



INTERVERTEBRAL DISC DISEASE IN DOGS – THE RELATIONSHIP BETWEEN RECOVERY AND TIMING OF SURGERY

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ABSTRACT

The aim of this study was to evaluate the relationship between functional recovery and timing of surgery in dogs diagnosed with intervertebral disc disease treated surgically. Intervertebral disc disease is the most common spinal disease in dogs; it plays a significant role in the scientific field by its high prevalence. There is also an existing hypothesis that the faster the surgery is performed, the better the outcome will be. The data were collected during two years at one institution. The patients were neurologically assessed using the modified Frankel score when they were first diagnosed with intervertebral disc disease at the clinic and later after the surgery and during the following weeks. A total of 36 dogs were included in this study, represented by 13 different dog breeds and crossbreeds. In total 17 were females and 19 males. The mean age of the patients was 6.9 ± 2.97 years (range 2—15 years) and the mean body condition score was 3.5 within a scale of 1—5. Out of the 36 evaluated dogs, surgery was performed on 25 of them. The mean time of duration of clinical signs before surgery was 9 ± 13 days. The main limitation of this study was the small group of investigated dogs. Although the study was based on a small number of participants, the findings suggested that the

timing of the surgery and recovery had a positive Pearson correlation coefficient of 0.39; implying that the timing of the surgery may have affected the recovery.

Key words: dog; herniation; intervertebral disc; recovery; surgery; timing

INTRODUCTION

Intervertebral disc disease (IVDD) is the most common spinal disease in dogs, and the surgery performed for IVDD is the most common spinal surgery in veterinary medicine. IVDD is a degenerative and age-related condition, but there is a certain predisposition in chondrodystrophic breeds, which can experience this condition also as young adults. Chondrodystrophic breeds are characterized by long bodies and disproportionally short and often curved legs; examples of these are: Dachshund, Basset Hound, Welsh Corgi, Shi Tzu, Beagle, Cavalier King Charles Spaniel, French and English Bulldog, Miniature Schnauzer, Lhasa Apso, Pekingese, American Cocker Spaniel and Tibetan Spaniel [14]. In these breeds, the IVDD mainly occurs in the cervical and thoracolumbar spinal segments, and typically around the age of 3—7 years [10, 14].

Intervertebral disc degeneration results in reduced

shock-absorbing capacity and it can thereby lead to intervertebral disc herniation, spinal cord compression and damage to the associated nerves [5]. The chondrodystrophic breeds are predisposed through abnormal maturation of the intervertebral disc, which causes premature dehydration and mineralization of the *nucleus pulposus*. When the *nucleus pulposus* is mineralized this can cause splitting of the *anulus fibrosus* and result in acute herniation of the disc material into the spinal canal [10].

The veterinary pathologist Hans-Jürgen Hansen first classified IVDD as type I and type II in 1951. This classification was mainly based on the type of intervertebral disc herniation (IVDH) and the types of breeds affected [3, 4]. It was assumed that the chondrodystrophic (CD) dogs were associated with Hansen I and suffered from chondroid degeneration, while fibroid degeneration associated with Hansen II occurred in the non-chondrodystrophic (NCD) dogs. A recent study from 2017, compared the histopathology of the degenerated intervertebral disc in NCD and CD dogs, and found that the histopathological changes were similar in both categories and appeared as chondroid metaplasia [4].

Dogs suffering from IVDD can experience varying neurological clinical signs, mostly with acute onset in the cases of Hansen type I or less often they can develop progressively in some cases of Hansen type II. These clinical signs include neck and/or back pain and varieties of neurological dysfunctions such as paresis or paralysis in one or more limbs, and/or the tail. This can present as a: loss of balance, co-ordination, ability to walk and in some cases, a loss of control of defecation and urination [3]. Indications for surgical treatment of IVDD include severe or progressive neurological deficits, irreversible pain and failure of previous non-surgical treatment [13]. It remains controversial which prognostic factors that are best to use for evaluation of the prognosis. These factors commonly include: duration of clinical signs, speed of onset, and the presence of deep pain perception [1, 8, 12, 15]. As an example, the study done by Ferreira et al. [2] involving 71 dogs, showed that the duration of the clinical signs seemed less significant for the clinical outcome for the patients but did affect the length of recovery time. It also showed that the rate of onset of the clinical signs significantly influences the outcome.

