TITLE: Ventral Slot Surgery to Manage Cervical Intervertebral Disc Disease in Three Cats

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Summary

Objective: This case series describes the clinical presentation, management and outcome of 3 cats diagnosed with cervical intervertebral disc disease that underwent decompressive ventral slot surgery.

Methods: Retrospective case series evaluating client owned cats undergoing a ventral slot surgical procedure to manage cervical intervertebral disc disease (n=3).

Results: A routine ventral slot surgery was performed in each case without complication, resulting in postoperative neurological improvement in all 3 cases.

Clinical Significance: Ventral slot surgery can be used to achieve effective cervical spinal cord decompression with a good longterm outcome in the management of feline cervical intervertebral disc herniation. To avoid creating an excessively wide slot with the potential for post-operative complications including vertebral sinus haemorrhage, vertebral instability or ventral slot collapse, careful surgical planning was performed with preoperative measurement of the desired maximum slot dimensions.

Introduction

The incidence of intervertebral disc disease in cats is reported to be 0.12-0.24% (1, 2), compared with 2% in dogs (3, 4), and both intervertebral disc extrusions (Hansen type I disc disease) and protrusions (Hansen type II disc disease) have been documented in the cat (1, 2, 5). Intervertebral disc extrusions are characterised by herniation of the nucleus pulposus through a rupture in the anulus fibrosus causing acute contusion and compression of the overlying spinal cord. In contrast, an intervertebral disc protrusion typically causes a more chronic spinal cord compression due to dorsal displacement of the nucleus pulposus through a hypertrophied, weakened anulus fibrosus (6, 7).

Medical and surgical treatment options exist for the management of intervertebral disc disease in both dogs and cats (2, 5, 8-10). Clinically relevant cervical(C) intervertebral disc disease accounts for approximately 16% of canine cases, while the incidence appears to be lower in cats, with most studies evaluating thoracolumbar disc disease (1, 11). Various surgical techniques have been reported in the management of cervical intervertebral disc disease in dogs, including ventral slot, dorsal laminectomy and cervical hemilaminectomy. A ventral slot provides direct access to ventrally herniated disc material, and has been associated with a rapid functional recovery in cases with cervical pain and mild to moderate neurological deficits (12, 13). As such, it is the technique of choice for many clinicians when accessing and removing extruded disc material from the ventral vertebral canal. To the best of our knowledge, there is only a single case report of its use in feline patients; the cat was diagnosed with a C2-C3 intervertebral disc extrusion, but died 3 days postoperatively following cardiorespiratory arrest (11). In the current case series we describe the successful surgical management of cervical intervertebral disc disease in three cats by ventral slot decompressive surgery.

Case 1

A 4.5 year old, male neutered British short hair cat was presented with a 6-month history of progressive proprioceptive ataxia affecting all limbs. General physical examination was unremarkable. On neurological examination the cat was found to be ambulatory with mild tetraparesis and moderate proprioceptive ataxia affecting all limbs, most apparent in the pelvic limbs. Paw placement and hopping responses were delayed in all limbs. Spinal reflexes were normal and no spinal hyperaesthesia was detected. These findings were consistent with a C1-C5 myelopathy.

Serum biochemistry detected a mildly elevated creatinine kinase activity (1589 U/l, Reference interval (RI): 52 – 506). Haematology was unremarkable. Magnetic resonance imaging[a] of the cervical spinal cord was performed whilst the cat was under general anaesthesia. Sequences included T2-weighted (T2W) and T1W sagittal and transverse images. MRI sequence parameters for all 3 cases are shown in Table 1. Mild to moderate bulging of hypointense intervertebral disc material was evident level with the intervertebral disc space at C5-C6 (Figure 1). The material occupied approximately 20 per cent of the height of the vertebral canal, resulting in mass effect with dorsoventral flattening of the overlying spinal cord.

The cat was premedicated with methadone (0.2mg/kg IV). Anaesthesia was induced with alfaxalone (2mg/kg IV) and was maintained with isoflurane vaporised in oxygen with mechanical ventilation. A routine ventral slot procedure was performed at C5-C6 (Figure 2A), using a pneumatic drill and a 1mm burr. The maximum slot width did not exceed 33% of the vertebral body width. The extruded nucleus pulposus was removed to decompress the spinal cord (Figure 2B).

Postoperative computed tomography (CT) was performed with a 16-slice scanner[b] to ascertain if the desired slot dimensions had been achieved alongside adequate spinal cord decompression. Images were obtained using helical acquisition, 120 kVp, 140 mAs, and 2.0 mm slice thickness. CT confirmed a maximum slot width of 3mm, <33% of the vertebral body width, with successful removal of the compressive extradural material (Figure 2C, D). Methadone analgesia was administered (0.1mg/kg IV) every 4-6 hours for 24 hours, followed by buprenorphine (0.01mg/kg IV) every 6 hours for a further 24 hours. No neurological deterioration was noted after surgery and the cat was discharged from the hospital 5 days postoperatively. A 7 day course of oral meloxicam (0.05mg/kg daily) was dispensed and the owners were advised to strictly rest the cat for 4 weeks. Follow up neurological examination 5 weeks after hospital discharge revealed the cat to be strongly ambulatory with mild proprioceptive ataxia of all limbs. On telephone conversation with the owner 8 months following surgery, the cat was reported to have continued to improve neurologically, and was felt to be neurologically normal.

