RATE OF NEUROLOGIC RECOVERY AS AN INDICATOR OF LONG-TERM PROGNOSIS IN DOGS WITH SURGERALLY TREATED THORACOLUMBAR DISC DISEASE

RYCHLOST OBNOVY NEUROLOGICKÝCH FUNKCI JAKO UKAZATEL DLOUHODOBÉ PROGNÓZY U PSŮ S CHIRURGICKÝ LÉČENÝM ONEMOCNĚNÍM TORAKOLUMBÁLNÍCH MEZIOBRATLOVÝCH PLOTÉNEK

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ABSTRACT: The time needed to regain the ability to walk without assistance was examined in 266 dogs, from the clinical group of 300 dogs with thoracolumbar disc disease treated by decompressive hemilaminectomy with removal of extruded disc material from the vertebral canal at the Clinic of Surgery and Orthopedics at University of Veterinary and Pharmaceutical Sciences in Brno during a four year period (April 1994 through March 1998). The time needed until complete recovery from TL-IWDD in 177 dogs in which the final outcome was graded as excellent was also evaluated. The outcome of surgical treatment was assessed based on 9 to 51 months follow-up. The time until dogs regained the ability to walk without assistance and until complete recovery (excellent outcomes only) differed (Mann-Whitney U-test; p < 0.01) between the groups of patients (grade II, III, IV A, IV B and IV C). Evaluating the time needed to regain the ability to walk without assistance in relation to the possible prediction of complete recovery (patients with excellent result of therapy compared to patients with very good and fair outcome of surgery) in dogs with grade IV A paraplegia a significant difference (Mann-Whitney U-test; p < 0.01) was found between patients with very good or fair outcomes and those with excellent outcomes. In grade IV A dogs, which underwent surgery within 48 hours after the onset of clinical signs, the following results were found: dogs with excellent outcomes regained the ability to walk in 1.70 ± 1.14 weeks after surgery, and dogs with very good or fair outcomes regained the ability to walk in 2.90 ± 1.47 weeks after surgery. In grade IV A dogs which underwent surgery more than 48 hours after the onset of signs, dogs with excellent outcomes regained the ability to walk in 2.15 ± 1.69 weeks after surgery, and those with very good or fair outcomes regained the ability to walk in 3.96 ± 2.29 weeks. Based on these results, the time in which a grade IV A dog regains the ability to walk unassisted is an objective prognostic indicator with a reliability of 95% (c95,95) for those operated on within 48 hours from the onset, and also those operated on later than in 48 hours if appropriate decompressive surgery is performed.

intervertebral disc disease; dog; hemilaminectomy; prognosis

ABSTRAKT: Doba potřebná k opětnému obnovení schopnosti chodit bez pomoci majitele byla sledována u 266 psů, vybraných ze souboru 300 pacientů s onemocněním torakolumbálních meziobratlových plotěnek léčených dekompresní hemilaminektomií. Výsledek chirurgické léčby vycházel ze sledování klinického stavu pacientů po dobu 9 až 51 měsíců od operace. Časový interval mezi dekompresní operací a okamžikem opětného obnovení schopnosti samostatné chůze, respektive kompletní obnovení všech neurologických funkcí, se liší (Mann-Whitney U-test; p < 0.01) u jednotlivých skupin pacientů (stupně II, III, IV A, IV B a IV C). Hodnocení vztahu mezi dobou potřebnou k obnově chůze bez pomoci majitele a možnou prognózou úplné obnovení neurologických funkcí u paraplegických pacientů stupně IV A odhalilo značnou rozdílnost (p < 0.01) mezi pacienty s velmi dobrou a či uspokojivěm výsledkem léčby a pacienty s výborněm pooperárním výsledkem. Psí s paraplegií IV A operovaný do 48 hodin po jejím vzniku, u kterých byl výsledek léčby označen jako výborný, začali znovu bez pomoci chodit v průměru za 1.70 ± 1.14 týdnů, zatímco psi s velmi dobrou či uspokojivěm výsledkem léčby byli schopni chodit za 2.90 ± 1.47 týdnů po chirurgickém zákroku. Pacienti stupně IV A operováni za více než 48 hodin po vzniku paraplegie, u kterých došlo k úplné obnově neurologických funkcí (výborný výsledek), začali chodit v průměru za 2.15 ± 1.69 týdnů po dekompresi. Jedinci s velmi dobrou či uspokojivěm výsledkem léčby byli schopni chodit až po 3.96 ± 2.29 týdnech od operace. Na základě těchto výsledků lze říci, že doba potřebná k opětnému obnovení schopnosti chodit po správně provedené dekompressní hemilaminektomii je u pacientů s paraplegií stupně IV A (operovaných jak do 48 hodin, tak po více než 48 hodinách od vzniku paraplegie) objektivním prognostickým ukazatelem konečného výsledku léčby.

