NEOPLASTIC DISEASE

Short Title: Vertebral Body Chordoma in a Cat

Cervical Vertebral Body Chordoma in a Cat

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Summary

A 9-year-old, neutered female Maine Coon cat with a 6-week history of progressive ataxia was diagnosed with a cervical vertebral body mass using magnetic resonance imaging. The mass displaced and compressed the cervical spinal cord. The cat was humanely destroyed and necropsy examination confirmed a mass within the second cervical vertebral body. Microscopically, the mass was composed of large, clear, vacuolated ('physaliferous') cells. Immunohistochemically, the neoplastic cells expressed both cytokeratin and vimentin and the final diagnosis was a cervical, vertebral body chordoma. This is only the third report of a chordoma in this species and the first in this location. Chordoma should be considered as a potential differential diagnosis for tumours arising from the cervical vertebra in the cat.

Keywords: cat; chordoma; vertebral body

Chordoma is a tumour believed to be of notochord origin, which is uncommon in human patients and rarely reported in domestic animals (Koestner *et al.,* 1999; Koestner and Higgins, 2002). Chordomas are typically slow growing and locally destructive tumours, most commonly arising in the sacrococcygeal region (Koestner and Higgins, 2002). These tumours are characterized histologically by the presence of large, clear, vacuolated ('physaliferous') cells, which are immunohistochemically positive for both epithelial and mesenchymal cell markers (Dunn *et al.*, 1991). Only a few cases have been described in dogs (Munday *et al.*, 2003; Gruber *et al.*, 2008; Woo *et al.*, 2008) with larger numbers reported in rats (Stefanski *et al.,* 1988) and ferrets, with the typical location being the distal tip of the tail in this species (Dunn *et al.,* 1991). To the authors' knowledge, there are only two reports of chordoma in the cat; the first being an intramuscular mass on the left side of

the neck (Carpenter *et al.*, 1990), presumed to have arisen from ectopic notochord tissue, and the second affecting the last coccygeal vertebra (Carminato *et al.*, 2008).

A 9-year-old, neutered female Maine Coon cat was presented to the Neurology and Neurosurgery Service, Queen Mother Hospital for Animals, Royal Veterinary College, London, for further investigation of a 6-week history of progressive ataxia. The cat had temporarily gone missing 8 weeks prior to presentation, and following its return was treated by the referring veterinary surgeon for bilateral otitis externa with a topical antibiotic and corticosteroid preparation. The clinical signs of otitis externa resolved; however, the cat was noted to develop progressive ataxia, intermittent inappetence and weight loss. On presentation, the cat was obtunded with vestibular ataxia and wide, side-to-side, head movements. The cat had a poor body condition score, holosystolic heart murmur and obstipation, having not passed faeces for more than 2 weeks.

Magnetic resonance imaging (MRI) of the cervical spine revealed a lobulated mass within the second cervical vertebral body, measuring 1.2 × 1.6 × 1.9 cm. The lesion was hyperintense on T2-weighted sequences, isointense on T1-weighted images and demonstrated homogeneous contrast enhancement. The spinal cord was displaced dorsally with evidence of marked spinal cord compression (Fig. 1). Evidence of moderate dilation of the ventricular system and T2-weighted hyperintense material filling the right tympanic cavity was also found. Based on the appearance of the mass arising within the second cervical vertebral body, a neoplasm was considered most likely, with spinal lymphoma and meningioma having been previously reported in cats (Bradshaw *et al.*, 2004). In addition, a solid tumour of mesenchymal origin, such as chondrosarcoma or osteosarcoma, was also considered. The cat was humanely destroyed and a full necropsy examination was performed within 14 h of death.

On transverse sectioning of the second cervical vertebral body, an expansile, friable mass with a cream–white cut surface was visible arising from the vertebral body and extending into the spinal canal, compressing and dorsally displacing the spinal cord (Fig. 2). The urinary bladder was markedly distended with urine and the colon was markedly distended with firm, brown faecal material. The urethra was patent and there was no physical cause of faecal obstruction identified following examination of the rectum. Examination and dissection of the brain, following fixation in 10% neutral buffered formalin, confirmed moderate dilation of the lateral ventricles.

Following fixation, a cross section of the mass within the vertebral body together with the associated spinal cord, underwent decalcification and was processed routinely and embedded in paraffin wax. Sections (4µm) were stained with haematoxylin and eosin (HE). Microscopically, expanding the medullary cavity of the vertebral body and replacing haemopoietic tissue, was a non-encapsulated, relatively well-demarcated, multilobular neoplasm, which extended to and disrupted the ventral border of the spinal canal. Bony trabeculae exhibited mild scalloping (bone remodelling). The neoplasm was composed of a dense population of large, mild to moderately pleomorphic, clear cells which contained variably large vacuoles which occasionally displaced the nucleus ('physaliferous cells') (Fig. 3). Small, pale, eosinophilic, cytoplasmic granules were present within many of the cells. The cells occasionally formed streams and were surrounded by a moderate amount of extracellular pale blue mucinous material. There was mild to moderate anisokaryosis with round to oval nuclei, which often contained prominent nucleoli and vesicular chromatin. Mitotic figures were not observed.

