

Spinal Fractures and Dislocations

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Disorders of the spine, spinal cord, and spinal nerves may cause pain, paresis, paralysis, and paresthesia (the 4 Ps). In dogs, disorders of the intervertebral disc are the most common cause of the 4 Ps. In cats, disc disease is common but usually asymptomatic and caudal paresis is most often due to lymphosarcoma or aortic thromboembolism. Spinal fracture/dislocation is an occasional cause of the 4 Ps in both species.

The pathophysiologic mechanisms that occur within the spinal cord after a fracture/dislocation, disc herniation, or vascular obstruction are similar, and thus the principles of diagnosis and treatment of spinal cord injuries are often the same, regardless of the specific cause. Nonsurgical methods such as analgesic and corticosteroid therapies appear to be useful in the management of vertebral, intervertebral disc, spinal cord, and spinal nerve disorders and may be used alone or in conjunction with surgical procedures. Surgical intervention is an option *if* the offending lesion (disc, tumor, displaced bone) has created a compressive “mass effect” that can or might be eliminated by surgery. Radiography and occasionally myelography may be necessary to determine if a mass effect exists. In cases of fracture/dislocation, spinal stabilization should be considered whenever there is a good chance that displacement and attendant cord/nerve compression are likely to develop. The likelihood of such an event can sometimes be predicted by careful analysis of the radiographic findings.

Consideration of the signalment and history coupled with careful neurologic examination and appropriate interpretation of the findings will provide answers to the following clinical questions:

- Where is the lesion?
- What is the lesion?

- How severe is the spinal cord injury?
- What should I do?

ETIOLOGY AND PREVALENCE

Traumatic injuries of the spinal column are diagnosed more often in the dog than in the cat; when compared with other bone and joint injuries, however, spinal fracture/dislocation is not common in either species. Most of these types of spinal injuries are the result of severe blunt trauma that causes hyperflexion, hyperextension, compression, and rotation of the vertebral column. In addition, traction forces may result in fracture/dislocation of the caudal (coccygeal) and sacral vertebrae. The nature of the disruptive force dictates the type of bone and joint injury that will be produced. This has important diagnostic (radiographic) and therapeutic implications.

Fracture/dislocation of the spine most frequently occurs at or near the junction of the various regions of the spine (transition zones); this is probably related to anatomic features that result in stress concentration (stress-riser effect) at these locations. Spinal fracture/dislocation is especially common at or near the thoracolumbar and lumbosacral junctions. Surgical methods have been developed with this fact in mind. Coccygeal and sacrococcygeal injuries are particularly common in cats and are frequently the result of avulsive or traction forces applied to the tail.

Vertebral fracture may be associated with a preexisting condition that weakens the bone. Pathologic fracture of the vertebra is not common in dogs or cats. In dogs, pathologic fractures are usually the result of spinal neoplasia; osteosarcoma or metastatic adenocarcinomas arising from the mammary glands or prostate are the most common cause. Pathologic fracture of the vertebra is exceedingly rare in cats.

SIGNALMENT AND HISTORY

Traumatic fracture/dislocation of the spine can occur at any age and in any breed of dog and cat; however, such injuries are most commonly diagnosed in young and large-breed dogs. Many of these dogs are free-roaming outdoor animals that failed to come home, were found near a road, or have other injuries that bespeak a traumatic event.

Pathologic fractures usually occur in old dogs; these animals may have had a previous neoplasm, or one may be found on physical examination. Dislocation of the spine may occur after seemingly minor trauma when there is preexisting spinal instability. Atlantoaxial luxation, which is most common in young, small-

breed dogs, may be associated with anomalies of the dens and supporting soft tissues. Rarely, spinal dislocation may occur at the site of a previous laminectomy or where a ventral cervical slotting procedure has been performed.

There is usually an acute onset of pain, paresis, or paralysis following traumatic fracture/dislocation of the spine, although in some cases these clinical signs develop hours or days after the traumatic event. With pathologic fracture or dislocation, there is little or no trauma associated with the onset of clinical signs. In such cases, owners may associate the onset of signs with slipping, falling, or jumping. In animals with vertebral neoplasia, there is usually some evidence of preexisting pain or neurologic dysfunction before overt paresis or paralysis develops.

PHYSICAL AND NEUROLOGIC EXAMINATION

It is imperative that the veterinarian knows how to perform and interpret physical and neurologic examinations on the traumatized animal. Many animals that have suffered blunt trauma will have multiple injuries. Complete examination helps to ensure that such injuries are not overlooked. Serial physical and neurologic examinations can help the veterinarian detect abnormalities and assess and revise treatment plans.