Our study was focused on a very important aspect of the surgical therapy, which is timing of the surgical de-

compression. When the period of time from the development of the clinical signs until the surgery is prolonged, it can have a negative effect on the outcome [8]. This is unluckily influenced by the approach of the owners, when they wait sometimes for a very long period until the dog is presented to the veterinarian. The goal of this study was to investigate how the timing of the surgery affects the outcome and prognosis of the patients.

MATERIALS AND METHODS

The data used in this study were collected from patients' records of dogs with a confirmed diagnosis of IVDD during a two year period. The inclusion criteria were: age, gender, breed, body condition score, body weight, modified Frankel score prior to surgery, duration of clinical signs prior to surgery, diagnostic imaging, type of surgery, outcome by means of the modified Frankel score recorded during observational period 6 months after surgery.

The modified Frankel score (MFS) is a neurological scoring system used to assess the severity and prognosis for spinal cord injury. It ranges from the favourable MFS grade 1 to the more severe neurological grade of MFS grade 5 (Table 1). Grade 1 is characterized by spinal hyperesthesia and no neurological dysfunction, grade 2 by ambulatory paraparesis, grade 3 by non-ambulatory paraparesis, grade 4 where the patient is paraplegic with intact pain perception in either pelvic limb and/or tail and lastly grade 5 with the paraplegic patients with absent deep pain perception in both pelvic limbs and tail [8].

The obtained data were expressed as Min-Max values and Mean $\pm$ SD. The Pearson correlation coefficient was

Table 1. Modified Frankel Score used for neurological scoring of the dysfunction

Modified Frankel Score	Neurological grade
Grade 1	Spinal hyperaesthesia, no neurological dysfunction
Grade 2	Ambulatory paraparesis
Grade 3	Non-ambulatory paraparesis
Grade 4	Paraplegic, with intact pain perception in either pelvic limb and/or tail
Grade 5	Paraplegic, with absent pain perception in both pelvic limb and/or tail

Table 2. Breed distribution of the 36 dogs with neurological dysfunction

Breed	Number of affected dogs
Cocker Spaniel	1
Dogo Argentino	1
German Shepherd	1
Great Swiss Mountain dog	1
Poodle	1
Short Hair Collie	1
Doberman	1
Lhasa Apso	1
Slovak Hound	2
Dachshund	3
Yorkshire Terrier	3
Maltese	4
Crossbreed	5
French Bulldog	11

Table 3. Age distribution of the 36 dogs with neurological dysfunction at the time of the diagnosis

Age in years	Number of affected dogs
2	2
3	5
4	2
5	4
6	8
7	4
8	0
9	4
10	2
11	3
12	1
13	0
14	0
15	1

used to express correlation between the timing of the surgery and the outcome, as well as the size of the patients and outcome. The timing of surgery was expressed in days while the size categories were divided according to the individual body weight in kilograms.

RESULTS

A total of 36 dogs were included in this study. The patients were represented by 13 different dog breeds in addition to a few crossbreeds. Breed distribution of the 36 dogs with neurological dysfunction are presented in Table 2.

In total, 17 of the dogs were females (10 castrated, 7 intact) and 19 males (5 castrated, 14 intact). The age of the patients ranged from 2 to 15 years (Table 3) with the mean age 6.9 ± 2.97 years and a mean body condition score (BCS) of 3.5 within a 5-degree scale. By means of the course of the disease, 15 dogs (41.6%) were presented with acute onset of the clinical signs, while the remaining 21 dogs (58.3%) were characterized with a chronic course.

