Case report

Medicina Veterinária

e-ISSN 2675-6617
v. 19 n. 2 (2025)

Osteoblastic cutaneous osteosarcoma in a cat: combining surgery and electrochemotherapy for local control

Osteossarcoma cutâneo osteoblástico em gato: combinação de cirurgia e eletroquimioterapia para controle local

Sarah Cristina Pinheiro Barbosa **Soares**[1*], Pedro Antônio Bronhara **Pimentel**[1], Giovanna Torres dos **Anjos**[2], Fernando Augusto de **Macedo**[3], Ana Carolina Coelho **Costa**[1], Letícia Araújo de **Santana**[4], Guilherme de Lima **Veiga**[5], Amália Genete dos **Santos**[6], Giovana de Abreu **Mota**[7]

[1]*School of Veterinary Medicine, Federal University of Minas Gerais (UFMG), Belo Horizonte-MG, Brazil.*
[2]*School of Veterinary Medicine, UniSALESIANO, Araçatuba-SP, Brazil.*
[3]*Veterinarian, ValleVet Veterinary Clinic, Jacareí-SP, Brazil.*
[4]*School of Veterinary Medicine, University of Brasília (UNB), Brasília-DF, Brazil.*
[5]*School of Veterinary Medicine, São Paulo University (USP), Pirassununga-SP, Brazil.*
[6]*School of Veterinary Medicine, São Paulo State University (UNESP), Araçatuba-SP, Brazil.*
[7]*School of veterinary Medicine, Federal Institute of Amazonas (IFAM), Manaus-AM, Brazil.*
**Corresponding author: sarahbarbosasoares@gmail.com*

Article info

Keywords
Adjuvant therapy
Feline injection-site sarcoma
Soft tissue sarcoma
Oncology
Feline

DOI
10.26605/medvet-v19n2-7145

Citation
Soares, S. C. P. B., Pimentel, P. A. B., Anjos, G. T., Macedo, F. A., Costa, A. C. C., Santana, L. A., Veiga, G. L., Santos, A. G., & Mota, G. A. (2025). Osteoblastic cutaneous osteosarcoma in a cat: combining surgery and electrochemotherapy for local control. *Medicina Veterinária*, *19*(2), 150-155. https://doi.org/10.26605/medvet-v19n2-7145

Received: July 10, 2024
Accepted: March 12, 2025

Abstract

Osteosarcoma (OSA) is a mesenchymal tumor originating from osteoblast precursors and is associated with some predisposing factors, including prostheses or metallic implants, areas of bone infarction, and radiation exposure. In cats, this neoplasm exhibits aggressive biological behavior and rapid growth. Extraskeletal OSA is a rare neoplastic disorder arising from stem cells in soft tissues. It is characterized by the proliferation of malignant mesenchymal cells that produce bone matrix or bone tissue without primary involvement of adjacent bone tissue or periosteum. This condition is often linked to previous trauma or chronic inflammation. Here, we present a case report of a 6-year-old, mixed-breed, spayed female cat with a cutaneous nodule located in the interscapular area (1.0x0.7x0.6cm). Clinical examination raised suspicion of feline injection-site sarcoma (FISS), and staging exams revealed no evidence of metastasis. To achieve better local control, the cat underwent surgery with wide margins (5cm lateral margins and two anatomic planes for deep margins), combined with intraoperative electrochemotherapy. Histopathological and immunohistochemical analyses supported the diagnosis of osteoblastic OSA (RUNX2+, S100+, 1A4-, Desmin, MyoD1-, and IBA1-). The patient remains alive and in complete remission (202 days). This case report highlights an innovative treatment for extraskeletal OSA in cats, combining electrochemotherapy with surgical intervention for effective local disease control.

