CONTINUING EDUCATION

Intervertebral Disc Herniation

MEET THE AUTHOR

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Intervertebral disc herniation (IVDH) is the most common spinal disease in dogs. This painful and debilitating disease occurs in about 2% of canine patients seen at teaching hospitals but is rarely seen in cats, horses, and food animals.[1] Hansen first classified intervertebral disc (IVD) disease as type I and type II in 1951. Type I IVDH is an extrusion of the nucleus pulposus, and type II IVDH is a protrusion of the annulus fibrosis. Management of IVDH by a combination of medical and surgical methods is now well established, with high success rates reported (up to 95%).[2] Veterinary technicians can play an important role in management of these cases.

PATHOPHYSIOLOGY

Intervertebral discs separate the vertebral bodies along the entire length of the spinal column, with the exception of the atlanto-axial joint, and between the bones of the sacrum.[3] These discs permit motion of the spine while providing support under movement. The *annulus fibrosis* is the ligament that makes up the periphery of the disc and attaches to the vertebral end plates. The *nucleus pulposus* is the highly hydrated central portion of the disc **(FIGURE 1)**. A common aging process known as *fibroid metaplasia* can result in degenerative changes in the disc. In this process, a decrease in proteoglycans, due to pathologic or age-related changes, results in decreased water content within the nucleus and annulus. These degenerative changes are accelerated in chondrodystrophic dogs, which predisposes them to early IVD degeneration.

MYELOGRAPHY uses contrast material injected into the subarachnoid space and review of a series of radiographs. After the contrast material outlined the spinal cord in this image, attenuation of the contrast agent identified the site of spinal cord compression.

Type I

As noted above, 2 types of disc degeneration have been described. Hansen type I IVD degeneration occurs commonly in chondrodystrophic breeds, such as the dachshund and beagle. However, it may also be seen in large breeds. This type of degeneration leads to an extrusion of the nucleus pulposus into the vertebral canal. Type I IVD degeneration affects young animals, with clinical signs developing between ages 3 and 6 years. Calcification of the degenerative disc is radiographically apparent in dachshunds by 6 to 18 months of age.[1] The degenerative process leads to a weakened annulus that cannot confine the calcified nucleus pulposus. Normal movements of the spinal column are enough to cause an acute disc herniation. This extrusion of nucleus pulposus leads to an acute onset of clinical signs.

Type II

Hansen type II IVD degeneration is most common in large nonchondrodystrophic breeds, such as the German shepherd and Labrador retriever. Fibroid metaplasia leads to a slow protrusion of the disc into the spinal canal. Both the annulus and the nucleus can protrude, but the annulus remains intact. Hansen type II degeneration develops more slowly than type I, and clinical signs become apparent between 5 and 12 years of age. Spinal cord compression from Hansen type II IVDH results in a slowly progressive myelopathy. German shepherds and Labrador retrievers may present with Hansen type I or type II IVD degeneration.

Traumatic

Traumatic IVDH is an acute, noncompressive nucleus pulposus extrusion. It is less common than Hansen types I and II but has been documented with magnetic resonance imaging (MRI). This type of IVDH usually results from heavy exercise that exerts excessive force on the disc. The result is expulsion of the nucleus pulposus through the annulus into the spinal canal. It is a low-volume/high-velocity herniation. The gelatinous nucleus pulposus then disperses along the floor of the canal and does not cause spinal cord compression.[1]