The examination of animals with suspected spinal injury should always be performed with care. Gentle manipulation will lessen the chance of further cord trauma. Conversely, the examination should not be abbreviated or delayed just because there is a fear of “hurting” the animal.

The neurologic examination will help the veterinarian establish the location and severity of spinal cord injury, which in turn will dictate treatment and prognosis. The neurologic abnormalities associated with spinal fracture/dislocation vary in type and intensity. Spinal pain is a common clinical sign because displacement of bone produces an extradural mass effect and/or attenuates spinal nerves. Spinal cord injury is common in these cases, and thus some degree of voluntary motor or sensory dysfunction is usually evident.

The progression of clinical signs associated with *acute* spinal cord injury is similar regardless of the inciting cause. As the autodestructive process continues, the following events will occur in the order listed:

- Loss of proprioceptive ability
- Partial loss of voluntary motor function (paresis)
- Complete loss of voluntary motor function (paralysis)
- Loss of sensory perception (sensorimotorplegia)

The neurologic status of the limbs and sphincters must always be determined because their proper function is critical to the animal. One should remember that lower motor neuron disease of limbs or sphincters carries a more unfavorable prognosis than does upper motor neuron disease of these structures. When examining the limbs, it is important to remember that the presence of a withdrawal (flexor) reflex does not indicate that the animal has sensory perception. It is imperative that the sensory status of the patient be accurately determined as the prognosis for recovery is extremely poor in sensorimotorplegic animals. Unfortunately, the temperament of the animal, the environment in which the examination is done, and the experience of the examiner influence the result of sensory testing. Inaccurate assessment of the sensory status will adversely affect the decision-making process and may lead to improper treatment.

Schiff-Sherrington phenomenon may be observed in animals having a fracture/dislocation in the caudal thoracic to cranial lumbar region. These animals remain laterally recumbent with the forelimbs held in *rigid* extension. Affected animals are usually sensorimotorplegic in the rear limbs. Presence of Schiff-Sherrington phenomenon implies a poor prognosis, and forelimb extension is due to disruption of ascending inhibitory stimuli by severe spinal cord injury. Presence of severe spinal pain may mimic or exaggerate the Schiff-Sherrington posture.

Areflexia caudal to the lesion following acute functional spinal cord transection is termed *spinal shock*¹ and occurs because of sudden interruption of facilitatory brain stem and forebrain input to spinal neurons. Spinal shock may last for months in humans and anthropoid apes but either is transient (hours) or fails to occur in carnivores. Spinal shock should be considered if areflexia is noted in the limbs of an animal that has a lesion normally associated with hyperreflexia (upper motor neuron lesion). In such cases, descending myelomalacia should be considered as well. Rapid and progressive neurologic dysfunction should be regarded as a poor prognostic sign.

RADIOGRAPHIC EXAMINATION

Great care should be taken to avoid further spinal cord injury during positioning for radiographs, surgery, and the like. General anesthesia may allow further displacement of the unstable spinal column.

The lateral radiographic projection is most useful, but lateral and ventrodorsal views are necessary to document all abnormalities. Careful study of two orthogonal views of the spine usually allows one to determine the nature of the injury (i.e., extensional, flex-

ional, rotational, avulsive, or compressive). Knowledge of the mechanism of injury is useful in predicting the degree of resultant instability and selecting a method of fixation. Occasionally, stress radiography may help further delineate the nature of the injury; however, stress films are usually not necessary when two orthogonal views have been made and should generally be avoided because manipulation of the spine increases the risk of further spinal displacement. Myelography is usually not indicated unless a mass effect has not been documented by plain radiography and the animal's neurologic status would make surgery warranted if one were present.

When correlating radiographic and clinical findings, it is important to remember that the degree of spinal displacement is not always associated with the severity of neurologic dysfunction. Also, the presence of bone lysis or production in animals with an acute onset of pain, paresis, or paralysis usually indicates a preexisting pathologic condition (neoplasia).

PRINCIPLES OF TREATMENT

The following guidelines should be followed when treating an animal with a fracture/dislocation of the spine.

1. Begin treatment immediately.
2. Look for other problems and determine the neurologic status of the animal (especially the limbs and sphincters).
3. Treat life-threatening problems (shock, pneumothorax).
4. Prevent further spinal displacement by confining the animal, by applying external coaptation, or by open reduction and internal fixation (see Surgical Treatment on p. 43).
5. Decompress the spinal cord/nerves (see Surgical Treatment on p. 43).
6. Provide proper nursing care:
 - Handle gently and restrict activity
 - Provide plenty of cage padding
 - Prevent urine and fecal soiling
 - Empty the bladder at least two times daily
 - Turn frequently
 - Give analgesics if the animal appears to be in pain
7. Administer corticosteroids—Give a “high” dose initially followed by lower dosages or none at all.
8. Administer antibiotics in cases where urinary retention, prolonged recumbency, or other factors that predispose to urinary tract infection, pneumonia, or decubital ulcers are present.
9. Conduct serial physical and neurologic examinations and modify treatment accordingly.

