were normal. The dog was admitted to the intensive care unit and treated with intravenous crystalloids² (4 ml/kg/h), methadone³ (0.2 mg/kg IV q6h), and amoxicillin with clavulanic acid⁴ (20 mg/kg IV q8h). The empirical administration of antibiotic medications was elected since admission was on the weekend and the patient’s clinical condition did not allow a delay until a definitive diagnosis could be made. The following day, the dog was anaesthetized and magnetic resonance imaging (MRI) examination of the cervical spine was performed with a 1 Tesla MRI unit⁵ using a knee coil.

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a Marbocyl FD²: Vetoquinol AG, Ittigen, Switzerland
b Plasma Lyte⁶: Baxter AG, Volketswil, Switzerland
c Methadon Streuli⁷: Streuli Pharma AG, Uznach, Switzerland
d Co-Amoni-Mepha⁸: Mepha-Pharma AG, Basel, Switzerland
e Panorama HFO 1.0 Tesla, open superconducting Magnet: Philips AG, Zurich-Manegg, Switzerland
An extradural left-sided ovoid shaped structure, oriented from dorsolateral to ventromedial at the level of the first and second cervical vertebrae (C1–C2), was observed in all sequences: sagittal and transverse T2, dorsal SPIR, transverse and dorsal T1, transverse T2*, sagittal T2 FLAIR, and dorsal and transverse post contrast T1. This structure contained a signal-free linear structure. In the T2-weighted images, the linear structure was embedded in hyperintense material surrounded by a hypointense rim. The spinal cord was mildly compressed on the left lateral aspect at this level (Figure 1). In addition, an irregular linear hyperintense structure was observed within the soft tissues on the left dorsolateral side of the neck, extending from the atlantoaxial joint to the C3-C4 facet joint. On post-contrast images (gadodiamide, 1.5 ml/kg (0.75 mmol/kg) IV), the observed structures displayed minimal enhancement (Figure 2) and the ovoid body displayed faint rim enhancement. Ultrasonographic examination of the soft tissues of the dorsolateral neck using a high-frequency linear probe revealed a multilinear hyperechoic structure of about 1 cm length (Figure 3). The results of cerebrospinal fluid analysis obtained by puncture of the cisterna magna were unremarkable.

Based on these findings, a linear foreign body within a small abscess with associated sinus tract and regional inflammation along the adjacent bone and dura surfaces at the level of C1–C2 was suspected. The dog was taken to surgery where a left-sided atlantoaxial approach was performed in sternal recumbency. A left dorsolateral atlantoaxial approach was performed to open up the abscess cavity and pus was drained off. A swab of the pus was obtained and cultured for bacterial growth. The access was carried deeper to the spinal canal where a 4 cm long grass-awn was identified and removed (Figure 4). The operating field was thoroughly irrigated with lactated Ringer’s solution and the wound was routinely closed.

Aerobic and anaerobic bacterial cultures of the swab obtained intra-operatively revealed moderate numbers of a mixed anaerobic bacteria including Fusobacterium sp., Bacteroides sp. and Streptococcus sp. Antibiotic sensitivity testing was not performed due to the mixed nature of the cultured bacteria. However, the bacteriology result must be interpreted with caution because the dog was previously medicated with antibiotic drugs.

Postoperative treatment included administration of amoxicillin with clavulanic acid (20 mg/kg IV q8h), fentanyl (5 µg/kg/h IV constant rate infusion) and carprofen (4 mg/kg IV q24h). For the first two days following surgery, the dog was reluctant to move and held its head in a cervical ventroflexed posture. On the third day following surgery, the dog was bright and alert with a normal rectal temperature and normal head and neck posture. On the fourth day after surgery, the dog was discharged from hospital with instructions to the owner to administer amoxicillin with clavulanic acid (12.5 mg/kg PO q12h) for a further six weeks. The dog made a full clinical recovery. The owner was contacted by telephone one year after surgery and reported the dog to be free of any abnormal clinical signs.

**Discussion**

Epidural empyema has been uncommonly reported in dogs and only rare cases describe epidural abscess (1–12). Although the term empyema, describing a diffuse purulent exudate in a natural cavity without a capsule, and abscess, describing an accumulation of purulent exudate in a newly formed cavity, are distinct, both terms are commonly used interchangeably for the same condition (7, 8, 12).

