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Case Report

Prognostic value with intervertebral herniation disk disease in dogs

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ABSTRACT

Objective: The objective of this retrospective study was to evaluate the preoperative clinical characteristics to predict postoperative neurologic recovery in dogs with intervertebral herniated disk disease (IVDD).
Materials and Methods: The dogs were classified according to postoperative neurologic recovery from clinical history of the hospital e-book. Excellent when dogs (n=13) were neurologically normal; good (n=8) when postoperative neurologic grade was improved from preoperative condition had improved sufficiently to require no or minor therapy after discharge; fair (n=4) is considered when postoperative neurologic status was unchanged from preoperative condition and poor (n=5) when major postoperative complication developed as a consequences neurologic grade had worsened at discharge than their preoperative score or the patient died. The evaluated preoperative clinical characteristics in all groups are breed, age, sex, duration of clinical sings appearance (DCSA), preoperative neurologic grading system (PNGS), compression rate (pre and post-operative) in MRI and CT scan, housefield unit (HU), type of IVDD and surgical procedures, and compared with excellent group.
Results: no definitive relationship was found between the clinical characteristics and neurologic recovery, except, DCSA and preclinical neurologic pathological condition. The DCSA were 73.54±15.00, 117.63±31.58, 171.25±99.56 and 175.00±94.83 ($P<0.05$), respectively. The PNGS were 3±0, 3±0, 4±0 and 4±0 ($P<0.01$), respectively.
Conclusion: Finally based on this clinical study, it is recommended that postoperative recovery greatly depends on DCSA and PNGS in IVDD dogs.

KEYWORDS

Dog; Intervertebral herniated disk disease; Prognostic value

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INTRODUCTION

Intervertebral disk herniation (IVDH) is a common feature of neurological disorders in dogs that may induce permanent sensorimotor and visceral function devastation (Monchaux et al., 2017; Zidan et al., 2018). Clinical signs of thoracolumbar IVDH are back pain, paraparesis (ambulatory or nonambulatory), paraplegia, urinary dysfunction and loss of deep nociception (Aikawa et al., 2012). Severe pathological condition is considered when the animal has no deep nociception. It is found in all types of breeds but small chondrodystrophic dog breeds are more susceptible than non-chondrodystrophic dog breeds (Smolders et al., 2013).

The surgical treatment of IVDH can be applied according to causes, pathological conditions and locations of the IVDH. The surgical procedures perform to relieve pain and neurologic disorders by surgical decompression of the spinal cord or nerves. Several studies have reported that surgeries alleviated pain intensity and corrected neurological deficits, and the overall success rate of functional outcome was ranged in up to 70–90% of cases (Salger et al., 2014; Aikawa et al., 2012; Shamir et al., 2008) and the rate of recurrence from 20–28% in dogs (Shamir et al., 2008). Moreover, dogs with paraplegic without pain perception are less certain of a good outcome nearly about 60% of dogs and many of these dogs are left with lack of strength and quadrupedal coordination (Zidan., et al., 2018).

The results of surgery for IVDD are difficult to predict. Various factors, such as breed, age, sex, duration of clinical sign appearance (DCSA), preoperative neurologic grading system (PNGS), pre and post-operative compression rate, housefield unit, type of IVDD and surgical procedures, may have been said to affect the results, but their effects on recovery have not been well established. Nowadays, imaging techniques, such pre- and postoperative computed tomographic and magnetic resonance imaging (MRI) have made it possible to visualize the cross-sectional size and shape of the spinal cord. We have evaluated the compression rate by these techniques in an attempt to predict the prognosis. The objective of this retrospective study was to evaluate the preoperative clinical characteristics to predict neurologic recovery in dogs IVDD and to discover how the results compared with those of the clinical methods previously believed to provide reliable prognosis.

MATERIALS AND METHODS

Ethical approval: Diagnosis and surgical treatment of clinical cases were performed by the expert veterinary surgeon by the team meeting at Royal Animal Medical Center. This retrospective study was approved by committee on the care of animal resources employed herein (Approval number: RAMC IACUC 16-KE-011).