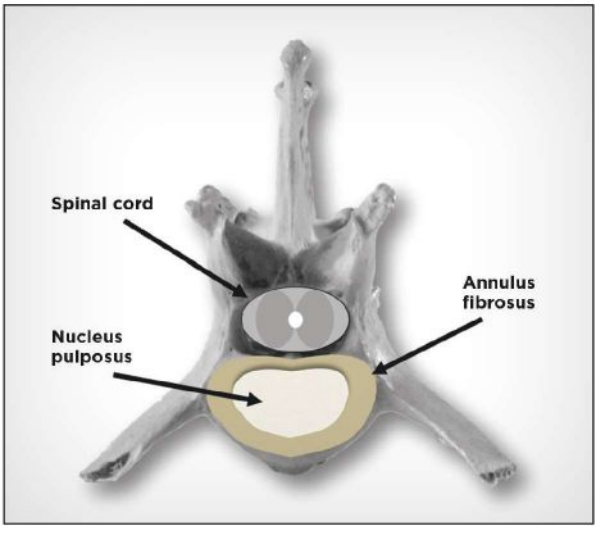

FIGURE 1. Position of the intervertebral disc.

TECHPOINT

Intervertebral disc herniation is the most common spinal disease in dogs and occurs in about 2% of canine patients seen at teaching hospitals.

CLINICAL SIGNS

Clinical signs of IVDH can range from spinal hyperesthesia (back pain) only to paraplegia without pain sensation. Spinal hyperesthesia is caused by compression of the nerve roots and meninges. Animals may have a hunchback appearance (kyphosis) and tense abdominal muscles if they are in pain. Paresis (weakness) or plegia (paralysis) may affect any limb depending on where the disc herniation is along the spine. When describing the extent of clinical signs, *mono* refers to one limb; *hemi*, to limbs on one side (eg, right thoracic and pelvic); *para*, to pelvic limbs; and *tetra*, to all 4 limbs.

For example, if the disc herniation is in the cervical spine, the animal may be tetraparetic (weak in all 4 limbs). However, if the disc herniation is in the caudal thoracic spine, the animal may be paraparetic (weak in the pelvic limbs). If the animal has lost all movement to the affected limbs, the correct term is *plegia*. If an animal is paraplegic, it is important to check the affected limbs for nociception (the ability to feel pain) because lack of nociception does affect prognosis. The disc herniation may be lateralized and compress one side of the spinal cord more than the other, which may produce asymmetric clinical signs.

DIAGNOSIS

A presumptive diagnosis may be made on the basis of signalment, history, clinical signs, and neurologic examination findings. However, a definitive diagnosis

can be based only on further diagnostic testing, such as myelography, computed tomography (CT), or MRI.

Radiography

Spinal radiography may show evidence of a degenerative disc and may also rule out other diagnostic differentials, such as neoplasia, discospondylitis, or spinal fracture. To obtain proper positioning for spinal radiography, the patient should be heavily sedated or under general anesthesia. Radiographic changes suggestive of IVDH include narrowing of the IVD space, narrowing of the space between the articular processes, and a small intervertebral foramen. Mineralized discs may sometimes be seen in the vertebral canal **(FIGURE 2)**.[1]

Myelography

Myelography used to be the standard diagnostic modality for spinal cord compression. This technique used contrast material injected into the subarachnoid space and review of a series of radiographs. After the contrast material outlined the spinal cord, attenuation of the contrast agent identified the site of spinal cord compression **(FIGURE 3)**. Injection of contrast material was associated with possible complications, including seizures. With myelography, clinical signs could also be exacerbated because of iatrogenic trauma or hemorrhage caused by spinal injections.[1]

Computed Tomography

Cross-sectional imaging, such as CT or MRI, is required to determine the active region of spinal cord compression, and is now considered the standard modality for evaluation of IVDH. CT may be used in conjunction with myelography to better delineate lateralization of the IVDH but may also be used as the sole diagnostic modality. It is noninvasive and fast, with images acquired in minutes. Diagnosis of spinal cord compression by using CT is similar to diagnosis via radiography in that it is based on identifying the anatomic landmarks where attenuation of the spinal cord is visible, but compared with radiography, it offers enhanced soft tissue contrast and visualization **(FIGURE 4)**. CT does have some advantages over MRI in the evaluation of bony lesions. In cases such as vertebral fractures or luxations, CT may provide more useful information than does MRI.

