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CLINICAL PRESENTATION AND OUTCOME OF DOGS TREATED MEDICALLY FOR THORACOLUMBAR INTERVERTEBRAL DISK PROTRUSION

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Abstract

Thoracolumbar intervertebral disc protrusion (IVDP) is a disabling degenerative condition, typically affecting older, large breed dogs. To date, very few studies have investigated the clinical characteristics of IVDP, and hence there is little information available to facilitate clinical decision-making and management of client expectations. The aim of this retrospective case series was to compare the clinical presentation of dogs receiving medical or surgical treatment for thoracolumbar IVDP, and to assess the outcome following medical treatment. Significantly more medically treated dogs (n= 31) had concurrent disease at the time of presentation and had less severe spinal cord compression, while significantly more surgically treated dogs (n= 53) had neurological deficits and were non-ambulatory at presentation. Outcome data was available for 27 of 31 medically managed dogs; 11 (40.7%) initially improved with treatment, 7 (25.9%) remained stable, and 9 (33.3%) deteriorated. The median survival time for dogs receiving medical treatment was 330 days. Of 18 dogs that initially improved or stabilised, 10 showed a recurrence of clinical signs (55.6%). Therefore, the clinical presentation differed between treatment groups, with surgically managed dogs typically having a more severe clinical phenotype. Medical management can provide a fair prognosis, however, recurrence of clinical signs is common.

Two types of degenerative intervertebral disc disease have historically been recognized. Type I intervertebral disc disease, or intervertebral disc extrusion (IVDE), involves the herniation of degenerate and calcified nucleus pulposus material through all layers of the ruptured anulus fibrosus into the vertebral canal. It is seen most commonly in chondrodystrophic dog breeds between 3 and 7 years old, and typically results in an acute onset of severe neurological deficits.[1-4] Type II intervertebral disc disease, or intervertebral disc protrusion (IVDP), more commonly affects older, non-chondrodystrophic large breed dogs. In contrast to IVDE, pathological abnormalities are predominantly seen in the anulus fibrosus. Dorsal displacement of the nucleus pulposus through the weakened anulus causes the anulus fibrosus to protrude into the vertebral canal, leading to progressive spinal cord compression. Affected dogs typically demonstrate a chronic onset of progressive, but relatively mild clinical signs, such as spinal hyperesthesia, ambulatory paresis and proprioceptive ataxia.[2,3,5] The vast majority of studies have evaluated IVDE and hence this type of intervertebral disc disease is well characterized with outcomes after medical and surgical management extensively reported.[6-11] However, very few studies have investigated the clinical characteristics of IVDP, and hence there is little information available to facilitate clinical decision-making and management of client expectations. As for IVDE, both medical and surgical treatment options exist for the management of thoracolumbar IVDP.[4,12,13] While there is relatively little discussion regarding the preferred surgical technique for dogs with thoracolumbar IVDE, which are typically managed with a hemilaminectomy, several techniques have been suggested for IVDP. These include a hemilaminectomy with anulectomy, dorsal laminectomy, lateral corpectomy, partial lateral corpectomy, and a hemilaminectomy combined with vertebral stabilization.[13-17] These suggested techniques are technically demanding and are complicated by the fact that affected dogs often present with multiple sites of spinal cord compression.[4,17] Furthermore, there is a risk of severe neurological

deterioration immediately after surgery due to the challenges of satisfactorily removing the protruded annulus without causing further spinal cord injury and the chronicity of the spinal cord compression with its associated pre-existing spinal cord pathology.[4,18,19]

Given the challenges inherent in surgical treatment, the option of medical management should be considered for cases presenting with IVDP. However, there is little known about the use of medical management for dogs with IVDP, also the factors that currently influence the decision on whether medical or surgical treatment is pursued. Therefore, the aims of this study were to compare the clinical presentation of dogs receiving medical or surgical treatment for thoracolumbar IVDP, and to assess the outcome following medical treatment. We hypothesized that medically treated dogs would show less severe clinical signs, with less severe spinal cord compression, compared to dogs treated surgically, and that medical management could result in a fair to good outcome.

