FULL PAPER *Surgery*

Usefulness of Hemilaminectomy for Cervical Intervertebral Disk Disease in Small Dogs

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ABSTRACT. Hemilaminectomy was performed to treat cervical disc disease in 18 small dogs. Cervical spinal cord compression was characterized by ventral and/or lateral compression on myelograms. The duration of follow-up examinations ranged from 2 to 72 months. The optimal response time after surgery ranged from 2 days to 3 months. The outcome was determined to be excellent if clinical signs resolved and the dog had completely improved. The outcome was determined to be good if the dog improved, but was not clinically normal or if the degree of the owner's satisfaction was insufficient. Fourteen dogs achieved complete neurologic recovery without complications. One dog was initially neurologically worse after surgery, but ultimately improved to normal neurologic status. These outcomes were judged to be excellent. In the remaining 3 dogs, 2 dogs had relapse of neck pain and one dog remained mildly ataxic. These outcomes were judged to be good. These results suggest that hemilaminectomy is an effective option for surgical treatment of spinal cord compression secondary to cervical disc disease in small dogs.

KEY WORDS: cervical disc disease, hemilaminectomy, small dog.

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Cervical disc disease in small breed dogs frequently leads to herniation of degenerative disc material that causes spinal compression. Severe neck pain is the most common clinical sign associated with cervical spinal cord compression. Other clinical signs include motor dysfunction including hemiparesis and tetraparesis or tetraplegia [5, 10, 15]. Symptomatic cervical disc disease occurs most frequently in chondrodysphoid breeds such as the dachshund, beagle, and poodle [1, 5, 12].

The treatment of cervical disc disease includes medical management with strict cage rest and corticosteroid administration or decompressive surgery [5, 10, 15]. Many dogs respond at least temporarily to medical therapy. However, cases of severe herniations or recurrences require decompressive surgery [5, 10, 15]. Various surgical techniques have been described that include ventral slot procedure, dorsal laminectomy, and hemilaminectomy for cervical spinal cord decompression [5, 8, 13]. The most commonly reported surgical technique in dogs with cervical disc disease is the ventral slot decompression. However, dorsolateral extrusions are most common in cervical disc disease [15]. Hemilaminectomy has the advantages of full access to the lateral and ventral aspect of the spinal canal. Therefore, hemilaminectomy is desirable in this location. The literature often refers to cervical hemilaminectomy [5, 13, 15], but clinical data noting results is sparse. This study reports the results of 18 small dogs that underwent hemilaminectomy for the treatment of compressive myelopathy secondary to cervical disc disease. The purpose of this study was to evaluate the effectiveness of hemilaminectomy in such patients.

MATERIALS AND METHODS

Criteria for inclusion: The medical records of all dogs that had hemilaminectomy as treatment for cervical disc disease between January of 1996 and January of 2004 were reviewed.

Information retrieved from the medical record of each case included the following: age, sex, body weight, clinical signs, duration of clinical signs, response to conservative therapy (for example corticosteroid therapy and strict cage rest), radiographic findings, cervical interspace(s) affected, type of lesion (Hansen type 2 disc protrusion or Hansen type 1 extrusion) determined intraoperatively, and the ultimate outcome.

Clinical evaluation: All patients had complete physical and neurological examinations. Hematological and biochemical blood analyses were performed. Based on physical and neurological examinations, the following scale was used to describe each dog's neurologic status:

Grade 0 (G0) Normal ambulation; no signs of neck pain

Grade 1 (G1) Normal ambulation with neck pain

Grade 2 (G2) Ambulatory mild tetraparetic status with or without neck pain; does not fall

Grade 3(G3) Ambulatory moderate tetraparetic status with or without neck pain; frequent falling; able to rise

Grade 4 (G4) Non-Ambulatory severe tetraparetic status with or without neck pain.