Resumo

O osteossarcoma (OSA) é um tumor mesenquimal originado de precursores osteoblásticos e está associado a alguns fatores predisponentes, como próteses ou implantes metálicos, áreas de infarto ósseo e exposição à radiação. Em gatos, essa neoplasia apresenta comportamento biológico agressivo e crescimento rápido. O OSA extraesquelético é um distúrbio neoplásico raro que surge a partir de células-tronco em tecidos moles. Ele é caracterizado pela proliferação de células mesenquimais malignas que produzem matriz óssea ou tecido ósseo, sem envolvimento primário do tecido ósseo adjacente ou do periósteo. Essa condição está frequentemente associada a traumas prévios ou inflamação crônica. Aqui, apresentamos um relato de caso de uma gata fêmea, sem raça definida, castrada, com 6 anos de idade, que apresentava um nódulo cutâneo localizado na região interescapular (1,0x0,7x0,6cm). O exame clínico levantou suspeita de sarcoma de aplicação felino (SAF), e os

exames de estadiamento não revelaram evidências de metástase. Para obter um melhor controle local, a gata foi submetida a uma cirurgia com margens amplas (5cm de margens laterais e dois planos anatômicos de margens profundas), associada à eletroquimioterapia intraoperatória. As análises histopatológicas e imuno-histoquímicas confirmaram o diagnóstico de OSA osteoblástico (RUNX2+, S100+, 1A4-, Desmin-, MyoD1- e IBA1-). A paciente permanece viva e em remissão completa (202 dias). Este relato de caso destaca um tratamento inovador para OSA extraesquelético em gatos, combinando eletroquimioterapia com intervenção cirúrgica para um controle local eficaz da doença.
Palavras-chave: terapia adjuvante; sarcoma de aplicação felino; sarcoma de tecidos moles; oncologia; felinos.

1 | Introduction

Osteosarcoma (OSA) in cats presents aggressive biological behavior, with rapid growth, but less metastatic than in dogs. The clinical signs of OSA vary according to the tumor's location, so skeletal OSA is responsible for more characteristic clinical signs, such as limb edema, lameness, pain, and discomfort (Helm and Morris, 2012).

Extraskeletal OSA is a rare neoplastic disorder originating from soft tissues. It is characterized by a proliferation of malignant mesenchymal cells, producing bone matrix or bone tissue without primary involvement of adjacent bone tissue or periosteum (Guim et al., 2019). This type of OSA appears to be less common in cats than dogs, with the subcutaneous region as the most frequent, especially in areas commonly used for vaccination (Thompson and Dittmer, 2016).

Extraskeletal OSA has been reported in various tissues, including subcutaneous areas, eyes, liver, spleen, and mammary glands (Helm and Morris, 2012; Verdes et al., 2019). Limited data on feline cases suggest longer survival in cats with extraskeletal OSA compared to axial OSA, despite challenging surgical margins (Heldmann et al., 2006; Almela et al., 2017).

The diagnosis of OSA involves evaluating history, anamnesis, clinical examination, and epidemiological factors like age, breed, and tumor location. Confirmation requires histological analysis of samples obtained via biopsy (Silveira et al., 2006; Oliveira and Silveira, 2008). Skeletal OSAs can be classified based on radiographic findings as lytic, showing radiographic signs of bone lysis; sclerotic, with increased radiopacity; or mixed, with areas of bone destruction and production associated (Andrade, 2009).

Extraskeletal OSAs are radiographically identified by increased soft tissue radiopacity resembling bone. Histologically, they exhibit disorganized mesenchymal proliferation with osteoblastic differentiation and production of osteoid or bone matrix. These neoplasms are categorized into six histological subtypes: chondroblastic, osteoblastic, poorly differentiated, fibroblastic, telangiectatic, and giant cell types, based on cell morphology and characteristics (Cavalcanti et al., 2004).

Regarding the treatment of OSAs, the most indicated is the excision of the tumor with wide surgical margins. The use of adjuvant therapies, such as chemotherapy and radiotherapy, may also be indicated. In cases of extraskeletal OSA, the location of the neoplasm should be evaluated regarding the possibility of surgical excision with adequate margins (Martano et al., 2011). The goal of this case report is to present an innovative treatment combining electrochemotherapy with surgery for local control of an extraskeletal osteosarcoma in a cat.

