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Myelography and Magnetic Resonance Imaging Findings of Neurological Lesions in the Cervical Region in Dogs

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Abstract: Direct spinal radiography and myelography are primary diagnostic techniques used to visualize the vertebral column in dogs. Although, the location of the lesion can be identified with myelography, this is not sufficient for the interpretation of its aethiology. Magnetic Resonance Imaging (MRI), on the other hand is a non-invasive method used to visualize the central nervous system. It has exceeded myelography in visualizing intervertebral disc diseases and intra-spinal lesions. In addition, to revealing the localization of spinal cord tumours it also gives clues regarding their character. In this study, cervical magnetic resonance images of 30 dogs with suspected cervical myelopathy were evaluated in transversal and sagittal T2-focused cross-sections with contrast agent and T1-focused cross-sections without any contrast. Findings were then compared to myelography images. Magnetic resonance images revealed intervertebral disc hernia in 15 dogs, intramedullary mass in 5 dogs, intradural extramedullary mass in 3 dogs, extradural mass in 1 dog, an epidural abscess in 1 dog, transverse myelitis in 1 dog and syringomyelia in 4 dogs. Although, the myelography imaging technique aids in determining the localization of a lesion in the cervical spinal region, magnetic resonance imaging is used for definitive diagnosis of specific lesions.

Key words: Myelography, magnetic resonance imaging, cervical spine, dog, tumour

INTRODUCTION

Direct spinal radiography and myelography are primary diagnostic tools for vertebral column evaluation in dogs (Levitski *et al*., 1999). In cases of pain and muscle spasm in particular, sedation or general anaesthesia is required for careful positioning and application of the technique. Under general anaesthesia, additional information may be obtained with myelography images taken by administering water-soluble, iodine-containing contrast agents via the cisterna magna (Dennis, 1987). With myelography, damage may occur during entry. Although, the localization of the lesion can be determined with myelography it may be insufficient in establishing the neurological problem. It is not possible to assess the intramedullary section of the spinal cord, nerve roots or intervertebral discs (Levitski *et al*., 1999).

Magnetic Resonance Imaging (MRI) has introduced new horizons in diagnosing animals with neurological disease. MRI is a non-invasive anatomical imaging method (Seiler *et al*., 2003; Penning *et al*., 2006). A single MRI procedure takes approximately 40-60 min and during this time general anaesthesia is essential for the animal to remain motionless. MRI features of body tissues result in various degrees of signal intensity. Images are usually formed in black, white and grey tones. In general, all soft tissues may be visualized with MRI. The appearance of a tissue type is named as hypointense (blacker), hyperintense (whiter) or isointense (similar tone) (Bagley, 2005).

The most widely used contrast agent is a paramagnetic material in the form of Gd-DTPA called Godalinium. This paramagnetic material cannot cross the intact blood-brain barrier. For this reason, it is useful in diagnosing abnormalities only (Bagley, 2005). MRI enables non-invasive examination of the spinal cord, nerve roots and intervertebral discs (Levitski *et al*., 1999; Gopal and Jeffery, 2001). The aim of this study has been to assess myelography and MRI findings in the diagnosis of neurological lesions of the cervical region.

MATERIALS AND METHODS

The study material consisted of 30 dogs of different age and breed brought to the Istanbul University Veterinary Faculty Research and Practice Hospital

