Surgical indications for cervical and thoracolumbar disc herniation

Björn Meij
DVM, PhD, Diplomate ECVS

Department of Clinical Sciences of Companion Animals,
Faculty of Veterinary Medicine, Utrecht University
The Netherlands

b.p.meij@uu.nl

Introduction

Intervertebral disc disease (IVDD) is a frequent problem affecting dogs and occurs rarely in cats. Cervical and thoracolumbar disc disease affect the spinal cord (ends inside lumbar vertebra L6) whereas lumbosacral disc disease affects the cauda equina. The intervertebral disc consists of the ring-like, fibrous, collagen-rich anulus fibrosus (AF) and the central, gelatinous, water-rich nucleus pulposus (NP). Degeneration of discs is associated with decreased water content and two types are distinguished: 1) Hansen type I: chondroid degeneration with extrusion of nucleus material through a ruptured dorsal anulus fibrosus into the vertebral canal, and 2) Hansen type II: fibrinoid degeneration with protrusion of the thickened anulus fibrosus. The pain suffered with disc disease arises from: 1) discogenic pain (ruptures in the anulus fibrosus), 2) meningeal pain (contact or pressure of extruded disc material on the meninges [dura mater] and/or foreign body inflammatory response to nucleus pulposus), 3) radicular pain or radiculopathy (compression or entrapment of nerve roots, 'root signature'). The spinal cord parenchyma itself has no sensory nerve fibers.

Injury to the spinal cord may ultimately lead to neurological deficits and with increasing pressure and/or longer duration the extent of deficits may be more prominent and less reversible. An extradural mass in the spinal canal will exert its effect on the spinal cord from the periphery to the center. The neuroanatomic background explains the classical stepwise development of deficits in the following order: ataxia (loss of coordination, loss of proprioception)>>paresis (muscle weakness)>>paralysis (loss of voluntary motor function)>>loss of deep pain sensation. The proprioceptive (position sense) nerve fibers are the largest, and most susceptible to compressive forces and lie superficially in the dorsal funiculus. The motor tracts (voluntary motion) lie somewhat deeper in the spinal cord parenchyma and are affected next. In contrast, the small deep pain nerve fibers that are most resistant to pressure lie in deeply positioned spinothalamic tracts. This explains why loss of deep pain perception is such a severe clinical sign. Neurological grading will be used to describe patients with cervical and thoracolumbar disc disease and herniation.

Grade 0: normal.
Grade 1: cervical or thoracolumbar spinal pain, hyperaesthesia.
Grade 2: paresis (muscle weakness) with decreased proprioception, ambulatory (able to stand and walk).
Grade 3: severe paresis with absent proprioception, not ambulatory (able to stand, not able to walk).
Grade 4: paralysis (not able to stand or walk), decreased or no bladder control, conscious deep pain perception present.
Grade 5: paralysis, urinary and fecal incontinence, no deep conscious pain perception.

Neurological grading in canine IVDD is used to follow the progression of neurological deficits in time (improvement or worsening), to choose the mode of therapy, for prognosis, and for assessment of outcome after medical or surgical treatment.

Cervical disc disease

Cervical disc disease occurs in small breeds, particularly those with chondrodystrophic characteristics such as Dachshunds, French Bulldogs, Pugs, Beagles, Poodles, Spaniels, Shih Tzu's, Pekingese, and Chihuahuas. Most small dogs are older than 2 years with a mean of 6-7 years. There is no gender predilection. Disc herniation is usually Hansen type I extrusion and the C2/C3 disc is most frequently affected, with the incidence decreasing caudally. Doberman and other large breeds (e.g. Rottweiler) suffer from cervical disc disease (Hansen type II disc degeneration) as part of the syndrome of caudal cervical spondylomyelopathy (CCSM, wobbler syndrome).

The predominant clinical sign is neck pain which may be acute or chronic. Dogs may scream spontaneously or upon approach. Affected dogs may be reluctant to eat unless the food is raised from the floor. The dog often shows low head carriage and hunched back (kyphosis, **Figure 1**) leading to misdiagnosis of the pain to the middle back region. Cervical pain is often elicited when the spine or muscles of the neck are palpated. In dogs with chronic pain or in the larger breeds like the Doberman with type II disc disease cervical pain may not be that prominent.

Neurological deficits in cervical disc disease are usually less frequent than in thoracolumbar disc disease due to the relative wide spinal canal for the spinal cord in the cervical area compared with the thoracolumbar area. Cervical disc extrusions are seen that obliterate the vertebral canal for 50% or more while the dog is still ambulatory; whereas comparable obliterations in the thoracolumbar spine would result in paraplegia of the pelvic limbs. Neurological deficits related to cervical spinal cord compression are paresis or lameness in a thoracic limb, hemiparesis, tetraparesis, and tetraparalysis. Nerve root signature (pain apparent on palpation or traction of the limb) is more often a feature of caudal disc involvement (C5/C6, C6/C7, C7/T1). Decreased or absence of deep pain sensation is an uncommon finding in cervical disc disease.

