Thoracolumbar intervertebral disc disease in a shih-tzu

Author : Micha? Mól

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ABSTRACT

A three-year-old, male shih-tzu, weighing 8.3kg, was presented with acute onset paraplegia post-exercise. The day before, the dog turned quickly, yelped and appeared reluctant to exercise. The following day this had progressed to inability to move both pelvic limbs. Neurological examination revealed non-ambulatory paraplegia with intact deep pain perception. Neuroanatomical localisation was a myelopathy at the T3-L3 spinal cord segments. MRI of the thoracolumbar spine identified an extruded intervertebral disc at T13-L1.

A right-sided hemilaminectomy at T13-L1 was performed. A large volume of extruded disc material and haemorrhage was removed. Lateral fenestrations were performed of T13-L1, L1-L2 and L2-L3. The dog was ambulatory and had good function of both pelvic limbs four weeks postoperatively. Types of decompressive procedures for thoracolumbar intervertebral disc disease (IVDD) are discussed. Indications and a comparison are made between conservative management and surgical treatment of IVDD and long-term outcome.

Hansen type-one intervertebral disc disease (IVDD), herniation of the nucleus pulposus through the annular fibre and extrusion of nuclear material into the spinal canal, most commonly occur within the thoracolumbar region of chondrodystrophoid breeds. The thoracolumbar junction (T12-T13 to L1-L2) accounted for the highest incidence of all disc lesions (Gage, 1975; Hoerlein, 1987).

Clinical signs can be variable, from spinal hyperaesthesia only to paraplegia with or without pain perception. Diagnosis is made based on signalment, history and neurological examination. Survey radiographs, myelographic contrast injection at the caudal lumbar region followed by radiographs if the correct site of disc extrusion cannot be determined, CT or MRI preferably are used to localise the spinal lesion.

Various decompressive procedures, including hemilaminectomy, dorsal laminectomy and pediculectomy, have been advocated to treat thoracolumbar IVDD.

Hemilaminectomy allows good visualisation of ventral and lateral aspects of the spinal cord and it is the best approach for most pathological conditions affecting the thoracolumbar vertebral column, spinal cord and nerve roots. It significantly improves retrieval of extruded disc material with minimal cord manipulation. The method of decompressive procedure may not affect the outcome; however, the ability to retrieve the disc material depends on the type of decompressive procedure.

Although controversial, prophylactic disc fenestration of at-risk intervertebral discs (T11-L3) has been suggested by most clinicians in chondrodystrophic breeds with degenerative disc disease.

History

A three-year-old male shih-tzu weighing 8.3kg was presented with acute onset paraplegia post-exercise. The preceding day, the dog turned quickly, yelped and appeared reluctant to exercise and by the following day this had progressed to inability to move the pelvic limbs. The dog was reported as not being 100% since falling the previous year and had experienced intermittent right hindlimb lameness since.

Clinical examination

General physical examination did not reveal any major abnormalities. The dog was overweight, had a body condition score of 7/9 and weighed 8.3kg. The heart rate was 114 beats per minute with no audible murmur. No pulse deficits were present. Respiratory rate was 42 breaths per minute and the rectal temperature was 38.5°C.

Neurological examination of gait/posture revealed non-ambulatory paraplegia with intact nociception. The dog was normally alert and appropriately responsive. Checking postural reactions, proprioceptive positioning, hopping, hemi-walking, and visual and tactile placing responses were absent in both pelvic limbs, and normal in the thoracic limbs. No abnormalities were detected in the cranial nerves. Spinal reflexes were normal to increased in the pelvic limbs, with marked hypertonus of the right hindlimb.

Palpation showed cutaneous trunci was cut off at L1 on both sides and spinal palpation revealed hyperaesthesia at the thoracolumbar junction. Evaluation of the pelvic limbs revealed withdrawal (flexor) reflex, patellar reflex and cranial tibial and gastrocnemius reflexes were within normal limits. Perianal reflex was normal.

A provisional diagnosis of neuroanatomical localisation of thoracolumbar spinal cord disease T3-L3 spinal cord segments was made, based on history and neurological examination.

