FROM PAIN TO PARALYSIS: TOP 10 THINGS YOU SHOULD KNOW ABOUT SPINAL CORD DISEASES

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1. What are the most common causes of spinal pain?
Spinal pain can be caused by any inflammatory, compressive, or neoplastic disease that affects the intervertebral disk (annulus fibrosus), the vertebra, the meninges, the synovial joints, and the paraspinal muscles because all of these structures have sensory fibers. The most common spinal cord diseases that cause spinal pain include intervertebral disk disease, meningitis, neoplasia, diskospondylitis, and trauma (fractures and luxations). Less common causes for spinal pain include polyarthritis and polymyositis.

**Intervertebral Disk Disease:** Acute disk extrusions (Type I disk disease) in the cervical or thoracolumbar spine are a common cause of spinal pain. This typically occurs in chondrodystrophic breeds (dachshund, beagle, basset hound, Shih Tzu, Pekingese, corgi) that are 3-6 years old. Clinical signs usually develop quickly (seconds to days) and range from spinal pain to paralysis. Spinal pain is caused from tearing of the annulus fibrosus as the nucleus pulposus extrudes and from irritation/compression of the meninges by the extruded disk material. Lateralized cervical disk extrusions may compress nerve roots innervating a forelimb and cause a lameness. This is referred to as “root signature”. Survey radiographs should be taken to identify degenerative changes typical of a disc herniation and to rule-out other causes of the signs. Changes indicative of a disk herniation include narrowing of the intervertebral disc space, narrowing of the intervertebral foramen, and the presence of mineralized material within the vertebral canal and disk space. However, advanced imaging (myelogram, CT scan, MRI) is needed for a definitive diagnosis and to identify the site of spinal cord compression. Dogs that only have spinal pain can be treated conservatively with strict cage rest for four weeks combined with pain relief (anti-inflammatory drugs, opiates and/or muscle relaxants). The aim of cage rest is to allow defects in the annulus fibrosus to heal. Resolution of pain does not mean that confinement should be discontinued. If the patient improves with conservative therapy, controlled exercise can be gradually reintroduced but the owners should be cautioned to prevent their pet from activities that involve jumping in the long term. Surgery should be considered if the pain is unresponsive to conservative therapy or if neurologic deficits develop.

**Meningitis:** Corticosteroid Responsive Meningitis (CRM) and Necrotizing Vasculitis/Meningitis (NVM) are causes spinal pain, especially in the cervical spine. CRM typically affects young, medium to large breed dogs. Boxers are predisposed. Clinical signs include severe neck pain and fever without other signs of systemic disease. NVM occurs in young Bernese Mountain Dogs, Beagles, and German Shorthaired Pointers. Severe neck pain, fever, and a peripheral
neutrophilia are clinical features of this disease. These diseases are diagnosed by cerebrospinal fluid (CSF) analysis. Long-term, immunosuppressive doses of corticosteroids is the recommended treatment.

**Neoplasia:** There are several tumors that arise from the vertebral body which can cause spinal pain. Commonly described tumors include: osteosarcoma, fibrosarcoma, chondrosarcoma, hemangiosarcoma, plasma cell tumor, carcinoma, lymphoma, and liposarcoma. Clinical signs are usually progressive, although they may be acute. Spinal pain is a prominent feature and can be attributed to meningeal compression and possibly vertebral destruction. Pathological fractures of the vertebral body can result in an acute onset of neurological deficits. Malignant nerve sheath tumors are another neoplasia that can cause spinal pain. These tumors arise from the sheath of peripheral nerves and usually present with a lameness initially. If the tumor grows along the nerve and into the spinal canal, spinal pain may be present. Diagnosis of vertebral body tumors is often based on survey radiographic findings, such as lysis, and pathological fractures secondary to tumor destruction of the bone. MRI is needed to diagnose a malignant nerve sheath tumor. Treatment options include surgery, irradiation therapy, chemotherapy, corticosteroids, pain medications, or various combinations of them. The overall prognosis is considered guarded to poor for dogs and cats with vertebral neoplasia.

