Feline osteochondromatosis in a FELV-negative European shorthair cat

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Key words
Feline osteochondromatosis, cat, palliative treatment, osteocartilaginous lesion, FELV infection

Summary
Objective: To report palliative treatment in a case of multifocal feline osteochondromatosis in a feline leukaemia virus (FeLV) negative European shorthair cat. Case: A 6-year-old spayed female European short-haired cat was presented because of a right forelimb lameness caused by an osteochondromatous lesion which had trapped tendons, vessels and nerves of the antebrachium. Several other lesions were present which did not cause the animal discomfort. The cat was tested negative for FeLV. Palliative surgical removal of the mass was performed, resulting in a marked improvement of mobility with no local recurrence. The cat developed a non-regenerative anaemia after surgery, however the underlying cause was not identified upon request of the owner. Overall survival after surgery was only 2 months. The cat was then euthanised due to severe progression of the anaemia. Conclusion: Palliative surgical removal of osteochondromas may result in local improvement. However, owners need to be aware that it does not increase overall survival and that the prognosis is poor. Infection with FeLV is not necessarily associated with such lesions.

Zusammenfassung

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Introduction
Osteocartilaginous exostoses have been reported in a number of species including man (3, 7), dogs (1, 2, 4), horses (5) and cats (6, 8–10). While the disease seems to be a hereditary skeletal growth disturbance in dogs and horses (9, 11, 20), in cats a hereditary pattern has not been identified except for Scottish Fold cats which have a special form known as Scottish Fold Osteodystrophy (18, 21, 26, 27).

The histological appearance of the lesions is comparable throughout different species, showing a cancellous bone outgrowth which is capped by cartilaginous tissue (9, 10, 22, 25). In the cat two different forms of the disease have been reported. In the solitary form, exostoses of cartilage capped cancellous bone arise from cartilaginous caps located in the periosteum. The average age of onset is around 6 years with no known gender predisposition (3, 5). The described localisations include the spine, long bones, head, ribs and pubis (2, 10, 16, 24, 25). The clinical symptoms caused by the lesions depend on the localisation and the mechanical impact on the surrounding structures. The prognosis after treatment by surgical excision is good, but local re-growth is a
common finding (5, 24). Malignant transformation may occur. Treatment options focus on local surgical debulking, but radiation therapy or amputation have been discussed (19). While the disease is well described, the underlying causes are not elucidated. A frequent association with a feline leukaemia infection is generally not discussed (28). The second form has been referred to as feline osteochondromatosis. The average age of onset is around 2–3 years with no known gender predisposition (19).

Feline osteochondromatosis is characterised by multiple osteocartilaginous outgrowths arising from the bone cortex at various sites – including scapulae, sternum, ribs, pelvis and lumbar vertebrae with a potential predisposition for Siamese cats (5, 16, 25). The exact etiology has not been elucidated but an underlying retroviral infection has been discussed since several reported cats have been tested FELV-positive and C-type particles have been found within the lesions (3, 8, 10). Controversially, a more recent publication did not identify an underlying FELV infection (16). We report an additional case of feline osteocartilaginous in a female European shorthaired cat that has been tested negative for FELV and a palliative attempt for treatment.

The prognosis for affected animals is poor with a mean survival below one year after onset and a potential for malignant transformation (5, 23).

Clinical report

Patient and history

A 6-year-old spayed female European shorthair cat was presented for investigation of multiple hard masses all over the body which had developed during the previous 6 months. During 4 weeks prior to presentation a lesion around the right forelimb had grown excessively to form a collar around the radius and ulna. The cat had developed lameness and was treated by administration of meloxicam (0.1 mg/kg once daily, Metacam®, Boehringer Ingelheim GmbH, Basel, Switzerland). Otherwise, the cat did not show any signs of discomfort. According to the owners the cat was fed a conventional cat diet.