Magnetic Resonance Imaging

MRI is the gold standard imaging modality for almost all neurologic disease processes. It provides superior soft tissue contrast, which allows further differentiation of anatomic structures. Like CT, images may be viewed in many different planes (sagittal, transverse, dorsal), which allows close scrutiny of anatomic regions **(FIGURE 5)**. In patients with multiple affected sites, MRI is best for differentiating the inciting cause of the current clinical signs.

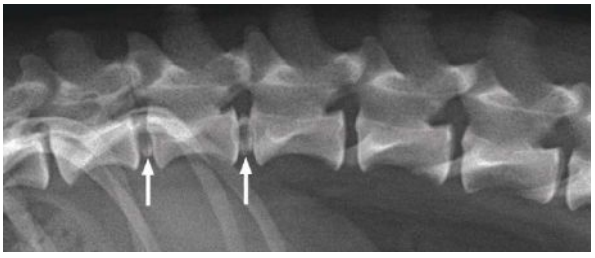

FIGURE 2. Radiograph showing mineralized intervertebral discs.

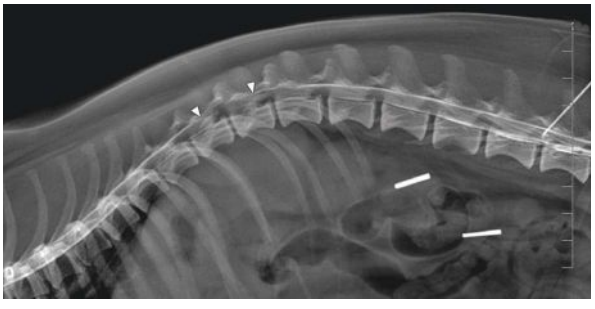

FIGURE 3. Myelogram with arrowheads showing attenuation of contrast column at site of compression.

FIGURE 4. CT scan with arrow pointing to herniated disc within the spinal canal causing compression of the spinal cord.

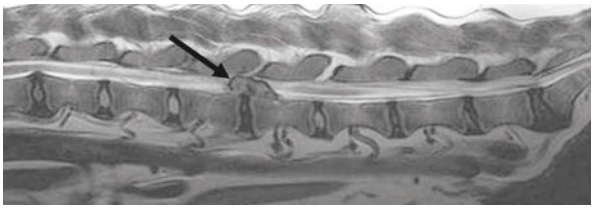

FIGURE 5. Sagittal MRI image with arrow pointing to herniated disc material within the spinal canal causing compression of the spinal cord.

MRI is based on the properties of hydrogen atoms, which are numerous in tissues with a high water content. When placed in a magnetic field, the hydrogen atoms line up. A radiofrequency pulse knocks the atoms out of alignment. When that pulse is removed, the atoms bounce back to their previous orientation and release energy in the form of another radiofrequency pulse. This second radiofrequency pulse is captured to form the resultant image.

The typical MRI finding with disc protrusion or extrusion is focal extradural spinal cord compression centered over a disc space.[3] MRI has few contraindications other than anesthetic risks (the patient requires general anesthesia to undergo MRI). Metallic implants or foreign bodies, such as gunshot, can cause artifacts in the images or can move during the procedure and harm the patient.

TREATMENT

Treatment recommendations for IVDH vary from case to case. There are no straightforward guidelines on which treatment option is best; rather, guidelines are based on whether surgery should be included as part of the treatment. There are pros and cons to surgery for IVDH. Clients should be informed of the benefits and risks of each treatment option before they make a decision.

Conservative Therapy

Conservative therapy is indicated for animals that have one episode with mild clinical signs, those whose owners have financial constraints, or those with other medical problems that preclude anesthesia and surgery. Hansen type II IVDH is more commonly treated with conservative therapy. These patients may be treated successfully for long periods with conservative management consisting of pain control and cage confinement; the more important of these is confinement. Strict cage rest is recommended for 4 to 6 weeks. The kennel should be big enough for patients to stand up and turn around in but not big enough for them to walk around in. The patient is let out of the kennel only to go on short-leash walks to urinate and defecate. If improvement is seen, exercise is restricted to a leash for another 3 weeks.