**Diskospondylitis:** This is an infection of the intervertebral disk and adjacent vertebral bodies. The most common route of infection is hematogenous spread from the genitourinary system, oral cavity, skin, or heart valves. Diskospondylitis is often associated with a urinary tract infection and bacteremia. Direct infection can occur from a penetrating wound, migration of foreign material (grass awn), or spinal surgery. The most common bacteria causes are *Staphylococcus pseudintermedius*, *Streptococcus* spp., gram negative bacteria, and *Brucella canis*. Spinal pain, fever, lethargy, and anorexia are the most common signs. A diagnosis is usually made from spinal radiographs which may show concentric lysis of adjacent vertebral end plates and various degrees of vertebral lysis surrounded by bony proliferation. Radiographic changes may lag behind the onset of clinical signs by 2-3 weeks. Antibiotic therapy is based on culture and sensitivity of blood, urine, or disk aspirate.

**Trauma:** Acute spinal cord trauma can result in fractures and luxations of the vertebral column. Diagnosis is often made from the history and physical examination in most cases. After treating the patient for shock and performing a thorough physical examination to identify other injuries, the patient is immobilized to prevent further injury of the spine. Two radiographic views of the spine are imperative to assess the degree of instability at the site of a fracture. Anesthesia or sedation may place the patient at risk of destabilizing the fracture site by reducing the paravertebral muscle spasm. MRI or CT are the imaging techniques of choice when evaluating both the integrity of the spinal column and the associated effects on the spinal cord.

Treatment (external splinting versus surgical reduction/fixation) is based on the degree of instability. Corticosteroids used to be the standard of care in veterinary medicine for acute spinal trauma. Current recommendations in humans suggests that it is of no benefit and it is associated
with higher morbidity; therefore, corticosteroids are not recommended as a treatment for spinal trauma.

It is important to remember that the spinal cord and brain parenchyma do not include sensory fibers and so, as a general rule, intra-axial diseases do not cause pain. Exceptions to this rule include diseases that irritate the sensory pathways in the spinal cord. The two most common examples of this are Chiari-like malformations and thalamic brain tumors. Chiari-like malformations are common in Cavalier King Charles Spaniels and are usually associated with a syringohydromyelia. The syringohydromyelia is believed to cause alterations in sensory processing within the dorsal horns of the spinal cord and may manifest as intense scratching at the neck, head, and face. While uncommon, cervical pain can be seen with brain tumors. The reason for the cervical pain unknown.

2. What are the most common non-painful spinal diseases?

Nonpainful spinal cord diseases usually occur within the spinal cord parenchyma because of the lack of sensory nerve endings.

**Fibrocartilaginous Embolism (FCE):** FCE is a syndrome in which fibrocartilage identical to that found in the nucleus pulposus embolizes the spinal cord vasculature and causes an area of ischemic necrosis. An FCE causes acute, nonpainful, nonprogressive, and often asymmetrical neurologic deficits. It most commonly occurs in the L4-S3 spinal cord segments but also occurs the C6-T2 spinal cord segments. Affected dogs are usually large, young nonchondrodystrophic breeds that are being active at the onset of signs. The dog maycry out when the FCE occurs but it is not painful on examination. Smaller breeds such as Shetland sheepdogs and Miniature Schnauzers can be affected with the FCE more likely to occur in the C6-T2 spinal cord segments. Advanced imaging is needed to exclude a compressive disease. CSF analysis is needed to eliminate an inflammatory disease. Treatment centers around successful rehabilitation of the dog. Improvement can be dramatic over the first seven days and will continue for one to three months after injury.

**Degenerative Myelopathy:** Dogs with degenerative myelopathy (DM) show a progressive ataxia and paresis of the pelvic limbs, which ultimately leads to paraplegia. Although the German Shepherd Dog is the most commonly affected breed, DM has been reported in many other pure and mixed breeds. There is no sex predilection. In most breeds, the mean age of onset of neurological signs is 9 years. A presumptive diagnosis is made by ruling-out other diseases that cause a progressive myelopathy. There is a DNA test offered through the Orthopedic Foundation for Animals that can identify dogs that are clear of DM, those who are carriers, and those who are at much higher risk for developing DM. However, even those dogs whose results show that they are at higher risk for developing DM may not develop the disease. The test does NOT diagnose DM. A definitive diagnosis of DM is determined post-mortem by histopathological examination of the spinal cord. There is no effective treatment of cure for DM. Aminocaproic acid has been advocated for long-term management of DM; however, there have
been no published clinical data to support drug efficacy. Physical rehabilitation regimens have also been advocated for management of DM. The long-term prognosis is considered poor.

**Neoplasia:** Tumors within the spinal cord are not associated with spinal pain. MRI is needed for a diagnosis. Treatment is palliative and the long-term prognosis is poor.

