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Acute Hemorrhagic Myelomalacia in an English Cocker Spaniel Dog

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Abstract : A 3-year-old, intact female English cocker spaniel dog was evaluated for an acute onset of tetraplegia. Utilizing magnetic resonance (MR) imaging, the cause of the neurologic deficits was determined to be an peracute hemorrhage of spinal cord. The MR study additionally demonstrated parenchymal hyperintensity on T2weighted images and similarly located hypointensity on T1weighted images. Hemorrhagic myelomalcia was suspected based on these MR characteristics, which was subsequently confirmed histopathologically.

Key words **:** English cocker spaniel dog, magnetic resonance imaging, myelomalacia, tetraplegia.

Introduction

Myelomalacia is normally used to refer to hemorrhagic infarction of the spinal cord that can occur as a sequel to acute injury, such as that caused by intervertebral disc extrusion (13), and it represents extensive damage of the intramedullary spinal vasculature (18). The exact etiology is poorly understood but it may develop in a region of trauma as a result of ischemia, release of cellular enzymes, vasoactive chemicals, or the immediate concussive effects of the trauma (15). Intervertebral disc extrusions in which a large volume of disc material is spread along the vertebral canal are said to be most likely to result in myelomalacia (9,15).

An ante-mortem diagnosis of myelomalacia can be difficult. Diffuse, progressive myelomalacia may become apparent in hours to several days after the onset of paraplegia (13,14,16,18). Clinical signs of myelomalacia may include flaccid paraplegia, total areflexia of the pelvic limbs, tail and anus, loss of deep pain perception caudal to the site of spinal cord injury, flaccid abdominal musculature, depressed mental state, and respiratory difficulty due to intercostal and diaphragmatic paralysis (1,5). Occasionally tetraparesis or tetraplegia may become apparent (13,18). Death from diffuse myelomalacia may occur as a result of respiratory paralysis when the ascending lesion reaches the motor nuclei of the phrenic nerves in the caudal cervical region (1,4,5,9,21).

The prognosis for patients with myelomalacia can be poor but improvement of neurologic function is possible in focal disease (6).

Two reports have described the myelographic appearance of myelomalacia in dogs (6,13). Magnetic resonance (MR) imaging has aided the understanding of spinal cord disease more than any other diagnostic modality developed in the last 30 years (17). In humans, the depiction of parenchymal spinal cord injury in MR images may have significant implications for prognosis and the potential for neurologic recovery (2,22). But minimal information presently exists on the assumed value of MR imaging for the investigation of spinal cord disease in dogs (3). The purpose of this report is to describe a English cocker spaniel dog with acute hemorrhagic myelomalacia and the MR characteristics of the lesion.

Case Report

A 3-year-old, intact female English cocker spaniel weighing 9 kg, was presented. She has the history of hind limb weight bearing lameness for one day. Six hours prior to admission the dog was lethargic, and reluctant to move. On physical examination, lumbar pain and hip joint pain were found. But neurologic response was normal. In survey radiograph, disc mineralization and disc protrusion were found at L6-7 (Fig 1B). At T11-12, narrowing of the dorsal articular process joint space was present (Fig 1A). Complete blood count and serum biochemistry, performed at the time of admission, were within normal limits. Based on these results, the differential diagnosis was made as T11-12 intervertebral disc herniation, caudal equina syndrome or lumbar-sacral joint instability. After deciding to observe the potential changes of symptoms, the case was referred to a local animal hospital followed by simple assessment and treatment.

One day later, a sudden onset of pelvic limb paraplegia occurred. This rapidly progressed to tetraplegia with loss of superficial or deep pain perception. And progressive neurologic deficits were noted. Thoracic limb sensory and motor evaluations were abnormal. The pelvic limb had reduced muscle tone and anal tone and perineal reflex was reduced bilaterally. Multifocal neurologic disease with thoracolumbar and lumbosacral myelopathic characteristics was considered. Tentative diagnoses included

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type I intervertebral disc disease (IVDD) with diffuse myelomalcia, infectious or nonpathogenic meningomyelitis.

Although the case was examinated by CT, which was done on site, no other apparent lesions were found except mild IVDD.

MR imaging of the thoracic to sacral spine was performed under general anesthesia using a 0.5 T MR unit. T1-weighted (T1W) and T2-weighted (T2W) images were obtained in sagittal, dorsal and transverse planes. There were loss of signals from the intervertebral disk (IVD) at the level of the L4- L5 (Fig 2B), T11-T13, and L1-L2 (Fig 2A). It has been confirmed that it was not due to protrusion but rather calcification of IVD. There was a diffuse increase in signal intensity in the spinal cord of the level of the C2 on T2W images but decrease on T1W images (Fig 3). Spinal cord suppression by extruded disc material and swelling of spinal cord were not found on the MR image. We suspected peracute hemorrhage over spinal cord, and therefore, a tentative diagnosis of hemorrhagic myelomalacia was made. The dog died from respiratory paralysis on day 7 after hospitalization. Consent for a postmortem examination was given by the owners.