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Surgery Clinic with neurological complaints such as inability to stand, stiffness in the forelegs, intermittent curving of the front paws or problem in the hindlimbs. Clinical examination revealed that some dogs could not get up at all and others had trouble with co-ordination when walking. In the neurological examinations, all dogs exhibited hyperreflexia in hindlimb reflexes (patellar, cranial tibial and gastrocnemius) and in forelimb reflexes (biceps, triceps and extensor carpi radialis) depending on the localization of the lesion. At the same time, hindlimb and forelimb proprioceptive reflexes were negative in these dogs. Clinical and neurological examination results suggested the presence of a cervical lesion. In order to determine the localization of the lesion, direct radiography and myelography images were obtained. For the myelography procedure, the dogs were put under general anaesthesia using intravenous propofol (Propofol 1%, Fresenius Kabi AB, Sweden) at a dose of 6 mg kg^{-1}. Following general anaesthesia, the cisterna magna area was clipped and disinfected. The patients were positioned on the X-ray table with the head at a 15-20 degree angle to the body and the cisterna magna area to be punctured was covered with sterile drapes. An 18-gauge spinal needle (Spinocan 18 G, BBraun, Germany) was used for the puncture. Following puncture, cerebrospinal fluid was observed advancing through the spinal needle and the same volume of cerebrospinal fluid was removed as that of the contrast agent to be administered. Prepared at a dose of 100 mg kg^{-1}, the contrast agent (Omnipaque, 300 mg mL^{-1}, GE Healthcare, Ireland) was slowly injected into the subarachnoid space.

Approximately 5 min later, radiographs were taken in lateral and ventrodorsal positions. MRI investigations were carried out in all patients for the definitive diagnosis of the lesion. For MRI, general anaesthesia was performed using propofol at a dose of 6 mg kg^{-1} IV. Patients were placed in ventral recumbency on the MRI table. Transversal and sagittal cross-sections were obtained, with emphasis on T1 and T2. Contrast agent (Gd-DTPA, Magnevist, Schering, Germany) was administered intravenously in cases where a mass lesion was identified.

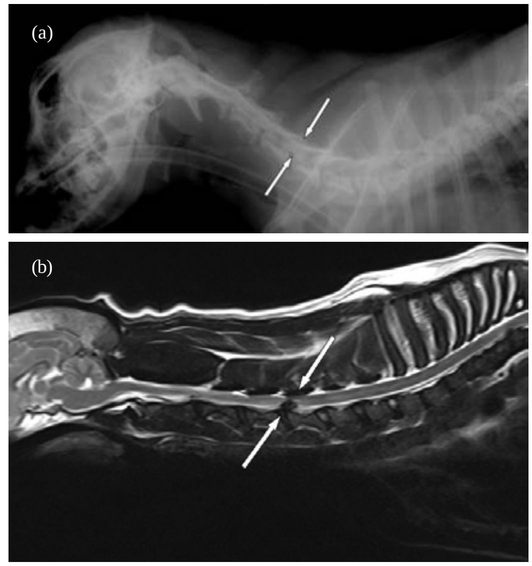

Fig. 1: a) Myelographic view of intervertebral disc hernia (the contrast agent had not moved caudally from C4-C5 space) and b) MRI view of intervertebral disc hernia

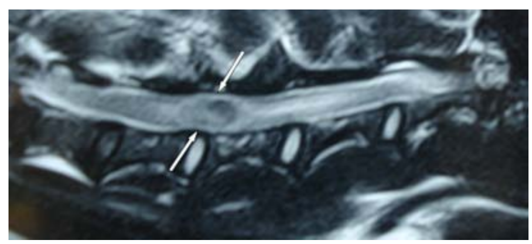

Fig. 2: Intramedullary mass

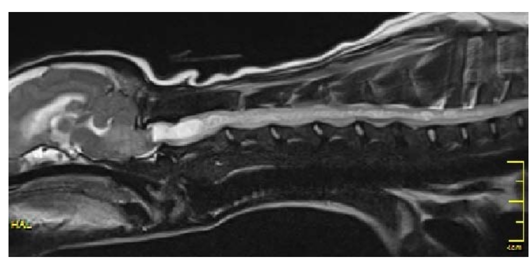

Fig. 3: Syringomyelia

RESULTS AND DISCUSSION

While present lesions were all located across the cervical intervertebral spaces, they were mostly localized in the C5-C7 intervertebral spaces. In the Magnetic Resonance Imaging of the cases, intervertebral disc hernia was diagnosed in 15 animals (Fig. 1a and b), a mass in 9 (Fig. 2), epidural abscess in 1, transverse myelitis in 1 and syringomyelia in 4 (Fig. 3). In the case diagnosed with syringomyelia, the syrinxes had spread to the entire cervical region. The masses diagnosed presented as intramedullary in 5 cases, intradural-extramedullary in 3 cases and extradural in 1 case. Detailed information of the cases is shown in Table 1. In diagnosing tumours of the nervous system, direct radiography, myelography, angiography, cavernous sinus venography, optic thecography, scintigraphy, electrophysiology,