Materials and methods

Digital medical records from 1st January 2006 to 30th April 2015 from the Royal Veterinary College Small Animal Referral Hospital were searched for the following terms: thoracolumbar intervertebral disc protrusion, thoracolumbar intervertebral disc herniation, and thoracolumbar intervertebral disc disease. Dogs with complete medical records, compatible clinical signs and a diagnosis of thoracolumbar IVDP confirmed by diagnostic imaging and/or surgical findings were included in the study. The diagnosis of IVDP was based on surgical confirmation of the type of IVDD, or published myelographic criteria[4], or previously evaluated MRI criteria.[20] Dogs were excluded if clinical records or imaging studies were incomplete or unavailable for review. The study was

approved by the Royal Veterinary College Ethics and Welfare Committee (Protocol number URN 20151344).

Information retrieved from the medical records included signalment, duration, type and severity of clinical signs, treatment received before referral, general physical and neurologic examination findings, presence and type of neurologic deficits, presence and type of concurrent medical conditions and results of diagnostic tests including diagnostic imaging. Neurologic status was graded by the modified Frankel score which was defined as paraplegia with no deep nociception (grade 0), paraplegia with no superficial nociception (grade 1), paraplegia with nociception (grade 2), non-ambulatory paraparesis (grade 3), ambulatory paraparesis and ataxia (grade 4), spinal hyperesthesia only (grade 5), or no dysfunction.[21] Concurrent medical conditions were further categorized as orthopaedic or non-orthopaedic. For dogs that received medical treatment prior to referral, a static or deteriorated clinical status before initial evaluation at the Royal Veterinary College was considered as unsuccessful medical treatment before referral.

Diagnosis of IVDP was made by evaluation of myelographic or MR images. Anesthetic protocols varied between dogs but typically included premedication with a combination of acepromazine maleate (0.01 mg/kg [0.0045 mg/lb], IV) and methadone (0.1 to 0.2 mg/kg [0.045 to 0.091 mg/ lb], IV), which was followed by anesthetic induction with propofol (4 to 6 mg/kg [1.82 to 2.73 mg/lb], IV) and maintenance of anesthesia with isoflurane in oxygen. Myelography was performed in dogs following intrathecal injection of iohexol[a] contrast medium (0.2 mL/kg [0.09 mL/lb] with a maximal dose of 10 mL) through the L5-6 interspace. The complete vertebral column was imaged during myelography and radiographs were obtained in orthogonal and oblique views. For MRI, a 1.5 Tesla unit was used.[b] Dogs

were placed in dorsal recumbency, and protocols included a minimum of T2-weighted (repetition time, 3,000 milliseconds; echo time, 120 milliseconds) and T1-weighted (repetition time, 400 milliseconds; echo time, 8 milliseconds) sagittal and transverse images. Slice thickness for sagittal and transverse images were 1.75 mm and 2.5 mm, respectively, with an interslice gap of 0.3 mm in both planes. Myelographic studies were assessed for location and number of compressive IVDPs. Magnetic resonance imaging studies were assessed for the location and number of compressive IVDPs, the presence of intramedullary/intraparenchymal signal intensity (ISI) changes and the degree of spinal cord compression. For the purpose of this study, a compressive IVDP was defined as an IVDP that caused distortion or deviation of the spinal cord. ISI changes were defined as focal intraparenchymal areas that had a different intensity (hyper or hypointense) compared to the surrounding normal spinal cord parenchyma. To evaluate the degree of spinal cord compression, the remaining spinal cord area was calculated at the site of the most pronounced compression. Measurements were made on T2-weighted images in the transverse plane. The remaining spinal cord area was defined as the cross sectional area of the compressed spinal cord segment divided by the cross sectional area at the adjacent, non-compressed spinal cord segment.[22] In dogs with multiple sites of spinal cord compression, the remaining spinal cord area was determined at the site where ISI changes were present or, if no ISI changes were present, at the site with subjectively the highest degree of spinal cord compression. All imaging studies were evaluated and all measurements performed by a board-certified neurologist unaware of the clinical presentation, type of treatment and outcome of the individual dog. Image analysis was performed with Osirix software.[c]