Out of the 36 dogs, nine dogs (3%) were presented with grade 2 MFS, 13 dogs (36%) were presented with grade 3 MFS, seven dogs (19.5%) were presented with grade 4 MFS, and seven dogs with grade 5 MFS.

Most of the dogs were diagnosed with myelography (25 dogs, 69.4%), the remaining five dogs with MRI (Magnetic Resonance Imaging) (13.8%) and three dogs with x-rays (8.3%). Three of the dogs were euthanized before any attempt to diagnosis at the owners request; these were paralyzed chondrodystrophic dogs with possible intervertebral disc disease.

Out of the 33 dogs that were diagnosed with imaging diagnostics, 8 dogs (24.2%) had the lesion located in the cervical segments, 16 dogs (48.5%) were affected in the thoracic segments, 8 dogs (24.2%) in the thoracolumbar segments and 1 dog (3%) in the lumbosacral segment.

Localization of lesions in acute and chronic patients is shown in Table 4.

Surgical intervention was performed on 25 of the dogs. The remaining 3 dogs were euthanized, 3 dogs ended up with the wheelchair as a solution and 2 dogs had owners that declined surgery with no further information about the dogs. Three dogs were operated within a day, 5 dogs after 2 days, 4 dogs after 3 days, 8 after 4—10 days and the remaining 5 dogs 14 days or more after the first onset of clinical signs.

The mean MFS at the time of diagnosis put most of the patients in grade 3, non-ambulatory paraparesis. Already one day post-surgery the mean MFS was below 3, placing

Table 4. Localization of lesions in acute and chronic patients

Localisation of lesions	Total	Acute	Chronic
Cervical	8	2	6
Thoracic	16	9	7
Thoracolumbar	8	2	6
Lumbosacral	1	0	1

the patients in grade 2, ambulatory paraparesis. Two weeks post-surgery the mean MFS of treated dogs dropped below 2 and improved even closer to 1 at 6 months post-surgery. Patients with MFS grade 1 were characterized by spinal hyperesthesia and no neurological dysfunction, which was characteristic for all dogs at 6 months follow up.

The outcome of the surgery according to the size of the dog shows that all sizes improved to a MFS of grade 1 within 6 months after the surgery. The medium sized breeds of dogs had the best total improvement of 2.0 MFS after 6 months. This group of patients also showed the fastest recovery, except at 1 week post-surgery where large breeds had the best MFS improvement, followed by the small breeds. Based on the MFS score recorded 6 months post-surgery and the size of the breed this gave a negative Pearson correlation coefficient of -0.87 ; meaning that the bigger dogs had the lower MFS and thereby the better outcome at 6 months post-surgery.

According to the localization of the lesion, the patients with a thoracic localization showed the best improvement at 1 day and 1 week post-surgery, and they also had the best total improvement from the time of diagnosis until 6 months post-surgery. The dogs with thoracolumbar lesions started off with the highest and thereby more severe MFS grade at the time of diagnosis, with 1.67 MFS improvement they still ended with the highest average MFS grade (1.83) at 6 months post-surgery, placing them closer to grade 2 when the other two categories improved to grade 1 at the end of the follow-up period.

DISCUSSION

The chondrodystrophic breeds of dogs have a certain predisposition to IVDD, usually occurring in animals from

3—7 years of age and involving mostly the cervical and thoracolumbar region [10, 11, 14]. The findings in our study showed a mean age of 6.9 ± 2.97 (2—15) years, placing it in the upper limit.

There were 13 different breeds represented in this study, 6 of these breeds were considered chondrodystrophic, 23 of the 36 (63.9%) diagnosed dogs. The French bulldog accounted for 30% of all diagnosed dogs, while it was characterized as chondrodystrophic this result may also be explained by the high popularity of this breed. The American Kennel Club reported this breed as the 3rd most popular dog breed in Europe in 2018. The Highland Canine breed ranked as the 7th most popular dog breed in the world by January 2022, based on google searches.