Case 2

A 3-year old, male neutered British short hair cat was presented with a 6-month history of progressive, episodic tetraparesis and proprioceptive ataxia affecting all limbs. General physical examination was unremarkable. Neurological examination revealed tetraparesis and proprioceptive ataxia affecting all limbs. The findings were consistent with a C1-C5 myelopathy.

Routine haematology and biochemistry analysis were unremarkable. MRI was performed whilst the cat was under general anaesthesia and revealed marked bulging of hypointense intervertebral disc material at the level of the C2-C3 intervertebral disc, occupying approximately 50 per cent of the height of the vertebral canal (Figure 3). The overlying

spinal cord was dorsally displaced and moderately compressed by the hypointense material. There was a poorly demarcated area of T2W hyperintensity within the spinal cord at the level of maximum compression.

The cat was premedicated with methadone (0.2mg/kg IV) and acepromazine (0.02mg./kg IV). Anaesthesia was induced with propofol (4mg/kg IV) and was maintained with isoflurane vaporised in oxygen, with mechanical ventilation. A routine ventral slot procedure was performed at C2-C3. The maximum slot width was 3mm, with a vertebral body width of 10mm. The extruded nucleus pulposus was removed to decompress the spinal cord.

Neurological deterioration was noted after surgery and the cat was non-ambulatory tetraparetic. It remained appetent and able to urinate voluntarily and a gradual improvement was noted thereafter. At the time of hospital discharge 8 days later, the cat was ambulatory with moderate tetraparesis and proprioceptive ataxia. The owners were instructed to cage rest the cat for a further 3 weeks but to encourage the cat to walk for 10 minutes 3 times daily. The oral administration of meloxicam for 10 days was prescribed. On re-examination 6 weeks after hospital discharge the cat had continued to improve, and was found to be strongly ambulatory with mild tetraparesis, and an improved neurological status compared to prior to surgery. On telephone conversation with the owner 6 months following surgery the cat was mildly ataxic, but able to jump well and with no evidence of paresis.

Case 3

A 9-year old, male neutered domestic short hair cat was presented with a chronic progressive tetraparesis, first noted in the right thoracic limb 9 weeks prior to referral. General physical examination was unremarkable. Neurological examination findings included ambulatory tetraparesis and proprioceptive ataxia of all limbs, consistent with a C1-C5 myelopathy.

Routine haematology and biochemistry analysis were unremarkable. Cervical radiographs revealed narrowing of the C2-C3 and C3-C4 intervertebral disc spaces (Figure 4A). MRI revealed a large volume of irregular T2W hypointense extradural material at the level of the C2-C3 intervertebral disc space, occupying approximately 50 per cent of the height of the vertebral canal and causing severe compression of the overlying spinal cord (Figure 4B-D). There was a poorly demarcated T2W hyperintensity within the spinal cord at this level. Additionally, there was mild bulging of hypointense intervertebral disc material overlying the C3-C4 disc space, which occupied approximately 20 per cent of the height of the vertebral canal and caused moderate compression of the overlying spinal cord. Multiple intervertebral discs in the cervical-thoracic and lumbar vertebral column were hypointense on T2W images, consistent with intervertebral disc degeneration.

General anaesthesia was performed as described for case 2. Two adjacent ventral slots were created at C2-C3 and C3-C4 and the herniated extradural material was removed to decompress the spinal cord. It was elected to decompress both sites given the degree of spinal cord compression present at both, and the concern that, if only the C2-C3 disc was decompressed, altered biomechanics at the site may lead to further herniation of the C3-C4 intervertebral disc.

Neurological deterioration was noted after surgery; the cat was non-ambulatory tetraparetic, but remained comfortable, appetent and able to urinate voluntarily. The cat was discharged 3 days postoperatively, at which time it remained non-ambulatory tetraparetic. The owners were instructed to cage rest the cat for further 3 weeks and to encourage the cat to walk for 10 minutes 3 times daily. Meloxicam was prescribed for 10 days. On re-examination 3 weeks after hospital discharge the cat had made a marked improvement, and was ambulatory with moderate tetraparesis and proprioceptive ataxia of all limbs. On telephone conversation with

the owner 4 months following surgery, the cat was reported to be ambulatory with mild ataxia, was able to jump and outdoor access had been resumed.