Owners were informed of the diagnosis of thoracolumbar IVDP and consulted with a board certified veterinary neurologist or resident in a veterinary neurology training program regarding available treatment options. The final decision to pursue medical or surgical

management was made by the owner(s) of each dog. Medical treatment consisted of restricted exercise, combined with analgesic medication if indicated. Surgical treatment consisted of a hemilaminectomy with anulectomy or with a partial discectomy. For the purposes of this study, dogs medically treated at our referral veterinary hospital but that subsequently received surgical treatment, due to inadequate response to medical treatment, were included in both treatment groups with regard to respective signalment and clinical signs.

Follow up data was obtained only from dogs receiving medical treatment. Surgically managed dogs were not evaluated. Data was obtained from medical records of re-examination visits at the Royal Veterinary College 4 to 6 weeks after the diagnosis of thoracolumbar IVDP was made. Local ethics and welfare committee guidelines stated that the owners of deceased dogs could not be contacted, and as all dogs had died by the time of evaluation, long term follow up data was obtained via review of the medical records of the referring veterinarians. Data collection included the date and cause of death, as well as the last documented clinical and neurological status. Successful management was defined as sustained improvement or stabilization of mild clinical signs, with no subsequent neurological deterioration. More specifically, dogs had to be independently ambulatory, urinary and fecal continent, and, according to the referring veterinary surgeons, not displaying obvious signs of spinal hyperesthesia. For the purpose of this study, dogs that subsequently underwent surgery because of progression of their clinical signs after medical management were considered to have an unsuccessful outcome.

Statistical analysis—Data analysis was performed with the aid of a standard statistical software package.[d] Data was assessed for normal distribution using the Shapiro-Wilk test for normality. An independent samples T-test was used to compare age, body weight and degree

of spinal cord compression between medically and surgically treated dogs. A Mann-Whitney U test was used to compare duration of clinical signs between medically and surgically treated dogs. A Fisher exact test was used to compare all other assessed variables. Values of $p < 0.05$ were considered significant.

Results

Eighty-four dogs were included in the study, of which 31 received medical treatment and 53 received surgical treatment.

Medical treatment group

The mean age of medically treated dogs was 9 years (SD ±2.3) and the mean body weight was 28.1kg (SD ±9.6) (Table 1). Fourteen dogs were female, and 17 were male. Breeds represented were the Staffordshire bull terrier (9), German Shepherd dog (8), Labrador retriever (2), Dalmatian (2), 8 breeds were represented by 1 dog each (Standard poodle, Bassett hound, Bull mastiff, English springer spaniel, Golden retriever, Border collie, Airedale and English Bull terrier), and 2 dogs were cross breeds. The median duration of clinical signs was 30 days (IQR 177). Presenting clinical signs included paraparesis (54.8%), proprioceptive ataxia of the pelvic limbs (46.7%), difficulty jumping (43.3%), pain (30%) and toileting in the house (13.3%). Neurological deficits were detected in 26 dogs (83.9%), including proprioceptive ataxia of the pelvic limbs (20), paraparesis (19), postural reaction deficits (25), and increased (7) or decreased (4) spinal reflexes in the pelvic limbs. All dogs were ambulatory on hospital admission. Affected dogs had neurological grades 4 (27) or 5 (4). 16 dogs (51.6%) had received medical treatment prior to referral. Treatment consisted of NSAIDs in 8 dogs, tramadol hydrochloride in 3 dogs, gabapentin in 2 dogs, a combination of