onemocnění meziobratlových plotěnek; pes; hemilaminektomie; prognóza

INTRODUCTION

Thoracolumbar (TL) intervertebral disc herniations are the most common cause of paralysis in dogs. Disc lesions in the thoracolumbar region of the spine represent from 84 to 86% of the clinical cases of intervertebral disc disease (IVDD) seen in dogs (Gage, 1975; Hoerlein, 1978). The age incidence for clinical manifestation of the disease in chondrodystrophic breeds is highest at 3 to 6 years (Toombs and Bauer, 1993). Males and females are approximately at equal risk (Hoerlein, 1953). The severity and duration of neurological deficits, as well as the method of therapy, are correlated with outcome (Něčas, 1995, 1999). There are controversies about the treatment of TL-IVDD with regard to the necessity for decompressive surgery, the type of decompressive surgery, the necessity to remove the compressive mass of extruded disc material, and the therapeutic value of disc fenestration (Henry, 1975; Denny, 1978; Bitteto and Thacher, 1987; Walker and Betts, 1985; Black, 1988; Jeffery, 1988; Butterworth and Denny, 1991; Davies and Sharp, 1983; McKee, 1992; Yovovich et al., 1994). Hemilaminectomy is the most commonly used surgical procedure for spinal cord decompression and removal of herniated disc material from the vertebral canal (Cook, 1992).

The prognosis for neurological recovery after treatment is dictated by the severity of injury to the spinal cord. To provide a prognosis before surgical exploration and visualization of the spinal cord, the clinical history and neurological examination are used. We believe that there are additional and more objective prognostic indicators that should also be used before surgery as changes in the creatine kinase and lactate dehydrogenase activities in cerebrospinal fluid of dogs with thoracolumbar disc disease (Něčas and Sedlákova, 1999).

The purpose of this study was to find a new and different objective prognostic indicator for neurological outcome in dogs with grade IV A paraplegia due to TL-IVDD. The time needed until these dogs regained the ability to walk without assistance was evaluated as a possible long-term prognostic indicator for those operated on within 48 hours from the onset, and also those operated on later than in 48 hours. The longest time needed to regain the ability to walk without assistance after the surgical procedure (according to which it was possible to predict a complete recovery) was assessed as $\sigma_{0.95}$ (mean $\pm$ 2 sd).

MATERIAL AND METHODS

The time needed to regain the ability to walk without assistance was examined in 266 dogs, from the clinical group of 300 dogs with TL-IVDD at the Clinic of Surgery and Orthopedics at University of Veterinary and Pharmaceutical Sciences in Brno during a four year period (April 1994 through March 1998). Dogs were treated by hemilaminectomy with removal of extruded disc material from the vertebral canal. Prophylactic fenestrations of other discs at the risk region of the thoracolumbar spine (from T11-T12 to L3-L4) were not performed. Nineteen of these 300 patients died or were euthanized during the perioperative or early postoperative period, and fifteen dogs never regained the ability to walk after surgery, and were lost for a follow-up.