Radiography: Survey radiographs were initially performed after induction of general anesthesia in most dogs, but were taken in some dogs without general anesthesia. Lateral and ventrodorsal views were routinely taken of the cervical spine and were examined for evidence of narrowed intervertebral disc space, vertebral spondylosis, and calcification of the intervertebral disc space. The affected inter-

vertebral discs and the left or right distribution of compressing mass in the spinal canal were confirmed by myelography (cisternal injection in 2 dogs, lumber injection in 13 dogs) with iotrolan (Isovist, 240 mg iodine/m*l*, Schering, Osaka) dosed at 0.45 m*l*/kg body weight (2 m*l* as minimum dose). Myelographic ventrodorsal, lateral, oblique, flexed, and traction views were obtained in all dogs. A myelographic image with the cervical vertebrae in flexion was carried out gently to avoid inflicting pressure damage on the spinal cord.

Surgical technique and postoperative care: Following the myelographic examination, all dogs underwent hemilaminectomy at the site(s) of spinal cord compression. Hemilaminectomy was performed ipsilateral to the compressive mass for lateralized lesions. Right versus left hemilaminectomy was determined by the preference of the surgeon for ventral compressive lesions. Hemilaminectomy was performed using published technique, which is the removal of the interarcuate ligament, rostral and caudal laminae, and articular facets of affected vertebrae [13]. The type of disc lesion was determined by gross observation intraoperatively. In cases with Hansen type 1 disc extrusions, extruded disc material was removed with a curette and microsurgical tissue forceps. Removal of vertebral bone in the region of compression was only performed in cases with Hansen type 2 disc protrusions. The surgical site(s) was flushed with a sterile, balanced, electrolyte solution after the hemilaminectomy, and an autogenous fat graft was placed over the laminectomy site(s). Overlying soft tissues were closed in the routine manner. Cefazolin sodium was administered to all dogs at 22 mg/kg intravenously twice a daily for five days after surgery. Perioperative corticosteroids were not administered to all dogs.

All patients were discharged from the hospital on the seventh postoperative day. Postoperative management of ambulatory patients included placement of a cervical collar, strict cage rest, and avoidance of stairs for 6 weeks. Postoperative management of nonambulatory patients included intensive nursing care and physical therapy that consisted of an elevated padded cage rack, frequent turning, hydrotherapy, and bladder expression four times a day.

Outcome: When possible, a follow-up examination was performed in the hospital by the veterinarian every 10 to 14 days after discharge. The time required for optimal response after surgery was estimated based on the veterinarian's assessment in all dogs. The outcome was determined by veterinarian's assessment and owner's satisfaction at the time of the final communication in the hospital. However, some owners were contacted by telephone and were asked to respond to a questionnaire if they were not able to report to the hospital in a timely manner. Outcomes in those cases were assessed solely on the owner's answers. Questions were asked regarding the dog's current status, outcome, and any evidence of recurrence of signs. The outcome was determined to be excellent if the veterinarian and the owner believed that the clinical signs had resolved and the dog had completely improved. The outcome was determined to be good if the veterinarian and the owner believed that the dog had improved but was not clinically normal or if the degree of owner's satisfaction was insufficient.

RESULTS

Signalment and clinical findings: Clinical data from the eighteen dogs included in our study are summarized in Table 1. Patients ranged in age from 3 to 11years and body weight ranged from 2.3 to 9.5 kg, with 6 breeds represented. Preoperative clinical signs were G1 (n=6), G2 (n=4), G3 (n=5), and G4 (n=3). Duration of clinical signs before surgery ranged from 1 day to 20 months (median time; 10 days). Sixteen patients had been previously treated medically with corticosteroids, analgesics, and strict cage rest. Eight of the sixteen dogs did not respond to the therapy. Eight dogs responded temporarily but with repeated recurrences.

Radiographic and surgical findings: Results of radiographic findings in each dog are presented in Table 2. Survey radiographic findings included disc calcification (n=14), narrowing of the intervertebral disc space (n=8), and spondylosis deformans (n=2). On myelograms, the distribution of compressing mass was symmetrical in 6 dogs and asymmetrical in 12 dogs. Where the compressing mass was located asymmetrically, the left side was involved in 9 of the dogs and the right side was involved in 3. One dog (dog 6) had dorsal protrusion of the cranial end of the fifth vertebrae into the spinal canal on the myelographic flexed lateral view. The compression was alleviated on myelographic traction view, which is suggestive of a dynamic compression. Fifteen dogs had a single lesion site, and the remaining 3 dogs each had 2 lesion sites. The most common sites of cervical disc disease were at the following levels: C3-C4 intervertebral disc space (n=5), C4–5 (n=5), C6–7 (n=5), C2–3 (n=3), and C5–6 (n=3).

