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Successful long-term outcome with radiation and prednisolone following a postoperative feline vertebral angiomatosis relapse

Hugo Leonardi[1], Valérie Poirier[2], Melanie Iverson[3] and Francesca Samarani[2]

Abstract

Case summary A 1-year-old male castrated domestic shorthair cat was presented to the Ontario Veterinary College for a week-long history of lethargy and reluctance to walk. CT and MRI revealed a monostotic T5 compressive vertebral lesion that was excised in surgery via pediculectomy. Histology and advanced imaging were consistent with feline vertebral angiomatosis. The cat relapsed both clinically and on CT 2 months postoperatively and was therefore treated with an intensity-modulated radiation therapy protocol (45 Gy over 18 fractions) and tapering doses of prednisolone. On follow-up CT and MRI at 3 and 6 months post-radiation, the lesion was static and then improved at 19 months post-radiation, with no signs of pain reported.

Relevance and novel information To our knowledge, this is the first described case of a postoperative relapse of feline vertebral angiomatosis treated with radiation therapy and prednisolone with a successful long-term follow-up.

Keywords: Vertebral angiomatosis; radiation; relapse; neurology

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Case description

A 1-year-old male castrated domestic shorthair cat was presented to the Ontario Veterinary College (OVC) emergency service for a week-long history of lethargy, reluctance to walk and growling when picked up. Prior to presentation, abdominal radiographs and ultrasound performed at the referral clinic did not reveal any abnormality. A complete blood count (CBC) and serum biochemistry revealed a mild non-regenerative normochromic normocytic anaemia (haematocrit 28%). It was treated by his referring veterinarian with gabapentin (8.9 mg/kg PO q8h), meloxicam (0.05 mg/kg PO q24h) and a single dose of methocarbamol (90 mg/kg PO), with no improvement in condition.

The cat was indoor-only, was up to date with vaccination, had no travel history and tested negative for feline immunodeficiency virus (FIV) and feline leukaemia virus (FeLV) at the time of adoption.

Physical examination was unremarkable upon presentation to the OVC. Neurological examination revealed mild low head carriage and diffuse lumbar and thoracolumbar discomfort. The cat also growled occasionally when being picked up. The remainder of the neurological examination was normal. Blood gas, blood electrolytes (including ionised calcium), CBC and creatine kinase were within normal limits. Three-view thoracic radiographs reviewed by a board-certified radiologist (ACVR) were unremarkable.

Cervical and thoracolumbar MRI T2-weighted (T2W) single-shot fast spin echo (SS-FSE), T2W sagittal and

[1]Department of Neurology, Azurvet, Saint-Laurent du Var, France
[2]Department of Clinical Studies, University of Guelph, Ontario Veterinary College (OVC), Guelph, ON, Canada
[3]Department of Pathobiology, University of Guelph, Ontario Veterinary College (OVC), Guelph, ON, Canada

Corresponding author:
Hugo Leonardi DVM, IPSAV, Dipl ACVIM (Neurology), Department of Neurology, Azurvet, 769 Av Pierre et Marie Curie, Saint-Laurent du Var 06700, France
Email: h.leonardi@azurvet.fr

transverse sections, T1W pre- and postcontrast (intravenous gadolinium) sections (1.5 T MRI [Signa Explorer, Software version 25.1; General Electric Medical Systems]) revealed a monostotic lesion involving the vertebral body of T5 with moderate spinal cord compression. The left dorsolateral aspect of the T5 vertebral body showed mixed T2W hypo- and hyperintensities, with a mass effect that showed strong and homogeneous contrast enhancement, protruding within the left ventrolateral portion of the vertebral canal. Partial circumferential attenuation of the T2W hyperintense signal of cerebrospinal fluid (CSF) and epidural fat was seen at this level on the SS-FSE sequence. CT (16-slice detector Brightspeed helical CT scanner; GE) showed the left dorsolateral T5 vertebral body and left ventrolateral T5 pedicle were thickened, with irregular margins within the central canal.

Retropharyngeal and jejunal lymph nodes were noted to be slightly enlarged on MRI. Cytology of the retropharyngeal lymph node was unremarkable. Cervical CSF analysis was unremarkable; lumbar CSF analysis revealed an albumino-cytological dissociation.