**Congenital Diseases:** Syringohydromyelia is a fluid-filled cavity within the spinal cord that often occurs in association with a Chiari-like malformation. Chiari-like malformations are most common in the Cavalier King Charles spaniel. Clinical signs are caused by progressive expansion of the syringohydromyelia. One of the most prominent signs in affected animals is persistent scratching in the neck, face, and shoulder region. MRI is needed for a diagnosis. Treatment may be conservative with anti-inflammatory doses of prednisone and pain medications (gabapentin and tramadol) or surgical decompression of the Chiari-like malformation. Congenital vertebral malformations can also cause neurologic deficits without spinal pain. Malformations include hemivertebra, block vertebra, and spinal bifida. Malformations are most commonly seen in screw-tail breeds (English and French Bulldogs, Boston Terriers, and Pug dogs) and tend to occur in the mid-thoracic region. Spinal radiographs usually diagnose these malformations. Treatment is either medical (corticosteroids) or surgical decompression and stabilization. The overall prognosis with congenital diseases varies with the severity of signs and underlying cause.

3. **What tests can be done in-house for a patient that has spinal pain?**
   a. Complete blood cell count (CBC), serum biochemistry panel and urinalysis should be performed to evaluate for infectious or inflammatory disease.
   b. Spinal radiographs should be obtained on every patient that has spinal pain to look for evidence of a disk herniation, diskospondylitis, vertebral neoplasia, fractures/luxations, or congenital anomalies. These should be taken with the patient sedated or anesthetized in order to obtain good quality spinal radiographs. Sedation or anesthesia may be contraindicated in some cases: a critically ill patient or a patient with a suspected unstable fracture or luxation. All sedated patients with spinal cord diseases should be handled carefully because there is less muscle tone and extension or flexion of the spine may exacerbate the problem. Lateral projections are usually obtained first. The patient should be supported with foam pads and sand bags to obtain good lateral views. To obtain good images of the caudal cervical spine, the thoracic limbs may have to be pulled caudally so that the shoulder doesn't overly the area of interest. In some diseases it is always advisable to radiograph the entire spine, even in the face of focal signs, in view of the multifocal nature of the disease. These include diskospondylitis, trauma and certain types of cancer (e.g. multiple myeloma). Multiple projections of the spine should be obtained to allow accurate interpretation (the divergent path of the X-ray beam prevents interpretation of the width of disc spaces at each end of the image). Coned radiographs should be centered over certain problematic areas including the atlanto-axial junction, the caudal cervical spine, the thoracolumbar junction and the lumbosacral junction. Once it has been established that it is safe to turn the animal (in the case of trauma) from the lateral
radiographs, the animal should be placed on its back and ventro-dorsal (VD) projections obtained. When interpreting spinal radiographs it is important to know the normal radiographic appearance. The normal dog or cat has 7 cervical, 13 thoracic, 7 lumbar and 3 fused sacral vertebrae. Much of the interpretation can be made from the lateral radiographs but ventrodorsal (VD) views are particularly important to evaluate the atlantoaxial and the lumbosacral junctions. VD views are also extremely important when evaluating cases with congenital malformations or fractures.

**Radiographic Characteristics of Common Spinal Disorders**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Radiographic Findings</th>
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<tbody>
<tr>
<td><strong>Type I IVDD</strong></td>
<td>• Narrowed or wedged disc space</td>
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<tr>
<td></td>
<td>• Dorsal displacement of mineralized nuclear disc material either within disk or into the spinal canal</td>
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<tr>
<td></td>
<td>• Opacification and change in shape of intervertebral foramen</td>
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<tr>
<td></td>
<td>• Narrowing of articular facet space</td>
</tr>
<tr>
<td>Fracture/luxation</td>
<td>• Lack of vertebral alignment in one or more planes</td>
</tr>
<tr>
<td></td>
<td>• Change in shape of vertebral body</td>
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<tr>
<td></td>
<td>• Fractures of dorsal spinous, articular and/or transverse processes.</td>
</tr>
<tr>
<td>Atlantoaxial subluxation</td>
<td>• Absence or hypoplasia of dens</td>
</tr>
<tr>
<td></td>
<td>• Lack of alignment of the atlas and axis Increased space between the dorsal lamina of the atlas and the dorsal spinous process of the axis</td>
</tr>
<tr>
<td>Diskospondylitis</td>
<td>• Lysis and sclerosis of adjacent end plates; disc space may be narrowed</td>
</tr>
<tr>
<td>Vertebral neoplasia</td>
<td>• Lysis and/or sclerosis of the vertebra</td>
</tr>
<tr>
<td></td>
<td>• Soft tissue mass around vertebral abnormality May see widening/distortion of vertebral canal or intervertebral foramen</td>
</tr>
<tr>
<td>Degenerative changes</td>
<td>• Bridging spondylosis ventral and lateral to a disc space</td>
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<tr>
<td>(may not be clinically</td>
<td>• Proliferative new bone formation around the articular facets</td>
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<tr>
<td>significant)</td>
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c. Joint taps should be obtained for cytology and culture if any joints appear swollen or painful. Urine and blood cultures (if possible) should be performed if diskospondylitis is present. Thoracic radiographs should be obtained if there is evidence of a vertebral neoplasia.