Analgesics and anti-inflammatory drugs should be used only if the client agrees to cooperate with the confinement instructions. Anti-inflammatory drugs, such as corticosteroids or nonsteroidal anti-inflammatory drugs (NSAIDs), alleviate pain and thus allow most dogs to be more active. This activity may cause more pressure to be placed on the disc, thereby leading to extrusion of more disc material into the vertebral canal. NSAIDs, gabapentin, or tramadol may be used for pain control. Some clinicians prefer an anti-inflammatory dose of prednisone in a decreasing regimen. However, steroids and NSAIDs should never be administered concurrently because doing so may cause severe gastrointestinal complications.[3] Physical rehabilitation, weight control, and prevention of jumping may help to reduce the risk for recurrence.[1]

Surgery

The following scenarios would require surgical management:

- Hansen type I cervical or thoracolumbar IVDH that is associated with minimal neurologic deficits but is refractory to conservative therapy.
- Hansen type I cervical IVDH with moderate to severe neurologic deficits (nonambulatory tetraparesis or tetraplegia). An acute onset of tetraplegia is a surgical emergency.
- Hansen type I thoracolumbar IVDH resulting in nonambulatory paraparesis to paraplegia. Dogs presenting with lack of nociception (or deep pain perception) should ideally have immediate decompressive surgery within 24 hours of onset of clinical signs. Prolonged loss of pain perception carries a poor prognosis.
- Hansen type I cervical or thoracolumbar IVDH causing deteriorating neurologic status, regardless of the severity of neurologic deficits.[3]

Many decompressive surgeries are used to treat IVDH, including hemilaminectomy, dorsal laminectomy, ventral slot (for cervical IVDH), and pediculectomy. Hemilaminectomy improves retrieval of herniated disc with minimal spinal cord manipulation **(FIGURE 6)**. Pediculectomy can be used as an adjunct technique in cases of a bilateral approach.[1] If surgery is required for Hansen type II IVDH, a hemilaminectomy, corpectomy, or pediculectomy is usually performed.[3]

Outcomes

Many dogs treated conservatively demonstrate initial improvement. Approximately 50% to 100% of patients recover with medical management, with a 30% to 50% relapse rate.[3] The recovery rate in nonambulatory patients treated conservatively is lower; deep

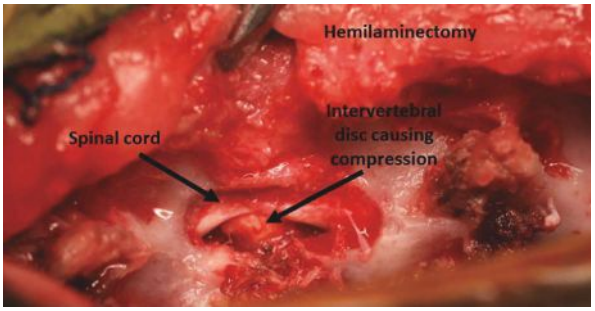

FIGURE 6. Hemilaminectomy.

pain–negative dogs treated conservatively have a recovery rate of 5% to 10%.[3] Among patients with Hansen type I IVDH that have intact pain perception, functional recovery is expected in 80% to 95%.

In patients with Hansen type I IVDH, the average time to ambulation is about 2 weeks. In nonambulatory tetraparetic or tetraplegic dogs with Hansen type I IVDH, it is reportedly about 1 week.