The diagnosis is based on clinical signs and confirmation by radiographic demonstration of narrowing (collapse) of the intervertebral disc space and dorsal displacement of mineralized disc material (calcified mushroom extrusion). When mineralized nucleus pulposus is situated in the center of the disc space without narrowing of the space (discopathy), these sites are usually not the cause of the cervical pain.

Computed tomography (CT) and/or magnetic resonance imaging (MRI) have completely replaced myelography as diagnostic imaging techniques. Cervical myelography (injection of contrast medium in the cisterna magna) has been used to localize the extent of compression. Oblique views may reveal the offending disc even as lateral and ventrodorsal projections of the myelogram are normal. MRI allows for sagittal scanning of the whole spine; discs and spinal cord can be assessed in the same image. On T2-weighted MR images the nucleus pulposus of a normal disc gives a white (hyperintense) nucleus signal (high water content). Therefore, a T2-weighted sagittal view of the spine quickly reveals the degenerated discs ('black disc', hypointense, decreased water content) (**Figure 2**). On transverse MR images the extent and lateralization of the disc extrusion can be assessed. A major advantage of MRI is that ischemic myelopathy may be evident from MR images, this will reveal itself by hyperintensity regions in the spinal cord overlying the disc herniation on T2-weighed images. The resolution of the MR images may not be sufficient for diagnosis with low field (0.3 T or less) MRI scanners especially in cats and when dogs are small, in comparison with high field (1.0 to 3.0 T) MRI scanners. CT reveals compression due to herniated NP when the extruded material is calcified, which is frequently the case in chondrodystrophic dogs. CT-myelography also reveals compression due to non-calcified NP material.

Nonsurgical treatment comprising cage rest and anti-inflammatory and/or opioid medications are appropriate in patients with cervical pain without severe neurological deficits (grade 1 or 2) since many patients respond well. NSAIDs or corticosteroids may be used, provided that strict cage rest is installed. NSAIDs and corticosteroids should not be combined. A dog that responds well to treatment should be kept rested for 2 to 4 weeks. Recurrence of clinical signs after nonsurgical treatment occurs in 40% of patients. Surgical treatment comprises ventral fenestration and ventral decompression ('ventral slot') (**Figure 3**). Indications for ventral decompression are the presence of neurological deficits and imaging evidence of spinal cord compression. The dog is positioned in dorsal recumbent position, the cervical area is elevated with supportive bags without overextending the head. Identification of the intervertebral discs in the ventral approach is done by palpation of the large transverse processes of C6 that are directed ventrally and the ventral processes in the midline; the intervertebral disc lies immediately caudal to the ventral process. The ventral slotting is performed with powered (electrical or air pressure) instruments. Burring is progressed until the inner cortical lamina is thinned out. Rongeurs are used to enlarge the opening. Removal of extruded nucleus pulposus material from the vertebral canal provides the most rapid resolution of clinical signs. Fenestration alone should be reserved for those cases with unremitting pain, failure to non-surgical treatment and when imaging is unable to show spinal cord compression at the affected disc site. Postoperative care after ventral slot consists of restricted exercise for 4 weeks and NSAIDs for 1 week. Dogs with severe neurological deficits benefit from animal physiotherapy and/or hydrotherapy once the pain has subsided. In cases that are not recumbent, soft bedding and hygiene is required to prevent decubitus or urinary dermatitis. The prognosis for dogs with cervical disc disease is generally good to excellent.

Thoracolumbar disc disease

Thoracolumbar disc disease predominantly affects chondrodystrophic breeds (e.g., Dachshund). Peak incidence is around 6-7 years of age. Nonchondrodystrophic breeds (e.g., German shepherd) are less frequently affected. Hansen type I disc disease is seen mainly in chondrodystrophic dogs, whereas Hansen type II is more typical for non-chondrodystrophic breeds. Over 50% of all thoracolumbar disc lesions occur at the T12/T13 and T13/L1 disc and over 75% occur between T11/T12 and L1/L2.

Thoracolumbar pain is usually less dramatic than cervical pain. The dog may show kyphosis and reluctance to run or jump, and discomfort when picked up or when palpated in the thoracolumbar region. Pain alone may be misinterpreted as being of abdominal origin. Neurological deficits are more prominent in thoracolumbar disc disease than in cervical disc disease and may range from mild posterior ataxia and paresis to complete posterior paralysis and paraplegia (**Figure 4**), bladder and fecal incontinence, and depressed or absent deep pain sensation in the pelvic limbs. The withdrawal reflex (spinal reflex) should not be mistakenly interpreted as conscious (cerebral) sensation of deep pain applied to the toes. Spinal hyperreflexia in the pelvic limbs is common due to loss of central inhibition on spinal reflexes. The forelimbs are not affected by thoracolumbar disc disease. In addition to the actual mass effect, the rate at which spinal cord injury occurs is also important. If it is rapid, like in a explosive rupture of the disc, progressive ischemic myelomalacia (rather than the mass of extradural disc material found during surgery) may be the main cause of the severe neurological deficits. Most of these dogs show grade 4 or 5 deficits and the prognosis is poor.

