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1 IMAGING DIAGNOSIS – IMAGING AND HISTOPATHOLOGIC

2 CHARACTERISTICS OF A VERTEBRAL HAMARTOMA IN A CAT

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- 11 Key Words: cat, hamartoma, paraparesis, spinal disease
- 12 Running head: Vertebral hamartoma in a cat

13 Abstract

14 A 9-month-old domestic shorthair cat had progressive ambulatory paraparesis, proprioceptive

15 ataxia, and thoracolumbar hyperesthesia. An extradural mass lesion affecting the left pedicle and

- 16 lamina of the second lumbar vertebra (L2) causing marked spinal cord impingement was
- 17 identified in magnetic resonance (MR) images. The mass was predominantly calcified in
- 18 computed tomographic images. A hemilaminectomy was performed to resect the mass. Clinical
- 19 signs were greatly improved at 6-month follow-up. The histopathologic diagnosis was vascular
- 20 hamartoma. To our knowledge, this is the first report describing the MR characteristics of a
- 21 vascular hamartoma associated with the vertebral column.

22 Signalment, history, and clinical findings

23 A 9-month-old male neutered domestic short hair cat had progressive pelvic limb proprioceptive 24 ataxia, ambulatory paraparesis and thoracolumbar hyperesthesia. The cat had an 8-week history 25 of vocalization, aggression on handling, and signs of pain on palpation of the abdomen and 26 thoracolumbar spine. No other clinical signs were reported prior to referral. Treatment with 27 meloxicam initially improved the clinical signs, but 4 weeks prior to referral the cat developed 28 progressive proprioceptive ataxia and paresis of the pelvic limbs. 29 When referred, the cat had normal vital signs. The cat had ambulatory paraparesis with marked 30 proprioceptive ataxia in the pelvic limbs and repeatable signs of thoracolumbar hyperesthesia on 31 direct palpation. There was voluntary urinary and fecal continence. The cat's demeanor 32 prevented full physical and neurological examination, including assessment of pelvic limb spinal 33 reflexes. The tentative neuroanatomical localization was T3-S3. Hematology, serum 34 biochemistry and urinalysis were within normal ranges. 35

36 Imaging, diagnosis and outcome

The cat was anesthetized in dorsal recumbency for MR imaging of the thoracolumbar vertebral
column using a 1.5 Tesla scanner (Intera, Philips Medical Systems, Surrey, UK) and a spinal
coil. Transverse and sagittal T1-weighted (TR 400–500 ms, TE 8 ms) and T2-weighted (TR
3000–3144 ms, TE 120 ms) images were acquired with slice thickness 1.8–2.5 and 0.25mm
interspace. T1-weighted images were acquired before and immediately after manual intravenous
injection of gadolinium-containing contrast medium (0.1 ml/kg gadoterate meglumine, Dotarem,
Guerbet, Milton Keynes, UK). A solitary focal, extradural mass was identified continuous with

44 the left pedicle and lamina of the L2 vertebra, extending into the vertebral canal and causing 45 marked spinal cord impingement (Fig. 1). When compared to normal spinal cord parenchyma the 46 periphery of the lesion was predominantly isointense to hyperintense on T2-weighted images and 47 hypointense on T1-weighted images. The center of the lesion was more heterogeneous in 48 appearance and appeared hypointense compared to normal spinal cord parenchyma on T2- and 49 T1-weighted images. At the interface between the lesion and the spinal cord at the cranial and 50 caudal aspects there is a well-demarcated area of tissue that is T2-weighted hyperintense and T1-51 weighted iso-hyperintense compared to normal spinal cord parenchyma. Postcontrast images 52 revealed moderate, homogenous contrast enhancement of the central zone of the mass and 53 marked contrast enhancement along its interface with the vertebral canal. The spinal cord was 54 markedly displaced to the right and flattened by the mass. No other spinal lesions were observed. 55 In order to further characterize the lesion, a CT scan was performed of the entire vertebral 56 column, thorax, and abdomen using a 16-slice helical scanner (MX 8000 IDT, Philips Medical 57 Systems). Images were obtained using helical acquisition, 120 kVp, 140 mAs, and 2.0 mm slice 58 thickness. The mass lesion associated with the left pedicle and lamina of the L2 vertebra was 59 densely calcified (mean 1130 HU) with an irregular inner border, and occupied the vertebral 60 canal without any increase in the outer dimensions of the vertebrae (Fig. 2). No other lesions 61 were observed. 62 Based on its imaging features and the clinical presentation, the most likely differential diagnoses

63 were considered to be neoplastic (e.g. fibrosarcoma, fibroma, osteosarcoma, chondroma),

64 infectious/inflammatory (osteomyelitis), or traumatic (excessive callous formation following

65 previous trauma).

66 A left-sided hemilaminectomy at L1-L2 was performed. The outer cortical bone had a normal 67 gross appearance but the vertebral cancellous bone of L2 was thickened with an enlarged porous 68 structure (Fig 3A). There inner cortical bone of the pedicle was poorly differentiated from the 69 cancellous bone and there was associated hemorrhagic soft tissue material on its medial aspect. 70 The dura was exposed to relieve the spinal cord compression (Fig 3B). Samples of the abnormal 71 bone were submitted for histopathologic examination and for bacterial culture. Post-operative 72 medications included methadone (0.1-0.2 mg/kg IV every 4 hours for one day; Comfortan, 73 Dechra, Shropshire, UK), buprenorphine (0.01-0.02 mg/kg for two days following methadone; 74 Buprecare, Animalcare, North Yorkshire, UK), meloxicam (0.05 mg/kg orally once daily for 10 75 days; Metacam, Boheringer Ingelheim, Berkshire, UK) and gabapentin (7 mg/kg orally twice 76 daily for 14 days; Gabapentin Medreich PLC, Feltham, UK). The cat recovered well from 77 surgery and had reduced signs of spinal pain when discharged four days later, although the 78 paraparesis and proprioceptive ataxia in the pelvic limbs were unchanged. Voluntary urinary and 79 fecal continence were retained after surgery. 80 Tissue samples for histopathological analysis were fixed in 10% neutral buffered formalin, 81 processed routinely and embedded in paraffin wax. Sections (4 μ m) were stained with 82 hematoxylin and eosin (HE). Present within the medullary cavities and extending to the 83 periosteum are variably dense proliferations of endothelial cells forming small caliber blood 84 vessels with and without a mural smooth muscle. These vessels are surrounded by a loose 85 myxoid stroma and extravasated erythrocytes. The surrounding trabecular bone is well

