Usefulness of Myelography with Multiple Views in Diagnosis of Circumferential Location of Disc Material in Dogs with Thoracolumbar Intervertebral Disc Herniation

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ABSTRACT. The usefulness of myelography with multiple views (lateral, ventrodorsal, left and right oblique view) in the diagnosis of the exact circumferential location of herniated disc material around the spinal cord in 80 dogs diagnosed with thoracolumbar intervertebral disc herniation at surgery was assessed by comparison of clinical and surgical findings. The circumferential location of the compressing mass was diagnosed in 94% of dogs on myelography. The oblique view was of more benefit than the ventrodorsal view in diagnosing the circumferential distribution of the compressing mass. Only the oblique view contributed to a diagnosis of lateralization of the compressing mass in 45% of dogs. Fourteen percent of dogs had clinical lateralization contralateral to myelographic lateralization. The myelographic localization agreed with the surgical localization in 97% of dogs with regard to the exact location of herniated disc material. The presence of clinical lateralization contralateral to myelographic lateralization and a high proportion of agreement of myelographic and surgical localization documents that myelography with multiple views is useful and essential to accurately determine the circumferential location of disc material around the spinal cord.

KEY WORDS: canine, multiple views, myelographic diagnosis, thoracolumbar disc herniation.

FULL PAPER


Thoracolumbar intervertebral disc herniation is the most common cause of neurologic dysfunction in the dog. Hansen type 1 extrusion is most frequently observed in chondrodystrophic breeds of dogs where it causes acute and severe neurologic dysfunction [1, 3, 14]. It is a frequent indication for surgical decompression in a small animal practice [3, 19, 20]. The more frequently performed surgical decompression techniques are a dorsal laminectomy or a hemilaminectomy [3, 19]. The choice of surgical decompression technique is determined by the precise location of the disc material [3, 16]. There is a tendency for a hemilaminectomy to be preferred over a dorsal laminectomy because of access to the lateral aspect of the spinal canal and ventral regions, where most of the herniated disc material will be found [3, 9, 11, 19, 20]. Therefore, it is critical to localize the right and left distribution of the herniated disc material within the spinal canal. The determination of the location of herniated disc material relies on clinical examination and radiography [20, 21]. Particularly, myelography has been proven to be the most effective technique for delineating disc herniation. It has been stated that myelographic oblique views are sometimes necessary for the determination of the exact circumferential location of herniated disc material [5, 7].

The purposes of this study were to compare clinical, myelographic, and surgical findings for localizing the site of intervertebral disc herniation, and to assess the importance of oblique views in determination of the right and left distribution of the herniated disc material and the usefulness of myelography with multiple views in the diagnosis of the exact circumferential location of the herniated disc material around the spinal cord.

MATERIALS AND METHODS

Eighty dogs with thoracolumbar intervertebral disc herniation treated by hemilaminectomy between January 2002 and July 2003 were reviewed. Clinical and myelographic findings were recorded. Subsequently, the dogs underwent a hemilaminectomy.

Clinical evaluation: A neurological examination that included gait evaluation, postural reactions, spinal reflexes and sensory evaluation was performed on all animals at the time of admission to the hospital. Based on the severity of neurologic dysfunction the dogs were graded according to the staging system by Griffiths (Grade 1 to 5) [2]. When the severity of the clinical signs was asymmetrical, the clinical lateralization was attributed to the most severely affected side (left versus right).

Radiography: All dogs were premedicated with atropine sulfate (0.05 mg/kg, intravenous injection (IV)) and midazolam hydrochloride (0.2 mg/kg, IV). After administration of thiamylal sodium (10 mg/kg, IV), endotracheal intubation was performed on all dogs. Anesthesia was maintained with 2% halothane and oxygen. Survey radiographs were initially performed to examine for evidence of the radiographic signs which could be considered a reason to suspect intervertebral disc herniation [4, 6, 12]. Subsequently, in all dogs myelography was performed by lumbar puncture using Iotroran 240 (Isovist, 240 mg iodine/ml, Schering, Osaka) at a dose of 0.45 ml/kg. Before lumbar puncture was performed, the contrast medium was warmed to minimize its
viscosity. The flow of contrast was monitored fluoroscopically. At the end of the injection, a lateral view was taken immediately on four to six vertebrae centering over the area where abnormalities were seen on fluoroscopy. If the abnormalities were not obvious on fluoroscopy, a lateral view was taken, centering over the suspected area from the neurological examination and the survey radiographs. Thereafter, the spinal needle was removed and the patient was rolled or tilted to ensure good spread of contrast medium. The following additional views were taken of the same area: a ventrodorsal view, a ventral 45° left dorsal right oblique view, and a ventral 45° right dorsal left oblique view. Subsequently, lateral and ventrodorsal view was again taken to evaluate the entire spinal cord. Multiple myelographic views were evaluated with regard to the circumferential location of the compressing mass around the spinal cord at the affected area. An example of a deviation of the contrast medium column of each myelographic view is shown in Figs. 1 A-D. The diagnosis of the exact circumferential location of the compressing mass was based on the combination of these myelographic views. When the disc material was located asymmetrically (myelographic lateralization), the side was recorded and compared with clinical lateralization.