Diagnostic techniques

Table 1. Differential diagnoses of thoracolumbar spinal cord disease

Mechanism of disease	Specific diseases
Degenerative	Intervertebral disc disease (Hansen types I and II) Degenerative myelopathy Spinal dural ossification Mucopolysaccharidosis Spinal synovial cyst Spondylosis deformans
Anomalus	Dermoid sinus Osteochondromatosis Vertebral and spinal cord anomalies Syringohydromyelia
Neoplastic	Extradural: metastasis, vertebral tumours (sarcomas, plasma cell tumours), lymphoma Intradural-extramedullary: meningiomas, nerve sheath tumours, spinal neuroepithelioma (nephroblastoma), metastasis Intramedullary: ependymomas, gliomas, metastasis, round cell tumours Insulinoma (paraneoplastic neuropathy)
Inflammatory	Discospondylitis, osteomyelitis Granulomatous meningioencephalomyelitis Infectious meningioencephalomyelitis Spinal empyema Canine distemper virus myelitis Protozoal myelitis Steroid-responsive meningitis-arteritis Vertebral physitis
Idiopathic	Arachnoid cysts Diffuse idiopathic skeletal hyperostosis
Traumatic	Fracture/luxation Spinal cord contusion Traumatic disc herniation
Vascular	Fibrocartilaginous embolism Spinal cord/epidural haemorrhage Thromboembolic disease

Table 1. Differential diagnoses of thoracolumbar spinal cord disease.

The differential diagnoses of causes of thoracolumbar spinal cord disease (**Table 1**) were documented and a further diagnostic and treatment plan was made. Both non-surgical treatment of thoracolumbar IVDD versus further investigation including MRI scan and possible surgical procedure were discussed with the owner, who decided on conservative management initially.

Biochemistry and haematology were unremarkable. A 22-gauge intravenous catheter was placed in the left cephalic vein. The dog was sedated with medetomidine 1mg/ml (25mcg/kg IV) and butorphanol 10mg/ml (0.2mg/kg IV). Lateral and ventrodorsal spinal radiographs revealed no spinal abnormalities. Medetomidine-induced sedation was antagonised with atipamezole 5mg/ml

(350mcg/kg IM).

Strict cage rest was initiated. The dog received pain relief of meloxicam 5mg/ml (0.2mg/kg IV), and methadone 10mg/ml (0.2mg/kg IM every four hours).

The dog was still paraplegic 36 hours after the onset of neurological deficits, so the decision was made to refer for a MRI scan.

A venous blood gas analysis was unremarkable prior to procedure. The dog received premedication with medetomidine 1mg/ml (10mcg/kg IM) and methadone 10mg/ml (0.2mg/kg IM). General anaesthesia was induced with propofol 10mg/kg (4mg/kg IV). A 7mm cuffed endotracheal tube was placed and anaesthesia was maintained on 2% isoflurane in oxygen using a circle circuit and a one litre reservoir bag.

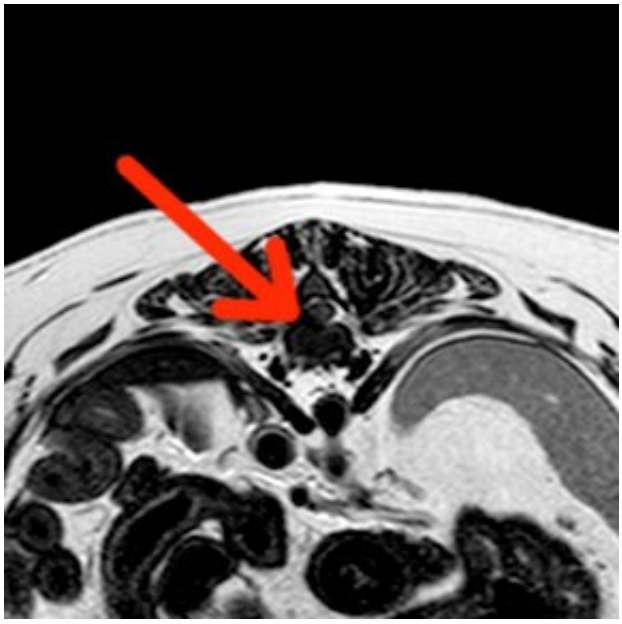
MRI of the spine (**Figure 1**) revealed T13-L1 IVD extrusion, right-sided, with impingement of the spinal canal and compression of the cord and likely haemorrhage extending from T12-13 to L1-2, L2-3 intervertebral disc (IVD) protrusion with mild spinal cord compression, indicative of degenerative IVDD.