Each dog received standard diagnostic evaluation, including neurological examination. These 266 dogs were classified into groups according to severity of signs (Tab. 1) (Toombs and Bauer, 1993). Ten of them elicited neurological signs of grade II involvement, 68 dogs grade III, 159 dogs grade IV A, 24 dogs grade IV B, and 5 dogs grade IV C. The duration of clinical signs was defined as the interval between the appearance of initial neurological deficit, which is typical of each group (i.e., grade III, grade IV A, grade IV B etc.) of the patients, and surgery. In cases of slow progression of paraplegia (loss of all pelvic limb sensory and motor function), paraparesis (still purposeful movements in the hind limbs), which preceded a plegia, was not considered as a clinical sign typical of the grade. The general anesthesia protocol used in a given patient was dependent upon its general condition (Paddleford and Erhardt, 1992; Wooten and Lowrie, 1993; Thurman et al., 1996). Survey radiographic examination and myelography, using transmedullary lumbar puncture (Barber et al., 1987)

I. Classification of dogs with TL-IVDD according to severity of clinical signs

<table>
<thead>
<tr>
<th>Grade</th>
<th>Clinical manifestation</th>
<th>Treatment options</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>first episode of back pain and no neurological deficit</td>
<td>M or F</td>
</tr>
<tr>
<td>II</td>
<td>recurrent pain and/or mild to moderate paraparesis</td>
<td>M, F, D, D + F</td>
</tr>
<tr>
<td>III</td>
<td>severe paraparesis</td>
<td>D or D + F</td>
</tr>
<tr>
<td>IV</td>
<td>paraplegia</td>
<td>D or D + F</td>
</tr>
<tr>
<td>A</td>
<td>with deep pain intact</td>
<td>M or D + d</td>
</tr>
<tr>
<td>B</td>
<td>deep pain absent 48 hours</td>
<td>D or D + F</td>
</tr>
<tr>
<td>C</td>
<td>deep pain absent 48 hours</td>
<td>M or D + d</td>
</tr>
</tbody>
</table>

Explanatory notes:
M = medical therapy, F = disc fenestration, D = decompressive surgery and removal of extruded disc material, d = durotomy (modified and reprinted with permission from Toombs and Bauer, 1993)
II. The time needed to regained ability to walk without assistance (mean ± sd) in relation to the severity of clinical signs in 266 dogs with TL-IVDD

<table>
<thead>
<tr>
<th>Severity of clinical signs*</th>
<th>Number of patients A = 266</th>
<th>The time needed to regained ability to walk (weeks) mean ± sd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade II</td>
<td>10</td>
<td>1.70 ± 2.21</td>
</tr>
<tr>
<td>Grade III</td>
<td>68</td>
<td>1.59 ± 1.01</td>
</tr>
<tr>
<td>Grade IV A</td>
<td>159</td>
<td>2.34 ± 1.71</td>
</tr>
<tr>
<td>Grade IV B</td>
<td>24</td>
<td>5.46 ± 4.02</td>
</tr>
<tr>
<td>Grade IV C</td>
<td>5</td>
<td>5.80 ± 8.04</td>
</tr>
</tbody>
</table>

* Classification of dogs into groups according to severity of clinical signs.

III. The time (mean ± sd) required for complete recovery (excellent outcome) in relation to the severity of clinical signs in 177 dogs with TL-IVDD

<table>
<thead>
<tr>
<th>Severity of clinical signs*</th>
<th>Number of patients A = 177</th>
<th>The time needed to complete recovery (weeks) mean ± sd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade II</td>
<td>8</td>
<td>5.00 ± 5.71</td>
</tr>
<tr>
<td>Grade III</td>
<td>55</td>
<td>5.82 ± 7.77</td>
</tr>
<tr>
<td>Grade IV A</td>
<td>105</td>
<td>7.63 ± 12.83</td>
</tr>
<tr>
<td>Grade IV B</td>
<td>7</td>
<td>9.57 ± 6.32</td>
</tr>
<tr>
<td>Grade IV C</td>
<td>2</td>
<td>10.00 ± 0.00</td>
</tr>
</tbody>
</table>

* Classification of dogs into groups according to severity of clinical signs.

Between L5 and L6 vertebrae, were performed prior to surgery.