Immunohistochemistry (IHC) was performed on serial sections using a BondMax^{TM} Autostainer and the Bond Polymer Refine Detection System^{TM} (Leica Biosystems, Newcastle-upon-Tyne, UK). Primary antisera were specific for cytokeratins AE1–AE3

(monoclonal mouse anti-human, clone AE1 – AE3; Dako, Ely, UK; 1 in 100 dilution; antigen retrieval in citrate buffer pH 6.0 for 30 min) and vimentin (monoclonal mouse anti-vimentin, clone V9; Dako; 1 in 500 dilution; antigen retrieval in citrate buffer pH 6.0 for 10 min). Immunohistochemically, the neoplastic cells exhibited strong, cytoplasmic expression of both cytokeratin and vimentin (Supplementary Figs. 1, 2). Negative and positive controls were processed with the evaluated slides and were stained appropriately.

The tumour identified in the cervical vertebral body of this cat had histological features consistent with a chordoma (Koestner and Higgins, 2002) and immunohistochemical expression of both epithelial and mesenchymal cell markers confirmed the diagnosis. Other differentials, based on the histopathological appearance of the tumour, were liposarcoma or chondrosarcoma. Both of these neoplasms, however, would have been negative for cytokeratin expression and typically would also be expected to exhibit additional cellular features of malignancy, such as cellular pleomorphism and mitotic figures. In the absence of any physical obstruction, either within the urethra or the rectum, a functional neurogenic abnormality, as a result of spinal cord compression by the mass, was considered the most likely cause of urinary and faecal retention.

This is only the third report of a chordoma in the cat and the first in this location. This suggests that chordomas may arise from residual notochord remnants within cervical vertebrae in addition to the presumed, ectopic, notochord tissue (Carpenter *et al.*, 1990) and remnants within the sacrococcygeal region (Carminato *et al.*, 2008). In the first reported case of chordoma in the cat, which was present intramuscularly in the neck with reported metastases to multiple lymph nodes, the cat was humanely destroyed due to detection of a biliary cystadenoma 10 months after identification of the chordoma (Carpenter *et al.*, 1990). In the second report of a chordoma, arising in the coccygeal region in the cat, surgical excision appeared curative with no recurrence or metastatic disease identified 7 months after

surgery (Carminato *et al.*, 2008). Despite there being no evidence of metastatic disease in the present case, the limited surgical accessibility and severe neurological clinical signs, due to local compression of the spinal cord, resulted in a poor prognosis in comparison with the previously reported feline cases. Although this continues to be a rarely reported tumour in domestic species, chordoma should be considered as a potential differential diagnosis for tumours arising from the cervical vertebral body in the cat.

Conflict of Interest Statement

The authors declare no conflicts of interest with respect to publication of this case report.

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Figure Legends

Fig. 1. Midline, sagittal, T1-weighted, pre-contrast magnetic resonance image of the cervical spine. The second cervical vertebral body mass, highlighted with an arrow, dorsally displaces the spinal cord and causes marked spinal cord compression. Cr, cranial; Cd, caudal.