Figure 1. Radiological findings

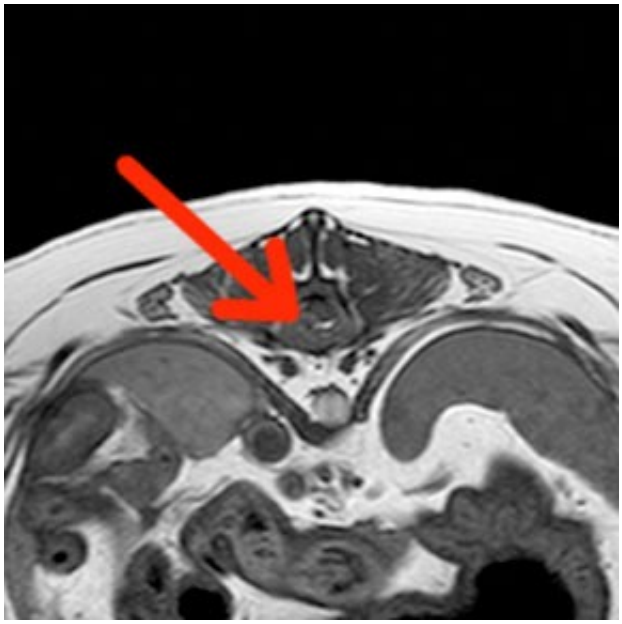
MRI of spine revealed hypointense extradural material, isointense to the disc within the right aspect of the vertebral canal at the cranial aspect of T13-L1. Cranial and caudal to this extending from the cranial aspect of L1-2 to T12-13 there is a variable amount of heterogeneous material within the right side of the vertebral canal. The spinal cord is displaced to the left with decreased cross-sectional area, most marked along the caudal half of T13 to the T13-L1 intervertebral disc (IVD), with variable thinning and loss of the epidural fat/cerebrospinal fluid (CSF) signal. There is a moderate protrusion of the L2-3 IVD, more right-sided, with dorsal displacement and slight flattening of the spinal cord and loss of the dorsal and ventral epidural fat/CSF signal. There is decreased or absent nucleus pulposus signal throughout the spine.

Radiological diagnosis

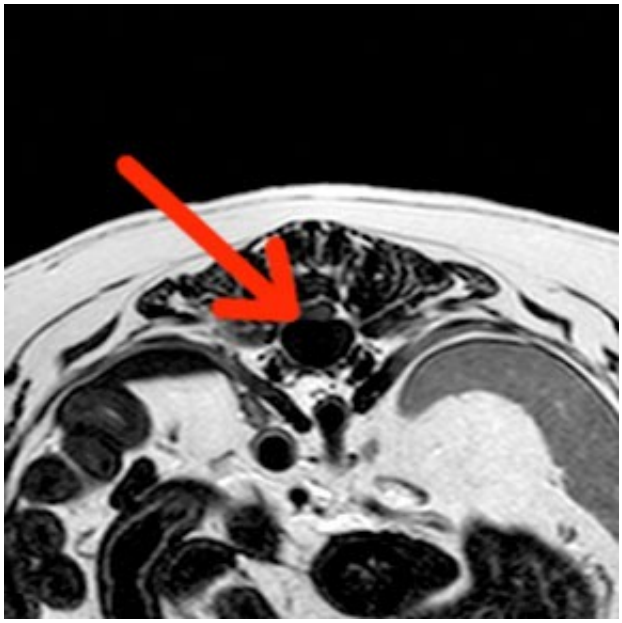
T13-L1 IVD extrusion, right-sided, with impingement of the spinal canal and compression of the cord and likely haemorrhage extending from T12-13 to L1-2, L2-3 IVD protrusion with mild spinal cord compression. Degenerative IVDD.