4. What are the medical treatments for a patient that has spinal pain?
While therapy is obviously tailored to the underlying cause (e.g. surgery for a herniated disk, antibiotics for diskospondylitis), spinal pain should also be treated appropriately with pain medications (opiates and gabapentin), anti-inflammatory drugs, and muscle relaxers (valium and methocarbamol).

Tramadol, butorphanol, and fentanyl transdermal patches can all be effective treatments for the patient at home. Extremely painful patients should be hospitalized for intravenous opiates. Constant rate infusions of fentanyl, lidocaine and ketamine may be needed in severe cases. Gabapentin is effective in treating neuropathic pain and can be very useful in treating spinal pain. Anti-inflammatory drugs (corticosteroids and non-steroidals) are useful whenever an inflammatory process is causing pain. These are most often used when treating disk herniations and meningitis. These drugs should not be used in combination with one another and appropriate washouts are needed when switching from one drug to the other. Cervical disk herniations can cause muscle spasms which can be painful. Diazepam and methocarbamol can help relax these muscles and should be used if muscle spasms can be seen or palpated.

**Common Drugs Used to Treat Spinal Pain**

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<tr>
<th>Drug</th>
<th>Dose</th>
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<tbody>
<tr>
<td>Prednisone</td>
<td>0.25-0.5 mg/kg/day; tapering dose</td>
</tr>
<tr>
<td>Tramadol</td>
<td>4 mg/kg PO TID</td>
</tr>
<tr>
<td>Gabapentin</td>
<td>5-10 mg/kg PO TID</td>
</tr>
<tr>
<td>Valium</td>
<td>0.25-1 mg/kg PO TID</td>
</tr>
<tr>
<td>Methocarbamol</td>
<td>15-20 mg/kg PO TID</td>
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Injectable steroids are not recommend as a treatment for spinal pain. While this is often extremely effective at controlling the pain in the short term, the patient may get too active and increase the severity of the underlying problem, especially a herniated disk. Injectable steroids may also hinder obtaining a diagnosis (e.g. steroid responsive meningitis). They could also exacerbate infectious diseases (e.g. diskospondylitis), sometimes with catastrophic consequences.

Keep in mind strict cage/crate confinement for a minimum of two weeks should always accompany medical treatment. The patient should be rechecked after this period of time. Lack
of improvement after two weeks of confinement or any deterioration in neurologic status during this time indicates treatment failure. If the patient has improved after the 2 week period, the activity level can be gradually increased over the next 6 weeks. Any chondrodystrophic breed suspected of having a disk herniation as the cause of the spinal pain should not be allowed to jump on/off furniture any more.

5. **When should I refer a patient that has spinal pain?**
There are several situations where a patient with spinal pain should be referred for evaluation.
- If the patient is in severe, intractable pain
- If a patient does not respond after 2 weeks of medical treatment
- If a patient’s neurologic status worsens during medical treatment
- If the patient has neurologic deficits (postural reactions absent, paretic, paralyzed)
- If a fracture or luxation is present

6. **Do the neurologic deficits correlate to the degree of spinal cord compression?**
Compressive spinal cord diseases will cause neurologic deficits in a specific order that vary with the degree of spinal cord compression. This is due to the diameter of the fiber size in the spinal cord. Larger fibers lose function before smaller fibers. Larger fibers convey proprioception and motor functions. Smaller fibers convey bladder function and deep pain sensation. This information is helpful in determining a prognosis, formulating treatments, and projecting a recovery.