Clinical examination and laboratory findings

On presentation the cat was bright, alert and responsive. The physical examination was unremarkable despite several palpable hard masses all over the body which were connected to the underlying bone and did not cause any pain: head (0.5 cm diameter), right scapula (4 x 10 cm), right pelvis (2 x 6 cm), right tibia (2 cm diameter) as well as a bony collar around the right radius and ulna (diameter 5 cm) and smaller lesions at the left forelimb (diameter 3 cm). The cat showed moderate right forelimb lameness. A neuromologic examination was unremarkable.

Haematological and biochemical blood analysis were within normal limits. Serum FELV-antigen as well as feline immunodeficiency virus (FIV) antibodies were tested negative using a commercially available ELISATest Kit (Snap® FIV/FeLV Combo Test, IDEXX GmbH Ludwigsburg, Germany). Analysis of Vitamin D₃ revealed a 25-hydroxy-vitamin D₃ serum level of 26.11 nmol/l (reference range 20–150 nmol/l) and a 1,25-dihydroxycholecalciferol serum level of 92 pg/ml (reference range < 30 pg/ml). The serum level of parathormone was 9 pg/ml (reference range 3–24 pg/ml).

Diagnostic imaging

Radiographs showed several dense lesions arising from the cortex of the pelvis, right scapula, sternum, skull, tibia, as well as moderate bony lesions which formed around the left radius and ulna and a severe bony callos-like collar around the right radius and ulna.

The owners were informed that curative treatment was unlikely to be successful and overall prognosis was poor. Since none of the lesions seemed to cause the cat discomfort except for the massive growth around the right radius and ulna that had recently caused lameness they opted for surgical debulking of this mass in order to see if it would result in pain relief for the cat, even if the prognosis was guarded.

A computed tomography scan was performed to evaluate which structures were involved in the lesion and whether surgical removal would be sensible. General anaesthesia was induced after premedication with glycopyrrolate (0.01 mg/kg i. m., Rubinol®, Riems Arzneimittel AG, Riems, Germany) by intramuscular administration of ketamine (10 mg/kg i.m., Ketamin, Selectavet Dr. Otto Fischer GmbH, Wearyn-Holzolling, Germany) and midazolam (0.3 mg/kg i. m., Midazolam B. Braun, B. Braun Melsungen AG, Melsungen, Germany). Anaesthesia was maintained by administration of isoflurane (Isofluran CR, CP-Pharma, Burgdorf, Germany) delivered in 100% oxygen after endotracheal intubation. Vital functions were monitored and the CT scan was performed in ventral recumbency (Philips Brilliance CT 64-channel Scanner, Philips Deutschland GmbH, Hamburg, Germany).

The CT identified a bone hypodense lesion of 0.5 cm diameter dorsally on the skull at the midline between both orbitae. A soft tissue swelling which extended from the metacarpalia to the elbow and contained cloudy bone hypodense structures forming a collar around the antebrachium surrounded the right forelimb. The lesions involved tendons, vessels and nerves of the antebrachium (8.4 x 4.2 x 3.6 cm). Comparable lesions of a lesser extent were visible at the left antebrachium. Additional bone hypodense lesions (6 x 3.7 x 3.2 cm) were located within the muscles surrounding the right scapula, within the mediastinum (2.7 x 1.2 x 0.7 cm) and attached to the cranial sternum (3.4 x 1.5 x 0.7 cm). A further lesion was found within the musculus longissimus lumborum at the height of the 11/12 intercostal space (1.3 x 0.5 x 0.3 cm) and cranially of the right ala ossis ili (4.1 x 2.5 x 1.4 cm). The last two lesions were located at the left hind limb, one on the medial aspect of the left knee (1.2 x 1.1 x 1 cm) and at the medial aspect of the tarsus (1.5 x 1.2 x 1 cm). ( Fig. 1). Due to the masses formed around the contralateral limb the owners decided against amputation as an option.
Surgical procedure