Table 1: Breed, age, sex, localization and lesion information of the cases

Breeds	Age	Sex	Localization	Lesion
Terrier	5	F	C2-C5 space	Transverse myelitis
Mix breed	6	F	Cervical medulla spinalis	Syringomyelia (due to intracranial mass)
Boxer	7	M	C5-C6	Intramedullary mass
German shepherd	2	F	C6	Extradural mass
Rottweiler	9	M	C4-C5	Intradural-extramedullary mass
Rottweiler	7	M	C5-C6	Intervertebral disc hernia
Rottweiler	2	M	C5-C6	Intramedullary mass
Dauchand	8	M	C4-C5	Intervertebral disc hernia
Mix breed	9	M	C6-C7	Intervertebral disc hernia
Mix breed	7	M	C7-T1	Intervertebral disc hernia
Mix breed	5	F	C6-C7	Intramedullary mass
Mix breed	4	F	C3-C5	Intramedullary mass
Mix breed	8	M	C6-C7	Intradural-extramedullary mass
Mix breed	10	M	C3-C4	Intervertebral disc hernia
Mix breed	10	F	C1	Intramedullary mass
Mix breed	12	M	C6-C7	Intervertebral disc hernia
Terrier	7	M	C6-C7	Intervertebral disc hernia
French bulldog	6	M	C4-C5	Intervertebral disc hernia
Golden retriever	5	F	C6-C7	Intervertebral disc hernia
Terrier	6	F	C5-C6	Intervertebral disc hernia
Golden retriever	5	F	C4-C5	Intervertebral disc hernia
Terrier	6	F	C5-C6	Intervertebral disc hernia
Terrier	3	F	C5-C6	Epidural abscess
Mix breed	9	M	C5	Intradural-extramedullary mass
Cavalier King Charles Spaniel	1	M	Cervical medulla spinalis	Syringomyelia
French bulldog	4	M	Cervical medulla spinalis	Syringomyelia
Rottweiler	11	M	C3-C4	Intervertebral disc hernia
Bullmastiff	8	M	C5-C6	Intervertebral disc hernia
Terrier	8	M	Cervical medulla spinalis	Syringomyelia (due to intracranial mass)
French bulldog	5	M	C5-C6	Intervertebral disc hernia

cerebrospinal fluid analysis, computerized tomography, magnetic resonance imaging and biopsy is used (Bagley *et al*., 1993). Furthermore, it has been reported that definitive diagnosis and localization of the tumours can be determined using advanced imaging techniques such as Computerised Tomography (CT) and Magnetic Resonance Imaging (MRI) (Bagley and Gavin, 1998; Bagley *et al*., 2000). While there were no findings in the direct radiographs taken in this study, in the myelography images it was observed that the contrast agent had not moved caudally from the location of the mass. However, definitive diagnosis of the mass could not be achieved. MR images confirmed the localization of the lesion and the fact that the present lesion was a mass. Despite myelography confirming localization of the lesion, the fact that a definitive diagnosis of the lesion could not be made caused an uncertain approach to medical treatment and surgical intervention which in turn lead to uncertainty in determining the prognosis.

Spinal tumours are classified as extradural, intradural-extramedullary and intramedullary. Although, it has been reported that most spinal tumours in cats and dogs are extradural (Bagley *et al*., 1993; Kippenes *et al*., 1999; Drost *et al*., 1996), in the study only 1 case had an extradural mass. Myelography determined only the localization of the lesion whereas MRI identified whether these masses were intramedullary or extramedullary, presenting valuable information regarding prognosis.