NSAIDs and gabapentin in 2 dogs, and oral prednisolone in 1 dog. This resulted in an improved clinical status in 10 (62.5%) of the 16 dogs prior to initial evaluation at our referral hospital. Twenty-two (71%) dogs had a concurrent disease at the time of presentation. Fifteen dogs (48.3%) had non-orthopaedic concurrent disease, including chronic skin disease (2), hyperadrenocorticism (2), hepatopathy (2), chronic kidney disease (2), pancreatitis (1), chronic peripheral vestibular disease (1), epilepsy (1), chronic respiratory disease (1), soft tissue sarcoma (1), inflammatory bowel disease (1) and hypothyroidism (1). Eighteen (58.1%) dogs had concurrent orthopaedic conditions including multiple joint osteoarthritis (8), elbow osteoarthritis (3), stifle osteoarthritis (3), partial cruciate ligament rupture (2) and hip osteoarthritis (2). Eleven dogs had a concurrent orthopaedic and non-orthopaedic condition. All 31 dogs underwent MRI of the thoracolumbar spinal cord. Nine dogs (29%) had a single IVDP identified on MRI, and 22 dogs (71%) had multiple IVDPs (12 dogs had 2 sites of IVDP, 8 had 3 sites and 2 had 4 sites). Intramedullary signal intensity changes at the site of the compressive IVDP(s) were detected in 15 dogs (48.4%). The mean remaining spinal cord area was 67.2% (SD ±18.1) at the site of most severe compression.

Surgical treatment group

53 dogs received surgical treatment, which consisted of a hemilaminectomy with anulectomy (29) or a hemilaminectomy combined with a partial discectomy (24). Breeds represented were the German Shepherd dog (22), Staffordshire bull terrier (10), Basset hound (5), Labrador retriever (3), Dalmatian (3), Golden retriever (2), with 4 breeds represented by 1 dog each (Bull mastiff, Rottweiler, English pointer, Bernese Mountain Dog) and 4 cross breeds. The mean age was 8.8yrs (SD ±2.1) and the mean body weight was 32.9kg (SD ±10.8) (Table 1). Thirteen dogs were female, and 40 were male. The median duration of clinical signs was 30 days (IQR 158). Presenting complaints included paraparesis (83%), proprioceptive ataxia of the pelvic limbs (49.1%), difficulty

jumping (9.4%), pain (22.6%) and toileting in the house (5.7%). Sixteen dogs (30.2%) had received medical treatment prior to referral. Treatment consisted of NSAIDs in 7 dogs, tramadol hydrochloride in 3 dogs, gabapentin in 1 dog, NSAID in combination with gabapentin in 1 dog, NSAID in combination with tramadol hydrochloride in 2 dogs and prednisolone in 2 dogs. This resulted in an improved clinical status in 2 (12.5%) of the 16 dogs prior to evaluation at our referral hospital. Neurological deficits were detected in all 53 dogs (100%), including proprioceptive ataxia of the pelvic limbs (38), paraparesis (36), paraplegia (4), postural reaction deficits (40), increased (14) or decreased (6) spinal reflexes in the pelvic limbs, and absent nociception in the pelvic limbs (1). Seventeen dogs (32.1%) were non-ambulatory at hospital admission. Thirty-six dogs were grade 4, 13 were grade 3, 3 were grade 2, and 1 was grade 0.

Twelve (22.6%) dogs had concurrent disease at the time of presentation. Five dogs (9.4%) had non-orthopaedic concurrent disease, including a heart murmur (1), anal furunculosis (1), urinary tract infection (1), laryngeal paralysis (1) and chronic diarrhea (1). Seven (13.2%) dogs had concurrent orthopaedic conditions, including osteoarthritis of multiple joints (4), hip osteoarthritis (1) elbow osteoarthritis (1) and partial cruciate ligament rupture (1). Five dogs underwent a myelogram, and the remaining 48 underwent MRI of the thoracolumbar spinal cord. Nineteen dogs (35.8%) had a single IVDP, and 34 dogs (64.2%) had multiple IVDPs (19 dogs had 2 sites of IVDP, 14 had 3 sites and 1 had 4 sites). Intramedullary signal intensities at the site of the compressive IVDP(s) were detected in 17 dogs (32.1%). The mean remaining spinal cord area was 54.8% (SD ±21.3), at the site of most severe compression.