Upon histopathologic examination of the spinal cord moderate autolysis and distortion of the parenchymal architecture and extensive hemorrhagic lesion were found on all section examined. Similar histologic feature were presented, characterized by

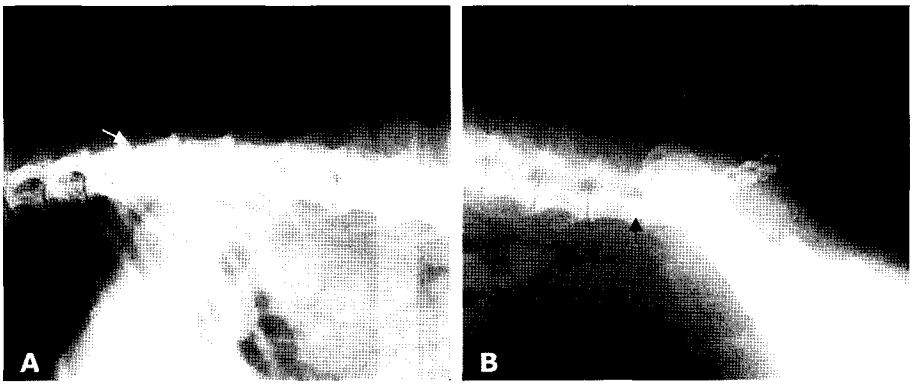

Fig 1. Right lateral view of the thoracolumbar spine (A) and caudal lumbar spin (B). A. At T11/12, narrowing of the dorsal articular process joint space (white arrow) was present. B. Disc mineralization and disc protrusion (black arrow) were found at L6/7 disk space.

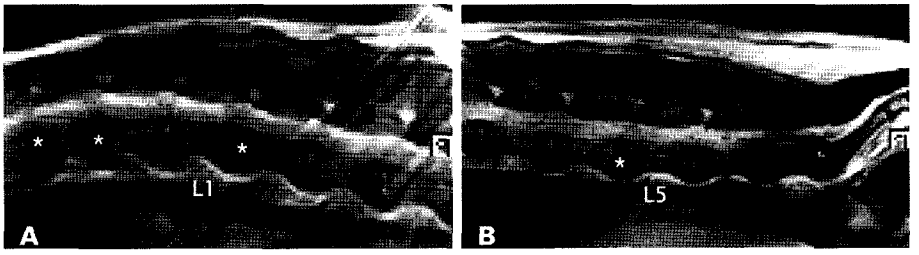

Fig 2. T2-weighted sagittal image of the thoracolumbar spine (A) and the caudal lumbar spine (B). A. At T11/12, T12/13, and L1/2 disk space there is loss of signal from the IVD (asterisks). B. At L4/5 disk space there is loss of signal from the IVD (asterisk). There was diffuse increase in signal intensity in the spinal cord.

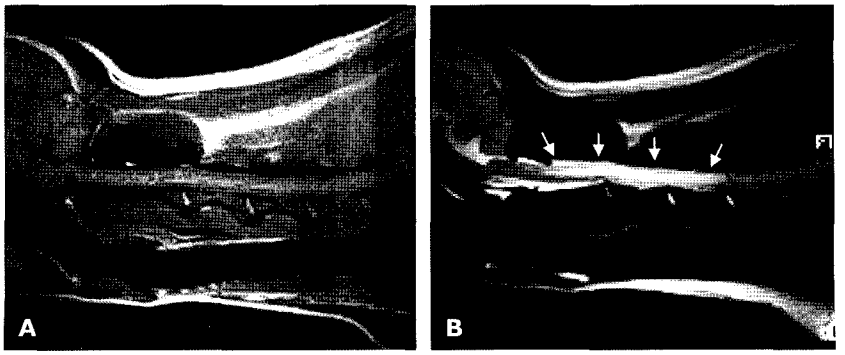

Fig 3. T1-weighted (A) and T2-weighted (B) sagittal image of the cervical spine. There was a diffuse increase in signal intensity (arrows) in the spinal cord of the level of the C2 on T2W images but decrease on T1W images.