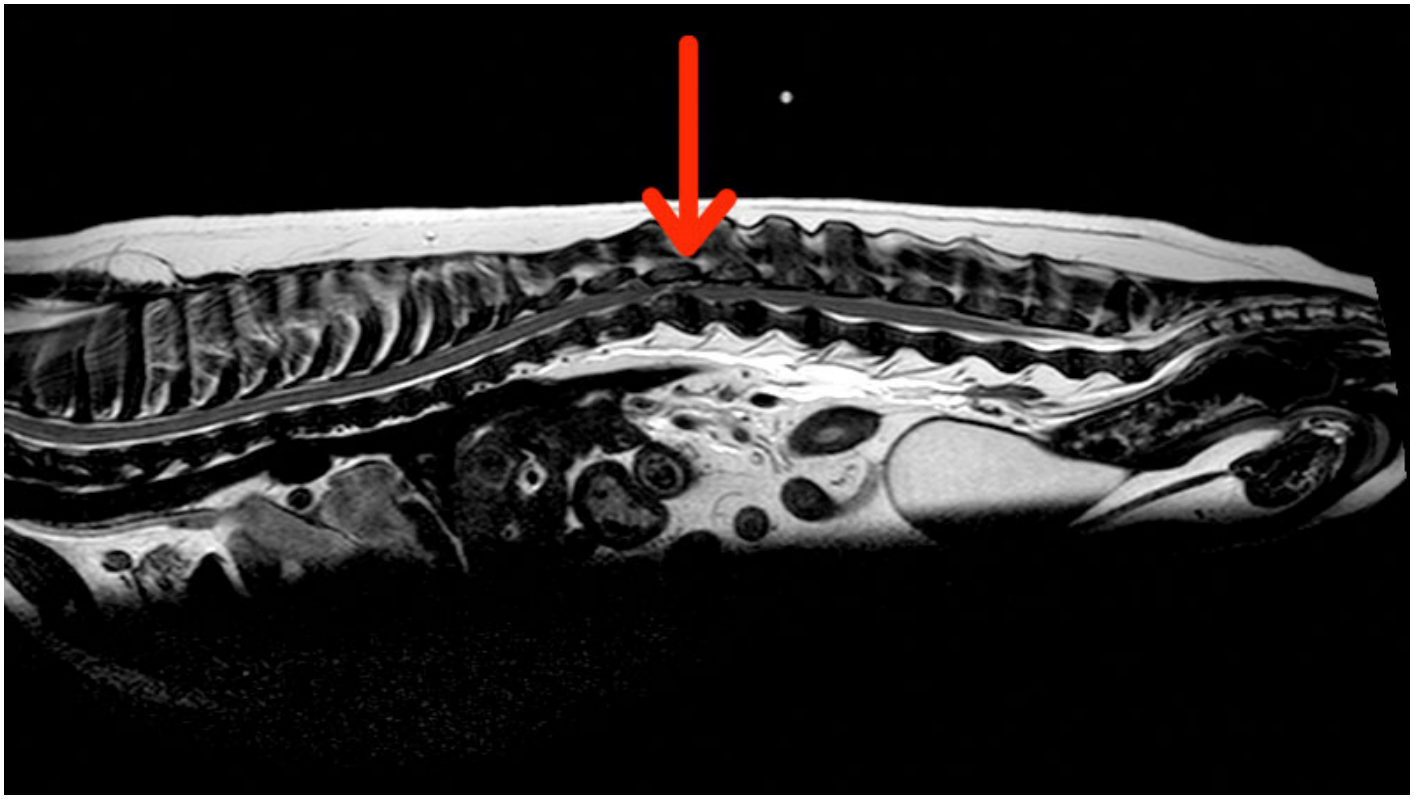
Transverse T2-weighted MRI image of T13-L1 IVD extrusion, right-sided.