Case selection: The clinical record database of the neurology unit at Royal Animal Medical Center was searched for dogs with a diagnosis of IVDH between Jan. 2012 and Apr. 2017. The clinical cases were selected when preoperative MRI, and pre and postoperative CT scan were performed in single disk herniation in IVDD dogs. The dogs were classified according to postoperative neurologic recovery from clinical history of the hospital electric medical chart. Excellent when dogs (n=13) were neurologically normal; good (n=8) when postoperative neurologic grade was improved from preoperative condition had improved sufficiently to require; fair (n=4) when postoperative neurologic status was unchanged from preoperative condition and poor (n=5) when major postoperative complication developed as a consequence neurologic grade had worsen at discharge than their preoperative score, or other clinical disability not present at admission was developed, or the patient died. The evaluated preoperative clinical characteristics in all groups are breed, age, sex, duration of clinical sings appearance (DCSA), preoperative neurologic grading system (PNGS), compression rate in MRI and CT scan, housefield unit, type of IVDD and surgical procedures, and compared with excellent and good group. Recording of clinical history was done by veterinary surgeons at admission and preoperative neurological grading was performed as described elsewhere (Olby et al., 2004; Aikawa et al., 2012; Salger et al., 2014; Balducci et al., 2017). Briefly the grading system were- 0, for normal, I for spinal pain only, 2 for ambulatory paraparesis; 3 for Non-ambulatory paraparesis, 4 for paraplegia with deep-pain perception intact and 5 for paraplegia without deep-pain perception. DCSA was recorded by questionnaires when owner first noted abnormality of pet.

The cases were selected carefully when the IVDD dogs were treated by surgically and had imaging results of preoperative MRI, and pre and postoperative CT scan. Without these criteria, it was excluded from this study. The total 30 IVDD dogs fulfilled this requirement and were included.

Diagnosis: Presumptive diagnosis was made by physical examination of clinical signs and symptoms, and clinical history. Confirmatory diagnosis was made by complete diagnostic imaging reports including survey radiographs and MRI or CT. The dogs had follow-ups until 3 months were included. CT imaging was performed using ECLOS 16-row detector CT scanner (Hitachi, Tokyo, Japan) and MRI (GE healthcare, New York, USA) were performed to exclude other pathology other pathological abnormalities. House field unit were evaluated from CT image as described Schwarz and Saunders (2011). Briefly, 0~300 was disk material; 400~800, hemorrhage and ≥1000, calcification.

RESUTS

As shown in **Table 1**, no relationship was found between neurologic clinical outcome (excellent, good, fair or poor) and with breed, age, sex body weight, site of location of herniation and pre and post-operative compression rate, except, DCSA and PNGS. The age of the excellent, good, fair and poor groups were 6.15±0.99, 5.50±0.80, and 5.25±0.85 and 7.14±1.70 years, respectively. The body weight was 7.61±1.17, 7.84±1.12, 5.67±1.60 and 7.62±1.82 kg, respectively.

The DCSA were 73.5±15.0, 117.6±31.6, 171.3±99.6 and 175.0±94.8 (P<0.05), respectively (**Figure 1**). The PNGS were 2.6±0.9, 2.5±0.5, 3.8±0.5 and 4.4±0.9 (P<0.01), respectively (**Figure 2**). Preoperative CT scan and MRI compression rates were 31.0±3.9% and 46.9±4.0% in excellent group, 33.5±5.4% and 35.5±2.8% in good group, 24.3±2.9% and 42.3±5.0% in fair group, and 36.0±6.1% and 38.8±5.8%, respectively (**Figure 3**). The postoperative compression rate in the spinal cord were measured by CT in these groups were found to be decreased 11.00±2.89, 10.00±4.63, 9.25±5.38 and 7.20±4.62, respectively (**Figure 3**). The HU were 162.31±56.21, 486.63±22.39, 147.00±67.52 and 384.20±165.89, respectively (**Table 1**).

DISCUSSION

A good estimate of the preclinical prognostic factors for neurologic recovery in IVDD dogs is important for the patient, the health care team, and the surgeons. Various factors, such as breed, age, sex, duration of clinical sign appearance (DCSA), preoperative neurologic grading system (PNGS), pre and post-operative compression rate, housefield unit, type of IVDD and surgical procedures, may have been said to affect the results, but their effects on recovery have not been well established except DCSA and PNGS in this study. However, previous studies reported that increasing age in dogs (Olby et al., 2003) and in human (Hartman et al., 2016), and body weight significantly slow the rate of recovery in dogs with absence of deep pain perception (Olby et al., 2003; Zidan et al., 2018). In this study we found that the stage of preoperative grading of IVDD is important in the evaluation of postoperative prognosis as the grading score of poor neurologic group was significantly differed from the group with excellent clinical outcome. Our results were consistent with the previous reports (Webb et al., 2010; Olby., et al 2004). It is wise to mention that lower recovery rates in dogs that present with loss of deep pain perception were reported previously (Scott and McKee, 1999; Olby et al., 2003).