In our case, signs of abscess were identified on MRI and confirmed during surgical exploration by the presence of a cavity surrounded by a capsule. To the authors’ knowledge, only two previous cases of grass awn-induced spinal abscess or empyema in dogs are reported in the thoracic and lumbar spine, respectively (1, 3). In addition, spinal epidural empyema was re-
ported in the cervical spine at the level of C3–C4 in a cat, in which the foreign body entered the spinal canal via the articular facet joint (2). Atlantoaxial spinal epidural abscess due to a migrated grass awn has not been previously described in dogs and only rare cases of atlantoaxial abscess have been reported in humans (14, 15).

The most frequent clinical signs of epidural abscess or empyema described in dogs are fever, spinal hyperaesthesia and spinal dysfunction, progressing to para- or tetraparesis (16). However, signs are non-specific and neurological dysfunction may be subclinical or absent. Differential diagnoses include more common pathologies, such as meningitis, neoplasia, subluxation, discospondylitis, intervertebral disc herniation, and fracture (17). Moreover, a point of penetration of the foreign body is rarely detected (1–3, 18). Indeed, the site of penetration and the existence of migration remain hypothetical in most described cases.

Grass awns commonly penetrate the body via the respiratory tract, or epaxial cervical, thoracic and lumbar musculature before migrating to a variety of sites where they cause an inflammatory reaction. Previously, other authors more suspected visceral migration following inhalation and subsequent migration through the thoracic cage (19–20). Magnetic resonance imaging has recently been reported to be a valuable method to localize foreign bodies within the spinal canal prior to exploratory surgery (1). In one previously described case, MRI revealed a foreign body within the left T12–T13 neural foramen causing a spinal epidural empyema and migration was determined by the tract of linear increased signal that extended from the grass awn ventrally to the erector spinae muscles (1). As an inlet portal in the skin was not detected, the authors suspected grass awn migration from the respiratory tract. In the reported case in a cat, MRI revealed neither an inlet portal nor a sinus tract (2). In the case described herein, a migration tract at the level of C4 originating from the dorsal skin caudal to the foreign body location (C1/C2) was seen on MRI. The most likely inlet portal was therefore supposed to be the skin at the level of C4 migrating to the spinal canal, then entering through the intervertebral foramen, and tracked cranially in the epidural space until reaching the level of C1–C2. As grass awns only migrate in one direction due to their spikelets, it is likely that the grass awn entered the spinal canal at the level of C4 and migrated within the spinal canal in a caudo-cranial direction to the atlantoaxial level (19).

Cerebrospinal fluid analyses may reveal elevated protein concentration and neutrophilic pleocytosis in association with spinal epidural empyema (6–8, 11). However, the lack of any abnormalities in the case reported herein may be explained by the formation of an abscess capsule enclosing the inflammation and no involvement of the subdural space. Commonly reported bacteria cultured from sites of foreign body migration in cats and dogs are *Streptococcus spp.*, *Staphylococcus aureus*, *Pasteurella multocida*, *Actinomyces spp.* and *Nocardia spp.* (19, 21). Previous reports of spinal epidural empyema due to grass awns in cats and dogs isolated *Pasteurella multocida*, *Prevotella* and *Clostridium perfringens* (1–3). The culture of *Streptococcus spp.* in the case reported herein is consistent with previous findings. Additionally, uncommon isolates of *Fusobacterium* and *Bacteroides* were also identified.

In human medicine, access to the ventral C1–C2 region is traditionally achieved by a transoral approach and two cases of epidural abscess drained in this manner have been reported (14, 15). This approach is associated with high morbidity but may be the most effective approach in humans (14). In our case, the surgical approach was a left-sided dorso-lateral atlantoaxial approach.

In people affected with epidural empyema or abscess, an early, accurate diagnosis increases the likelihood of successful treatment. In one report of spinal epidural empyema in two dogs, both were euthanatized because of the extensive nature of the disease process and poor clinical status (6). In contrast, five of seven dogs and four of five dogs were reported to have a good outcome in two other previous reports (4, 7). In our case, a rapid diagnosis by MRI and surgical decompression at an early stage of disease led to a successful outcome. It is possible that epidural abscesses develop...
less extensively and rapidly as empyema because of the limiting capsule surrounding the purulent exudate. Nevertheless, a spinal epidural abscess should be considered a neurosurgical emergency due to the risk of progressive compression of the spinal cord, rupture into the subdural space, or a combination of both. Moreover, epidural abscess at the atlantoaxial level may cause additional life-threatening complications due to the proximity of the brainstem.

**Conclusion**

Spinal epidural abscess and empyema due to foreign body migration should be considered as a differential diagnosis for spinal and atlantoaxial pathologies in dogs. Early surgical decompression and extraction of the foreign body in combination with appropriate antimicrobial therapy are indicated when spinal epidural abscess is suspected on imaging and can lead to successful outcome.

**Conflict of interest**

None declared.

**References**