A pediculectomy on the T5 vertebrae was performed to remove the spinal cord compression and for biopsy purposes. Abnormal thickness of the vertebral pedicle was confirmed intraoperatively, and an extension on the floor of the vertebral canal was appreciated. Samples of abnormal vertebral bone were obtained and submitted for histopathology.

Histology revealed small trabeculae of lamellar bone surrounded by fibrous connective tissue containing well-differentiated, densely arranged capillaries with small interspersed arterioles and venules. Vessels were lined by slightly plump endothelium and there were low numbers of neutrophils within the lesion. No organisms were identified on haematoxylin and eosin staining or by Warthin–Starry stain. The findings were considered to be most consistent with vertebral angiomatosis. Figure 1 shows a microscopic section of the vertebral bone lesion described.

Postoperatively, the cat received a continuous rate infusion of fentanyl (2–4 µg/kg/h IV) and dexamethasone (0.1 mg/kg IV q24h), and was switched to oral medications the first day postoperatively: gabapentin (8.9 mg/kg PO q8h), buprenorphine (0.01–0.02 mg/kg PO q 8h) and a tapering course of prednisolone (starting at 0.45 mg/kg PO q24h). At the time of discharge, 3 days postoperatively, the cat was ambulatory with a mild proprioceptive ataxia and paraparesis, and was not painful.

Six weeks postoperatively and a week after discontinuing the prednisolone, the cat was considered painful at home and prednisolone was restarted (0.45 mg/kg PO q24h).

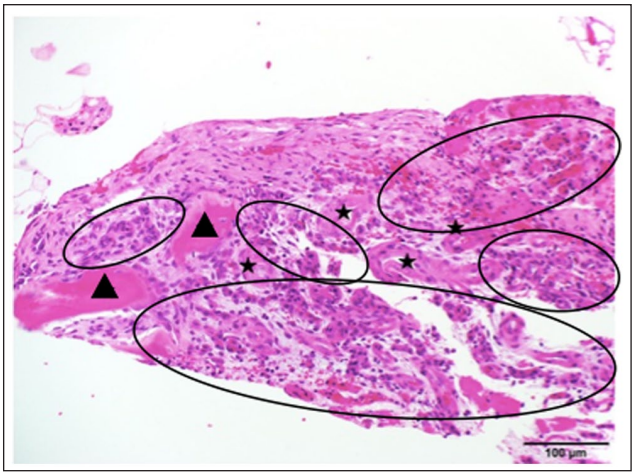

Figure 1 Microscopic section of the vertebral bone lesion (haematoxylin and eosin). The lesion consists of proliferations of well differentiated blood vessels. Circles indicate capillaries; stars indicate arterioles and venules; and triangles indicate small trabeculae of lamellar bone

The cat's neurological examination 2.5 months postoperatively was unremarkable and it was displaying occasional yelps only when landing from jumps at home, despite the prednisolone treatment. Follow-up CT and MRI revealed a regrowth and progression of the lesion, creating a larger mass protruding on the vertebral canal, with adjacent thickening of the T5 vertebral body, arch and pedicle.

The cat was then treated with intensity-modulated radiation therapy (IMRT)/image-guided radiation therapy (months 3 and 4 postoperatively). It received 45 Gy over 18 fractions. Figure 2 presents the gross tumour volume (GTV), the clinical target volume (CTV) and planning target volume (PTV) for the radiation course. GTV was contoured on CT, CTV expansion was 1 cm within the vertebral body and surgery site, and PTV expansion was 2 mm ventrally, cranially and caudally, and 5 mm laterally.

After radiation treatment, the cat was discharged on prednisolone (0.45 mg/kg PO q24h) and continued on buprenorphine and gabapentin. The medications where then weaned completely 6 months after radiation without relapse of pain and recovery of a normal gait. The cat is still doing well at home with no signs of pain at the time of writing. Follow-up advanced imaging studies revealed a static T5 monostotic lesion at 3 and 6 months after radiation on CT, with improvement of the spinal cord compression seen at 6 months on MRI. Further improvement was seen on CT at 19 months post-radiation with a less-thickened vertebral peduncle (4.1 mm vs 4.4 mm on previous CT). Figures 3 and 4 compare the preoperative CT and MRI, and after radiation therapy.