Searching for necessary data we used clinical records on hospitalised patients, and outpatients, respectively. A long-term follow up was obtained by examination of the dog at our hospital when feasible, and by telephone conversation with the owner when not. Owners were asked to estimate the time needed until their dogs regained the ability to walk without assistance and to describe the most complete extent of recovery that was evident in the dog and the time in which this was noted following surgery. Residual weakness and/or incoordination, and recurrence of back pain, paresis or paralysis were also recorded. Patients were observed at least 9 months after surgery (9–51 months follow-up) and results of the therapy were classified as excellent (complete recovery of motor and urinary function), very good (minimal motor deficit when walking on a slippery surface, and complete recovery of urinary bladder function), fair (obvious remaining dysfunction, either motor or urinary, but animal retained independent function and usefulness) and poor (not enough improvement to be returned to the owner as an independent animal).

The time needed until complete recovery from TL-IVDD in 177 dogs in which the final outcome was graded as excellent was also evaluated.

The longest time to regain the ability to walk without assistance (according to which it is possible to predict complete recovery) was assessed as \( \sigma_{20,95} \) (mean ± 2 sd).

Means and standard deviations were calculated for all variables. The values were analyzed using Mann-Whitney U-test. Statistical analyses were done using Stat plus 1.10 (Matoušková et al., 1992).

RESULTS

Twenty-four different breeds of dogs, including mongrels, were represented in 300 clinical cases of thoracolumbar disc disease. The most commonly affected breeds in our study were: Dachshund (71.00 %), Mongrel (8.67%), Pekingese (4.67%), Cocker Spaniel (2.67%), Miniature Schnauzer (1.67%), Poodle (1.67%), French Bulldog (1.67%), Lhasa-apso (1.33%), Basset hound (1.00%), American Cocker (0.67%) and Shih-tzu (0.67%). The age of the dogs varied from 2 to 13 years with an average of 6.82 ± 1.58 years. One hundred seventy-two dogs (57.33%) were males and one hundred twenty-eight (42.67%) were females. The rate of neurological recovery was different in each group of dogs according to the severity of clinical signs (grades II, III, IV A, IV B and IV C) (Nečas, 1999).

Two hundred sixty-six cases were identified as appropriate subjects for this portion of the study. All of these dogs regained the ability to walk after surgical intervention and had complete and long-term follow-up information available in the medical record. The variables concerning the complete recovery from TL-IVDD were evaluated in 177 dogs with excellent outcomes.

The time needed until dogs regained the ability to walk without assistance (Tab. II) and until complete recovery (in dogs with excellent outcomes) (Tab. III) differed between the groups of patients. The mean time after which dogs with grade II involvement were able to walk without the owner’s assistance was 1.70 ± 2.21 weeks. The time of complete recovery from neurological deficits in these dogs varied from 1 to 16 weeks, with the average of 5.00 ± 5.71 weeks. The mean time after which dogs with grade III involvement were able to walk without the owner’s assistance was 1.59 ± 1.01 weeks (1 to 4 weeks) and the mean time until complete recovery in these dogs was 5.82 ± 7.77 weeks (1 to 50 weeks). In dogs with grade IV A involvement, the ability to walk was seen from 1 to 10 weeks following surgery, with an average of 2.34 ± 1.71 weeks. Complete recoveries in these dogs were achieved within 7.63, 12.83 weeks after hemilaminectomy (1 to 100 weeks). When selecting only those patients with duration of grade IV A paraplegia less than 48 hours, the ability to walk was regained within 2.03 ± 1.34 weeks after surgery (1 to 8 weeks) and complete recovery was evident in 6.81 ± 14.12 weeks following the procedure (1 to 100 weeks).
The same variables in dogs with a duration of IV A paraplegia which exceeded 48 hours were as follows: 3.02 ± 2.18 weeks (1 to 10 weeks), and 8.32 11.73 weeks (1 to 70 weeks), respectively. The mean time in which dogs with grade IV B involvement regained the ability to walk without assistance was 5.46 ± 4.02 weeks following the surgery (1 to 16 weeks). The time until complete recovery varied from 3 to 20 weeks, with an average of 9.57 ± 6.32 weeks after surgery. Dogs with grade IV C involvement regained the ability to walk in 5.80 ± 8.04 weeks after surgery (1 to 20 weeks) and those with the excellent outcomes recovered completely in 10.00 ± 0.00 weeks after surgery.

