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Duration of Regain of Deep Pain Perception after Decompression Surgery as a Parameter of Surgical Outcome for Acute Thoracolumbar Disc Herniation Hansen Type I with Loss of Deep Pain Perception in Dogs

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Abstract : The object of this study was to evaluate the durations from onset of neurological sign until surgery and regaining of the deep pain perception (DPP) after decompression as prognostic indicators for the outcome of decompression surgery in dogs with thoracolumbar intervertebral disc disease (IVDD). The compression lesions in the thoracolumbar vertebrae were localized by plain radiograph, computed tomography and neurological examination in 28 dogs with hindlimb paralysis. The follow up was carried out for 6 months after laminectomy. During the follow up, regaining DPP and walking ability were evaluated. Improvement to normal or paretic gait after surgery was judged as success of the surgical treatment.The success rate of surgical treatment was 70 % (7 out of 10 dogs) when surgical intervention was carried out within 24 hours but 38.9 % (7 out of 18) over 24 hours ($P<0.05$). The success rate of surgical treatment was 87.5 % (14 out of 16 dogs) when DDP was regained within 5 weeks after surgery but there was 0 % (0 out of 12 dogs) when DDP was not regained within 5 weeks after surgery ($P<0.05$). Other parameters such as compression rate in CT scan and laminectomy methods did not related with the success of the surgery. These results suggested that the time of surgery after onset and duration of regaining of DPP after decompression were useful parameter to predict the success of surgical treatment for thoracolumbar disc herniation in dogs.

Key words **:** disc herniation, decompression, deep pain perception, prognostic parameter, dog

Introduction

Decompression surgery of the spinal cord tends currently to be the first choice of treatment for the majority of intervertebral disc disease (IVDD) (9). The surgery is a well-established method of treatment with all grades of neurological dysfunction secondary to spinal cord compression (5,11, 16,22). However, decompression surgery is seldom recommended if deep pain perception (DPP) has been absent for more than 48 hours (30). The reported successful outcomes of decompression surgery range from 0 % to 76 % (2,5,8,11, 17,23). The difference in the recovery rates of preoperatively nonambulatory dogs varied according to the time interval from initial clinical signs to surgery and the duration of absence of DPP (16).

The prognosis for functional recovery is determined mainly by the severity of injury to the spinal cord (16). The mass of material extruded as well as spinal canal diameter to spinal cord diameter ratio are important factors in the spinal cord pathology and subsequent clinical signs (5,24). Acute high velocity disc extrusions generally have a more guarded prognosis than those of the slow disc extrusion (14,18). Poor clinical outcome is also associated with severe neurological deficits, especially the loss of DPP and the duration of its absence (8,22).

The purpose of this study is to evaluate of significant factors affecting the clinical outcome after decompression surgery.

Materials and Methods

Animals

Medical records of the Department of Surgery, Veterinary Medical Teaching Hospital in Seoul National University were reviewed in order to identify cases of IVDD during the years 2003-2007. The study population consisted of 28 dogs, referred for IVDD with loss of DPP.

Breeds of dogs described in this study were Cockerspaniel (n=7), Pekingese (n=7), Maltese (n=6), Dachshund (n=2), Poodle (n=1), Beagle (n=1), Miniature schnauzer (n=1), mixed breeds (n=3), the mean age ($\pm$2.21) was 4.68 years, mean body weight ($\pm$3.33) and sex distribution were 6.45 kg and male (n=10), female (n=11), neutered male (n=6), neutered female (n=1), respectively.

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Neurological examination

All dogs were subjected to a detailed neurological examination separately by 4 clinicians and the results integrated in order to estimate the severity of neurological status. The clinicians determined the presence or absence of pain perception by applying pressure to the digits of the hind limb with hemostatic forceps. Also behavioral assessment was performed to evaluate the functional recovery of the hind limbs. Each dog walked for a minimum of 10 steps. Dogs with non-weight bearing on their hind limbs were supported by holding the base of their tail.

Grading was performed according to the following scale : Grade I - initial episode of back pain, no neurological deficits and respond to conservative therapy; Grade II - pain, ambulatory paraparesis; Grade III - nonambulatory paraparesis, loss of superficial pain perception; Grade IV - nonambulatory paraplegia, loss of DPP.

Diagnostic imaging

To evaluate the site and degree of compression, computed tomography was performed using a helical CT scanner (GE CT/e; General Electronic Medical System, Japan) under general anesthesia using the iodionated contrast medium iohexol (3 ml/kg, Omnipaque-300® Amersham Health Cork, Ireland). Initially, scout lateral and ventrodorsal views were obtained. Thereafter, axial scanning was performed at the thoracolumbar vertebra level (slice thickness: 1 mm, interval: 1 mm, 120 kVp, 80 mA). The area of spinal canal was measured using a vertebra window and the area of extruded materials was measured. A-index, the ratio of the area of extruded material to spinal canal, was calculated (29). Compression rate was determined using the A-index and expressed as percentage of occlusion.

Surgery and postoperative care

Dorsal and hemi-laminectomy were performed in thirteen and fifteen dogs, respectively. Methylprednisolone sodium succinate (30 mg/kg, IV) was administered immediately before surgery. Then, decompression surgery was performed with reasonable approach according to CT findings. Postoperative treatment was recorded. All paralyzed dogs were managed in a similar manner included bladder management, nursing care to prevent decubital ulcers, cage rest, passive range of motion physical therapy and physiotherapy (laser therapy, electrical acupuncture, active movement of limbs).

Follow-up and outcome

Postoperative physical and neurological examinations were performed daily during 1 month of hospitalization. Pain perception and gait were assessed. Durations from onset of clinical signs to diagnose and until regain of DPP after surgery were recorded. Normal and paretic gaits (grades I and II) were evaluated as successful outcome.