SURGICAL VERSUS NONSURGICAL TREATMENT

The practicing veterinarian must be capable of making a decision concerning the advisability of surgical versus nonsurgical treatments and euthanasia. Such decisions can be made only after careful consideration of the neurologic status of the patient, location and type of fracture/dislocation, size of the patient, temperament of the animal, and needs and wishes of the owner.

Most animals with fracture/dislocation of the spine can be placed in one of three clinical categories.

I. Animals with Significant Sparing of Neurologic Function, Minimal Pain, and a Mechanically Stable Spine

Such patients are generally managed without surgery. Nonsurgical management continues to be indicated as long as the animal appears to be recovering (i.e., there is no further deterioration of neurologic function). Many of these animals will regain full function if proper nursing care is provided.

II. Animals with Sensorimotorplegia of Limbs or Atonic/Areflexic Sphincters

Sensorimotorplegic patients rarely regain neurologic function even if there has been early surgical intervention with complete spinal cord decompression. The chance of walking again is further lessened if the lesion affects the lower motor neurons of the limbs. If recovery does occur, the convalescence is protracted. Surgery is not generally recommended in such situations, and many of these animals are euthanatized. If the owners do not choose euthanasia, surgery might be performed to reduce pain and decompress the spinal cord. The use of a cart can allow smaller animals with upper motor neuron sensorimotor paraplegia and sphincter disease to have an active “happy” life even when their neurologic status fails to improve.

Surgery is usually not helpful in cats with avulsive injuries involving the sacral and caudal vertebrae. Cats that are ambulatory but have atonic areflexic sphincters are difficult to manage as indoor pets because of “overflow” incontinence. However, some owners are willing to deal with any such problems as long as the cat can walk.

III. Animals Whose Neurologic Status Lies Somewhere between the above Extremes

These animals are often candidates for surgical intervention, which is generally indicated when:

- The animal is neurologically intact but has an unstable injury that is precariously close to allowing further damage to the spinal cord. Careful consideration of the radiographs may provide some insight concerning the relative stability or instability of the injury. Fortunately, clinical experience has shown that catastrophic further displacement is a rare event.
- Neurologic function (voluntary motor activity) is significantly impaired and the presence of a mass effect (cord compression) has been documented by radiographic examination.
- The animal is in intractable pain, a common occurrence when the fracture/dislocation is in the area of the cauda equina (L7, S1–3, caudal vertebrae).

SURGICAL TREATMENT

If surgical intervention is to be performed, it is best left to those with experience in spinal surgery. Unfortunately, this generally means that one will have to assume the risks associated with transporting a compromised patient. Sedatives may help calm and quiet the animal but may preclude accurate assessment of the animal's physical (neurologic) status by the surgeon.

The goals of surgery are to decompress the spinal cord and spinal nerves and stabilize the spinal column. Such goals are difficult to attain when there are multiple fragments or the vertebral body is compressed. The bone of the vertebral body is cancellous, and the cortical bone of the body, laminae, spinous processes, and facets is thin. These factors and the small size and irregular shape of the vertebrae make the application of screws, pins, and plates very difficult.

Surgeons frequently disagree about the indications for and timing of surgical intervention. Likewise, there are differences of opinion concerning which type of fixation will provide the best stability or outcome. Prior to the procedure the surgeon must consider the risk of further destabilization of the spine during soft tissue dissection and surgical manipulation. Essentially, the neurologic status of the patient and the financial situation of the owner dictate whether surgery should be performed. There is very little that surgical or medical therapy can do to interrupt the autodestructive sequence of events once a certain critical degree of spinal cord injury has been sustained. In addition, surgery has little chance of benefiting the patient when there is no detectable mass effect.

The method of fixation is highly dependent on the type and location of the injury. Hyperflexional injuries are generally the easiest to stabilize because the ventral supporting soft tissues are intact; additionally, the facets can act as a guide to reduction and can facilitate fixation.

The outcome of surgical treatment is significantly influenced by postoperative circumstances and treatments. Before surgery is performed the surgeon must consider the size and temperament of the animal and the ability of owners and hospital staff to provide proper care, especially if convalescence is expected to be protracted. Adequate communication will insure that the client's expectations are reasonable.

REFERENCE

1. Kornegay JN: Pathogenesis of diseases of the central nervous system, in Slatter DH (ed): *Textbook of Small Animal Surgery*, ed 1. Philadelphia, WB Saunders, 1985, p 1277.

