

Magnetic resonance imaging findings of a metastatic chemodectoma in a dog

S H Naudé^{a*} and D B Miller^b

ABSTRACT

A 6-year-old, male, Collie-cross was presented with a non-weight bearing right thoracic limb lameness, right *m.deltoideus*, *m.infraspinatus* and *m.supraspinatus* atrophy, and severe neck pain with spasm of the cervical epaxial muscles. MRI revealed complete destruction of the 5th and 6th cervical vertebral bodies with lateral extradural spinal cord compression at the level of the 4th and 5th cervical vertebrae. These lesions were very clearly demonstrated on magnetic resonance images, while only subtle changes were seen on survey radiographs. *Post mortem* investigation revealed a large heart base chemodectoma with multiple smaller tumours in the cranial mediastinum and a single tumour nodule on the thoracic aorta. The 5th cervical vertebral body had necrotic, haemorrhagic and lytic changes. Histopathology of the heart base tumour, the nodules in the cranial mediastinum and on the thoracic aorta and samples from the 5th cervical vertebra confirmed the presence of a malignant aortic or carotid body tumour originating from the chemoreceptor organs. Diagnostic imaging features and *post mortem* findings are described. To our knowledge, this is the first report of the magnetic resonance features of a metastatic chemodectoma in a dog.

Key words: cervical spine, MRI, metastatic chemodectoma, neck pain, thoracic limb lameness.

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INTRODUCTION

The carotid and aortic bodies consist of groups of chemoreceptor cells situated in the adventitia of the carotid bifurcation and aortic arch respectively^{2,11}. These bodies are of neuro-ectodermal origin and alter respiratory rate and blood pressure after detecting changes in arterial blood oxygen, carbon dioxide and pH^{7,9}. Neoplasms of the chemoreceptor organ system include aortic body tumours as well as carotid body tumours¹² and both have been reported in dogs and cats¹³. Both these tumours are also known as chemodectomas. Aortic body tumours are four times more prevalent than carotid body tumours⁹. Carotid body tumours are found in the cervical soft tissue at the bifurcation of the common carotid artery into the internal and external carotid arteries⁷. Chemodectomas are usually non-functional and generally cause symptoms by exerting a space-occupying

mass effect on surrounding structures and by local invasion⁵. It has been reported that 12–22% will metastasise with the lungs most commonly affected, but metastasis to the lung⁶, liver, myocardium, lymph nodes, brain, adrenals, kidney¹³, spleen, cerebellar dura mater, spinal cord, bone and pancreas^{1,3,8,10,15,16} has also been described. It has also been reported that 49 % of chemoreceptor tumours occur concurrently with other endocrine tumours, with testicular tumours being most prevalent⁴. Other tumours that have been described in conjunction with chemodectomas originate from the adrenal medulla, pituitary and parathyroid glands^{13,14}.

This report describes a malignant chemodectoma (presumed aortic body tumour) of the heart base with metastasis to two adjacent cervical vertebrae. As reported by Callanan and others in 1991², only mild radiographic evidence of bone lysis was seen on survey radiographs of the spine, but the abnormalities were both clearly visible and severe on MR investigation.

CASE HISTORY

A 6-year-old male Collie-cross was examined for a progressive right thoracic

limb lameness of three weeks' duration. Orthopaedic examination revealed severe pain on manipulation of the neck and right shoulder joint. The dog had marked muscle spasm of the cervical epaxial muscles, characterised by guarding of the neck on attempted manipulation, and atrophy of the right shoulder muscles including the *m.deltoideus*, *m.infraspinatus* and *m.supraspinatus*. Normal conscious proprioception was observed in all limbs except the right front, which the dog refused to place on the ground. The pain and anxiety the patient experienced made a proper neurological examination extremely difficult and the interpretation of limb reflexes was considered inconclusive. The differential diagnoses included scapulo-humeral osseous pathology, pathology of the cervical spinal cord or brachial plexus, and infectious or neoplastic disease of the soft tissue structures surrounding the shoulder region. The dog had normal temperature, pulse and respiration and no heart murmur was auscultated. The first diagnostic step after history-taking and clinical examination was a survey radiographic examination of the shoulder region and caudal cervical spine.