Results of surgical findings in each dog are presented in Table 1. The diagnosis of Hansen type 2 disc protrusion was based on the absence of disc material and the diagnosis of Hansen type 1 disc extrusion was based on the presence of disc material intraoperatively. Among the 21 lesion sites, 12 were Hansen type 2 disc protrusion, and 9 were Hansen type 1 disc extrusion. Postoperative complications such as a seroma and surgical wound infection were not observed in any of our cases.

Outcome: Results of neurologic status on the seventh postoperative day, optimal response times, and outcomes are presented in Table 1. On the seventh postoperative day, neurologic grade improved from 1 to 3 grades in 9 dogs, remained unchanged in 8 dogs, and worsened in one dog. Eleven of 13 dogs with neck pain were pain free. The duration of follow-up examinations ranged 2 to 72 months (median, 9.5 months). The optimal response time after surgery ranged from 2 days to 3 months (median, 17.5 days). The average response times in accordance to grade were as follows: G1, 9.8 days; G2, 13.8 days; G3, 22.6 days; and G4, 60.3 days. Fourteen dogs achieved complete neurologic

Table 1. Clinical data of 18 dogs that had hemilaminectomy for cervical intervertebral disk disease

Dog	Signalment	Body weight (kg)	Grade of signs		Duration of signs	Preoperative response to conservative therapy	Type of lesion*	Optimal respons time	Outcome	Followup (months)
			Preoperative	7 days Postoperative						
1	Miniature Dachshund 11 years, Female	7.6	Grade 2 + neck pain	Grade 0	7 days	Poor	Type 2	6 days	Excellent	7
2	Miniature Dachshund 5 years, Female	5.3	Grade 2 + neck pain	Grade 0	11 days	Poor	Type 1	4 days	Excellent	33
3	Maltese 9 years, male	2.3	Grade 3	Grade 2	1 month	Recurrence repeatedly	Type 2	2 weeks	Excellent	16
4	Beagle 3 years, Male	7.0	Grade 1	Grade 1	52 days	Recurrence repeatedly	Type 2	17 days	Excellent	72
5	Beagle 5 years, male	9.0	Grade 1	Grade 1	20 months	Recurrence repeatedly	Type 1	29 days	Good	18
6	Yorkshire Terrier 4 years, male	2.5	Grade 3 + neck pain	Grade 3	20 days	Recurrence repeatedly	Type 2	18 days	Excellent	2
7	Shih Tzu 4 years, Male	6.3	Grade 4	Grade 4	7 days	Poor	Type 2	3 months	Good	48
8	Miniature Dachshund 6 years Female	3.5	Grade 3 + neck pain	Grade 3	1 day	Poor	Type 1	54 days	Excellent	38
9	Miniature Dachshund 7 years, Female	6.6	Grade 1	Grade 0	14 days	Recurrence repeatedly	Type 1	5 days	Excellent	19
10	Pomeranian 5 years, Male	9.4	Grade 2 (left)	Grade 2	7 days	Poor	Type 2	18 days	Excellent	18
11	Miniature Dachshund 5 years, Male	4.3	Grade 3 + neck pain	Grade 2	2 months	Recurrence repeatedly	Type 1	22 days	Excellent	12
12	Miniature Dachshund 6 years, Male	5.0	Grade 1	Grade 0	7 days	No treatment	Type 2	3 days	Good	6
13	Miniature Dachshund 6 years, Female	5.3	Grade 2 + neck pain	Grade 4	19 days	Recurrence repeatedly	Type 1	27 days	Excellent	6
14	Yorkshire Terrier 9 years, Male	2.5	Grade 4 + neck pain	Grade 4	24 days	Recurrence repeatedly	Type 2	66 days	Excellent	7
15	Yorkshire terrier 5 years, Male	4.1	Grade 3	Grade 0	2 days	No treatment	Type 2	5 days	Excellent	4
16	Miniature Dachshund 11 years, Male	8.1	Grade 4	Grade 4	3 days	Poor	Type 1	25 days	Excellent	4
17	Beagvle 4 years, Female	9.5	Grade 1	Grade 0	6 days	Poor	Type 1	2 days	Excellent	6
18	Miniature Dachshund 6 years, Female	6.6	Grade 1	Grade 0	9 days	Poor	Type 1	3 days	Excellent	3