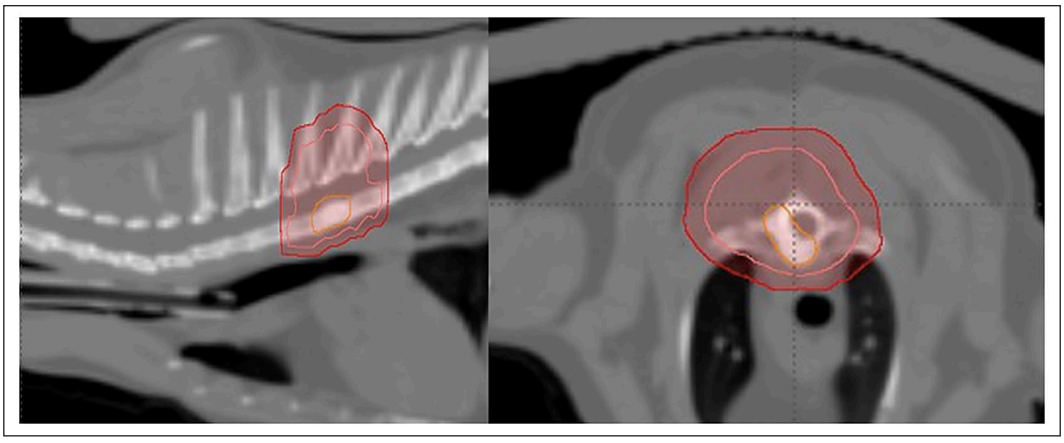

Figure 2 Transverse and sagittal CT view at the T5 vertebral lesion, highlighting the radiation therapy contour planning. The red circles denote the planning target volume; the pink circles denote the gross tumour volume; and the orange circles denote the clinical target volume

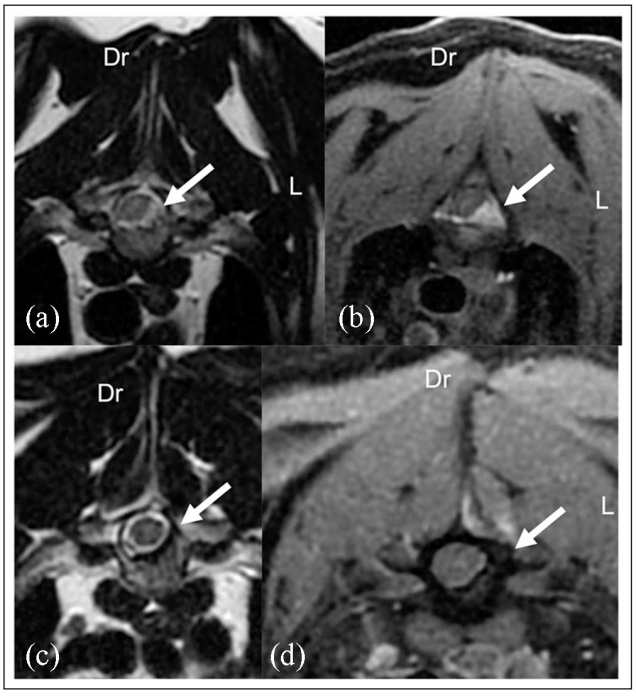

Figure 3 Comparative MRI images. Top images were obtained at the time of diagnosis (preoperatively and before radiation therapy). Bottom images were obtained at 6 months post-radiation therapy. (a) Transverse T2-weighted (T2W) at the level of T5 showing a moderate left-sided compression of the spinal cord by an heterogeneous extradural mass originating from the T5 vertebra. (b) Transverse T1-weighted (T1W) fat saturation (FAT SAT) image postcontrast at the level of T5, showing homogeneous contrast enhancement of the extradural mass. (c) Transverse T2W at the level of T5 showing a mild left-sided compression of the spinal cord by a heterogeneous extradural mass originating from the T5 vertebra and (d) Transverse T1W FAT SAT postcontrast image at the level of T5 showing no abnormal contrast enhancement of the extradural mass. The white arrow points at the extradural mass effect resulting from the thickened left vertebral pedicle of T5. Dr = dorsal; L = left

Discussion

Vertebral angiomatosis is a clinical and histopathological syndrome that has been reported in six cats only.[1–5] The cat presented in this report was diagnosed with vertebral angiomatosis based on the similar radiological and histopathological features reported in the literature.[1–5] The physiopathology is poorly understood, and a benign congenital malformation has been hypothesised.[1–5] This hypothesis has been corroborated by the absence of significant inflammation or microorganism on histology with normal vascular wall architecture, negative surgical site cultures (3/6 cats) and negative FIV/FeLV serologies (4/6 cats).[1–5]