Radiographs

Survey radiographs (lateral and ventro-dorsal views) of the cervical and cranial thoracic spine showed no evidence of osteolysis or intervertebral disc space narrowing or vertebral deformity. The lateral radiographic view of the caudal cervical and cranial thoracic vertebrae revealed a cranial thoracic mass causing elevation of the trachea (Fig. 1). At the level of C5, the ventral floor of the vertebral canal was incomplete with large depressions in the vertebral bone and very thin bone (2 × 2 mm) forming the ventral line of the vertebral canal floor (Fig. 2). This image was unfortunately slightly rotated and this can cause reduced visibility of the ventral floor line of the vertebral canal.

Magnetic resonance imaging

On the owner's insistence an MRI study of the lower neck region was performed in order to reach a diagnosis for the limb pain. Further investigation of the lameness

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was performed by means of a magnetic resonance study in an attempt to correlate the severe symptoms seen in the thoracic limb with the finding of a cranial thoracic mass. The sequences performed included T1-weighted, T2-weighted and inversion recovery (STIR) in the sagittal plane, gradient echo in the transverse plane, as well as post gadolinium – DTPA (Magnevist, Schering, Midrand, South Africa) contrast enhanced T1 sagittal images. The MRI unit used to perform this investigation was a 1,5 tesla Philips® Gyroscan Intera (Wilgeheuwel Hospital, Johannesburg, South Africa).

T1 sagittal

A lesion was evident originating from the dorsal aspect of the vertebral bodies of the 4th and 5th cervical vertebrae (C4 and C5). The lesion was situated on the right lateral aspect of the spinal cord and was hyperintense compared with spinal cord and bone. Infiltration of the entire 5th cervical vertebral body and the dorsal margin of the 4th cervical vertebra with extension of the lesion dorsally to the level of the dorsal lamina of C4 and C5 was present. A second lesion that appeared iso-intense to the pathology seen at C4 and C5 infiltrated the 6th cervical vertebral body and extended ventrally past the ventral margin of the body of the 6th cervical vertebra. The two lesions appeared hypointense to the subcutaneous fat layer and the intermuscular fat (Fig. 3).

T2 sagittal

The lesions seen on the T1-weighted images were also seen on the T2-weighted sequence but appeared more hyperintense to bone and only slightly hyperintense to the spinal cord. The lesions were hypointense to the cerebrospinal fluid (CSF) and appeared more infiltrative and not as well defined as seen on the T1-weighted sequence. Similar dorsal extension at C4 and C5 and ventral extension at C6 were noted. The cranial lesion was also located on the right lateral aspect of the spinal cord (Fig. 4).

STIR sagittal

On this sequence the lesions were hyperintense to all surrounding tissue, including CSF, and even less well defined than seen on the T2-weighted sequence.

T1-weighted post gadolinium-DTPA sagittal

Both lesions enhanced uniformly on T1-weighted sequences after intravenous administration of gadolinium-DTPA (Magnevist, Schering, Midrand, South Africa) at a dosage of 1 ml/5 kg. This

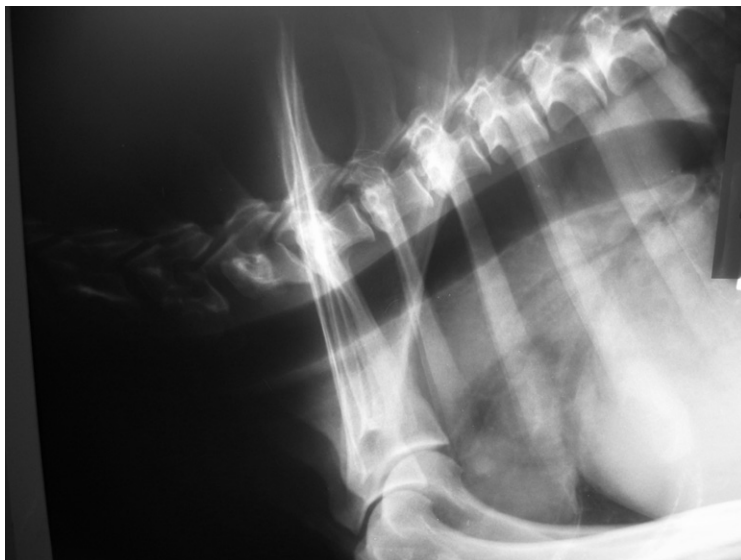


Fig. 1: Lateral radiographic view of caudal cervical and cranial thoracic region. Note elevated trachea.



Fig. 2: Lateral radiographic view of cervical vertebrae C4–6. Note mild loss of thin radiodense line of floor from vertebral canal of C5.