Comparison of clinical presentation between medically and surgically treated dogs

Compared with medically treated dogs, more surgically treated dogs had neurological deficits on presentation ($p=0.015$), were non-ambulatory at the time of hospital admission ($p<0.0001$), had a lower neurological grade ($p=0.001$) and had undergone unsuccessful medical treatment prior to

referral (p=0.009) (Table 1). More medically treated dogs were found to have concurrent disease (p<0.0001) at the time of presentation, as well as a greater remaining spinal cord area (p=0.0.14), implying less severe spinal cord compression. The age, body weight, duration of clinical signs, presence of single or multiple sites of IVDP and the presence of ISI changes were not significantly different between treatment groups.

Treatment and outcome for medically treated dogs:

Medically treated dogs underwent 2 to 6 weeks (mean 4.3 weeks, median 4) of restricted exercise. Additionally, NSAIDs were administered in 14 dogs, gabapentin in 5, tramadol hydrochloride in 2, and gabapentin in combination with a NSAID in 3. Twenty-four of the 31 dogs were re-examined 4-6 weeks after a diagnosis of IVDP was made. Of these, 15 (62.5%) demonstrated a clinical improvement compared with their initial presentation, 6 (25%) remained stable and 3 (12.5%) had deteriorated. Four dogs (16.7%) were found to be neurologically normal on re-examination, while the remaining 20 (83.3%) showed neurological deficits (all with a neurological grade of 4).

All 31 dogs had died at the time of data collection and, due to ethical and welfare committee approval of the study, long-term follow up data was obtained from the referring veterinarians. Interval from diagnosis to collection of follow up information ranged from 24 to 118 months (mean: 67.3 months, median: 67.7). Sufficient long term outcome data was available for 27 of the 31 dogs; 11 (40.7%) improved with treatment, 7 (25.9%) remained stable, and 9 (33.3%) deteriorated after starting medical management of thoracolumbar IVDP (Figure 1). Of these 9, 3 were euthanized because of their IVDP 5, 28 and 35 days after hospital discharge. The remaining 6 dogs (66.7%) subsequently underwent surgical treatment due to their unsatisfactory response to medical management. The interval from diagnosis to surgical

treatment ranged from 6 to 120 days (mean and median of 59.5 days). Surgery in these 6 dogs was without complications, and all dogs showed a clinical improvement postoperatively, although 3 showed persistent ataxia and paresis of the pelvic limbs (neurological grade 4).

Of the 11 dogs that improved with medical treatment, 5 then remained stable (4 were reported to be neurologically normal and 1 showed mild paraparesis) and were finally euthanized for unrelated reasons (median survival time of 563 days), 4 remained stable for a median of 165 days before showing neurological deterioration leading to euthanasia and the 2 remaining dogs remained stable for 310 and 365 days before acute neurological deterioration leading to euthanasia. Further diagnostic investigations were not undertaken prior to euthanasia in any of the dogs.

Of the 7 dogs that remained stable with medical treatment, 3 were ultimately euthanized for unrelated reasons with a median survival time of 363 days (all 3 showed mild paraparesis and proprioceptive ataxia, neurological grade 4), 3 remained stable before then showing gradual neurological deterioration leading to euthanasia (median survival time of 120 days), and the remaining dog remained stable for 84 days before acute neurological deterioration and euthanasia. Further diagnostic investigations were not undertaken prior to euthanasia in any of these dogs.