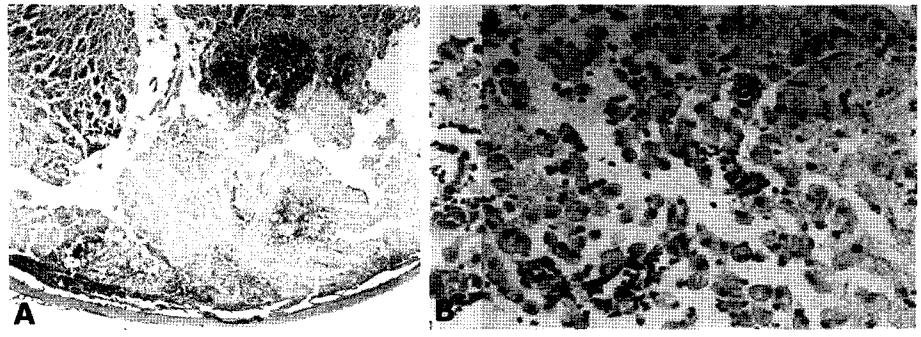

Fig 4. (A) H&E-stained section photomicrographed at × 20 magnification. It demonstrates general liquefactive necrosis of the white matter with extesive areas of hemorrhage. (B) H&E-stained section photomecrographed at × 800 magnification. An area of necrosis with large number of macrophages is evident.

extensive liquefactive necrosis and infiltration of large number of macrophages (Fig 4A and B). Areas of neuronal degeneration and moderate multifocal area of hemorrhage were also observed at the periphery of necrosis and within these areas (Fig 4A). Infectious organism were not identified and the pathologic lesions were considered compatible with a diffuse hemorrhagic myelomalacia.

Discussion

This report illustrates a English cocker spaniel dog with acute hemorrhagic myelomalacia and the MR characteristics of the lesion. The exact pathophysiology of myelomalacia is poorly understood but it seems to be the result of the concussive effects of trauma, ischemia, and the release of vasoactive substances, oxygen-free radicals and cellular enzymes. When the spinal cord is acutely damaged, white blood cells respond to chemotactic signals and enter the damaged area within 3-6 hours (8). Cell death in the gray matter may occur within 4 hours, with this area of necrosis expanding for a few day (18). Initially the white blood cells and neutrophils but macrophages become more prominent by the third day (10,11). From the level of spinal cord injury, a core of necrosis may extend cranially and caudally, typically in the base of the dorsal funiculi (12). Focal areas of necrotic tissue, distant from the immediate point of impact, may reflect regions of ischemia following post-traumatic secondary injury to blood vessels (19). Such areas of spinal cord necrosis can be seen secondary to intervertebral disc extrusion, in the segments neighboring the site of injury, but do not seem to have a prognostic inference (18). But in two retrospective studies of dogs with loss of deep pain perception following intervertebral disc prolapse, evidence of myelomalacia was found in 6 of 34 (18%) dogs (6) and in 20 of 46 (43%) dogs (6).

In a recent report, the MR diagnosis of myelomalacia has been described in a dog. The spinal cord parenchyma appears hyperintense on T2W images, but the pathology is often poorly marginated on T1W images. The presence of hemorrhage in addition to the myelomalacia may present an opportunity for more specific MR diagnoses (17). MR provides an excellent definition for both intramedullary hemorrhage and edema in animal models (20). The MR appearance of the hemorrhage can depend on the duration of the lesion. In the acute phase following injury, deoxyhemoglobin is most commonly generated, at the site of the hemorrhage, which is depicted on high field-strength scans as a discrete area of hypointensity on the T2W images. This is representative of acute hemorrhagic necrosis of the spinal cord (2,7). In this case, the spinal cord swelling was not visible on the MR images, but it is the most nondescriptive imaging finding associated with spinal cord injury. By itself, swelling does not specifically describe any signal changes in the spinal cord. Spinal cord swelling is reported to be best seen on the T1W sagittal images; the parenchyma may be normal to slightly hypointense (20).

In this case, there was no substantial evidence to confirm the myelomalacia secondary to IVDD. However, as previously mentioned, it is important to keep in mind that the myelomalacia secondary to IVDD has a good chance of occurrence at a proper rate (6,16). Myelography has been described in the diagnosis of IVDD in dogs (3). However, there is only a limited amount of information on the myelographic characteristics of myelomalacia (17). As it has also been confirmed by this case, it is difficult to diagnose myelomalacia by CT image or survey radiograph. Although the prognosis of spinal cord injury is yet to be assured by MR images and no accurate treatment has been provided thus far, precise analysis of parenchymal damage of spinal cord identified on MR images will be able to assist with the decision making process.

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잉글리쉬 코카 스패니얼 견에서 발생한 급성 출혈성 척수연화증

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요 약 : 3년령의 암컷 잉글리쉬 코카 스패니얼 견이 급성 사지마비 증상을 나타내었다. 자기공명영상검사를 통해, 신경반응의 결손이 척수의 초급성 출혈에 기인함을 진단하였다. 자기공명영상은 T2 강조 영상에서 실질조직의 고신호로 동일부위의 T1 강조 영상에서는 저신호로 나타났다. 자기공명영상에서 나타난 특징적 소견에 의거하여 출혈성 척수연화증으로 잠정 진단하였고 사후 부검시 조직병리학적 검사를 통해 확증하였다.

주요어 : 잉글리쉬 코카 스패니얼 견, 자기공명영상, 척수연화증, 사지마비