Surgery: Surgery was performed during the same period of anesthesia as the myelography. A hemilaminectomy was
carried out at the side of spinal cord compression ipsilateral to the side that was indicated on myelography. If ventral and/or dorsal compression was indicated on myelography, the side of hemilaminectomy was decided by surgeon’s preference. When the location of compressing mass in the spinal canal and affected intervertebral disc was not indicated on myelography, the surgery site was decided by the location of the intervertebral disc suspected of herniation on the survey radiographs, and the side of the hemilaminectomy was decided by the surgeon’s preference. The diagnosis of Hansen type 1 extrusion or Hansen type 2 protrusion was determined and the exact location of the disc material within the spinal canal was confirmed by the surgeon during surgery. The surgical localization of disc material was compared with the myelographic localization.

RESULTS

Ten breeds were represented (Table 1). The most common breed was the Dachshund which accounted for 63/80 (79%) of all dogs. The age of the dogs ranged 1 to 11 years (mean age; 5.4 years). The body weight of the dogs ranged 2.8 to 13.3 kg (mean body weight; 6.0 kg). Forty nine males and 31 females affected.

Clinical evaluation: One dog presented as grade 1, 5 dogs as grade 2, 30 dogs as grade 3, 36 dogs as grade 4, 8 dogs as grade 5. Clinical lateralization was presented in 35 (44%) of the dogs, 21 on the right and 14 on the left. There was 1 dog which had had previous episodes of neurological deficits associated with intervertebral disc herniation, occurring 3 months before the current presentation. This dog had undergone surgery for thoracolumbar disc herniation at that time and had been reported to be normal in the interim between the previous episodes and the current disease.

Radiography: In the survey radiographs, narrowing of the intervertebral disc space was seen most frequently (62 discs), followed by narrowed space between articular processes (10 discs), vertebral spondylosis (4 discs), and the presence of opacities in the intervertebral foramen (6 discs).

The results of myelography are presented in Table 2. The circumferential location of the compressing mass within the spinal canal was diagnosed in 75 dogs (94%). Of these dogs, the circumferential location was symmetrical in 19 (25%) and asymmetrical in 56 (75%) dogs. Where the compressing mass was located asymmetrically, the right side was involved in 34 (61%) of the dogs and the left side was involved in 22 (39%). The most common location of compressing mass was ventrolateral to lateral, and the next most common was ventral. The oblique view was most beneficial, contributing to a delineation of the circumferential location of the compressing mass in 48 (64%) dogs. A lateral and ventrodorsal view contributed to a delineation of the circumferential location of the compressing mass in 32 (42%) and 31 (41%) dogs respectively. In the dogs with an asymmetrical circumferential location, 25 dogs, only the oblique view contributed to a diagnosis of the right or left distribution of compressing mass, that is, the location of the compressing mass did not include lateral aspect. Three dogs had a filling defect of contrast medium over an area greater than 2 vertebrae and 2 dogs had the opacification of the substance of the spinal cord (Fig. 2). In these 5 dogs, the origin

Table 1. Breed incidence and the percentage of dogs with thoracolumbar disc herniation seen between January 2002 and June 2003 (n=80)

<table>
<thead>
<tr>
<th>Breed</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dachshund</td>
<td>63</td>
<td>79</td>
</tr>
<tr>
<td>Shih Tzu</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Cross breed</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Beagle</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Papillon</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Shetland Sheepdog</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Pekingese</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Cocker Spaniel</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Toy Poodle</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Welsh Corgi</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2. The circumferential location of the compressive mass within the spinal canal from myelography (n=80)

<table>
<thead>
<tr>
<th>The circumferential location</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symmetric (n=19)</td>
<td></td>
</tr>
<tr>
<td>Ventral</td>
<td>16</td>
</tr>
<tr>
<td>Ventral and dorsal</td>
<td>3</td>
</tr>
<tr>
<td>Asymmetric (right; n=34, left; n=22, total; n=56)</td>
<td></td>
</tr>
<tr>
<td>Ventral to Ventrolateral</td>
<td>12</td>
</tr>
<tr>
<td>Ventrolateral</td>
<td>11</td>
</tr>
<tr>
<td>Lateral</td>
<td>8</td>
</tr>
<tr>
<td>Ventrolateral to lateral</td>
<td>22</td>
</tr>
<tr>
<td>Ventrolateral to dorsolateral</td>
<td>1</td>
</tr>
<tr>
<td>Dorсолateral</td>
<td>1</td>
</tr>
<tr>
<td>Ventral and dorsolateral to dorsal</td>
<td>1</td>
</tr>
<tr>
<td>Undetected (n=5)</td>
<td></td>
</tr>
<tr>
<td>Opacification of substance of the spinal cord</td>
<td>2</td>
</tr>
<tr>
<td>Contrast medium filling defect</td>
<td>3</td>
</tr>
</tbody>
</table>

