Acute Spinal Cord Injury

Tetraplegia and Paraplegia in Small Animals

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KEYWORDS

• Spinal cord injury • Tetraplegia • Paraplegia • Cellular therapy

KEY POINTS

- Basic neurologic principles, such as the concept of upper motor neuron versus lower motor neuron, are essential in correctly assessing animals following spinal cord injury (SCI).
- Autonomic dysfunction occurs concomitantly with tetraplegia and paraplegia and leads to urinary incontinence and respiratory dysfunction, which are critical in treatment planning for animals with SCI.
- Current evaluation of SCI relies heavily on imaging (by magnetic resonance imaging [MRI]), but new functional tests such as clinical scoring and kinematic analysis are becoming more widely applied.
- Standard of care for animals with acute SCI consists of medical stabilization in the emergency phase of the disease and, where appropriate, surgical decompression, as neuroprotective drugs have not yet reached the clinic.
- Prognosis following severe SCI is best predicted clinically by the presence or absence of pain sensation at the time of injury, but other markers (such as MRI characteristics of the lesion and biomarkers in the cerebrospinal fluid) might help to refine this prognosis.

Videos of: (1) extension of the digits in response to stimulation of the plantar surface in a dog following severe SCI; (2) 5-year-old male neutered paraplegic Dachshund showing evidence of neuropathic pain around the lesion site; (3) and 8-year-old female neutered Jack Russell terrier following a road traffic accident and complete luxation of the C5-C6 vertebrae accompany this article at http://www.vetsmall.theclinics.com/

Spinal cord injury (SCI) in animals has been recognized and treated for decades,[1] providing basic knowledge and understanding of the disease, from its pathophysiology to its current management.[2–6] SCI is a common problem in animals (mainly

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because of the prevalence of acute disc herniation in dogs[7]) for which treatment aimed at repairing parenchymal lesions is lacking, and information gained from its study has benefit for both companion animals and humans in developing new therapeutic approaches.[8–11] There is a plethora of publications and recent reviews on specific individual aspects of SCI in dogs and cats (including lesion localization,[12] advanced imaging,[13] pathogenesis,[6] traumatic causes of SCI,[3] intervertebral disc herniation [IVDH],[2] and fibrocartilaginous embolic myelopathy[14] causing SCI). The topic seems so vast that it would be almost impossible to summarize it appropriately in a single article. With this in mind, this review provides an overview of the main concepts that are useful for clinicians in assessing companion animals with severe acute SCI. Currently available advanced ancillary tests and those in development are reviewed. In addition, the current standard of care for companion animals following SCI and recent advances in the development of new therapies are presented, and new predictors of recovery discussed.

ETIOLOGY OF SPINAL CORD INJURY

SCI refers to any trauma applied to the spinal cord, although there are numerous possible causes. In dogs, IVDH remains the main cause of SCI (up to 34% in some hospitals[15]), followed by road traffic accidents (~7% of cases[3,15]). The different types of IVDH (extrusion of the degenerate nucleus or 'type I', protrusion of the degenerating annulus or 'type II', traumatic disc prolapse, or hydrated nucleus pulposus extrusion) have recently been reviewed.[4] However, the proportion of animals presented with the most severe deficits (ie, paraplegia and loss of pain sensation), which constitutes those presenting the greatest clinical problem, is not well defined. In large case series reporting IVDH outcome in dogs (**Table 1**),[16–22] 337 out of 2051 reported cases (~16%) were presented with the most severe deficits according to a classification by Schulz and colleagues[23]). These data could be an overestimation of the prevalence in the general population because cases with severe signs are more likely to be referred rather than managed in first-opinion practice, or underestimated, because cases with a poor prognosis may be euthanized before referral. Of note, the prevalence in Japan was approximately 25%, which might be a more accurate

Table 1
Prevalence of dogs presented with spinal cord injury classified by clinical grade, as proposed by Schulz and colleagues[23]

Grade 2	Grade 3	Grade 4	Grade 5	Total	Prevalence of grade 5 cases (%)	Reference
108	56	70	25	259	10	Brisson et al,[18] 2004
79	53	54	16	202	8	Brisson et al,[17] 2011
28	12	16	7	63	11	Macias et al,[20] 2002
10	68	167	36	281	13	Necas,[21] 1999
N/A	N/A	N/A	25	250	10	Ruddle et al,[22] 2006
47	32	63	17	165	10	Itoh et al,[19] 2008
274	180	161	211	831	25	Aikawa et al,[16] 2012
		Totals	**337**	**2051**	**16**	

Grade 2: mild ataxia with motor function adequate for weight support; grade 3: severe ataxia with motor function inadequate for weight support; grade 4: no apparent motor function but intact pain response; grade 5: no pain perception.
Abbreviation: N/A, no data available.
Data from Refs.[16–22]