The median survival time for all dogs receiving medical treatment was 330 days.
Overall, 8 of 27 (29.6%) dogs for which long term follow up information was available were considered to have a successful outcome, defined as sustained clinical improvement with no recurrence of neurological deficits, after medical treatment for thoracolumbar IVDP.

Discussion

This study compared the clinical presentation of dogs receiving medical or surgical treatment for thoracolumbar IVDP (Hansen type II intervertebral disc disease), and assessed the outcome following medical treatment. Compared with medically treated dogs, dogs treated surgically for thoracolumbar IVDP were significantly more likely to have neurologic deficits at presentation, to be non-ambulatory, and to have received unsuccessful medical treatment prior to referral. In agreement with previous findings[14,23,24], the results of this study indicate that more severely affected dogs, as well as those that fail initial medical management, were generally treated surgically, while dogs with a less severe clinical phenotype were typically treated medically. As the success of treatment is likely to be influenced by the severity of the underlying disease, the differences in clinical presentation found in this study unfortunately prevent a direct comparison of the outcome between medically and surgically treated dogs. Outcome after surgical treatment was therefore not evaluated.

Concurrent disease at the time of presentation was more common in the medically treated group. Such concurrent disease may influence clinical decision-making in terms of the anticipated perioperative morbidity associated with such conditions, as well as their potential impact on long-term quality of life and survival time.

Only 29.6% of dogs were considered to have a successful long-term outcome after medical management for thoracolumbar IVDP and 13 of the 27 dogs for which long-term follow-up information was available were ultimately euthanized for progression or recurrence of their spinal disease. These results are similar to a previous study evaluating medical management of large breed dogs with anulus fibrosus protrusions,[4] but are lower than those reported for suspected cervical and lumbar disc herniations[12,24], as well as for disc-associated cervical spondylomyelopathy and degenerative lumbosacral stenosis.[22,23] It is therefore possible that

thoracolumbar IVDP may be associated with a less favorable prognosis than other disc-associated degenerative spinal disorders.

Eighteen of 27 of dogs showed an initial good response to medical treatment with improvement or stabilization of mild clinical signs for several months. However, this period was followed by neurological deterioration in 10 of the18 dogs, resulting in euthanasia of all 10. Unfortunately, none of these dogs underwent repeat diagnostic investigations and hence the cause of the deterioration is unknown and potentially multifactorial. Thoracolumbar IVDP is often associated with multiple sites of spinal cord compression and hence deterioration of neurological status could have been caused by development or progression of compressive IVDPs at adjacent intervertebral disc spaces. This hypothesis is similar to the development of adjacent segment disease, which has been reported after lumbar fusion in human medicine[25,26] and with medical management of dogs with disc-associated cervical spondylomyelopathy.[22] Alternatively, deterioration may also be caused by progressive herniation of the initially affected intervertebral disc. Finally, we cannot exclude that an unrelated spinal disease may have caused the neurological deterioration. Further studies to evaluate the pathogenesis of this clinical deterioration may reveal risk factors for disease recurrence and hence guide clinical decision-making.

The poor response to medical management found in this study suggests that further studies of outcome after surgical decompression and of alternative medical treatment options for dogs with chronic spinal cord compression would be worthwhile. In a recent study the potassium channel antagonists 4-aminopyridine and the T-butyl carbamate derivative of 4-aminopyridine were found to improve hind limb function in chronically non-ambulatory dogs. Their use in thoracolumbar IVDP may therefore prove beneficial.[27] Furthermore, physiotherapy and hydrotherapy have become increasing available in veterinary medicine,

but no studies have yet objectively evaluated their use in dogs with thoracolumbar IVDP.

All dogs in the present study underwent a period of restricted exercise. However, there is growing evidence in both research models and in human clinical trials to suggest that controlled exercise can be beneficial in controlling pain, minimizing degenerative changes and potentially promoting repair within the intervertebral disc[28-33]. Therefore, restricted exercise may be inappropriate, and the use of regular controlled exercise regimen should be investigated. Furthermore, physiotherapy and hydrotherapy have become increasingly available in veterinary medicine, but no studies have yet objectively evaluated their use in dogs with thoracolumbar IVDP.