Assessing the time needed to regain the ability to walk without assistance in relation to severity of clinical signs before surgery, a significant difference was seen between grade III dogs (paraparesis) and grade IV A dogs (paraplegia; deep pain intact) using Mann-Whitney U-test (p < 0.01). The results of the statistical analysis showed significant differences (p < 0.01) in the time necessary to regain the ability to walk between dogs of grade IV A (deep pain intact; operated on within 48 hours after the onset of clinical signs) and dogs of grade IV B (no deep pain sensation up to 48 hours). Significant differences (p < 0.01) were found between patients of grade IV A (deep pain intact; operated on more than 48 hours after the onset of clinical signs) and those of grade IV C (no deep pain perception more than 48 hours). Comparing the time needed to walking without assistance significant differences (p < 0.01) between dogs of grade IV A operated on within 48 hours after the onset of paraplegia and those operated on later than in 48 hours were found. No differences were found when parctic dogs of group II were compared with those of group III.

The time needed to achieve complete recovery in dogs with excellent outcomes was significantly different (Mann-Whitney U-test; p < 0.01) between grade II dogs (mild to moderate paraparesis) and grade III dogs (severe paraparesis). Similar differences (p < 0.01) were also evident between grade III dogs (paraparesis) and grade IV A dogs (paraplegia with deep pain intact). Significant differences (p < 0.01) were also seen in the time required for complete recovery between grade IV A dogs (paraplegia with deep pain intact; operated on within 48 hours after the onset of clinical signs) compared to grade IV B dogs (paraplegia with no deep pain sensation up to 48 hours). Similar differences (p < 0.01) were found between paraplegic dogs of grade IV A (deep pain intact; operated on more than 48 hours after the onset of clinical signs) and those of grade IV C (no deep pain perception more than 48 hours). Significant differences (p < 0.01) in the time needed to achieve complete recovery were also seen between dogs of grade IV A operated on within 48 hours after the onset of paraplegia and those operated on later than in 48 hours.

Evaluating the time needed to regain the ability to walk without assistance in relation to the possible prediction of complete recovery (patients with excellent result of therapy compared to patients with very good and fair outcome of surgery) in dogs with grade IV A paraplegia (Tab. IV) a significant difference (Mann-Whitney U-test; p < 0.01) was evident between patients with very good or fair outcomes and those with excellent outcomes. In grade IV A dogs, when surgery was performed up to 48 hours after the onset of signs, a significant difference (p < 0.01) was found between dogs with very good or fair outcomes and those with excellent outcomes. When surgery was performed more than 48 hours after the onset of signs in group IV A dogs, a similar difference was found between dogs with very good or fair outcomes and those with excellent outcomes (p < 0.01). Dogs with grade IV A paraplegia which recovered completely (excellent outcomes), regained the ability to walk in 1.81 ± 1.30 weeks after surgery. Dogs with grade IV A paraplegia with very good or fair outcomes, regained the ability to walk in 3.37 ± 1.94 weeks after surgery. Evaluation of the same parameters in grade IV A dogs which underwent surgery within 48 hours after the onset of clinical signs, revealed the following results: dogs with excellent outcomes regained the ability to walk in 1.70 ± 1.14 weeks after surgery, and dogs with very good or fair outcomes regained the ability to walk in 2.90 ± 1.47 weeks after surgery. In grade IV A dogs which underwent surgery more than 48 hours after the onset of signs, dogs with excellent outcomes regained the ability to walk in 2.15 ± 1.69 weeks after surgery, and those with very good or fair outcomes regained the ability to walk in 3.96 ± 2.29 weeks.