The absence of deep pain perception is associated with a poor prognosis. A recovery rate of about 50% is reported for dogs with absent pain perception. These dogs may have a better outcome if they undergo surgery within 12 to 24 hours of losing deep pain perception.[3] The prognosis after surgical treatment of Hansen type II IVDH is guarded compared with that for Hansen type I IVDH, especially for thoracolumbar lesions. Neurologic deterioration after surgery is more common with Hansen type II IVDH, but the reason is unknown.[3]

A condition known as *myelomalacia* is a concern for dogs without deep pain perception. Myelomalacia is liquefaction of the spinal cord parenchyma. It may be focal or diffuse. Myelomalacia affects 10% of dogs lacking deep pain perception.[3] Therefore, if a dog does not have deep pain perception, the surgeon may elect to perform a durotomy during surgery to visualize the spinal cord. Diffuse myelomalacia carries a grave prognosis. Recovery in dogs with focal myelomalacia is rare.

NURSING CARE AND REHABILITATION

Supportive Care

Supportive care of nonambulatory animals should include prevention of decubital ulcers, urinary tract infections, and muscle atrophy. To prevent decubital ulcers, the animal should be kept on a well-padded bed and rotated from side to side every 4 to 6 hours (FIGURE 7). The skin over bony prominences should be checked daily for reddening. The patient should be kept clean and dry at all times.

FIGURE 7. Decubital ulcer.

Nonambulatory dogs with thoracolumbar IVDH are often unable to voluntarily urinate. If this is the case, the bladder will need to be manually expressed by applying gentle pressure to the caudal abdomen, or the patient will need intermittent or indwelling urinary catheter placement. Animals that cannot voluntarily empty their bladder completely are at risk for urinary tract infections. The urine should be monitored for foul odor and change in color so that treatment may be instituted if a urinary tract infection does develop.

Physical Rehabilitation

Physical rehabilitation can help to shorten the recovery time for return to ambulation.[1] Before a physical rehabilitation plan is developed for any patient with IVDH, it is important to consider the various stages of healing so that treatments may be better customized. Postoperative patients will need to be kept strictly rested for 6 to 8 weeks. These patients are allowed out of the kennel for only a few minutes 3 times daily to urinate and defecate and to perform controlled physical rehabilitation exercises. When out of the kennel, they should be kept controlled while on a short leash.

Postoperative pain from inflammation may be relieved by **cryotherapy**. A cold pack should be applied to the incision for 10 to 15 minutes every 4 hours for the first 48 hours after surgery.[4] After the acute inflammatory period of healing is over, heat therapy may be instituted. This can be accomplished by using a commercially available gel pack. The heat pack can be applied to the incision for 10 to 15 minutes every 4 to 6 hours before other exercises are begun. The patient should be closely monitored during these treatments.

Passive range of motion (PROM) is intentional movement of a joint that is performed without muscle contraction. It is used when a patient is unable to move joints on its own or when active movement may be deleterious to the patient. PROM can be performed immediately after surgery and before active weight-bearing and is used to help prevent joint contracture, maintain mobility of soft tissue, reduce pain, enhance blood and lymphatic flow, and improve synovial fluid production. PROM will help maintain joint health; however, it will not improve strength or prevent muscle atrophy. Proper technique for PROM is important. The patient should be relaxed in lateral recumbency and the limb should be supported. The upper limbs are put through a comfortable flexion and extension for 15 to 20 cycles. The limb is then moved through a "bicycle" pattern another 15 to 20 times. This is repeated on each limb and is performed 3 to 4 times a day until the patient is ambulatory.

Standing exercises should begin as soon as physical rehabilitation exercises are initiated. Support is provided as needed while the patient is placed in a standing position to ensure loading/weight-bearing of the pelvic limbs and correct positioning of the feet. This is performed for 2 to 5 minutes 3 times daily. After the patient is able to maintain a standing position and the confinement period is over, exercises to challenge balance, such as weight shifting and wobble board exercises, may be instituted.[5]

Ambulation is allowed at slow paces in patients with voluntary motor function. Assisted sling walking or underwater treadmill hydrotherapy is used to unload weight while allowing ambulation. An underwater treadmill can facilitate active movements while supporting the dog's body weight through buoyancy (FIGURE 8). For example, a dog bears 91% of its body weight with the water at the level of the hock. Increasing the water level to the height of the stifle decreases weight bearing to 85%, while adjusting the water to the level of the hip decreases it to 38%.