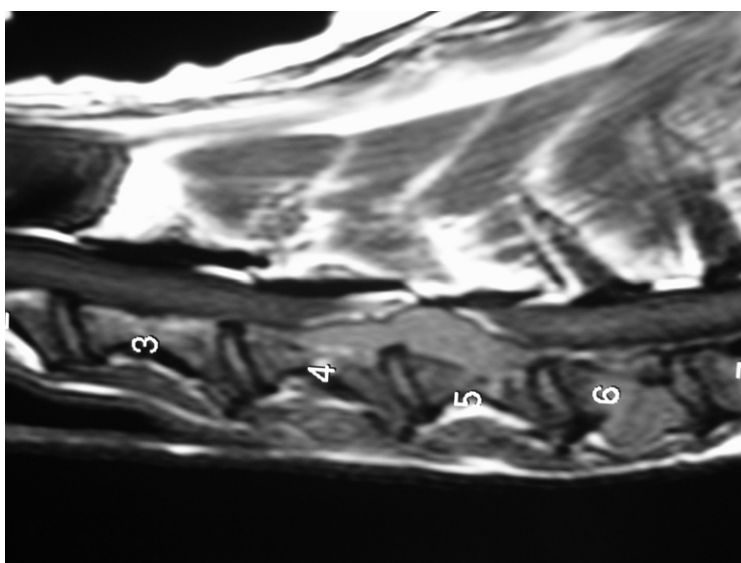


Fig. 3: Pre-contrast T1-weighted sagittal sequence of caudal cervical spine.

demonstrated the vascularity of these lesions and suggested the possibility of neoplastic involvement. The lesions were hyperintense to the pathology seen on T1-weighted pre-contrast images, with the same location and demarcation noted. On this sequence the lesion was also present ventral to the spinal cord with dorsal displacement of the cord at the level of C6. Most of the vertebral bodies of C5 and C6 are infiltrated by these lesions. (Fig. 5).

Gradient echo transverse

At the level of C4 and C5 the lesion appears distinctly mass-like causing displacement of the spinal cord dorsally and to the left in the vertebral canal. The lesion is hyperintense to the spinal cord and hypointense to the fluid surrounding the spinal cord. The mass is situated on the right ventro-lateral aspect of the spinal cord and extends through the neuroforamen (Fig. 6). Marked compression of the spinal cord is noted in some images and seen as loss of the hyperintense surrounding fluid layer (Fig. 7).

At the level of C6 the mass lesion could be seen extending ventrally to the vertebral body. Mild ventral and slightly to the left side some attenuation was noted of the fluid surrounding the spinal cord. The lesion extends dorsally in 2 lobes with the left side more prominent.

POST MORTEM EXAMINATION

Owing to the poor prognosis and the extreme pain the dog was experiencing, euthanasia was performed. A full *post mortem* examination was conducted. The evaluation revealed a large heart base tumour with a diameter of 180 mm, multifocal tumours in the cranial mediastinum (15–40 mm in diameter) and a single tumour (50 mm in diameter) adjacent to the thoracic aorta. Moderate dilation of both cardiac ventricles with infiltration of the large heart base tumour into the right atrial wall and moderate hepatic congestion were also seen. All lymph nodes, adrenal glands and thyroid glands were normal. Examination of the neck showed necrotic, haemorrhagic and lytic changes of the vertebral body of C5 and a large dorsal extension of the pathology from the vertebral floor causing compression of the spinal cord. Aerobic bacterial culture of a sample from C5 was performed to investigate the possibility of osteomyelitis being present primarily or secondarily. This proved to be negative for bacterial growth.

HISTOPATHOLOGY

Sections of the tumour-like masses in the cranial mediastinum and from the

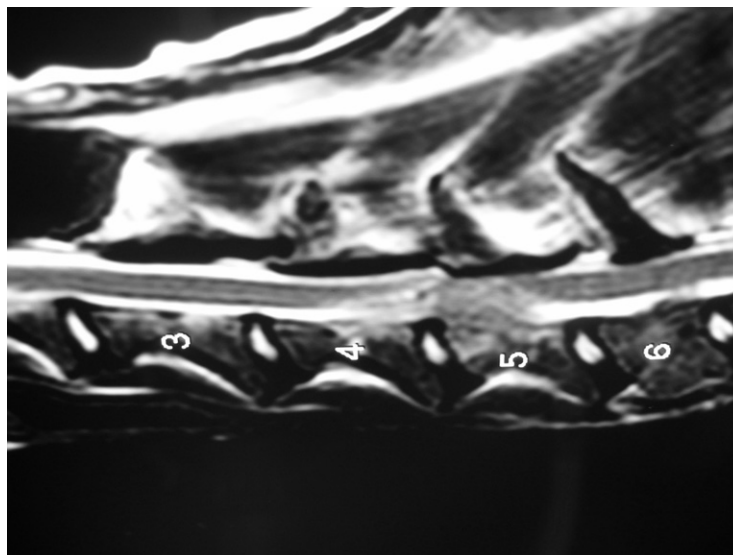


Fig. 4: T2-weighted sagittal sequence of caudal cervical spine.