According to Nelson and Couto [9], most of disc extrusions occurred in the caudal thoracic or lumbar spine. Lemarié et al. [7] reported that 15% of the reported canine IVDD cases have cervical localization. In acute thoracolumbar disc extrusions, 65% are localized between Th11/12, for cervical discs, the C2/3 intervertebral disc was most frequently affected [9]. Our study included 33 patients where the exact localization of the lesion was determined through the imaging diagnostics. The thoracic lesions were most common, accounting for 16 of the patients, 9 of these with acute onset. We found the exact same number of patients with cervical as with the thoracolumbar lesions, representing 8 patients each, both with 6 chronic and 2 acute onsets. Only one patient was presented with a lumbosacral lesion and was considered chronic.

Martin et al. [8] found, that when the period from the first occurrence of clinical signs until the surgery is delayed overnight, the patient has an increased risk of deterioration. Their study was focused on dogs with thoracolumbar disc extrusions, which had spinal decompressive surgery. It has been shown by several studies [6, 11], that neuronal death can continue for hours to days after initial spinal cord injury, as well as further extrusion of disc material constitutes a risk of deterioration of the clinical signs with worsening prognosis.

Our results showed a positive correlation coefficient of 0.39 for the duration in days from the onset of clinical signs until the surgery and the MFS evaluated at 6 months post-surgery. This indicated that these two variables moved in the same direction, stating the duration from onset of clinical signs until surgery decreases, so does also the MFS at 6 months post-surgery. It also indicated that

in the case of the opposite scenario, when the duration of this period increases, so does also the MFS at 6 months post-surgery. It was the group of patients that were operated within 1 day and after 2 days that had the highest MFS of improvement after 2 weeks post-surgery, with the group operated after 2 days having improvements that were more favourable and earlier.

Controversially, our study demonstrated that both the group operated after 2 days and after 3 days had a better total improvement at 6 months post-surgery than the group of patients operated within 1 day. There can be several reasons for this, also as both these groups had a higher mean MFS at the time of diagnosis and as recovery is individual and depends on more factors than timing, like for example etiology and severity.

The main source of error was the small number of patients in this study. The number of patients were also unequal in the different groups, as not all of the dogs that were diagnosed with IVDD had surgery and therefore could not be included in the group that focused on recovery. The real statistical value from this study is therefore decreased and the correlation coefficients are mostly informational as the group is too small to be representative for all dogs with IVDD.

All patients that had surgery had the same treatment with: massage, passive range of motion exercises and hydrotherapy following the surgery. However, some physiotherapy exercises and movement restrictions were to be performed by the owners at home and are therefore considered as possible sources of error and differing outcomes.

CONCLUSIONS

The main limitation of this study was the small group of patients. Although the study was based on a small number of participants, the findings suggested that the timing of the surgery and recovery had a positive Pearson correlation coefficient of 0.39; implying that the timing of the surgery affected the recovery.

When investigating the most affected groups of patients, this study found a negative Pearson correlation coefficient of -0.87 between the size of the patient and the recovery, implying that the larger breeds had better improvement of MFS after surgery than the medium and small sized breeds.

The relevance of anatomical phenotypes implying that chondrodystrophic breeds are predisposed remains clearly supported by our study, accounting almost 64% of all patients, with French Bulldogs as the most prominent breed. This study also found that sex and castration status had less impact in the development of IVDD, while the BCS of the patients implied that obesity was a common factor among the affected dogs without necessarily being a predisposing factor of IVDD development.

Taken together these findings suggest that the duration from onset of clinical signs of IVDD until surgery affects the recovery rate of these dogs. Intervertebral disc disease is the most common spinal disease in dogs, further research with larger groups of patients are needed to estimate and validate the exact degree of importance this factor has on the recovery.

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Received June 16, 2022

Accepted July 25, 2022