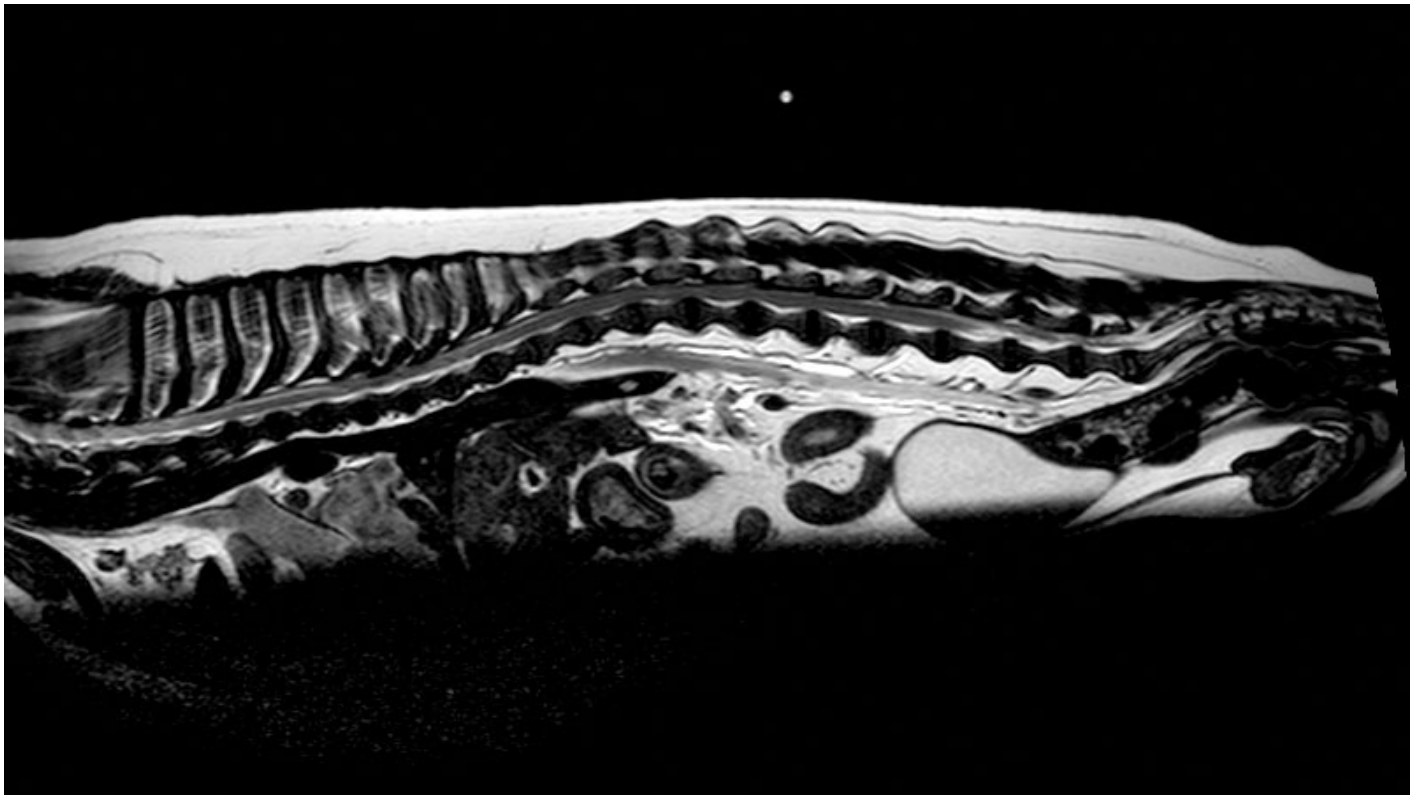
Transverse T1-weighted MRI image of thoracolumbar area showing a variable amount of heterogeneous material within the right side of the vertebral canal.



Transverse T2-weighted MRI image showing mild spinal cord compression of L2-3 IVD with loss of ventral epidural fat/CSF signal.



Sagittal T2-weighted MRI midline image of thoracolumbar spine also showing (arrow) T13/L1 IVD disc extrusion.



Sagittal T2-weighted MRI midline image of thoracolumbar spine showing severe degenerative intervertebral discs with hypointense signal.

Treatment

Sodium lactate (IV) was initiated at a rate of 10ml/kg/hr. Cefuroxime 75mg/ml (15mg/kg IV) was given twice at 90-minute intervals before and during the surgical procedure.

The dog was positioned in sternal recumbency with front limbs extended cranially and pelvic limbs caudally. The thoracolumbar area was clipped and prepared for aseptic surgery using 4% chlorhexidine gluconate.

A longitudinal skin incision was made centred to the side of the hemilaminectomy. The subdermal, then lumbodorsal fascia around spinous process was incised, followed by a deep incision centred on the right hemilaminectomy site.