Fig. 2. Lateral myelographic view. There is opacification of substance of the spinal cord (arrow heads). This finding is associated with myelomalacia. Opacity in the intervertebral foramen is also present (arrow).
and location of the compressing mass could not be determined. In all dogs, no complications that could be attributed to myelography were observed.

**Surgery:** A hemilaminectomy was performed via a right dorsolateral approach in 42 dogs (53%) and a left dorsolateral approach in 38 dogs (47%). Seventy eight dogs (98%) had Hansen type 1 extrusion, and disc material was retrieved in all. The remaining 2 dogs had a Hansen type 2 protrusion and decompression and fenestration was performed. In 2 of 3 dogs which had a ventral and dorsal compressing mass on myelography, the exact herniated disc material was located at the ventral site and a blood clot was only presented at the dorsal site. In the 3 dogs which had the filling defect of contrast medium on myelography, an exploratory hemilaminectomy and durotomy was performed at the site of narrowing of the intervertebral disc, and diffuse intramedullary swelling was found. In 2 of these dogs, disc material was removed from a site contralateral to the side of hemilaminectomy. An exploratory hemilaminectomy and durotomy was performed at the site of narrowing of the intervertebral disc or where there were opacities in the intervertebral foramen in the 2 dogs that had exhibited the opacification of substance of the spinal cord on myelography, and evidence for an intradural hemorrhage was found. In 1 of these dogs, disc material was removed from a site contralateral to the side of the hemilaminectomy. The distribution of the affected discs and their location as detected during surgery is given in Table 3.

**A comparison of clinical and myelographic lateralization:** A comparison of the clinical and myelographic lateralization is shown in Table 4. Of 35 dogs which had clinical lateralization, 30 (86%) had clinical lateralization ipsilateral to myelographic lateralization, whereas 5 (14%) had clinical lateralization contralateral to myelographic lateralization. Of 45 dogs which did not have clinical lateralization, 21 (47%) had myelographic lateralization.

**A comparison of the exact surgical and myelographic localization of the disc material:** A comparison of the surgical and myelographic localization of the herniated disc material is shown in Table 5. Five dogs were not compared with the other 75 for surgical localization because myelographic examination failed to localize the compressing mass. In 73 of 75 dogs (97%) diagnosed by myelography, the circumferential location of the compressing mass around the spinal cord agreed with the surgical localization. The remaining 2 dogs, which had ventral and dorsal compression, were not regarded as being in agreement with the surgical localization because the exact disc material was situated ventrally, and the cause of dorsal compression was due to only a blood clot.

**DISCUSSION**

The mean age, and the high representation of Dachshunds in this study was similar to other reports [11, 15, 21]. The most common site of intervertebral disc herniation was T12–13, with T13-L1 the next most commonly affected disc space. This incidence was similar to previous studies [11, 12].

It has been reported that in some dogs with thoracolumbar intervertebral disc herniation, clinical lateralization has been identified contralateral to the myelographic or surgical findings [16, 17]. In this study, the clinical lateralization was contralateral to myelographic lateralization in some dogs. Furthermore, myelographic lateralization was observed in dogs which did not have clinical lateralization. These facts suggest that the greater damage to the opposite side may have been due to a high velocity compression or to a severe compression of the spinal cord. This emphasizes that the exact location of the lateralized herniation of intervertebral disc material should be detected by myelography regardless of the clinical lateralization.