The DCSA were significantly higher in poor clinical outcome group when compared with excellent group. The maximum DCSA was recorded in the group with poor clinical outcome (175.0±94.8h) while the lowest was in the dogs with excellent clinical outcome (73.5±15.0h). The DCSA may allow tissue injury. The limitation of this

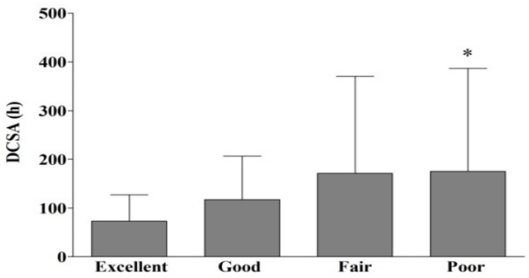

Figure 1. Effects of duration of clinical signs appearance (DCSA) on postoperative prognodtic factors in dogs with IVDD. The data are reported as the mean ± SEM; Analyzed by Bonferroni post hoc test following one-way ANOVA versus excellent recovery group,*P<0.05.

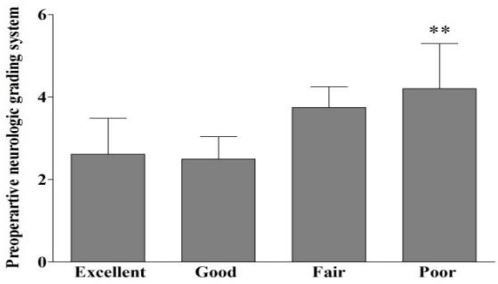

Figure 2. Effects of preoperative neurologic grading system (PNGS) on postoperative prognodtic factors in dogs with IVDD. The data are reported as the mean ±SEM; Analyzed by Bonferroni post hoc test following one-way ANOVA versus excellent recovery group **P<0.01.

Table 1. Clinical characteristics of intervertebral disk herniation in dogs on the basis of postoperative recovery (2013-2017)-

Clinical outcome/ prognosis	Breed	Age	Sex	Body weight	Site of herniation	DCSA	Grading	Type of IVDH	Surgical procedure	MST after surgery (days)	MWT after surgery (days)	Preoperative compression rate (MRI)	Preoperative compression rate (CT scan)	Postoperative compression rate (CT scan)	HU	CT findings
Excellent (n=13)	MT	4	F	2.54	T12-13	18 h	2	I	HL	2	2	49	22	20	582	H
	Dach	4	F	8.1	T12-13	120 h	2	I	HL	3	4	51	50	0	177	H
	CS	13	M	11	C3-4	4d	2	I	VS	2	2	60	24	5	60	D
	Mixed	6	SF	5.4	T11-12	2 d	2	I	HL	4	6	64	40	25	49	D
	Mixed	8	CM	17.4	L4-5	3 d	3	I	HL	5	8	30	17	0	32	D
	FB	2	F	11.9	L2-3	5 h	2	I	HL	3	6	39	27	16	111	D
	Sch	13	M	4.5	L2-3, L7-S1	3 d	3	I	HL	4	4	36	42	0	29	D
	Dach	7	SF	6.9	L2-3	7 d	3	I	HL	3	8	51	58	0	73	D
	FB	2	M	10	T11-12	13h	2	I	HL	5	8	33	27	23	27	D
	MT	7	F	3.88	T13-L1	6 d	3	I	HL	3	6	53	20	12	88	D
	MT	6	M	3.94	T12-L1	7 h	2	II	HL	4	7	20	16	0	90	D
	MT	5	F	4.11	T13-L1, L4-5	3 d	3	I	HL	5	5	55	30	24	162	D
	Dach	3	M	9.24	T12-13	6h	4	I	HL	3	4	68	40	18	630	D
Good (n=8)	Peki	3	F	4.1	T11-12	3 d	2	I	HL	5	10	28	13	0	29	D
	Mixed	8	F	7	T13-L1, L2-3	7 d	3	I	HL	7	7	37	15	0	1807	C
	MT	5	CM	4.12	T12-13	4 h	3	I	HL	4	8	44	25	5	68	D
	CS	7	CM	10.23	C2-3	5 d	2	I	VS	5	7	24	37	32	761	H
	Bulldog	3	CM	9.85	C3-4	12 d	3	I	VS	7	7	35	33	0	132	D
	Dach	4	SF	10.23	T12-13	6 d	3	I	HL	5	8	36	45	25	124	D
	Dach	9	F	12.1	T12-13	25 h	2	II	CT	4	5	48	58	18	879	H
	Peki	5	CM	5.1	C3-4	5 d	2	I	VS	3	4	32	42	0	93	D
Fair (n=4)	PD	3	CM	4.26	T13-L1	17 d	4	I	HL	4		53	22	0	24	D
	PD	5	CM	3.74	T11-12	11 d	4	I	HL			37	33	0	63	D
	Dach	7	M	10.45	T10-11	6 h	4	I	HL			48	21	20	325	D
	MT	6	F	4.23	C4-C5	7 h	3	I	VS			31	21	17	176	D
Poor (n=5)	Mixed	9	CM	11.58	C4-5	5 h	4	I	VS			54	28	0	72	D
	CS	12	F	14.6	L4-5, T13-L1	6 h	3	II	HL			48	46	5	1001	C
	PD	2	M	4.6	L4-5, L5-6	11 d	4	I	HL			25	25	6	423	H
	Mix	12	M	7.6	T12-13, T13-L1, L4-5	21 d	4	I	HL			26	26	0	135	D
	MT	13	M	5.1	T11-12	4d	4	I	CT			41	55	25	290	D