The multifidus muscle was separated from the dorsal spinous process using a periosteal elevator. The tendinous attachment to the spinous process was cut with Metzenbaum scissors. A combination of Gelpi retractors and a periosteal elevator were used to maintain lateral retraction of the multifidus muscle on the articular facets and to expose its attachment to the articular facets. A bipolar cautery was used to coagulate enclosed vessels.

The paraspinal muscle attachment to the facets, and tendinous attachment of the longissimus muscle to the accessory process of the more cranial vertebra, were cut with a number 11 scalpel blade and scissors. The articular facets were removed with a combination of a high-speed burr and rongeurs. The hemilaminectomy rectangular defect from the base of the dorsal spinous processes dorsally, accessory process ventrally, articular facet of the cranial vertebra and the articular facet of the caudal vertebra was created using a high-speed burr. The outer cortical bone was drilled, exposing the red medullary layer to the inner cortical layer. A Kerrison punch and a tartar hook were used to gently pick away the inner cortical layer. A large volume of extruded disc material and haemorrhage was removed.

Lateral fenestrations were performed of T13-L1, L1-2, and L2-3. For the fenestration procedure, retractors were used to expose the lateral surface of the annulus fibrosus; muscle fibres were retracted dorsally and muscle fibres, spinal nerves and spinal vessels ventrally. A window in the lateral aspect of the annulus fibrosus was made. A tartar scraper and a curved spatula were used to remove the nucleus pulposus.

The lumbodorsal fascia was closed with a cruciate mattress technique using synthetic material 2-0 polydioxanone. The subdermal fascia was apposed with a single continuous 2-0 absorbable suture, and the skin was sutured in an interrupted cruciate pattern using 2-0 polyamide non-absorbable suture. Recovery from anaesthesia was smooth and rapid.

The dog was kept on a mattress and turned every four hours to prevent decubital ulcers. Postoperative analgesia was achieved with a single dose of methadone 10mg/ml IM followed by buprenorphine 0.3mg/ml (0.01mg/kg IV every six hours). Meloxicam 5mg/ml (0.1mg/kg IV) was administered, followed by meloxicam 1.5mg/ml (0.1mg/kg per os once daily). Administration of gabapentin 100mg three times daily per os was started. Physiotherapy, initiated at day one after surgery, was performed in a standard manner during hospitalisation.

The bladder function and size were monitored. The dog had mild urinary incontinence until it regained normal bladder function 48 hours postoperatively.

The dog was discharged three days postoperatively with meloxicam 1.5mg/ml (0.1mg/kg once daily per os) and gabapentin (100mg three times daily per os). The dog had good motor/voluntary pelvic limb and tail movement. Exercise was restricted, only allowing lead-walking three times daily for toileting. Methods to assist rehabilitation including physiotherapy, massage and passive limb flexion were explained and recommended to be performed three times daily.

Progress and outcome

Routine suture removal was performed 12 days postoperatively. Moderate pelvic limb ataxia was present. Neurological examination of gait/posture performed four weeks postoperatively revealed slight ataxia in both pelvic limbs. The dog was able to walk unaided. Postural reactions examination exposed slightly delayed hopping in both pelvic limbs, but normal paw positioning. Spinal reflexes were intact in both pelvic limbs, and there was no pain reaction on spinal palpation.

Continual improvement was reported and physical and neurological examination was unremarkable 12 weeks postoperatively.

Discussion

The primary neuroanatomical localisation of thoracolumbar IVDD is suspected from the signalment, medical history and neurological examination. Radiographic survey of the animal is essential to identify degenerative changes associated with disc herniation and to exclude other causes of the clinical symptoms. If definitive diagnosis cannot be achieved with radiographs alone, either myelography, CT or MRI are indicated to identify the site of spinal cord compression.

Myelography is invasive and has the potential to cause side effects, such as seizures and exacerbation of neurological signs (Allan and Wood, 1988).

MRI has largely replaced myelography because it avoids the need for intrathecal contrast medium administration and provides a relatively complete anatomic depiction of the spinal cord and vertebral column.

Myelographic or CT myelographic assessment of lesions is difficult when there is circumferential attenuation of the subarachnoid space that excludes contrast medium, for example, in dogs with acute disc extrusions and extensive epidural haemorrhage.