Syringomyelia is the presence of fluid-filled abnormal cavities within the parenchyma of the spinal cord. These cavities are called syrinx (Bagley, 2005; De Lahunta and Glass, 2009; Taga *et al*., 2000; Rusbridge *et al*., 2006). Generally, syringomyelia cannot be seen in direct radiography and myelography due to the contrast agent entering the syrinx. If syringomyelia is presented together with scoliosis, vertebral deviation may be observed in direct spinal radiographs. In the examination of animals with central nervous system disease with the wider use of MR images, syringomyelia has become a relatively common disease of the spinal cord (Bagley, 2005). In myelography images of the case in the study, no lesion was determined in the cervical region. In MR images taken across the cranium and cervical region of the case, syringomyelia was identified in the cervical region. The fact that the lesion could not be detected in myelography images suggests this to be due to the contrast agent filling the syrinxes.

In MR images focusing on T2 while the syrinxes appear as hyperintense areas in comparison to the spinal cord, in T1-focused MR images these spaces appear as hypointense (Couturier *et al*., 2008; Kirberger *et al*., 1997). These spaces are more prominent in images focusing on T2 (Bagley, 2005). Parallel to literary data, hyperintense areas were encountered in the entire cervical region in T2-focused MR images and hypointense areas in

T1-focused images. However, more definitive diagnoses were made compared to T2-focused images. Neurological findings emerging as a result of the cervical spine being under pressure in relation to degenerative and congenital changes in the cervical spinal cord are called Wobbler Syndrome or cervical spondylomyelopathy. Hypertrophy or protrusion of the annulus fibrosus, hypertrophy of ligamentum flavum and the dorsal longitudinal ligament, synovial membrane hypertrophy, synovial cyst formation and degenerative changes on joint surfaces cause this syndrome (Da Costa *et al*., 2012; Decker *et al*., 2010; Lipsitz *et al*., 2001; Natasha, 2004; Penderis and Dennis, 2004; Ronald and Feeney, 2003). The Wobbler Syndrome observed in dogs in the study was seen to occur in relation to cervical disc protrusion.

Alongside the use of direct radiography and myelography techniques in the diagnosis of Wobbler Syndrome, CT or MRI is recommended for definitive diagnosis (Bahr, 2007; Burk and Feeney, 2003; Natasha, 2004).

In this study, no degenerative lesion was identified on direct radiographs taken due to disc protrusion leading to Wobbler Syndrome. Myelography images revealed localization of the lesion however, a definitive diagnosis could not be made. The final diagnosis was reached using MR images.

CONCLUSION

As a result while direct radiography and myelography are useful imaging techniques in determining the localization of any lesion in the cervical region, the MRI technique is the most suitable method for a definitive diagnosis to be reached in specific lesions.

REFERENCES

Bagley, R.S. and P.R. Gavin, 1998. Seizures as a complication of brain tumors in dogs. Clin. Tech. Small Anim. Pract., 13: 179-184.

Bagley, R.S., 2005. Fundamentals of Veterinary Clinical Neurology. 1st Edn., Blackwell Publication, USA.

Bagley, R.S., G.M. Silver and P.R. Gavin, 2000. Cerebellar cystic meningioma in a dog. J. Am. Anim. Hosp. Assoc., 36: 413-415.

Bagley,R.S., J.N. Kornegay, R.L. Page and D.E. Throll, 1993. Central Nervous System. In: Textbook of Small Animal Surgery, Slatter, D. (Ed.). Saunders Publication, USA., pp: 2137-2165.

Bahr, A., 2007. The Vertebrae. In: Textbook of Veterinary Diagnostic Radiology, Thrall, D.E. (Ed.). 5th Edn., Saunders Elsevier, USA., pp: 179-193.

Burk, R.L. and D.A. Feeney, 2003. Small Animal Radiology and Ultrasonography: A Diagnostic Atlas and Text. 3rd Edn., Saunders Publication, Philadelphia, USA., ISBN: 0721681778, Pages: 784.