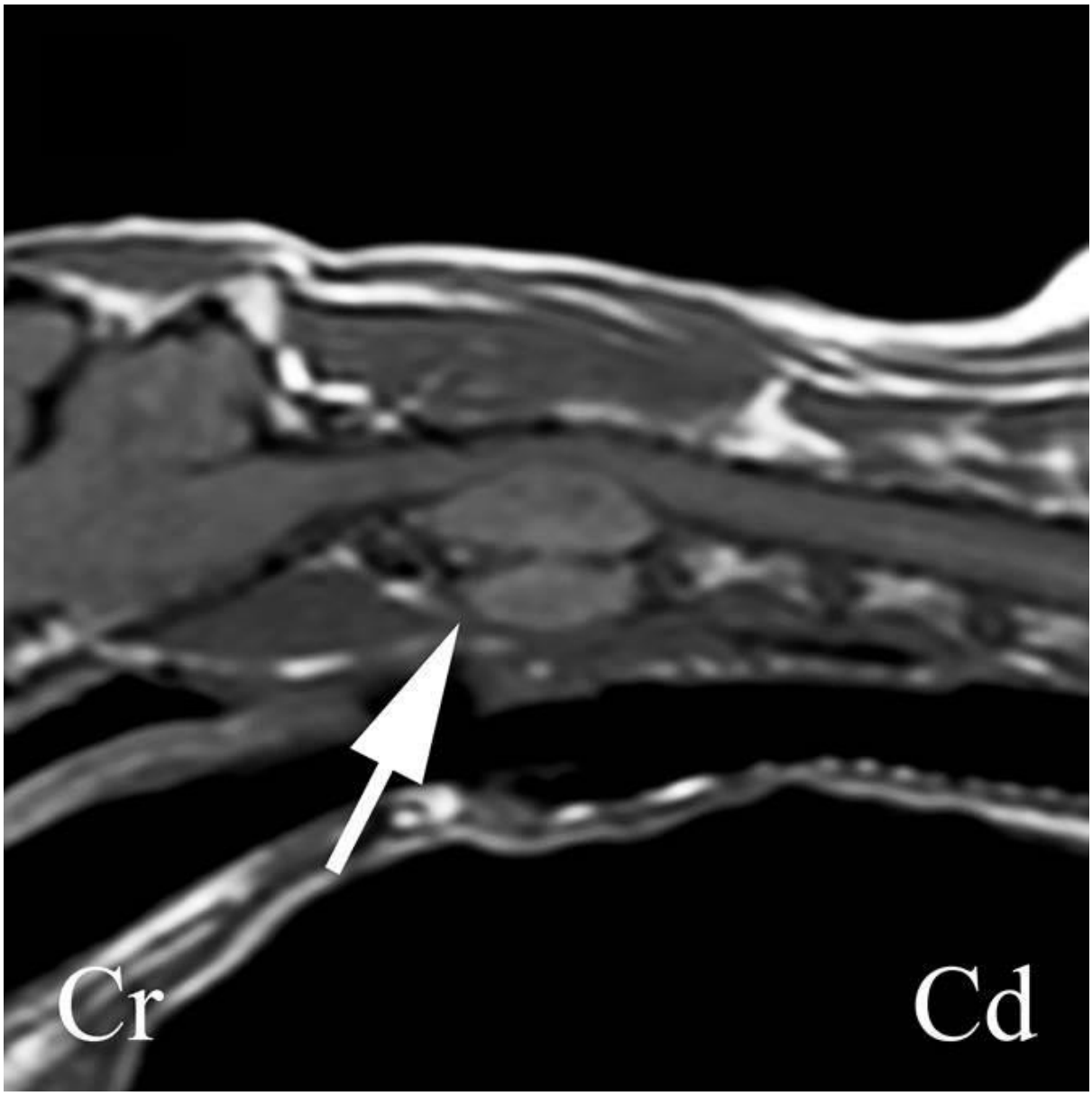


Fig. 2. The mass arises from the second cervical vertebral body and extends into the spinal canal, compressing and dorsally displacing the spinal cord. Bar, 1cm.

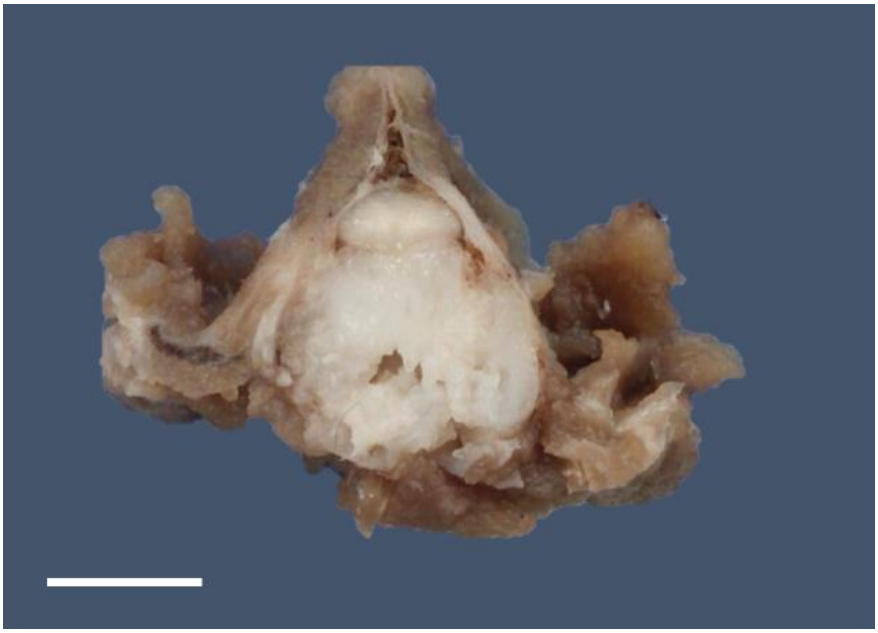
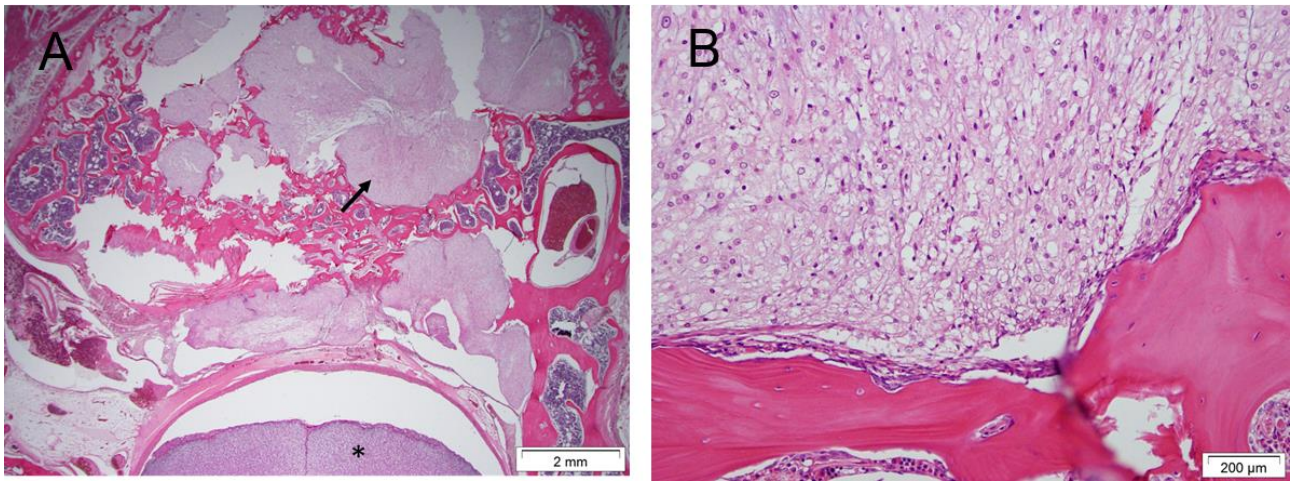