2 | Case description

A female, feline, 6 years old, mixed breed, spayed, attended at a Veterinary Oncology Service due to a 1cm nodule in the left scapular region growing for about one month. The patient presented adequate physical condition, normal appetite and water intake, and no complaints of respiratory clinical signs. Hematological and biochemical tests were requested, in which no noteworthy alterations were found. Tests for Feline Immunodeficiency Virus (FIV) and Feline Leukemia Virus (FeLV) were also performed, showing negative results, and an abdominal ultrasound examination revealed alterations that may be associated with chronic hepatopathy or fatty infiltration with diffusely hyperechoic parenchyma, but no alterations indicative of metastases. Chest radiography (Figure 1) showed well-defined areas of increased radiopacity, similar to bone tissue, present in the skin, dorsal to the patient's scapula, in the interscapular region. No changes suggestive of pulmonary metastasis were seen.

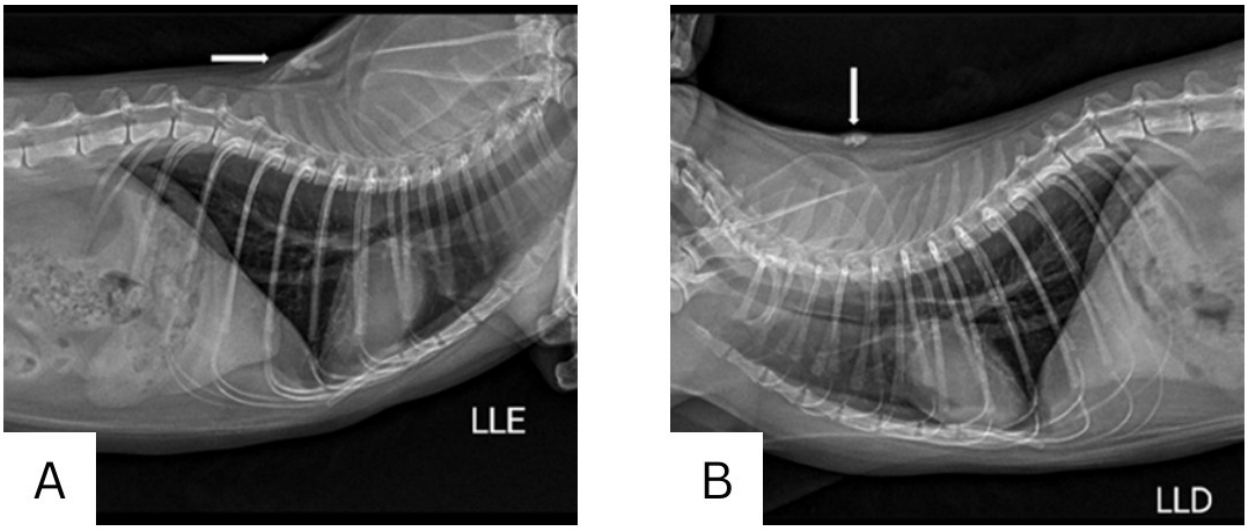

Figure 1. Thoracic radiographs in (A) left lateral and (B) right lateral projections. White arrows indicate the location of the cutaneous neoplasm, with radiopacity similar to bone tissue.

