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EMERGENCY AND ACUTE NEUROLOGY:
THE SPINE

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INTRODUCTION
Acute spinal injuries are true emergencies in veterinary practice. The appropriate treatment can have a positive influence on the outcome, and the opposite is also true. The principles that apply to trauma also apply to other causes of acute paralysis, including disc disease and vascular events.

In making decisions regarding treatment of spinal fractures, several important factors must be considered. They include the neurological status and the general health of the patient, the expertise of the clinician and the expectations of the client. Medical, surgical and nursing aspects are all of great importance. Medical and nursing therapy are required in all patients that are treated for spinal injuries.

Close monitoring of the injured animal and serial examinations are important in order to note new findings and record progress or deterioration of neurological function. This monitoring may modify the therapeutic approach (from medical conservative treatment to surgical treatment) and the prognosis (loss of deep pain perception or ascending paralysis). One aspect of the neurological examination is of great importance - the presence or absence of deep pain perception in the limbs caudal to the lesion. Absence of deep pain perception after trauma is a poor prognostic sign, particularly if this has been the situation for more than 48 hours. Surgical treatment is probably unjustified in such patients.

MEDICAL TREATMENT
Spinal Cord Injury

There are two important features of spinal cord injury; the initial trauma, whether it is laceration, concussion, compression etc., and the secondary injury. The concept of ischaemia-induced secondary injury is clinically relevant because it is potentially treatable and reversible. Functional recovery may be facilitated by treatment that interrupts the molecular processes involved in the interruption of spinal cord blood flow and the resultant secondary degenerative phenomena.

It is well established that in persistent spinal cord compression, prompt decompressive surgery is indicated. However, spinal cord decompression following acute spinal injury where compression is not a feature is of no value.

Many therapeutic regimes assessed for the treatment of spinal injuries have met with little or no success. Methylprednisolone sodium succinate at high dose has neuroprotective capabilities in addition to its hormonal corticosteroidal activity. The currently recommended human regime is as follows:

- Methylprednisolone sodium succinate @ 30 mg/kg IV within 8 hours of injury
- Infusion at 5.4 mg/kg/hour
- If the bolus is given within 3 hours of injury, continue infusion for 24 hours
- If the bolus is given from 3-8 hours of injury, continue infusion for 48 hours

It should be noted that there is limited published support for such a regime in veterinary patients and opinion amongst neurologists is divided.

The mechanism of action involves its ability to inhibit oxygen free radical-induced lipid peroxidation. This beneficial effect has stimulated the development of newer methylprednisolone esters and a novel series of effective inhibitors of oxygen radical-induced lipid peroxidation, the non-glucocorticoids 21-aminosteroids, or lazaroids. These promising molecules inhibit post-traumatic microvascular lipid peroxidation thus avoiding a progressive decline in spinal cord blood flow. Use of opioid antagonists, calcium channel blockers, DMSO, and other chemicals cannot be recommended for general use in acute spinal cord injury at this time.

Treatment Of Ancillary Conditions

Patients with cervical and sometimes thoracic lesions may experience respiratory depression, and ventilator support may be indicated. Because of vasomotor paralysis, the vascular space is already expanded and thus, pulmonary oedema is a potential complication of fluid overload. Measurements of the urine output and of its concentration are indicated.

Gastrointestinal ulceration is prevalent in animals with spinal injuries and the use of corticosteroids increases the incidence. cimetidine, misoprostol, antacids and gastric protectants are beneficial in these circumstances. Urinary function is often impaired in spinal injury. It is vital that the bladder is emptied regularly, otherwise retention cystitis or permanent detrusor muscle damage may ensue. This is best achieved by manual expression, which may be aided by use of skeletal muscle relaxants (diazepam, dantrolene) and a-blocking agents (phenoxycarbamide). A less satisfactory alternative is intermittent aseptic catheterisation, or rarely use of indwelling catheters, but the latter should not be maintained for more than two days.

SURGICAL TREATMENT
General Considerations

The objectives of surgical management of vertebral fractures are:

- decompression of the spinal cord where there is persistent compression
- reduction of fractures or luxations
- stabilisation via internal fixation.

Decisions regarding the need for surgical reduction and stabilisation, or operative decompression of the vertebral canal, will be based on a radiological as well as a clinical evaluation. It should be emphasised that injuries with similar radiographic appearances may require very different management. If decompressive surgery is considered, myelography or advanced imaging (CT, MRI) are required to determine the presence of persistent compression.

If operative intervention is elected, one needs to decide the following:

- when to operate in regard to the status of the patient, the ancillary lesions, and the degree of spinal cord compression
- whether to perform a decompressive procedure
- what stabilisation technique to use.
There are no effective methods for closed reduction of fractures in small animals, but immobilisation of fractures that are minimally displaced is possible with body casts and by cage confinement.

Decisions regarding surgical intervention are heavily influenced by the factors mentioned above. Some general guidelines can be given. Decompression is only indicated if there is imaging evidence of persistent cord compression. This should be performed at the earliest possible opportunity. Decompression is of no value if persistent compression is not present. Also, it should not be performed if deep pain sensation has been absent for more than 48 hours. Fracture fixation is desirable in the following circumstances:
- instability
- severe pain
- overriding oblique vertebral body fractures
- where there is neurological deterioration with nonsurgical treatment

Following decompressive surgery in trauma cases, fracture stabilisation is essential.

**Surgical Decompression**
Because of a secondary injury, early decompression may reduce post-traumatic oedema and improve the blood supply to the cord by relieving pressure from any abnormal contour of the vertebral canal. The presence of persistent compression is determined radiographically. Bone fragments or soft tissue encroaching into the vertebral canal are best removed via a dorsal or lateral approach. Dorsolateral hemilaminectomy is preferable to dorsal laminectomy, as the former reduces stability less. Dorsal laminectomy removes the dorsal arch, which is then not available for fracture fixation.

The value of durotomy is unclear. It releases the swollen cord from the poorly extensible meninges, but there is doubt about the efficacy of this procedure. It is however useful for determining whether or not the cord is undergoing malacia. If the cord is malacic, the prognosis for neurological recovery is hopeless.

**Surgical Reduction And Stabilisation**
The second phase in correction of an unstable spinal fracture or luxation is immobilisation. The main purpose of reduction and stabilisation is to lessen the risk of further damage to the cord, and to correct or reduce the spinal deformity. Techniques that are satisfactory to stabilise the vertebral column should be selected according to the situation and the experience of the surgeon because none is suitable in all situations. Internal fixation is superior to external casting in small animals.

Current techniques that can be applied are: Lubra plates (Flexible plastic plate bolted in between the spinous processes); Auburn spinal plates (metal plate bolted to the dorsal arch, which is then not available for fracture fixation).

POST OPERATIVE EXAMINATION
Survey radiographs performed after early reduction and stabilisation will demonstrate the extent to which the ventral vertebral length is regained and that the normal dorsal cortical alignment is restored. The owner must be prepared for numerous weeks of aftercare. Because of loss of sensory perception, discomfort from urine retention will not be experienced, but frequent emptying of the bladder is essential. Decubital ulcers may be very difficult to treat successfully. Water beds are good in this regard, and a daily bath decreases skin problems.

CONCLUSION
Prompt initiation of medical management, prompt decompression of the compressed cord and effective immobilisation of the involved spinal trauma maximises the chances of recovery, but return to function is not guaranteed because of permanent damage of the spinal cord parenchyma. Although the practitioner’s ability to treat acute spinal cord injury continues to improve, promising research in the future may come in the area of regeneration of central nervous tissue.

FURTHER READING