Fig. 3. (A) Lobules of neoplastic cells (arrow) expand the medullary cavity of the second cervical vertebral body, displacing the spinal cord (asterisk). HE. (B) The neoplasm is composed of large, mild to moderately pleomorphic, vacuolated (‘physaliferous’) cells. HE.



Supplementary Figures

Fig. 1. Neoplastic cells exhibit strong cytoplasmic expression of cytokeratin. IHC.

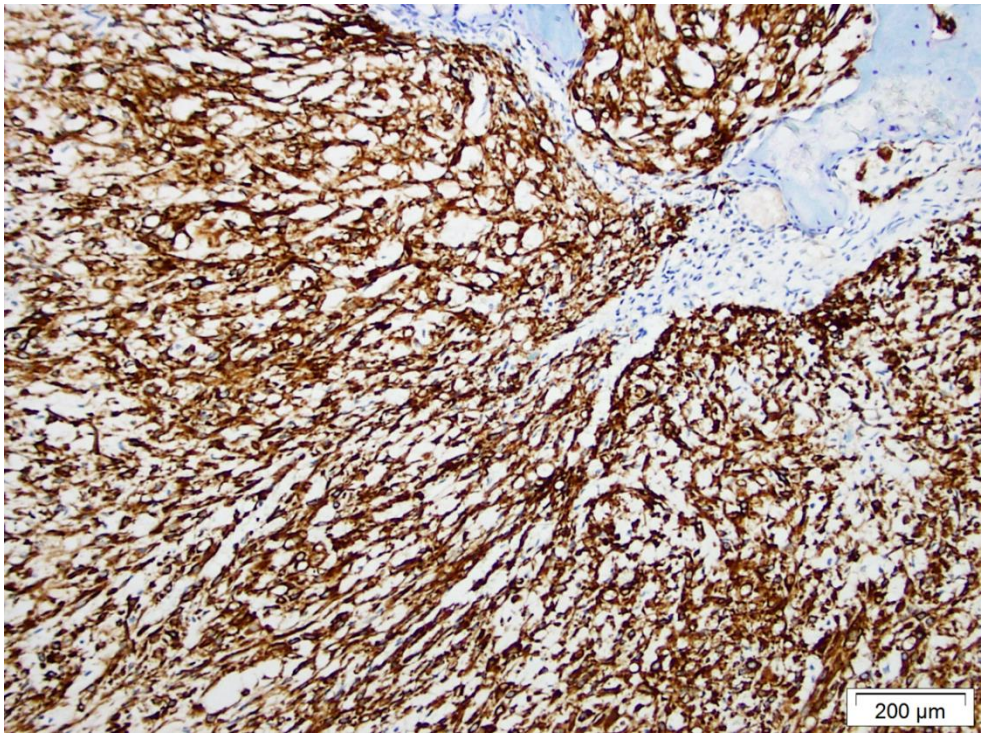


Fig. 2. Neoplastic cells exhibit strong cytoplasmic expression of vimentin. IHC.