With the patient under general anaesthesia, an excisional biopsy was performed and the sample was sent for histopathology and, if necessary, immunohistochemistry. The decision for an excisional biopsy was made with a diagnostic and therapeutic intent. In the histopathological examination, macroscopically, a brownish fragment measuring 1.0x0.7x0.6cm with a whitish-brown internal surface, sometimes blackened, firm, and sometimes calcified and irregular was evidenced. Microscopically, the fragment presented as a malignant neoplasm diffusely invading the sampled tissue, characterized by fusocellular proliferation of cells large, oval, with voluminous, elongated cytoplasm, indistinct borders, and sparse mitoses (6 figures of mitosis per 2.37mm²). The cells formed loose groups and small clusters interspersed with fibrous stroma, with chondroid and bony differentiation. The histopathological diagnosis was conclusive for poorly differentiated fusocellular sarcoma, morphologically suggestive of OSA or feline soft tissue sarcoma. A general immunohistochemical panel was performed to characterize the mesenchymal neoplasm. Tissue sections processed routinely for histology and embedded in paraffin were placed on previously silanized slides. Antigen retrieval by wet heat method was performed in a steam cooker for 20 to 30 minutes. Incubation with primary antibodies was carried out overnight at 4°C. The revelation was performed using the advanced system. Staining was done with 3,3'-diaminobenzidine and counterstained with hematoxylin. External and/or internal controls were used to validate the reaction. The neoplastic cells expressed RUNX2 and S100 and did not express 1A4, Desmin, MyoD1, and IBA1. Thus, the immunohistochemical and morphological profile favored the diagnosis of osteoblastic OSA.

Following the diagnosis, a new surgical procedure was performed to remove the neoplasm with adequate surgical margins. The patient was anesthetized under a pre-anesthetic medication protocol consisting of dexmedetomidine at a dose of 1µg/kg and methadone at 0.3mg/kg both administered intramuscularly. Induction was performed with propofol at a dose of 5mg/kg associated with fentanyl at a dose of 5µg/kg. Maintenance of the anesthetic plane was achieved with inhaled Isoflurane associated with intravenous (IV) fentanyl. With the patient in sternal recumbency and wide trichotomy of the left scapular region, marking was performed with a surgical dermographic pen (Texta®) recommending wide margins in length and depth, followed by prior and definitive antisepsis with germicidal chlorhexidine (2%) and 70% alcohol. Immediately afterward, an incision was made in a geometric figure (circular) for removal of the neoplasm with lateral margins of 5cm in all directions around the neoplasm, involving the latissimus dorsi muscle in deep margins. After removal, was administered 15UI/m²/IV of bleomycin (Bonar®), and after 8 minutes, electroporation (Electrovet EZ - Leroy Biotech® parallel needles, two rows of 4 needles,

needles with a diameter of 0.68mm, length of 25mm, distance between needles of 5mm) was performed in the surgical bed for 20 minutes (8 pulses, 5Khz, voltage of 500V and wave length 100λ). Upon completion of electrochemotherapy, suturing was performed in three planes, with the muscle sutured in a Sultan pattern with absorbable monofilament polyglyconate 3-0 suture (Bioline®), subcutaneous tissue in an intradermal pattern with absorbable monofilament polyglyconate 3-0 suture (Bioline®), and dermis in a simple interrupted pattern with non-absorbable monofilament nylon 3-0 suture (Figure 2).