MT Maltese; Dach, Dachund; FB, French Bulldog; CS, Cocker Spaniel; PD, Poodle; F, Female; SF, spayed female; M, Male; CM, castrated male; HL, hemi laminectomy, VS, ventral slot; CT, corpectomy; MST, mean standing time; MWT, mean walking time. H, hemorrhage; C, calcification, D, disk material.

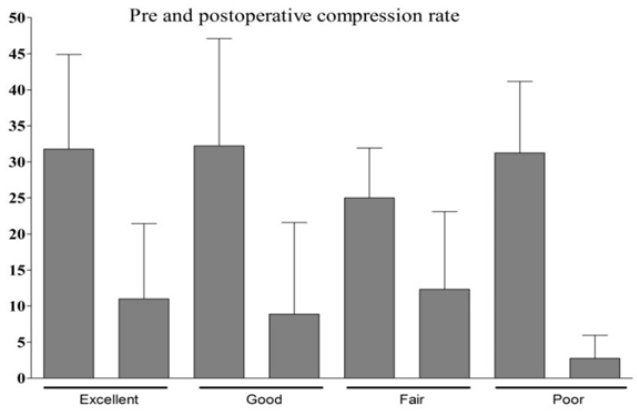

Figure 3. Graphical presentation of pre and post-operative compression rate of intervertebral disk herniation in dogs. Post-operative compression were reduced but had no impact on neurologic outcome. The data are reported as the mean ± SEM; Analyzed by Bonferroni post hoc test following two-way ANOVA pre and postoperative compression rate versus excellent recovery group. No significant difference were found between pre and postoperative compression rate.

study is that we could not measure and compare the histopathological changes among the groups as it is clinical case report but not experimental study. Onset and duration of clinical signs have been evaluated as prognostic factor for dogs with intervertebral disc herniation and found that it was correlated with the recovery (Scott and McKee, 1999). However, this finding was inconsistence with the Kazakos et al. (2005). They mentioned that time taken for the non-ambulatory appears to be the most significant prognostic indicator for dogs with IVDD. There are many clinical sings for IVVD dogs have described such as pain, ataxia, paresis, non-spinal distractors but it may confuse with other clinical diseases (Jeffery et al., 2013). The clinical cases were included here only when confirmed IVDD by CT and MRI images along with clinical sings.

The pre and post-operative compression rate were measured by CT and preoperative compression rate by MRI. We did not find any relationship of compression rate and house field unit with the clinical recovery. Presence of preoperative tissue injury diagnosed by hyper intensity of MRI of the spinal cord (on T2-weighted images) considered as prognostic factor (Ito et al., 2005) rather than compression (Webb et al., 2010). Interestingly, we found that the compression rate diagnosed by MRI was slightly higher but not significant than CT-scan. Its might be for that MRI offers a clear boundary of compression than CT images. So, MRI may be considered as gold standard for diagnosis disk herniation.

Hounsfield units had been used in this study to detect herniated disk material, hemorrhage and calcification from CT images as described by Schwarz and Saunders (2011). The hemorrhage and calcification is related to spinal cord injury and prognosis (Bozzo et al., 2011). However, we found hemorrhage and calcification in all groups indicating that it had no significant relation with clinical prognosis.

CONCLUSION

In view of the above arguments and the new data presented herein, we strongly propose that poor preclinical neuropathologic stage and longer DCSA time have a negative influence on post-operative recovery.

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CONFLICT OF INTEREST

The authors declare that there is no conflicting interest with regards to the publication of this manuscript.

AUTHORS' CONTRIBUTION

All authors contributed equally.

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