Survey radiographs may give a tentative diagnosis of thoracolumbar disc disease. Disc space narrowing and radio-opacity of the intervertebral foramen are the most common findings. However, the thoracic intervertebral disc spaces are normally more narrow than the lumbar disc spaces. In cats, disc disease may occur in the lower lumbar region (L5/L6 and L6/L7) and calcified disc material may be seen in the spinal canal. Similar to cervical disc herniation, myelography, CT or MRI can be used for confirmation of diagnosis (Figure 5). In case the myelogram stops cranial to the disc lesion because of spinal cord swelling (especially in acute cases) lumbar myelography (injection of contrast medium between L4/L5) may be performed. Lateral and ventral radiographs should be taken. Oblique views are usually required to identify whether the compressive lesion is situated more on the left or the right side which determines the side for the hemilaminectomy. The advantage of MRI in case of thoracolumbar disc herniation is that, in addition to imaging of the herniated disc, also information is obtained on the condition of the spinal cord parenchyma overlying the herniated nucleus pulposus.

Strict cage rest is the most important consideration in nonsurgical treatment of thoracolumbar disc disease. Anti-inflammatory medication (NSAIDs or corticosteroids) may be helpful. The animal should rest in a confined space (bench) for 2-4 weeks and is only allowed outside the cage for urination and defecation. Animals that do not rest during treatment with NSAIDs, have a great risk of (sudden) deterioration of neurological status with worsening of the prognosis. Overall recovery in dogs with grade 1-3 deficits is 80% to 90%. For paraplegic dogs with grade 4 or 5 deficits non-surgical treatment is rarely the treatment of choice because of the low response rate. In dogs with grade 5 neurological deficits the duration of absence of conscious deep pain sensation is an important prognostic parameter. Dogs with grade 4 or 5 neurological deficits should be regarded as emergencies and require surgery within 24-48 hours. When grade 5 neurological deficits persist beyond 3 days the chance for functional recovery of any treatment (surgical or nonsurgical) becomes minimal.

Dorsal right-sided or left-sided hemilaminectomy is the most common surgical treatment for thoracolumbar disc disease (**Figure 6**). Dorsal laminectomy is not recommended in the thoracolumbar area because it causes considerable biomechanical instability and may lead to neurological worsening. Indications for hemilaminectomy are grade 2 or 3 lesions unresponsive to medical therapy, grade 4 and 5 lesions less than 48 hours duration and imaging evidence of significant spinal cord compression. The dog is positioned in a ventral recumbent position and supported with bags. Identification of the affected disc is by palpation of the last rib-vertebral body joint and the transverse process of L1. There are frequent anatomical variations in the T13/L1 junction and therefore the survey radiographs (besides the myelogram) or CT or MR scout views are required in the operating room to relate anatomic findings with radiographic findings. Hemilaminectomy is performed using powered instruments and rongeurs on the side of the disc herniation which is determined by the myelogram, CT or MRI. Burring is progressed until the inner cortical lamina is thinned out. Rongeurs are used to enlarge the opening. Extruded disc material is usually situated lateral and ventral of the spinal cord and frequently entraps the exiting nerve root at the intervertebral foramen. The disc material is removed by the combination of gentle suction, flushing with saline solution and the use of a thin ball-tipped probe to scoop out material from beneath the spinal cord. For closure of the laminar defect an autologous fat transplant is used to prevent dural adhesions.

The most important consideration in the postoperative care after hemilaminectomy is to ensure that the bladder is regularly emptied ('bladder' management), for this reason all dogs are given a postoperative Foley urinary catheter. Urinary retention is the most common postoperative problem in thoracolumbar disc disease. Great care should be given to bedding and hygiene and paraplegic dogs should be bathed at least once a day to prevent decubitus which complicates the recovery. The dogs should be daily examined for pressure points (sciatic tuberosities) and the perineum should be kept clean at any time. Animal physiotherapy including passive motions of hind limbs and massage should be started the first day after surgery and hydrotherapy can be started in the second week after surgery.

The prognosis for functional recovery is good for dogs with grade 1, 2, and 3 lesions irrespective of the treatment choice. Dogs with grade 4 lesions have better prognosis after surgical treatment than after nonsurgical treatment. In dogs with grade 5 lesions that are treated within 24-48 hours of onset, the animal has a chance of making a functional recovery. Neurological recovery after surgery occurs in reversed order: deep pain returns within 3 days, motor function within 6 weeks and postural reactions (proprioception) within 6 months.