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Lose
Pain
Proprioception Deficits
Paresis
Paralysis
Loss of Bladder Function
Loss of Deep Pain

Regain
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It can often be difficult to determine if a paralyzed patient can voluntarily urinate or not. Any patient that is paralyzed should be treated as though it cannot voluntarily urinate to prevent over distention of the bladder.

7. **Should I treat a paralyzed patient with a suspected disk herniation with high dose injectable steroids?**
Methylprednisolone sodium succinate (MPSS) has been advocated as a free radical scavenging therapy for the concussive injury caused by a disk herniation based on the results of the human NASCIS trials. However, the conclusions of these trials have since been questioned and the results remain contentious. High dose corticosteroids also cause secondary complications that can be severe. There is currently no clear evidence that MPSS will improve the outcome of
spinal cord injuries in dogs. Therefore, high-dose injectable corticosteroids are not recommended for any type of spinal trauma or injury.

8. What is so important about deep pain and how do I test for it?
When assessing a paralyzed patient, the most important question that needs to be answered is “What’s the prognosis for regaining motor function?”

Deep pain sensation is the primary predictor for the patient regaining motor function. The sensory nerve fibers that conveying deep pain sensation to the cerebrum are very small, multi-synaptic and are very resistant to injury. Animals that have intact deep pain sensation have a good prognosis (80-90%) for regaining motor function, whereas animals that lack deep pain sensation have a guarded prognosis (50%) for regaining motor function.

Assessing deep pain sensation should be done by pinching the digits of the affected limbs with hemostats. Animals that have intact deep pain should consciously respond to the pinching - bark, bite, turn their head, attempt to pull themselves away. Note that a withdrawal reflex does not constitute intact deep pain sensation.

Animals that lack deep pain sensation should also be assessed for myelomalacia. Myelomalacia is a general term for spinal cord damage involving hemorrhaging and subsequent softening of the spinal cord. It is irreversible damage and there is no treatment or cure. It is often seen with acute disk herniations. Animals will myelomalacia will have neurologic deficits that localize to more than one neuroanatomical section of spinal cord (e.g. T3-L3 myelopathy and an L4-S3 myelopathy). For example, in addition to paralysis and absent deep pain sensation, rear limb reflexes can be decreased or absent (L4-S3 myelopathy) and the cutaneous trunk reflex will be absent caudal to the thoracolumbar junction or more cranial (T3-L3 myelopathy). Be aware that this condition can ascend and descend the spinal cord, which can ultimately affect the nerves innervating the forelimbs and those needed for respiration. Animals suspected of having myelomalacia, are tetraplegic, and are hypoventilating (short, open-mouthed, abdominal breaths) should be euthanized.

9. How should I treat/manage a paralyzed patient when the client cannot afford an MRI?
Paralyzed patients can be treated medically (see Question #4). Making sure that the bladder is emptied is an important part of medical treatment but is often overlooked. The risks associated with bladder dysfunction include damage to the detrusor muscle caused by over-stretching, urinary tract infections, urine scalding, and ureter and kidney damage with retention syndromes. The patient’s bladder should be checked at regular intervals (every 3–4 hours). Bladder expression may be difficult with any lesion from the brainstem to the L7 spinal cord segment (UMN bladder), so medications may be needed to help relax the urethral sphincters.
### Drugs Used to Decrease Urethral Resistance

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<thead>
<tr>
<th>Drug</th>
<th>Dosage</th>
<th>Side Effects</th>
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<tbody>
<tr>
<td>Phenoxybenzamine</td>
<td>0.25-0.5 mg/kg PO q12h</td>
<td>hypotension</td>
</tr>
<tr>
<td>Prazocin</td>
<td>dog: 1 mg/15 kg PO q8-12h cat: 0.25–0.5 mg PO q12–24h</td>
<td>hypotension, salivation, sedation</td>
</tr>
<tr>
<td>Diazepam</td>
<td>0.25-1mg/kg PO q8-12h</td>
<td>sedation, hepatocellular necrosis in cats</td>
</tr>
</tbody>
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10. What information can I give owners to help them care for their paralyzed dogs?

[www.dodgerslist.com](http://www.dodgerslist.com)
[www.ruffwear.com](http://www.ruffwear.com)
[www.helpemup.com](http://www.helpemup.com)
[www.handicappedpets.com](http://www.handicappedpets.com)