Of the nine dogs that deteriorated despite medical treatment, six underwent subsequent surgical decompression and showed a clinical improvement post-operatively, suggesting that prior medical treatment does not exclude the possibility of a positive response to surgery. Three dogs failed to regain a normal neurological status post-operatively and so it is possible that a higher degree of clinical improvement may have been seen if surgical decompression had not been delayed. Further studies to evaluate the results of surgical treatment after prolonged medical management and more gradual neurological deterioration would be worthwhile.

The present study was limited by its retrospective nature, and the associated variability in evaluation of objective clinical outcome measures. Although an accepted neurological grading system was used, the majority of dogs were ambulatory at presentation and were therefore assigned a similar neurological grade, which likely limited recognition of more subtle differences in severity of clinical signs. It is therefore important to realize that most accepted and validated grading systems for dogs with spinal disease are designed for dogs with acute thoracolumbar spinal disorders, such as IVDE[21,26,34], with few studies focusing on

grading ambulatory dogs or dogs with chronic thoracolumbar spinal disease.[35] Finally, the study population consisted of a referral hospital's case load which may represent cases with a more severe clinical phenotype and/or highly motivated owners, and may not accurately represent the general dog population.

Despite the limitations of the present study the data obtained revealed that medical management of thoracolumbar IVDP is typically reserved for ambulatory dogs that have shown a positive response to prior medical treatment and have less severe spinal cord compression. Furthermore, these dogs tend to have concurrent disease at the time of presentation. Medical treatment of thoracolumbar IVDP was associated with a fair to guarded prognosis with a success rate of 29.6% (8/27) and a median survival time of 330 days. Further studies are needed to prospectively compare medical and surgical treatment of thoracolumbar IVDP, to determine prognostic indicators of treatment response and disease recurrence, as well as to investigate new treatment modalities for the management of chronic spinal cord compression.

a. Omnipaque, 240 mg I/mL, GE Healthcare, Diegem, Belgium.

b. Intera 1.5T, Philips Medical Systems, Eindhoven, The Netherlands.

c. OsiriX, v. 6.0.2, Pixmeo SARL.

d. SPSS, v. 21.0.1, SPSS Inc, Chicago, Ill.

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Figure legends:

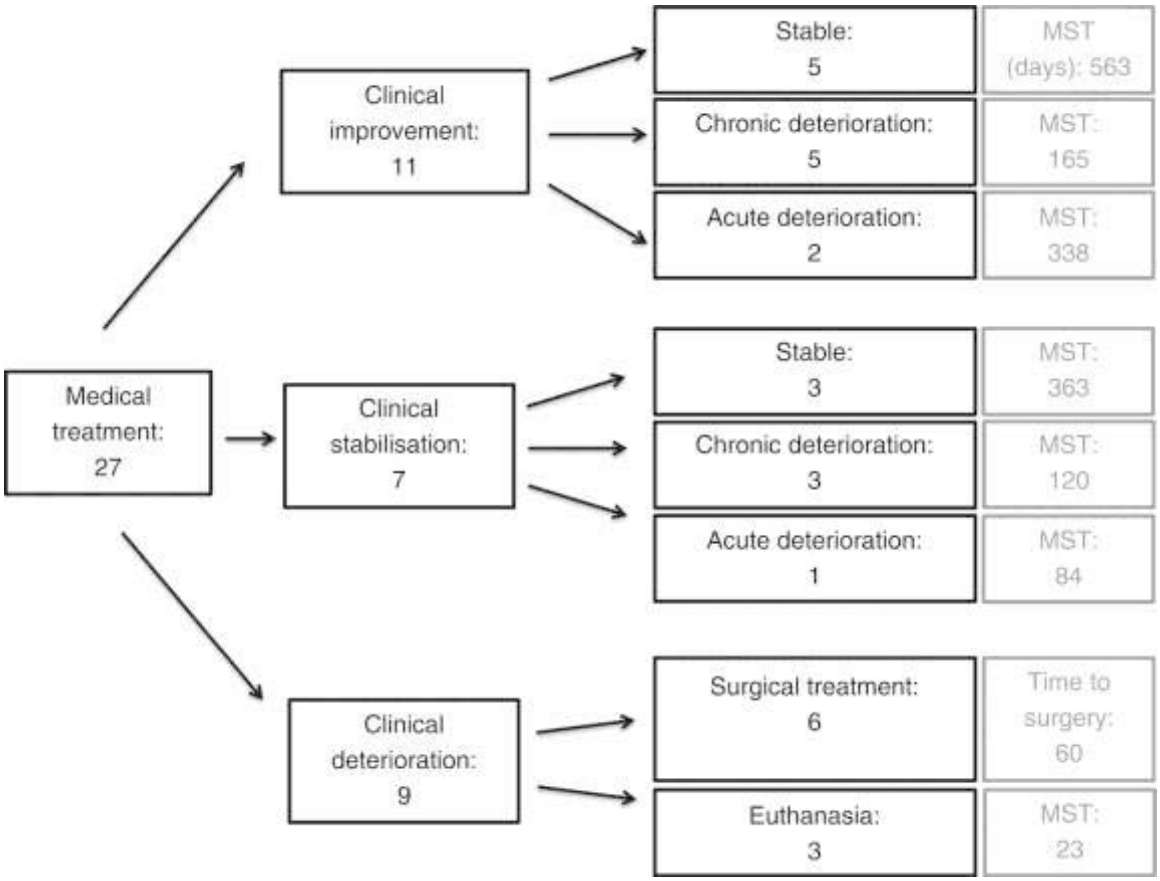
Table 1: Signalment, clinical signs and imaging findings of dogs treated medically and surgically for IVDP at a small animal referral hospital. IVDP: intervertebral disk protrusion, yrs: years, ISI: intramedullary signal intensity, SD: standard deviation.

Figure 1: Schematic depiction of the long term outcome for dogs receiving medical treatment for thoracolumbar IVDP. (MST: median survival time).

Table 1:

Variable	Medical (n=31)	Surgical (n=53)	p value
Age (yrs)	9 (SD±2.3)	8.8 (SD±2.1)	0.254
Male	17	40	0.052
Female	14	13	0.052
Body weight	28.1kg (SD±9.6)	32.9kg (SD±10.8)	0.168
Duration of clinical signs (days)	30	30	0.985
Neurological deficits	26 (84%)	53 (100%)	0.015
Ambulatory at hospital admission	31 (100%)	36 (68%)	<0.000
Medical treatment prior to referral	16 (52%)	16 (30%)	0.033
Positive response to medical treatment	10 (63%)	2 (13%)	0.009
Concurrent medical condition Orthopaedic Non-orthopaedic	22 (71%) 18 15	12 (22.6%) 7 5	<0.000 0.007 <0.000
Single IVDP Multiple IVDP	9 (29%) 22	19 (36%) 34	0.385 0.385
ISI changes	15 (48%)	17 (32%)	0.168
Remaining spinal cord area (%)	67.2 (SD ± 18.1)	54.8 (SD ± 21.3)	0.014

Figure 1


Medical treatment: 27
Clinical improvement: 11
Clinical stabilisation: 7
Clinical deterioration: 9
Stable: 5
MST (days): 563
Chronic deterioration: 5
MST: 165
Acute deterioration: 2
MST: 338
Stable: 3
MST: 363
Chronic deterioration: 3
MST: 120
Acute deterioration: 1
MST: 84
Surgical treatment: 6
Time to surgery: 60
Euthanasia: 3
MST: 23