Discussion

The current case series describes 3 cats with cervical intervertebral disc disease that underwent surgical treatment. Two were British short hairs, and the third was a domestic short hair. In a recent study evaluating thoracolumbar intervertebral disc disease, British short hair cats and Persians were found to be overrepresented (1), which may indicate a potential genetic predisposition to intervertebral disc disease in these breeds. Further studies are needed to verify this potential genetic predisposition and to elucidate its mechanism.

Intervertebral disc disease is a degenerative condition typically affecting older cats. However, the reported age range varies from 9 months to 17 years, with the median typically around 9 years (1, 2, 5, 8). The 3 cats reported in the current series were 4.5, 3 and 9 years old, with no history of trauma. A chronic, progressive clinical deterioration prompted referral in all three cases. Thus, cervical intervertebral disc disease should be considered as a differential diagnosis in young adult cats with a cervical myelopathy.

The current case series describes the successful use of a ventral slot procedure in 3 cats with cervical intervertebral disc disease. Various perioperative risks have been associated with ventral slot surgery in canine patients. In a recent study of 546 dogs undergoing ventral slot surgery, adverse events were encountered in 9.9% of cases (13). The most commonly

reported adverse events were postoperative deterioration in neurological status, persistent pain and intraoperative haemorrhage.

Smith and colleagues (14) reported an almost 25% incidence of perioperative haemorrhage with ventral slot surgery. Disruption of the internal vertebral venous sinus was recognised as a common cause. Correct patient positioning prior to surgery and ensuring a ventral midline approach are important in preventing considerable haemorrhage (14, 15). Furthermore, creation of the slot within well defined margins and strict centring of the slot over the sagittal midline are considered important precautions to minimise the potential for inadvertent trauma to the internal vertebral venous sinus (14, 15). By adhering to these principles significant venous sinus haemorrhage was avoided in the current case series.

Vertebral subluxation has been associated with ventral slot widths exceeding 50% of the vertebral body width (13, 16, 17). As a result it has been reported that the slot width should be no greater than 33% of the vertebral body width to minimise the risk of postoperative instability and vertebral subluxation (13). The inherently smaller size of the feline patients raised concerns in regard to ensuring that the slot width would not exceed 33% of the vertebral body width, yet would still allow adequate access to the vertebral canal and removal of the compressive disc material. Measurements of the vertebral body width were performed preoperatively to enable precise surgical planning, and these measurements were then carefully adhered to intraoperatively. Intra-operative magnification facilitated surgical precision and adherence to the planned slot dimensions. A 1mm burr was used to ensure the smallest possible slot was made. However, such small burrs are typically sharp, necessitating consideration of the vertebral body height and cautious drilling to avoid inadvertent penetration of the vertebral canal and spinal cord injury. Despite the small dimensions, the ventral slot was sufficient to enable placement of nerve hooks and small curettes into the

vertebral canal, with effective removal of the disc material and visualisation of the ventral dura.

Immediately postoperatively, cases 2 and 3 showed a neurological deterioration compared to the pre-operative status. However, this neurological deterioration was short lived and the cats showed a steady improvement thereafter. Transient neurological deterioration following surgical decompression of chronic spinal cord compression has been reported in dogs, and while its precise pathogenesis remains unclear, proposed mechanisms include intraoperative spinal cord manipulation, reperfusion injury, altered haemodynamics, and exacerbation of pre-existing spinal cord pathology (10, 18-20). As for all spinal cord surgery, efforts to ensure minimal spinal cord manipulation with perioperative maintenance of adequate blood pressure is recommended to attempt to minimise the extent of postoperative neurological deterioration (21).

In the current veterinary literature there is a single case report describing a ventral slot surgery in a cat (11). The cat was non-ambulatory tetraparetic on presentation, and developed respiratory compromise with cyanosis, suspected to be secondary to intercostal and diaphragm paresis as a result of the cervical spinal cord compression. Postoperatively, the cat required oxygen therapy due to ongoing respiratory compromise and died 3 days postoperatively following cardiorespiratory arrest. The 3 cases in the current series showed less severe neurological deficits on presentation, with no evidence of respiratory compromise and each cat made a good post-operative recovery. While the limited number of cases makes it difficult to draw firm conclusions, this may suggest that careful consideration of the clinical case and the associated severity of neurological compromise is important when counselling owners on anticipated perioperative risks and postoperative outcome.

While intervertebral disc disease is less common in the cat compared with the dog, both extrusions and protrusions have been reported in all regions of the vertebral column. We describe 3 clinical cases in which cervical intervertebral disc disease resulted in a chronic, progressive C1-C5 myelopathy in adult cats, which was successfully managed using a routine ventral slot surgical procedure. Careful planning of slot dimensions should be performed to minimise the risks of perioperative haemorrhage and postoperative vertebral instability.

Footnotes:

[a] Intera 1.5T, Philips Medical Systems, The Netherlands

[b]Philips Mx8000 IDT, Philips Medical Systems

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