No consensus exists on the appropriate treatment and outcome of feline vertebral angiomatosis. Five of six cats were treated with surgery alone, which consisted of hemilaminectomy or laminectomy, depending on the location of the abnormal bone.[2–5] One cat was euthanased after failing to recover from a cardiac arrest suffered during recovery from anaesthesia.[3] Two cats had an excellent long-term outcome at 1 and 1.5 years, respectively, with full recovery and a normal gait.[4] One cat had an excellent short-term outcome at 4 months, with a normal gait.[2] The last cat had an initial full recovery but relapsed at 7 months with the recurrence of clinical signs and imaging consistent with a relapse of angiomatosis. This cat underwent a second decompressive surgery but did not regain ambulation and was euthanased 14 months after the initial diagnosis.[5] Those case reports suggest that decompressive surgery alone may offer a good long-term prognosis, although relapses are possible. Additionally, relapses may not respond well to repeat surgeries, although more cases are needed to evaluate repeat surgeries as a treatment of vertebral angiomatosis relapses.

In one report, a cat was treated with a combination of surgery, radiation therapy and prednisolone, with a good

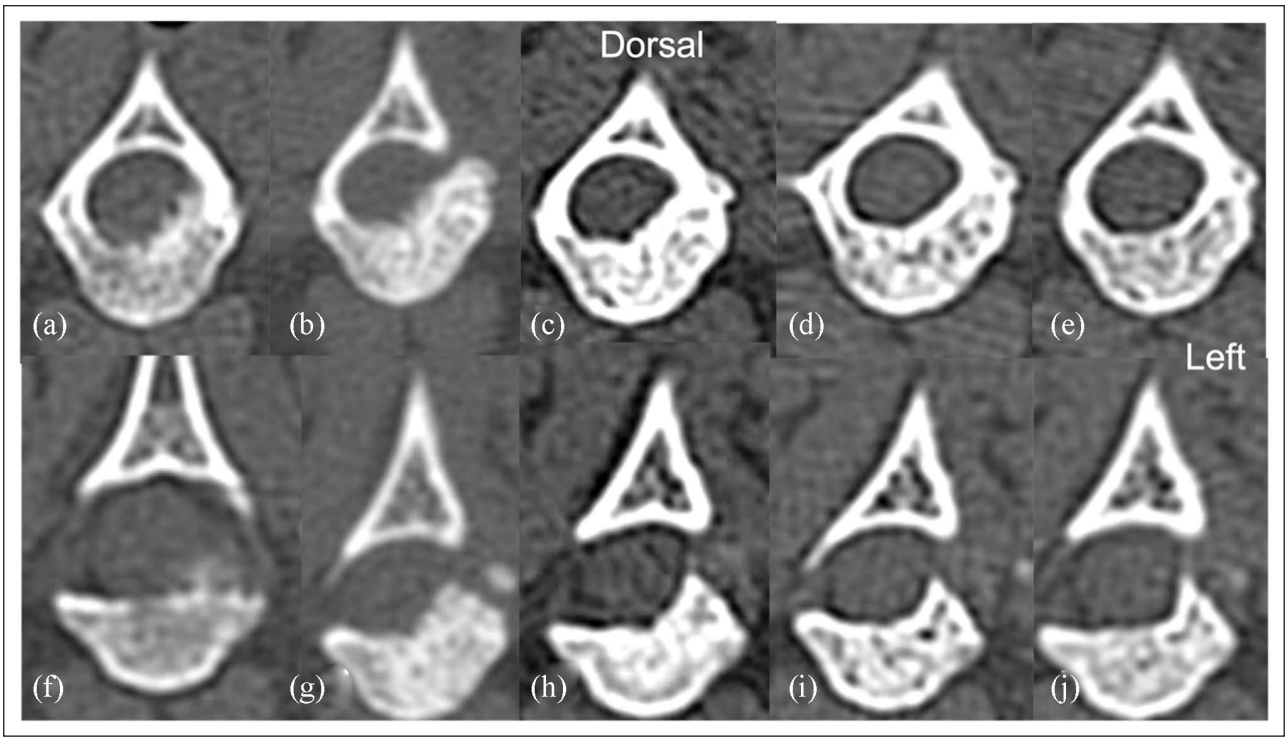

Figure 4 Transverse CT images and bone window at the level of the mid part of the T5 vertebra (top images) and the caudal part of the T5 vertebra (bottom images) at different time points after radiation therapy. (a,f) At the time of diagnosis, prior to surgery, (b,g) 2 months postoperatively at the time of clinical relapse, (c,h) 3 months post-radiation therapy, (d,i) 6 months post-radiation therapy and (e,j) 19 months post-radiation therapy

