Application of Short-time Magnetic Resonance Examination for Intervertebral Disc Diseases in Dogs

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ABSTRACT. The usefulness of magnetic resonance (MR) is already established, but it has a disadvantage of requiring a long scanning time. A short-time examination is more or less needed so as to be more practical in veterinary clinics. A protocol of the short-time MR examination was devised based on parameters determined, and validity of the protocol was assessed through the diagnosis of clinical cases with intervertebral disc diseases. With this protocol, it was possible to complete an MR examination for the spine within 15 min. The MR images and myelographic findings were correlated well in this study, suggesting the short-time protocol of MR examination can be used in the clinical diagnosis of spinal diseases.

KEY WORDS: anesthesia, canine, magnetic resonance (MR), myelography, spine.

Radiographic myelography is an important method for diagnosing spinal diseases. With the advent of non-ionic contrast agents [1, 6], the safety of radiographic myelography has remarkably improved, but radiographic myelography is sometimes difficult to use in obese animals and it cannot be denied that this procedure entails substantial intervention with vertebral canal puncture [3, 5]. The usefulness of magnetic resonance (MR) has already been established; it enables the clinician to delineate the lesion three-dimensionally in a non-invasive manner. In addition, not only compressive lesions but degeneration, edema or other lesions, which cannot be delineated by myelography or computed tomography (CT), can be delineated, but it has the disadvantage of requiring a long scanning time. As in CT, a shorter scan time may be more practical and widely available in veterinary practice. Then, the problem of long scan time in MR examination is sometimes difficult to use in obese animals and it cannot be denied that this procedure entails substantial intervention with vertebral canal puncture [3, 5].

RESULTS

Establishment of parameters: Appropriate parameters of the first spin echo pulse sequence were obtained by comparing images at repetition time (TR) of 2,000, 3,000 and 4,000 msec, and with a number of echoes per TR of 11, 17 or 23 times, respectively (Fig. 1). Echo time (TE) was fixed at 120 msec, at which the scan time was not affected. The scan time of each images is shown in Table 1. The longer the TR and the fewer the number of echoes per TR, the higher the S/N obtained and the longer the scan time. With shorter TR, and the greater the number of echoes per TR, the lesser the S/N and the shorter the scan time. In consideration of the S/N, contrast between tissues and the scan time, a TR of 3,000 msec, and the number of echoes per TR of 17 times were selected as parameter for the T2 weighted image. A sagittal image of the spine obtained with the determined parameter setting is shown in Fig. 2. This image was a 1.5 mm slice obtained with a 256 matrix, 4 data averagings and a scan time of 6 min 3 sec. Cerebrospinal fluid (CSF) was depicted at high signal intensity. The epidural fat would also have as high a signal intensity as the cerebrospinal fluid. There was
The protocol of MR examination for the spine: The protocol of the MR examination prepared based on the parameters determined is shown in Table 2. The dorsal plane and transverse scout views were each scanned for 20 sec. Sagittal T2 weighted images were then scanned for 6 min 3 sec, followed by MR myelography (Fig. 3) with scanning for 4 min 35 sec. MR myelography visualizes CSF three-dimensionally without the use of any contrast agent by the maximum intensity projection image processing method of heavy T2 weighted images (fast advance spin echo, TR/TE/inversion time=5,000/250/150 msec). With this protocol it is possible to complete the examination within 15 min.

Clinical case #1: A 4-year-old female Beagle dog (14.5 kg) presented with paraplegia of the hindlimb. A herniated intervertebral disc in the lumbar region was suspected due to lower motor neuron (LMN) signs. MR revealed spinal cord compression at L5-L6 and L6-L7 levels (Fig. 4, a, arrows). Interceptions of the contrast agent were observed at L5-L6 and L6-L7 on myelography (Fig. 4, b, arrows). MR myelography provided the same information as in sagittal T2 weighted image and myelography. Although their relation to the clinical manifestation was unclear, Fig. 5 (a, b, c) shows a type I vertebral disc protrusion which extended not only to the intervertebral disc but also the vertebrae (T12, T13) from the ventral right, causing cord compression. This was confirmed on the ventrodorsal image of the myelography (Fig. 5, a, b, c).
Clinical case #2: A 9-year-old male Dachshund (8.6 kg) presented with quadriparesis and cervical pain was suspected of having cervical intervertebral disc disease. MR examination demonstrated intervertebral disc protrusion in C2-C3 (Fig. 6, a, arrow). The compression at C2-C3 was also evident on myelography (Fig. 6, b, arrow). MR myelography provided the same information as in a sagittal T2 weighted image and myelography.

Clinical case #3: A 12-year-old male Beagle dog (18.4 kg) presented with paresis of the hindlimb. An intervertebral disc herniation in the lumbar region was suspected due to LMN signs. Multiple disc protrusions within the lumbar spine region were observed on MR (Fig. 7, a, arrows), and were also evident on myelography (Fig. 7, b, arrows). MR myelography provided the same information as in sagittal T2 weighted image and myelography. The case was diagnosed as spondylopathy. The owner opted for euthanasia. Gross pathologic findings verified these findings.

DISCUSSION

This investigation represents an attempt to establish parameters for MR examination of the spine of dogs and devises a protocol for short-time MR examination. With the determined parameters obtained it was found feasible to scan...
1.5 mm thin slices, thus involving less partial-volume effects. With this protocol, it was possible to complete an MR examination within 15 min from the time the patient was brought in till the time it was taken out of the examination room. This made it possible to do this procedure under short-time intravenous anesthesia with thiopental, propofol or other chemical restraint enough for short-time immobilization. We did not scan the transverse image except for scout views because of low S/N in small fields of transverse images, hence scarcely affording additional diagnostic information. If diagnostic transverse images with numbers of data averaging are scanned, it requires a longer, therefore inadequate scan time for this protocol. We found that MR myelography provides information about lateral compression as well as transverse images (unpublished data), but we do not deny detailed long-time MR examination including transverse images and additional $T_1$ weighted images; but with long-time examination there are more likely to be accidental motion artifacts. The short-time protocol of MR examination can be more practical in the clinical diagnosis of spinal diseases.

The results of MR were in close accord with those of radiographic myelography, and the two methods proved to be comparable in diagnostic performance. MR is advantageous over radiographic myelography in that it entails no use of contrast agents, so that there is no risk of adverse effects of iodine contrast agents. Doses of contrast agents are rather intricate, and failure in radiographic myelography due to disregard of breed type has been encountered [4]. MR does not require shaving or surgical disinfection, or intervention with vertebral canal puncture. Differing levels of skill do not produce noticeable differences in imaging outcome, which would make interpretation of the myelogram difficult. There is no such interference as enhancement of the epidural space. Above all, the examination can be completed within a short-time. Current problems are its high cost and practicability because of the use of a high magnetic field strength MR unit, but these problems will be solved in the near future by widespread application of MR units. The protocol of the non-invasive, short-time MR examination can be a new option for imaging diagnosis in clinical veterinary work.

REFERENCES