86 organized, with prominent lacunal osteocytes and an overlying single cell layer of osteoblasts.

87 Occasional spicules of necrotic bone are also present. The histopathological findings were

considered to be consistent with a benign vascular hamartoma (Fig 4). ¹ Culture of bone from the
site revealed no bacterial isolates after 48 hours of aerobic and anaerobic incubation.

90 At 4-weeks post-surgery the cat tolerated handling without signs of pain. There was mild pelvic

91 limb paraparesis, mild proprioceptive ataxia with no postural reaction delays, and no apparent

92 spinal hyperesthesia on palpation of the thoracolumbar area. At 6-month follow up it was

93 reported that the cat had no recurrence of clinical signs.

94

95 Discussion

96 A hamartoma is an excessive and unorganized growth of normal cells and associated tissue that

97 are intrinsic to the organ in which they occur and is considered to be congenital malformation.²

98 Hamartomas demonstrate minimal growth in the mature animal and are therefore not considered

99 to be neoplastic in origin.³ The majority of hamartomas are diagnosed in young patients, often

100 before the onset of skeletal maturity. ⁴⁻⁶

Hamartomas may occur as an incidental finding; however, depending on their location, vascular hamartomas can cause clinical signs secondary to spontaneous hemorrhage, mass effect, or adherence to adjacent tissues.^{2, 7-9} There are reports of hamartomas occurring in many different species including humans, dogs, cattle, horses, goats and cats where they are reported to occur at multiple different sites and involve many tissue types.^{1, 7-13}

106 Hamartomas causing myelopathic signs have been reported in veterinary species due to both

107 vertebral and intramedullary lesions.^{1, 6, 7} A previous report of a cat with a vascular hamartoma

108 affecting a cervical vertebra described similar clinical features to those described here, including

109 young age (15 months) and signs of progressive ataxia and paresis.¹ Computed tomography

110	demonstrated an expansile lesion compressing the spinal cord, which was surgically resected,
111	also resulting in a good outcome. Important differential diagnoses for vascular hamartomas
112	occurring within bone include hemangiomas, hemangioblastomas, and arteriovenous
113	malformations, and these can be differentiated on the basis of histopathological features. ¹⁴⁻¹⁷
114	Previous studies have described MR characteristics associated with intramedullary hamartomas
115	in the cervical and thoracic spinal cord of dogs. ^{18, 19} In contrast to our case of a vertebral
116	hamartoma, these case reports describe the intramedullary hamartomas as heterogeneously
117	hyperintense compared to normal spinal cord on T2W images, isointense on T1W images, with
118	no evidence of contrast in cervical hamartoma and some peripheral, ventral contrast
119	enhancement in the thoracic hamartoma. ^{18, 19}
120	To our knowledge, this is the first report describing the MR characteristics of a vascular
121	hamartoma arising from the vertebrae and the first report of a lumbar vertebral hamartoma in a
122	cat. MR clearly depicted the lesion and its effect of the spinal cord, although the signs were not
123	specific for vertebral hamartoma. The combined findings of MR and CT indicated a solitary,
124	non-aggressive, predominantly osseous lesion, which supported surgical treatment in order to
125	decompress the spinal cord and enable further characterization by histopathology. Based on the
126	presenting case and previous literature the prognosis for a cats with vascular hamartomas
127	associated with vertebral column that can be surgically excised is good. ¹

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205 Legends

Figure 1: Midline sagittal T2-weighted (A) and transverse T2-weighted (B) and T1-weighted pre- (C) and post-contrast (D) through the mid-body of L2. There is a focal extradural mass lesion associated with the left pedicle and lamina of the L2 vertebra within the vertebral canal causing marked displacement of the spinal cord. The mass is iso-to hypointense to normal gray matter on T2-weighted images (A, B) and hypointense on T1-weighted images (C). There is moderate, homogenous contrast enhancement of the central zone of the mass and marked contrast enhancement along its interface with the vertebral canal (D).



213

- 216 images showing a focal, calcified extradural mass lesion associated with the left pedicle and
- 217 lamina of the L2 vertebra. Adjacent vertebrae are unaffected.



- Figure 3: Intra-operative photograph of the L2 lesion at the hemilaminectomy site. (A) The
- 221 appearance of normal inner cortical bone of L1 (*) contrasts with the proliferative tissue within
- the vertebral canal of L2 (arrow). (B) Removal of the proliferative tissue to expose the dura
- 223 (arrowhead) surrounding the spinal cord.



Figure 4: Hematoxylin and eosin section (at x 600 magnification) shows irregular proliferations
of plump endothelial cells (arrow), which form numerous small calibre blood vessels. These
vessels are surrounded by a loose myxoid stroma (*) and numerous extravasated erythrocytes
(arrowhead). Scale bar = 30µm.