Surgery was performed directly after the CT Scan. Fentanyl (5 µg/kg, Fentanyl®-Janssen, Janssen-Cilag GmbH, Neuss, Germany) was injected intravenously for analgesia prior to surgery and maintained by continuous rate infusion throughout the surgical procedure (10–20 µg/kg per hour to effect). The cat was prepared for surgery and positioned in ventral recumbency. After a dorsal approach to the radius the lesion including the incorporated fascia was slowly excised using a rongeur and a scalpel blade. Care was taken to identify vessels, nerves and tendons within the lesion which were spared from excision. In the deeper areas where the lesion met the radius and ulna it was easily peeled off the bone. During surgery the wound showed excessive diffuse bleeding from the center of the lesion which was controlled by the use of electrocautery. The remaining soft tissues were routinely closed in layers (PDS 3.0) and the skin was closed after resection of a small piece in order to adjust to the new diameter of the antebrachium. Radiographs were taken after surgery to allow objective post surgical follow-up of regrowth (Fig. 2).

Histopathology

For histopathological analysis, samples of the resected lesion were fixed in 10% neutral-buffered formalin, decalcified in EDTA solution and embedded in paraffin wax. Tissue sections were stained with haematoxylin and eosin. Additional sections were used for immunohistochemistry by applying the avidin-biotin complex method using a primary antibody directed against feline leukaemia virus antigen (monoclonal anti-FeLV gp70; clone C11D8; Custom Monoclonals International, Sacramento, USA) with minor modifications as described by Schwab et al. (26). Briefly, sections were dewaxed and antigen was demasked by citrate treatment for 20 minutes.

Histological examination revealed a lobulated mass which was partly covered with a collagen-rich fibrous tissue (interpreted as periosteal remnants). The mass consisted of an osteochondromatous proliferation, often with a peripheral arrangement of the cartilaginous part (Fig. 3). The degree of cartilaginous versus osseous differentiation varied depending on the lo-
calisation examined. The cartilagenous tissue displayed a slightly irregular growth with a mild cellular pleomorphism. The well differentiated osseous part was primarily composed of trabecular bone. The intertrabecular marrow spaces contained a loose fibrous connective tissue, mature adipocytes and islands of hematopoietic progenitor cells. There was no evidence of a malignant transformation and less than one mitotic figure per high power field was detected. Based on the multicenter character of the lesions and the histopathological features feline osteochondromatosis was diagnosed. Immunohistochemically, FeLV-antigen was not detected within the lesions.

Follow-up

The recovery from surgery was unremarkable. The cat was administered cefazoline (2 mg/kg s. c. once daily, Excenel®, Pfizer AG, Zürich, Switzerland) and meloxicam (0.1 mg/kg once daily, Metacam®, Boehringer Ingelheim GmbH, Basel, Switzerland) for 7 days. Wound healing was uneventful and the cat showed full weight bearing and function of the affected limb directly after surgery.

A haematological control on the day after surgery showed anaemia with a packed cell volume (PCV) of 12% (before surgery PCV 30%, reference range 27–45%). The cat was given a whole blood transfusion (PCV after transfusion 18%), and further laboratory controls on days 2, 3 and 4 after surgery showed a stable PCV at 16% with no signs of regeneration. The cat was discharged 5 days after surgery and further follow-up care involving control of anaemia and re-growth were scheduled to be performed by the local veterinarian. On telephone request 2 weeks after surgery the owners reported that the cat was doing well with full resolution of right forelimb lameness. However, 2 months after surgery the cat was euthanized due to recurrent severe anaemia.

Discussion

Feline osteochondromatosis is a disease which is rarely documented in cats, accounting for 20% of primary bone tumours in this species (6). Based on the literature the prognosis for the animals is poor, with a reported survival time of less than one year after onset (2, 16). The presented case describes feline osteochondromatosis in a patient that has been tested negative for FELV and a palliative treatment approach.

While most of the lesions did not cause the animal pain, a rapid growth of osteocartilaginous tissue around the right radius and ulna which enclosed tendons, vessels and nerves of the antebrachium caused right front limb lameness. Since the cat was not painful on palpation of the limb and no neurological impairment was detected, this lameness was most likely due to mechanical impairment.