Myelography proved to be the best way to adequately detect the circumferential location of the compressing mass (94%). In our 56 dogs where the compressing mass was located asymmetrically and the right or left distribution might have been determined with a ventrodorsal or oblique view, we found that the oblique view was of more benefit in diagnosing the circumferential distribution of the compressing mass, in agreement with a previous study [5], because the majority of compressive lesions involved the ventrolateral aspect of the spinal cord. In previous reports, myelography
graphic oblique views are sometimes necessary for the determination of the exact circumferential location of herniated disc material [4,6], but the issues were not discussed further. In the dogs with an asymmetrical circumferential location, this study showed that in a significant proportion of the dogs (45%), only the oblique view contributed to a diagnosis of lateralization of the compressing mass. Furthermore, in 12 dogs (21%), the compressing mass was only situated ventrolaterally or ventrodorsally. In these dogs, the lateral and ventrodorsal view showed no delineation of the compressive mass. Obvious deviation of the contrast medium column in these cases was only visible on the oblique view (Fig. 3). If the exact location of the compressing mass was assessed without an oblique view, the possibility of a surgical approach from the incorrect side exists. Also, in our study, disc herniations have occurred in various directions. This demonstrates that herniated disc material migrates to various positions around the spinal cord. Surgical decompression may theoretically be achieved either by removal of the herniated disc material or by removal of vertebral bone in the region of spinal cord compression [2, 18]. As much as possible, removal of the herniated disc material without excessive spinal cord manipulation is desirable. Therefore, an accurate localization of its position in the spinal canal is required to avoid further spinal cord damage in addition to the diagnosis of a right or left distribution. These facts amply illustrate that oblique views are essential in all dogs with thoracolumbar intervertebral disc herniation for

![Fig. 3. (A) Lateral myelographic view. There is mild contrast medium column attenuation at L1-2. (B) Ventrodorsal myelographic view. There is mild deviation of the contrast medium column on the right side. (C) Ventral 45° left-dorsal right myelographic oblique view. There is marked deviation of the contrast medium column on the right (arrow head). (D) Ventral 45° right-dorsal left myelographic oblique view. There is no deviation of the contrast medium column. These findings indicate that a compressing mass is present ventrolaterally on the right side in the spinal canal.](image-url)
the accurate lateralization of intervertebral disc material and that the location of intervertebral disc material in the spinal canal should be interpreted by multiple views on myelography prior to hemilaminectomy.

Some lumbar myelographic techniques for the exact localization of the compressing mass recently were described [5, 7, 18]. It was stated that warming the contrast medium, tilting or rolling the animal, and taking an immediate radiograph after injection of contrast medium may improve the delineation of the lesion. We also used similar techniques, and furthermore used fluoroscopy to enable immediate visualization of the affected disc. As a result, in our study, the circumferential location of the compressing mass was successfully diagnosed a high percentage of the time. These myelographic techniques also may be very important to obtain better delineation of the lesion.

An extradural hemorrhage due to rupture of the internal vertebral venous plexus by the herniated disc material has occurred in intervertebral disc herniation [7, 19]. This hemorrhage may produce an extradural myelographic lesion [7]. In our 2 dogs that were diagnosed with a ventral and dorsal lesion, the lesion of the dorsal aspect was diagnosed to be a blood clot at surgery. It may be important to consider the possibility of a hemorrhage, or blood clot, or both when interpreting any extradural myelographic lesion.

It has been known that spinal cord swelling or myelomalacia occur in dogs with acute intervertebral disc herniation [7, 10, 14, 19]. Spinal cord edema may obliterate the subarachnoid space causing the filling defect of contrast medium on myelography. Opacification of the substance of the spinal cord on myelography has been described as a sign of myelomalacia [4, 7, 10]. These conditions may obscure origins and locations of the lesion on myelography [7]. In the 5 dogs in this study that had a filling defect of contrast medium or opacification of the substance of spinal cord on myelography, the origins and locations of the compressing mass were not detected. Therefore, an exploratory hemilaminectomy was performed on the side of surgeon's preference at the intervertebral discs where the intervertebral disc herniation was suspected on survey radiographs. In all these dogs, the origin of the lesion agreed with the intervertebral discs where the intervertebral disc herniation was suspected on survey radiographs. However, in a recent study of the accuracy of survey radiographic diagnosis of intervertebral disc herniation, it was demonstrated that its accuracy was only in the range 51–61% [8]. This result indicates that exclusive reliance on survey radiographs for diagnosis of thoracolumbar intervertebral disc herniation might lead to an incidence of wrong diagnosis. Therefore, the determination of the surgery sites should not rely on survey radiography. Computed tomography (CT) and magnetic resonance imaging (MRI) has become more widely available to veterinary medicine recently and can provide useful information in the diagnosis of the intervertebral disc herniation [3, 13, 14]. Postmyelographic CT or MRI may be useful, if the origins and locations of the compressing lesion cannot be readily detected on myelography. However, there is a limitation in the use of these imaging techniques in private practice. We consider that the myelographic study has been and should still be the standard method of diagnosing intervertebral disc herniation.

In this study, it was interesting to note that myelography with multiple views led to a high proportion of accuracy in determining the circumferential location of disc material in agreement with surgical localization. Oblique views are particularly essential to diagnose the right or left distribution of herniated disc material. Myelography with multiple views are a superior method and should be performed readily and routinely for the success of surgical techniques, particularly for hemilaminectomy in dogs with thoracolumbar disc herniation.

REFERENCES