long-term prognosis.[1] The cat underwent a L2 hemilaminectomy to remove spinal cord compression owing to the proliferative laminae. Three weeks postoperatively, the cat underwent a 48 Gy total radiation dose over 16 doses and tapering prednisolone doses. The cat has remained with a single monoparesis on the ipsilateral pelvic limb and was clinically free of pain at the 26 month follow-up period. Additionally, repeat MRI at 26 months revealed a thickened laminae without spinal cord compression or contrast enhancement, suggesting the absence of relapse of the angiomatosis.[1] Therefore, the use of radiation therapy in combination with surgery may be useful in preventing relapses of vertebral angiomatosis. However, it is unknown whether surgery alone or the combination of surgery and radiation has been effective in improving pain level for this cat.

In the cat presented in this report, an initial worsening of neurological signs was seen and attributed to the spinal cord manipulation during surgery. The relapse of clinical signs while tapering prednisolone suggested either a rapid regrowth of the lesion or incomplete removal of the compression. In surgery, mainly the pedicle part of the vertebral lesion was removed, while the body part was difficult to remove due its location. Therefore, it is possible that the relapse seen on CT 2 months postoperatively was subsequent to incomplete removal of the ventral body part of the lesion.

Treatments for human benign vertebral vascular tumours, such as haemangiomas, include surgery and radiation therapy, although no consensus exists.[6] Surgery is recommended for cases showing clinical signs with rapid deterioration or spinal cord compression. Radiation may be used for slow progressing cases or to prevent postoperative relapses.[6] In a cohort of 96 patients, a 34 Gy radiation protocol has shown to achieve a 90.5% patient response in human vertebral haemangiomas, suggesting that radiation may be a useful treatment of vertebral vascular proliferative disorders.[7]

Owing to the rapid regrowth of the vertebral lesion, the involvement of a difficult surgically approachable vertebral body lesion and the previously reported poor prognosis of a surgical revision, another surgery was not elected for in the cat presented herein. Instead, a radiation therapy protocol was elected to treat the relapse of the vertebral angiomatosis 3 months postoperatively.

The lesion remained static on initial CT re-evaluation at 3 and 6 months post-radiation, and was subsequently thinner at 19 months post-radiation. While it did not completely remove the lesion, the radiation therapy protocol was considered successful in controlling the progression and improving the compression of the spinal cord. It remains possible that the lesion would have stopped its progression, regardless of treatment, or that prednisolone would have also affected the regrowth

of the lesion without the use of radiation therapy. However, this was considered less likely as the lesion had continued to progress postoperatively while the cat was receiving prednisolone treatment.

Conclusions

To our knowledge, this is the first described case of feline vertebral angiomatosis with a postoperative relapse treated with radiation therapy and prednisolone with long-term follow-up. This case report supports the hypothesis that radiation therapy may stop the progression of proliferation of the vertebral angiomatosis in case of relapse. However, further studies are needed to determine the best treatment approach for the management of feline vertebral angiomatosis.

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Ethical approval The work described in this manuscript involved the use of non-experimental (owned or unowned) animals. Established internationally recognised high standards ('best practice') of veterinary clinical care for the individual patient were always followed and/or this work involved the use of cadavers. Ethical approval from a committee was therefore not specifically required for publication in *JFMS Open Reports*. Although not required, where ethical approval was still obtained, it is stated in the manuscript.

Informed consent Informed consent (verbal or written) was obtained from the owner or legal custodian of all animal(s) described in this work (experimental or non-experimental animals, including cadavers) for all procedure(s) undertaken (prospective or retrospective studies). For any animals or people individually identifiable within this publication, informed consent (verbal or written) for their use in the publication was obtained from the people involved.

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