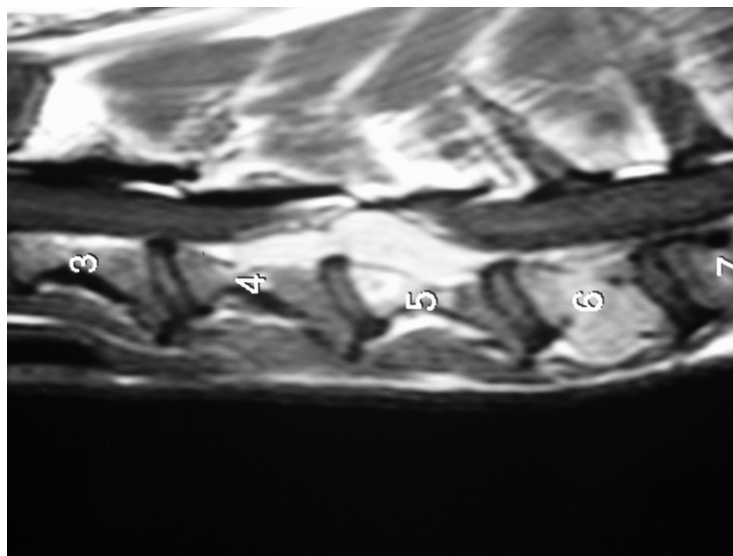


Fig. 5: Post-contrast (gadolinium DTPA) T1-weighted sagittal sequence of caudal cervical spine.

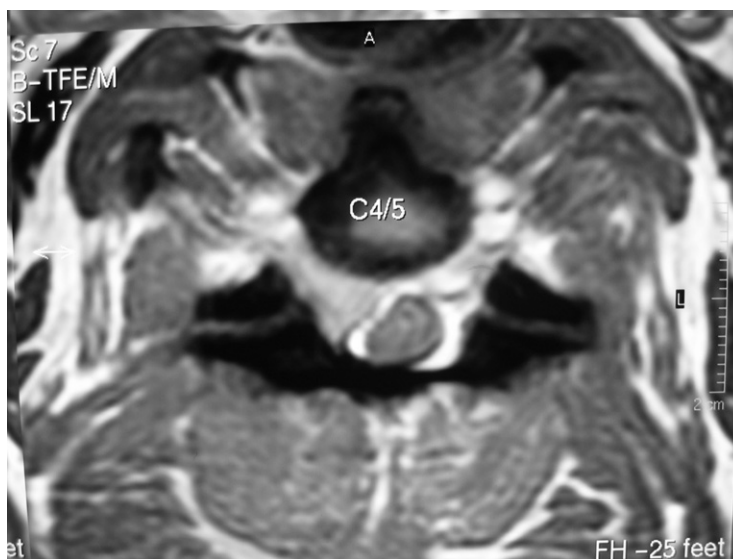


Fig. 6: Gradient echo transverse sequence of C4/5 region. Note direct spinal cord compression.