Figure 1. American Cocker Spaniel with typical posture due to severe cervical pain.

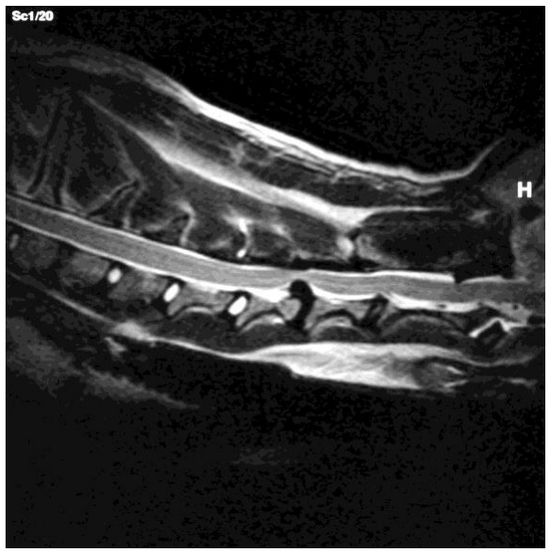

Figure 2. Cervical T2-weighted MRI: HNP type I at C3-C4 with ventral spinal cord compression.

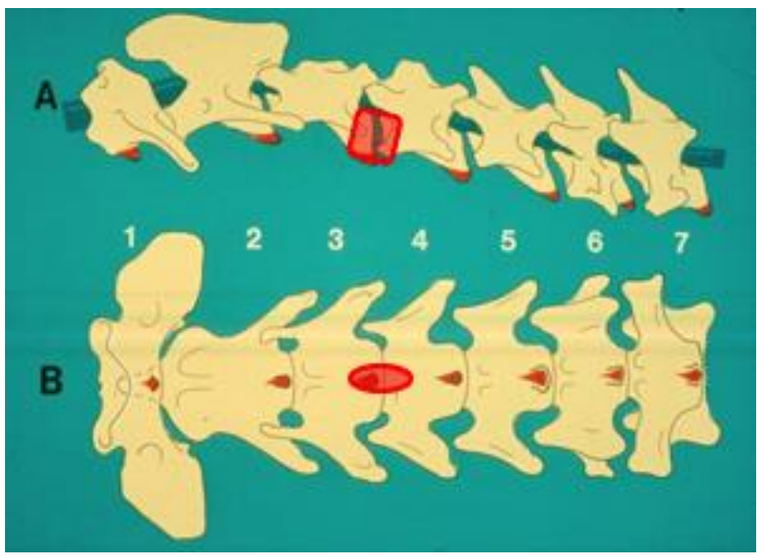

Figure. 3. Schematic presentation on lateral (A) and ventral view (B) of region (red) of ventral decompression between C3 and C4.

Figure 4. Dachshund with posterior paralysis.

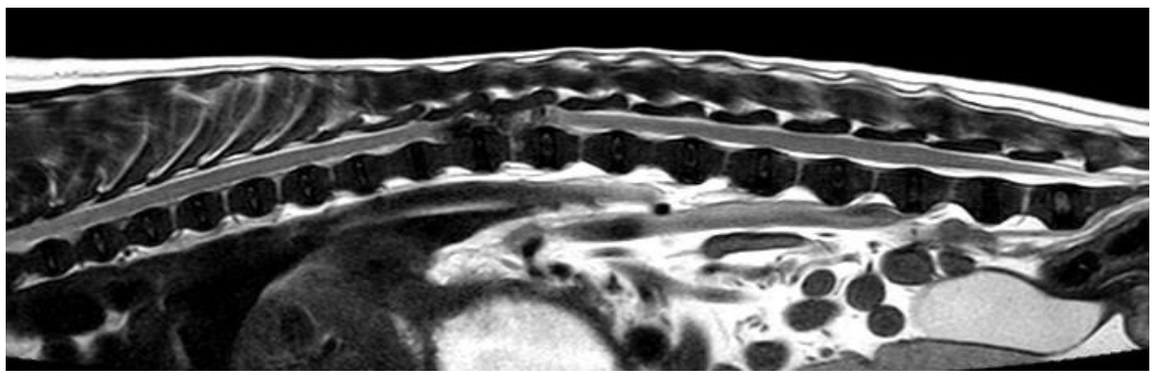

Figure 5. Thoracolumbar T2-weighted MRI: severe HNP type I at T12-T13 with spinal cord compression. Note the black discs at most intervertebral disc locations (chondrodystrophy).

Figure 6. Hemilaminectomy, right side at L1-L2: extruded disc material (grey).