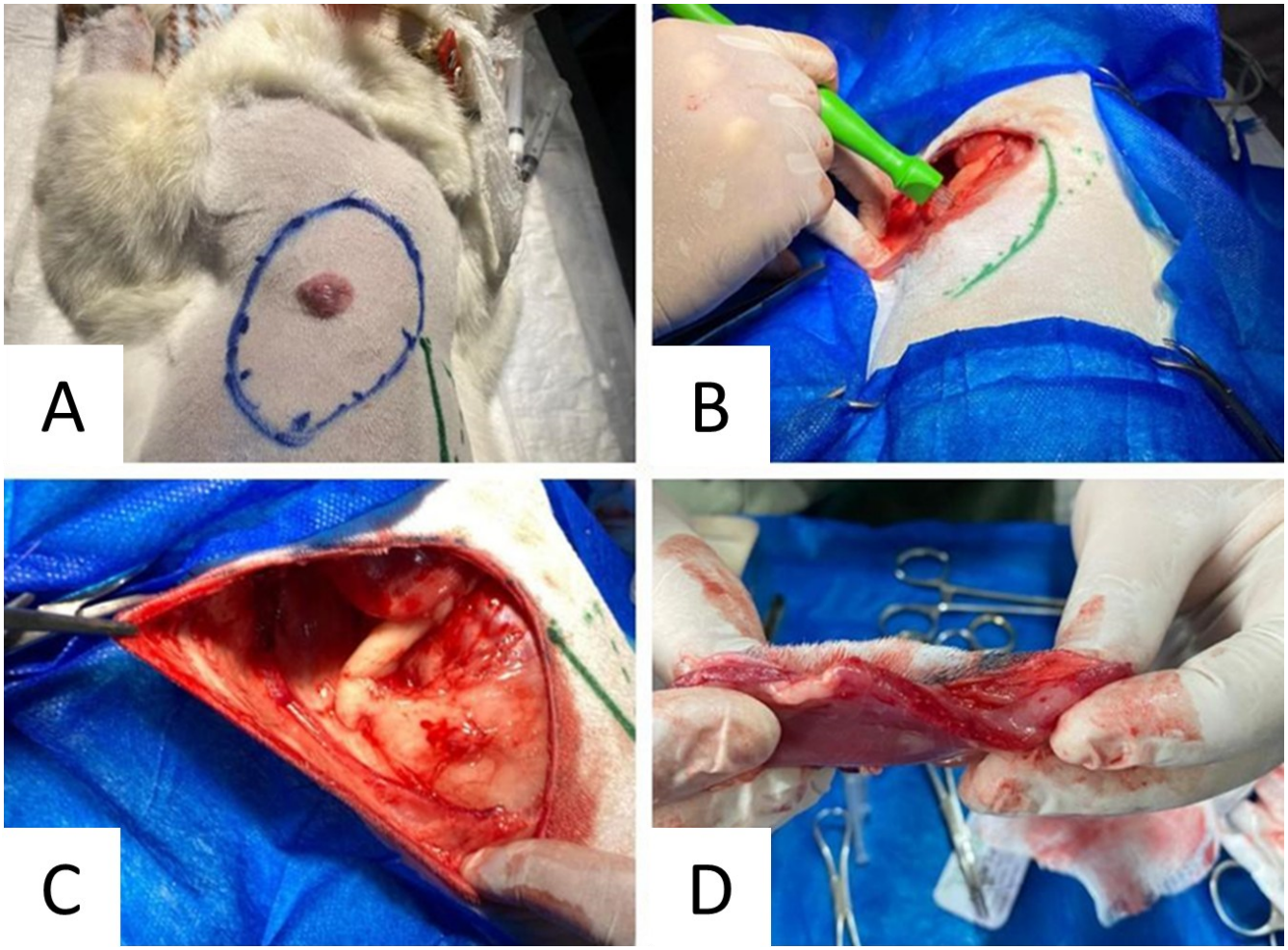

Figure 2. Surgical procedure for the removal of the neoplasm, showing the (A) demarcation of the tumor area, (B) the electrochemotherapy procedure in the surgical bed with bleomycin, (C) the remaining area after removal of the neoplasm and safety margin, and (D) the tissue fragment removed with the neoplasm.

Immediate postoperative pain control protocol was initiated subcutaneously with dipyrone 25mg/Kg (Dornil®), meloxicam 0.1mg/Kg (Flamavet®), tramadol hydrochloride (Cronidor®) 2mg/Kg, and antibiotic amoxicillin + clavulanic acid (Agemoxi®) 12.5mg/Kg. Amoxicillin + clavulanic acid (Agemoxi®) 12.5mg/Kg orally (PO) (every 12 hours, for 7 days) and meloxicam (Maxicam®) 0.1 mg/Kg (every 24 hours, PO, for 5 days) were prescribed for home treatment. The surgical specimen was sent for histopathological evaluation, which revealed fragments of malignant neoplasia in a focal arrangement characterized by proliferation of elongated and oval cells, with moderate nuclear pleomorphism, free histological margins, and a conclusive diagnosis of sarcomatous neoplasia compatible with extraskeletal osteoblastic OSA.