Providing three-dimensional delineation of the spinal cord, MRI is more accurate in predicting the site, severity and nature of spinal cord compression. Without MRI, many patients with acute noncompressive nucleus pulposus extrusions are subjected to unnecessary spinal decompression, justified on the basis a compressive lesion could not have been ruled out without surgical investigation.

MRI and surgical findings enabled the subclassification of IVDD into Hansen type-one category. MRI provided the precise orientation of pathological changes: right-sided disc extrusion with impingement of the spinal canal and compression of the cord and haemorrhage.

Hemilaminectomy (Hoerlein, 1956), dorsal laminectomy (Funkquist, 1970; Prata, 1981) and pediculectomy (Braund, 1976; Bitetto and Thacher, 1987) are the decompressive surgical

procedures for thoracolumbar IVDD. The selection of method depends on the localisation of the lesion and the surgeon's preference.

In this case, MRI enabled the decision between hemilaminectomy and laminectomy, and supported establishing the length of the decompression defect preoperatively. Pediculectomy is the least invasive and least destabilising technique, reserved as an adjunct method in cases requiring a bilateral approach to the vertebral canal.

Right-sided lateralisation had been present, so hemilaminectomy was preferred to laminectomy. The main advantages of hemilaminectomy are a smaller operation area, intact spinous process, intact lamina, one side of the spinal canal smooth, and retrieval of extruded disc material with minimal spinal cord manipulation compared with dorsal laminectomy. Moreover, hemilaminectomy provides short postoperative convalescence period and epidural fibrosis.

In thoracolumbar disc herniation, fenestration of the affected intervertebral disc space is essential to prevent further herniation of the remaining disc material (Forterre et al, 2008; Brisson et al, 2011).

In the author's opinion, this procedure is indicated for all at-risk IVD spaces (T11-L3) in chondrodystrophic dogs with thoracolumbar disc disease. Creating an additional lateral window in the disc may decrease this potential risk, so future extrusions will probably occur through that opening, rather than into the vertebral canal. However, the recurrence of IVDD resulting in subsequent non-fenestrated discs herniation at a site different from the initial lesion has been reported in several instances.

The amount of disc material that should be removed to prevent disc extrusion during fenestration has not been established. Results of studies indicate regardless of the technique used, fenestration does not result in curettage of all the nucleus pulposus. The amount of herniated disc material could also influence the decision to fenestrate the affected IVD space.

Conservative therapy of thoracolumbar IVDD consists of strict cage confinement and use of anti-inflammatory drugs, opioids and muscle relaxants. Conservative management may be elected for a first time episode of spinal pain only, mild to moderate paraparesis and where there is financial constraint.

Postural reactions were absent in both pelvic limbs 36 hours after the onset of neurological deficits; it was a second episode of spinal pain and the owner finally gave consent to an MRI scan followed by hemilaminectomy. Early decompressive surgery may benefit both the quality of restored function and the rate of recovery. Ferreira et al (2002) claimed animals that had shown clinical signs for more than six days took significantly longer to regain the ability to walk, when compared with those that had shown clinical signs for less than two days, or more than two, but less than six days, respectively.

Nociception is considered the most important prognostic indicator for functional recovery, particularly if dogs are treated surgically. Paresis unresponsive to medical therapy is an indication for surgical management of thoracolumbar IVDD. Retrospective studies of medically managed dogs with thoracolumbar disc disease reported recurrence rates between 30% and 50% in dogs with minimally affected ambulatory status (Levine et al, 2007; Mann et al, 2007).

In conclusion, the precise diagnosis of canine IVDD was demonstrated in detail by MRI. The choice of treatment of thoracolumbar IVDD will depend on many factors. Communication with the client is essential when considering the conservative versus surgical method of decompression. Decompression with retrieval of extruded disc material, to prevent continued extrusion of the disc material at the fenestrated disc space, can be suggested as a surgical treatment choice for canine IVDD in thoracolumbar region. The objective of choosing the decompressive surgical method is to provide satisfactory exposure to retrieve the disc material while minimising spinal cord manipulation. Whichever regime is chosen, it should be instituted as soon as possible.

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