<table>
<thead>
<tr>
<th>Dogs of grade IV A*</th>
<th>Number of patients</th>
<th>Time needed to regain the ability to walk (weeks)</th>
<th>Number of patients</th>
<th>Time needed to regain the ability to walk (weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 159</td>
<td>n = 105</td>
<td>mean ± sd excellent outcome</td>
<td>n = 54</td>
<td>mean ± sd very good and fair outcome</td>
</tr>
<tr>
<td>IV A paraplegia up to 48 hours</td>
<td>79</td>
<td>1.70 ± 1.14</td>
<td>30</td>
<td>2.90 ± 1.47</td>
</tr>
<tr>
<td>IV A paraplegia more than 48 hours</td>
<td>26</td>
<td>2.15 ± 1.69</td>
<td>24</td>
<td>3.96 ± 2.29</td>
</tr>
<tr>
<td>Total IV A</td>
<td>105</td>
<td>1.81 ± 1.30</td>
<td>54</td>
<td>3.37 ± 1.94</td>
</tr>
</tbody>
</table>

* Classification according to duration of clinical signs.
DISCUSSION

Dogs in this study represent a typical sample of clinical patients, among which dachshunds predominate (71%). The age of the dogs (mean 6.82 ± 1.58 years) was similar to that in previous reports (Gage, 1975; Hoerlein, 1978; Toombs and Bauer, 1993).

Based upon our results, it is possible to conclude that useful correlations exist between the time needed to regain the ability to walk unassisted, the severity of neurological deficits, and duration of these signs at the time of presentation. Similar correlations exist between the time needed to the complete recovery (excellent outcomes), the severity of neurological deficits, and duration of signs after onset.

The mean time within which these patients were able to walk without assistance was approximately 1 to 2 weeks after surgery in dogs with grades II or III involvement, 2 to 3 weeks in dogs with grade IV A involvement, and 5 to 6 weeks in dogs with grades IV B or IV C involvement (Tab. II).

Similarly it is possible to estimate the time until complete recovery (in cases which achieve excellent outcomes) which in our patients was 5 to 6 weeks in grade II or III dogs, 7 to 9 weeks in grade IV A dogs, and 9 to 10 weeks in grade IV B or IV C dogs (Tab. III). In predicting the eventual outcome for our surgical TL-IVDD patients the following guideline applies: the more severe the spinal cord injury, the longer the recovery from paraparesis/paraplegia.

The mean time within which grade IV A dogs regained the ability to walk was 1.70 ± 1.14 weeks in the subset of patients which had surgery within 48 hours and eventually achieved complete recovery. If similar patients underwent surgery later than in 48 hours after the onset of signs, this value increased to 2.15 ± 1.69 weeks. In our study, the longest time needed to regain the ability to walk without assistance after the surgical procedure, was accurately predicted by the likelihood of complete recovery (σA0,95). In grade IV A dogs this time was σA0,95 ≤ 3.98 weeks (mean + 2 sd) when decompressive surgery was performed within 48 hours from the onset of paraplegia, and σA0,95 ≤ 5.53 weeks when surgery was performed later than in 48 hours.

When describing the case prognosis to the owner, it is possible to predict, for example, that the dog with grade IV A paraplegia operated on within 48 hours after the onset of signs, which regains the ability to walk unassisted within 1.70 ± 1.14 weeks has a high likelihood of achieving complete recovery. This supposes no neurological deficits before this episode of transverse myelopathy and appropriate postoperative management (Hart et al., 1997; Jerram et al., 1997).

Conversely, grade IV A dogs, operated on within 48 hours from the onset which were able to walk unassisted within 2.90 ± 1.47 weeks after surgery (σA0,95 = 5.84 weeks), never recovered completely from paraplegia. Similarly, grade IV A dogs operated on later than 48 hours after onset, which were able to walk unsa-

sisted within 3.96 ± 2.29 weeks after surgery (σA0,95 = 8.54 weeks), never recovered completely from paraplegia.

Based on these results, the time in which a grade IV A dog regains the ability to walk unassisted is an objective prognostic indicator with a reliability of 95% (σA0,95) for those operated on within 48 hours from the onset, and also those operated on later than in 48 hours if appropriate decompressive surgery is performed.

REFERENCES


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