Surgical debulking has been discussed as a possible palliative treatment approach for cats suffering from osteochondromatosis (5, 24) and other benign bone abnormalities such as osteomas (13). The purpose of surgical treatment was to reduce lameness and thus the quality of life for the cat. With some care taken to preserve vessels, nerves and tendons the lesion could be easily peeled off the underlying bone. However, the procedure was accompanied by substantial bleeding from the bone which necessitated a blood transfusion after surgery. Once the lesion was removed the bleeding was easily controlled. On admission the cat showed no anaemia and had a PCV of 30% (reference range 27–45%). The PCV dropped after surgery and was stable after blood transfusion (16%) but only a moderate increase in reticulocytes, indicating no regeneration was observed. Since the cat had been sent home 5 days after surgery and the owners did not carry out the advised controls we do not know if the post surgical anaemia persisted or resolved. However, given the short time between surgery and euthanasia it seems likely that the cat may never have fully recovered. There are numerous causes of anaemia in the cat including chronic inflammation, neoplasia, retroviral infection, iron deficiency, chronic blood loss, renal insufficiency, pure red cell aplasia, myelophthisis, myelofibrosis, myelonecrosis or myelodysplasia (5). Feline osteochondromatosis itself has not been directly linked to anaemia so far.

While the cat was hospitalized, findings suggesting iron deficiency or renal insufficiency have not been detected in blood and urine samples but none of these reasons can be excluded since no testing was performed at the time of death 2.5 months later.

Among the viral causes the FELV infection is one very common reason which has additionally been linked to the presence of multiple osteochondromas in the cat (8–10, 25). Infection of periosteal cells with the FELV is suspected as an aetiological source
Conclusion

Palliative surgery may be an option for cats where mechanical disturbance by the lesions causes lameness. However, owners need to be aware of the overall prognosis of the disease and that no curative treatment is known to date. The true etiological role of FeLV in cats developing feline osteochondromatosis remains speculative.

since most of the initially reported cases were tested positive and viral particles could be found within the lesions (2, 10, 25). Atypical feline fibrosarcoma virus as well as feline oncornavirus as an aetiological source have also been discussed (16, 23) but the exact mechanism has never been identified. We could not support this thesis since the cat presented in this study was tested negative for serum FeLV antigen and FeLV particles were not identified within the lesion. This finding is consistent with another more recent report of feline osteochondromatosis by Levitin et al. (16). With regard to the small number of published cases the aetiological role of FeLV remains questionable.

We also lack knowledge about predisposing factors or induction of the disease and we know little about the differences and similarities of development between the various forms of osteo-cartilaginous outgrowths in different species. While age of onset, localisation and prognosis tend to differ between species, the lesions themselves seem remarkably comparable (1, 2, 10, 17, 20, 22). Typical findings are bony masses with cancellous bone covered by hyaline cartilage and a proliferative periostel response with thickening of the cambium layer. In some areas of the lesion enchondral ossification is present, other areas show marrow spaces with adipocytes and even rarely haematopoietic cells (16, 25).

In man (12, 14, 15), dogs (9, 11) and horses (20) a hereditary pattern has been described which – according to Pool et al. (23) – could not be confirmed for the cat.

The prognosis for affected animals remains poor. Other authors reported a survival time of less than one year after onset of symptoms due to proceeding functional impairment or malignant transformation of the lesions (20). The overall survival time of our cat after notification of the first lesion by the owners was 8.5 months. A direct etiological connection between feline osteochondromatosis and anaemia has not been published.

While the palliative surgery resulted in fast relief of lameness with no excessive regrowth at the surgical site within 2 months, the remaining lesions continued growing. The definite cause for anaemia that ultimately caused death in the cat was not elucidated.

Conflict of interest

The authors confirm that they do not have any conflict of interest.

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