Furthermore, the resistance of the water helps to improve or build muscle strength. Water is much more resistant than air, making water exercise a better strengthening exercise than land walks. Hydrostatic pressure of the water has been shown to reduce edema and swelling, which may be of benefit in nonambulatory patients. Walking or swimming in water also improves general circulation. The water should be kept warm to provide the beneficial effects of heat to body tissues. Heat increases the elasticity and blood flow of tissue and also helps to relax the patient.

FIGURE 8. Underwater treadmill.

FIGURE 9. Cavaletti poles.

Strengthening exercises can be added when ambulation improves and after the kennel rest period. Strengthening exercises may consist of walking up and down inclines, weaving around obstacles, walking on varying textures (eg, sand, tall grass), stepping over objects of varying size (for proprioceptive awareness), and sit-to-stand exercises (FIGURE 9).[5]

Neuromuscular electrical stimulation may be beneficial to increase tissue perfusion, decrease pain, and delay the onset of muscle atrophy. It can be used to delay the onset of neurogenic muscle atrophy in patients with lower motor neuron disease. It is contraindicated over the incision following a hemilaminectomy. Neuromuscular electrical stimulation should be applied to affected muscle groups once daily for 15 minutes until the patient is ambulatory (FIGURE 10).[4]

A minimum of 3 weeks of physical rehabilitation is recommended. However, the degree of success with physical rehabilitation varies greatly, and a successful outcome may take several months.[5]

SUMMARY

IVDH is one of the most common diseases causing paresis in dogs. It may result in a variety of clinical signs, ranging from spinal hyperesthesia to paraplegia. Many dogs recover if given the proper

FIGURE 10. Neuromuscular electrical stimulation.

treatment and nursing care. The skilled veterinary technician is an essential part of the veterinary team and may possess the nursing skills needed to get these patients back on their feet again. ■

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1. This type of intervertebral disc degeneration results in a *protrusion* of the annulus fibrosus into the vertebral canal.
a. Hansen type I IVDH
b. Hansen type II IVDH
c. Traumatic IVDH
d. None of the above

2. Which of the following would be an indication for conservative management of Hansen type I IVDH?
a. Animal with an initial episode of mild neurologic dysfunction
b. Animal with owner who has financial constraints
c. Animal with other medical problems precluding general anesthesia and surgery
d. All of the above

3. The recommended time frame of cage confinement with conservative management of intervertebral disc herniation is _____ weeks.
a. 1 to 2
b. 2 to 3
c. 3 to 4
d. 4 to 6

4. What is the most important aspect of conservative therapy for Hansen type I IVDH?
a. corticosteroid administration
b. NSAID administration
c. enforced kennel rest
d. physical rehabilitation

5. Hansen type II IVDH is most common in which of the following dog breeds?
a. Dachshund
b. German shepherd
c. Great Dane
d. Shih tzu

6. Hansen type I IVDH is most common in which of the following dog breeds?
a. Dachshund
b. German shepherd
c. Cavalier King Charles spaniel
d. Labrador retriever

7. Which of the following is the gold standard imaging modality to diagnosis IVDH?
a. Myelography
b. Radiography
c. CT
d. MRI

8. Which surgical procedure is known for improving retrieval of the herniated disc in thoracolumbar IVDH with minimal spinal cord manipulation?
a. Ventral slot
b. Hemilaminectomy
c. Corpectomy
d. Dorsal laminectomy

9. During underwater treadmill therapy a dog bears _____ of its body weight with the water level at the greater trochanter.
a. 38%
b. 91%
c. 85%
d. 14%

10. _____ is liquefaction of the spinal cord parenchyma. It is a concern for dogs with absent deep pain perception.
a. Discospondylitis
b. Myelitis
c. Meningomalacia
d. Myelomalacia