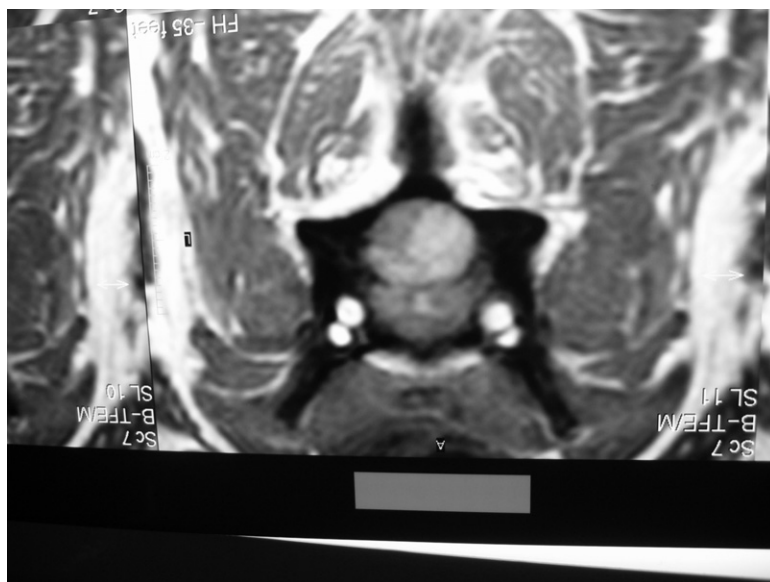


Fig. 7: Gradient echo transverse sequence of C4/5 region demonstrating severe spinal cord compression.

large heart base mass as well as the single mass along the thoracic aorta were examined.

Each specimen was identified to originate from the chemoreceptor organs situated at the base of the heart and along the aorta and all were diagnosed as malignant chemodectomas. The neoplastic cells revealed pleomorphism with prominent anisokaryosis. This could be seen where large megalocytic cells were observed among the small chemoreceptor neoplastic infiltrates. Sections of the 5th cervical vertebra, after decalcification confirmed metastatic spread of the malignant chemodectoma to the vertebral body causing secondary bone atrophy and necrosis. Haemorrhage was noted within the vertebral tumour. Mild oedema and status spongiosis of the spinal white matter was observed but there was no neoplastic infiltration into the spinal cord. The spinal nerve roots appeared unaffected. Sections were not made of the 6th cervical vertebra. Electron microscopy and immunohistochemistry were not performed on any of the samples. This could have distinguished between aortic body tumours, carotid body tumours and ectopic thyroid tumours.

DISCUSSION

The case described here is the first report to our knowledge of the MRI appearance of a metastatic chemodectoma with vertebral involvement. The clinical presentation of the patient was suggestive of a lateralised spinal cord lesion of the cervical spinal cord or a peripheral neuropathy. Survey radiographs revealed mild or no bony changes with no definitive diagnosis. The incidental discovery of a cranial mediastinal mass

was not investigated further before the cervical spine was imaged in more detail. This could have been approached in a different sequence with ultrasonography of the cranial thoracic cavity and fine-needle aspirates to possibly obtain a morphological diagnosis. The authors decided to proceed with a MR investigation of the patient's neck because the dog presented with severe pain and front limb lameness and the owner could not be convinced that a fine-needle aspirate of the mediastinal mass was not life threatening. Retrospectively the correct order of procedures would have been to fully investigate the thorax including all the necessary radiographic projections, followed by ultrasonography and fine-needle aspirates and possibly computed tomography. The decision to perform a MRI study and not a myelographic examination was made to prevent having to conduct a MRI after the myelogram in the event that the myelogram was inconclusive and the owner was concerned about the invasiveness of a myelographic study. The advantage of the MRI is also the ability to properly evaluate the soft tissues surrounding the right shoulder region and brachial plexus if necessary.

This case clearly demonstrates the remarkable difference in sensitivity of MRI as compared to conventional radiography to determine bone pathology. Subtle changes like the loss of the thin radiodense line of the floor of the vertebral canal is one of the first features depicted on radiographs of the pathological involvement of bone and appeared to indicate a mild bone lesion, while the MRI showed severe changes to the specific structures and also characterised the lesion as highly vascular, infiltrative and

clearly demarcated the lesion's margins.

Owing to the obvious difference in the sensitivity of MRI compared with radiographs, it is the authors' opinion that in cases of neurological deficit or severe pain suspected to originate from the vertebral column, where survey radiographs are negative for pathology, a diagnosis of discogenic disease cannot be assumed as it is possible that a lytic bone lesion was not detected, as described in this case. We do not feel that MRI should eclipse a thorough history, clinical examination or survey radiographs, but owing to these findings, it is the authors' recommendation that all cases of severe neurological deficit or muscle wasting or non-resolvable pain should be followed up with a MRI study if survey radiographs (with or without a myelogram) are negative.

The ability of MRI to accurately differentiate tissue density and structure, and the fact that sequences can be manipulated to enhance or suppress certain tissue types, provide us with a very versatile alternative imaging modality.

The MRI study revealed the underlying cause of the problem accurately, and prolonged suffering of the patient was avoided.

We conclude that this imaging modality was safe and reliable in determining the suspected diagnosis in the described clinical report.

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