Couturier, J., D. Rault and L. Cauzinille, 2008. Chiari-like malformation and syringomyelia in normal cavalier King Charles spaniels: A multiple diagnostic imaging approach. J. Small Anim. Pract., 49: 438-443.

Da Costa, R.C., R.L. Echandi and D. Beauchamp, 2012. Computed tomography myelographic findings in dogs with cervical spondylomyelopathy. Vet. Radiol. Ultrasound, 53: 64-70.

De Lahunta, A. and E. Glass, 2009. Veterinary Neuroanatomy and Clinical Neurology. 3th Edn., Saunders Publication, USA.

Decker, S., J. Caemaert, M.C. Tshamala, I.M.V.L. Gielen and H.J.J. van Bree *et al*., 2010. Surgical treatment of disk-associated Wobbler Syndrome by a distractable vertebral titanium cage in seven dogs. Vet. Surgery, 40: 544-554.

Dennis, R., 1987. Radiographic examination of the canine spine. Vet. Record, 121: 31-35.

Drost, W.T., N.E. Love and C.R. Berry, 1996. Comparison of radiography, myelography and computed tomography for the evaluation of canine vertebral and spinal cord tumors in sixteen dogs. Vet. Radiol. Ultrasound, 37: 28-33.

Gopal, M.S. and N.D. Jeffery, 2001. Magnetic resonance imaging in the diagnosis and treatment of a canine spinal cord injury. J. Small Anim. Pract., 42: 29-31.

Kippenes, H., P.R. Gavin, R.S. Bagley, G.M. Silver, R.L. Tucker and R.D. Sande, 1999. Magnetic resonance imaging features of tumors of the spine and spinal cord in dogs. Vet. Radiol. Ultrasound, 40: 627-633.

Kirberger, R.M., L.S. Jacobson, J.V. Davies and J. Engela, 1997. Hydromyelia in the dog. Vet. Radiol. Ultrasound, 38: 30-38.

Levitski, R.E., D. Lipsitz and A.E. Chauvet, 1999. Magnetic resonance imaging of the cervical spine in 27 Dogs. Vet. Radiol. Ultrasound, 40: 332-341.

Lipsitz, D., R.E. Levitski, A.E. Chauvet and W.L. Berry, 2001. Magnetic resonance imaging features of cervical stenotic myelopathy in 21 dogs. Vet. Radiol. Ultrasound, 42: 20-27.

Natasha, J.O., 2004. Tetraparesis. In: Bsava Manual of Canine and Feline Neurology, Platt, S.R. and N.J. Olby (Eds.). 3th Edn., BSAVA, India, pp: 214-236.

Penderis, J. and R. Dennis, 2004. Use of traction during magnetic resonance imaging of caudal cervical spondylomyelopathy ("Wobbler Syndrome") in the dog. Vet. Radiol. Ultrasound, 45: 216-219.

Penning, V., S.R. Platt, R. Dennis, R. Cappello and V. Adams, 2006. Association of spinal cord compression seen on magnetic resonance imaging with clinical outcome in 67 dogs with thoracolumbar intervertebral disc extrusion. J. Small Anim. Pract., 47: 644-650.

Rusbridge, C., D. Greitz and B.J. Iskandar, 2006. Syringomyelia: Current concepts in pathogenesis, diagnosis and treatment. J. Vet. Intern. Med., 20: 469-479.

Seiler, G., H. Hani, J. Scheidegger, A. Busato and J. Lang, 2003. Staging of lumbar intervertebral disc degeneration in nonchondrodystrophic dogs using low-field magnetic resonance imaging. Vet. Radiol. Ultrasound, 44: 179-184.

Taga, A., Y. Taura, M. Nakaichi, N. Wada and T. Hasegawa, 2000. Magnetic resonance imaging of syringomyelia in five dogs. J. Small Anim. Pract., 41: 362-365.