* Type 1; Hansen type 1 extrusion Type 2; Hansen type 2 protrution.

Table 2. Radiographic findings of 18 dogs that had hemilaminectomy for cervical intervertebral disk disease

Dog No.	Survey radiographic findings	Myelographic findings
		Affected discs (distribution)
1	C5–6 c	C5–6 (left)
2	C3–4 c	C3–4 (right)
3	#	C4–5 (right), C5–6 (–)
4	C2–3–4c	C6–7 (–)
5	C4–5 c, C5–6 n	C6–7 (–)
6	C4–5 n	C4–5 dc (–), C6–7 (–)
7	C6–7 c	C6–7 (left)
8	C3–4–5 c, C4–5 n	C4–5 (left)
9	C2–3 n	C2–3 (left)
10	#	C3–4 (left)
11	C4–5 c	C4–5 (left)
12	C2–3 c	C2–3 (–)
13	C3–4 c	C2–3 (right)
14	C3–4 n, vs, C5–6 n, C6–7 vs	C4–5 (left)
15	C5–6 n	C5–6 (–), C6–7 (left)
16	C3–4 n	C3–4 (left)
17	C3–4–5 c	C3–4 (–)
18	C2–3 c	C3–4 (–)

c; Disc calcification. n; Narrowing. dc; Dynamic compressions. vs; Vertebral spondilosis. #; No findings. (–); Compressing mass was located symmetrically.

recovery without complications. One dog (Dog 13) was initially neurologically worse after surgery, but improved to normal neurologic status at 27 days after surgery. Ultimately, the outcomes in these 15 dogs were judged to be excellent. One dog (Dog 7) could walk without falling down, but remained ataxic. Two dogs (Dog 5 and 12) had relapse of neck pain only once at 2 months and 1 month after surgery, respectively. It remains unknown whether or not these recurrences were associated with the surgical site or a new lesion site because the owners declined further examination of these dogs. However, both of the dogs eventually responded to medical therapy with prednisolone. Clinical signs were not observed during long-term follow-up, but the owner's satisfaction was not obtained at the time of the final communication. Ultimately, the outcomes in these 3 dogs were judged to be good.

DISCUSSION

The most common site of an affected cervical disc was reportedly the C2–3 intervertebral disc space. The incidences at other cervical sites decreased progressively when proceeding caudally [13, 15]. However, in our study, the most common sites of affected cervical discs were at the C3–4, C4–5, and C6–7 intervertebral disc spaces. Furthermore, 62% (13/21) of affected discs were caudal cervical (C4–5, C5–6, and C6–7) intervertebral discs. Fitch *et al.* [3] concluded that caudal cervical intervertebral disc protrusions present more commonly than previously emphasized. It is considered that the incidence of cervical disc disease may be high in the caudal spaces even in small dogs.