Statistical analysis

Significance of the differences of outcomes of decompression surgery in relation to durations from onset of clinical signs to admission and until regain of DPP after surgery, compression rates and operation methods were evaluated by means of the Fischer's exact test using the SPSS.

Results

The thoracolumbar region, particularly T10-L2, was affected in the 23 of 28 dogs. Successful outcome was observed in 7 out of 10 dogs (70 %) in which decompression surgery was carried out within 24h. This success rate was significant higher than that of dogs which received surgical treatment after 24h (38.9 %) ($P<0.05$) (Table 1). But, the rate for regaining of DPP in 5 weeks had no significant difference ($P=0.32$). In the 15 of 20 dogs showed more than 50 % of spinal cord compression rate in CT scan (Table 2). There were no significant differences of successful outcomes between 26-50 % and 51-75 % of spinal cord compressions. Successful outcomes of dorsal and hemi-laminectomies were 53.3 % (8/15) and 46.2 % (6/13), respectively, which was not significantly different between dorsal laminectomy and hemi-laminectomy.

Sixteen of 28 dogs (87.5 %) recovered DPP within 5 weeks but the dogs that had no DPP within the 5 weeks did not (0/12, 0 %) (Table 3).

Discussion

In the present study success of decompression surgery was judged by regaining paretic gait from hindlimb paralysis.

Table 1. Success rates of operation and days of regains of deep pain perception in relation to days from onset of signs to surgery

Time from onset of signs to surgery	Success rate (%)	Regaining of DPP* within 5 weeks (%)
Before 24h	70.0 (7/10)**	70.0 (7/10)
After 24h	38.9 (7/18)**	50.0 (9/18)

(number of improved dogs/total dogs)
* DPP: deep pain perception;
** The success rate in dogs underwent surgical decompression within 24 hours after clinical signs showed significantly higher than those after 24 hours ($P<0.05$).

Table 2. Success rate of operation according to spinal cord compression rate in CT scan

Compression rate (%)	Number of dogs	Success rate (%)
0~25	0	0
26~50	5	40
51~75	15	53.3
76~100	0	0

Table 3. Success rate of operation in relation to durations of regain of DPP* after surgery

Duration of regain of DPP* after operation	Success rate (%) (number of improved dogs/total dogs)	
within 1 week	100 (4/4)	
within 2 weeks	75 (3/4)	Subtotal
within 3 weeks	75 (3/4)	87.5 %(14/16)
within 4 weeks	100 (3/3)	
within 5 weeks	100 (1/1)	
Not regained DPP	0(0/12)	0 %

* DPP: deep pain perception.

Other reports have also used similar parameter to evaluate success of the surgery (13).

In other study, the success rate of hemilaminectomy and dorsal laminectomy was 46.2 % and 53.3 %. respectively, it was reported that recovery rate was not significantly different between hemilaminectomy (17/39 dogs, 43.6 %) and dorsal laminectomy (2/7 dogs, 28.6 %) (5). The surgical method was depended on the site of herniated disc materials.

In this study, there was significant difference of successful outcomes between the durations of less than 24 hours (70 %) and over 24 hours (38.9 %) until surgery ($P<0.05$). And previous studies also reported a better recovery rate when duration of the loss of DPP was less than 12 hours compared with 24 to 48 hours, although statistical analysis was not performed (8, 23).

In another report, however, no significant differences were found in the clinical outcome for dogs grouped by duration of absence of DPP prior to surgery (13). In dogs with no DPP for less than 24 hours (n=41 dogs), neurologic recovery was found for 19 dogs (46.3 %) whereas in dogs with no DPP over 24 hours (n=5 dogs) and had no neurologic recovery ($p=0.07$) (13).

In this study, the different degrees of spinal cord compression were observed in most disc herniated dogs. However, there was no significant difference between recovery and compression rate. This results were same as other study (27).

Subsequent to disc herniation, a series of pathophysiological events occurs in the injured tissue that leads to secondary injuries. These include hemorrhagic necrosis, ischemia, edema, inflammation, lipid peroxidation and hydrolysis in cellular membranes (1). Both lipid peroxidation and hydrolysis can damage cells directly. The time course of secondary injury suggests that the pathophysiological events result in irreversible damage to spinal cord (1).

The prognosis for functional recovery in dogs with IVDD has been traditionally based on the duration and severity of neurological dysfunction, especially the preservation or not of deep pain sensation, with animals exhibiting grade III and IV spinal cord dysfunction being the least likely to recover (8,23,30).

Deep pain sensation is carried by non-myelinated fibers of the spinothalamic and spinoreticular tracts deep in the white matter of the lateral and ventral funiculus of the spinal cord (7). As theses fibers are relatively resistant to compression, loss of DPP in dogs with IVDD indicates severe spinal cord injury and are considered a poor prognosis (5,11,17).

In previous studies, it is known that the return of DPP or improvement by at least one neurologic grade within two weeks after decompression surgery was associated with better prognosis for recovery (2,16,23). Also, Anderson et al (1) showed the return of deep pain sensation or improvement within two weeks after decompression surgery was associated with a better prognosis (2,23). But our data showed good prognosis with the return of DPP until 5 weeks.

In conclusion, this retrospective study supports the previous reports that the dogs which had thoracolumbar disc disease without DPP were recommended surgical decompression as soon as possible, and the return of DPP within assigned number of weeks after surgery is prognostic indicator postoperatively.

Data obtained in this study demonstrate that the return of DPP within 5 weeks after surgery is a useful prognostic indicator for successful outcome of surgery.

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