Several different surgical decompressive techniques have been described for the treatment of cervical disc disease. The most commonly used decompressive technique for surgical treatment of cervical disc disease is the ventral slot procedure [10, 13]. This technique is the procedure of choice for removal of protruded disc material if the location of compression can be documented to lie on the floor of the cervical canal. However, when considering stability and vertebral body strength, there is a limitation in the size of the slot that can be safely performed [2, 4]. Furthermore, it has been reported that cervical vertebral instability can occur secondary to ventral slot procedures in the caudal cervical spine [3, 7, 12]. In small dogs, particularly, adequate slot size may be difficult to achieve for the removal of the protruded disc material. Additionally, it is difficult or practically impossible to approach a lateralized or dorsally located compressive lesion with the ventral slot procedure [2, 5]. Recently, dorsal laminectomy for treatment of cervical disc disease and caudal cervical spondylomyelopathy has been reported to yield good clinical results [4, 11]. However, a disadvantage of this surgery is the inability to visualize the mass of a herniated disc if its location lies ventral to the spinal cord. On the other hand, hemilaminectomy provides for visualization of the lateral and ventral aspect of the spinal cord and nerve roots, and can be used to remove extruded disc material from these locations [5, 9, 13, 15]. In our study, 12 dogs had a lateralized compressive lesion over the cervical spinal cord that was evident on myelograms. We consider that the lateralized compressing lesion dictates decompression by hemilaminectomy rather than by other decompression techniques. Although the large mass of muscle may make this approach technically difficult, especially in large dogs, we find this approach may be achieved easily in small dogs. Complications associated with cervical hemilaminectomy include nerve root damage and exces-

sive hemorrhage from the internal intervertebral venous plexus intraoperatively [5, 13]. This bleeding obscures visualization of spinal cord and may lead to iatrogenic spinal cord trauma. We did not encounter excessive intraoperative hemorrhage in any of the dogs in our study. One of our patients was neurologically worse after surgery, but this was attributed to excessive spinal cord manipulation to remove the extruded disc material from the spinal canal. Although this dog eventually recovered completely, its neurologic deterioration immediately after surgery emphasizes the importance of gentle manipulation of the spinal cord to gain access to the floor of the spinal canal.

Outcomes for patients treated surgically for cervical disc disease depend on neurologic status and the location of the lesion [13]. In this study it was found that the duration of the recovery period correlated with the grade of severity of the presenting signs. There is usually a rapid improvement in the degree of neck pain after surgery [5, 13]. Eleven of our 13 patients with neck pain were pain free within 7 days after surgery. However, in the remaining 2 dogs (dog 4 and 5), neck pain was prolonged. These 2 dogs took a long time to obtain an optimal response (17 and 29 days respectively) despite a preoperative neurologic sign of G1. These dogs had very long durations of signs (52 days and 20 months, respectively). In chronic compression, pain caused by compression, inflammation, or ischemia of tissue is often the predominant clinical sign. Sources of pain in disc disease include radicular pain, meningeal pain, and discogenic pain [15]. Chronic disc extrusions are also associated with inflammatory tissue and adhesions to the dura and venous sinus [6, 15]. It is considered that simple removal of the disc material or removal of only a portion of vertebral bone at the site of compression does not instantly reverse this chronic pathology. Therefore, we suggest that the recovery time was influenced by duration of clinical signs, even if the grade of signs is mild.

In the Hansen type 2 thoracolumbar disc protrusions, surgical removal of protruded disc material may result in clinical improvement. However the neurologic status of some dogs may be permanently worsened [6]. In our 9 dogs, the disc material could not be found despite careful observation of the lateral and ventral aspect of the spinal cord during surgery. These dogs were diagnosed with a Hansen type 2 disc protrusion. Removal of the protruding annular mass was not attempted in these dogs to avoid further spinal cord or nerve root damage, which is attributed to excessive spinal cord manipulation to remove the protruded disc material. Swaim and Hyams [14] indicated that the ventral slot procedure is effective for the treatment of cervical disc protrusion. If the removal of the protruded disc by ventral slot procedure was inadequate, compression may be prolonged. Regardless, with hemilaminectomy, all dogs that had protrusion showed clinical improvement. Hemilaminectomy does allow sufficient removal of vertebral bone and exposure of spinal cord even in small dogs. Therefore, the sufficient removal of a portion of vertebral bone at the site of compression by this technique may allow relief of the compression to the spinal cord and yield good clinical results in the Hansen type 2 in cervical disc disease.

In conclusion, cervical hemilaminectomy had good decompressive effects in our 18 small dogs with cervical disc disease. We believe that it is an effective surgical technique that may result in good-to-excellent outcomes in small dogs with cervical disc disease.

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