No complications were noted following the removal of the suture 15 days post-surgery, and the animal underwent a new evaluation 3 months after the suture removal, with 6-month follow-ups until 2 years. No other adjuvant therapies were performed other than electrochemotherapy. Three months after the surgical procedure, the patient underwent new staging imaging exams (abdominal ultrasound and chest radiography in three projections), and no alterations suggestive of metastases were detected. The disease-free interval and survival time currently stand at 202 days.

3 | Discussion

Osteosarcoma (OSA) is a primary malignant tumor of osteoblastic cells with a high metastatic rate (Ehrhart et al., 2020). The histological aspect of OSAs varies but is characterized by the proliferation of neoplastic cells of osteoid tissue (Craig et al., 2016; Keith and Keren, 2016). Extraskeletal OSA in felines is rare, accounting for approximately 40% of feline OSAs (Heldmann et al., 2006; Durham et al., 2008).

The patient in the present report had a cutaneous manifestation of osteoblastic OSA, as shown in the histopathological and immunohistochemical examinations. In felines, one of the histological types of application sarcoma is extraskeletal OSA (Novaes et al., 2024). Cases of feline injection-site sarcoma (FISS) can be caused not only by vaccines but also by medications, metallic implants, non-absorbable sutures, and other materials (Saba, 2017).

The patient in the present study is 6 years old, which is consistent with the literature, as some authors observed that animals that developed tumors at the vaccination site were younger than those with similar tumors in other areas of the body and had a bimodal age distribution at 6 to 7 years and 10 to 11 years (Martano et al., 2011).

The therapeutic approaches for osteosarcoma involve radical surgical procedures combined with adjuvant chemotherapy (Farjanikish et al., 2018). In the present case, Bleomycin was not used as a standalone adjuvant chemotherapy. Instead, it was employed in the electrochemotherapy technique (combined with electroporation) as an adjuvant treatment for margin control, differing from the approach reported by the referenced authors.

Mesenchymal tumors in cats respond poorly to systemic chemotherapy, but studies show that adjuvant Electrochemotherapy (ECT) improves local control and survival compared to surgery alone. ECT extended survival with minimal side effects, demonstrating its effectiveness in managing feline sarcomas (Spugnini and Baldi, 2019). A retrospective study indicated that the Bleomycin/Cisplatin combination is well tolerated by cats, with mild dermatologic toxicities (Spugnini et al., 2020). However, it should be emphasized that intravenous cisplatin is contraindicated in cats, mainly due to its pulmonary toxicity. When used in electrochemotherapy, the route of application should be intratumoral or in the surgical bed (Spugnini et al., 2020).

Recent research has shown that adjuvant treatment with ECT and bleomycin using plate and needle electrodes is considered a promising approach to contribute to tumor removal, even in cases of bone invasion (Martins et al., 2021). The patient in this report was in complete remission (202 days) by the end of the documented case, which may have been favored by the appropriate surgical technique associated with electrochemotherapy. Furthermore, it is worth highlighting that ECT acts on the adjacent margins, thus eliminating possible infiltrated tumor cells, common in sarcomas (Miklavcic et al., 2012).

Surgery alone is rarely curative for FISS and their histological types (such as extraskeletal osteosarcoma), and adjuvant therapy is necessary, as only 13.8% of cats treated with surgery alone had long-term survival (> 2 years) (Novosad, 2003). FISS presents high local aggressiveness and tends to recur after surgical excision; however, metastases are rare (Porcellato et al., 2017). In the present study, as well as in the report by Nesi et al. (2000), no metastases were identified after surgical resection. Therefore, reports in the literature describing osteosarcoma in dorsal cutaneous tissue in felines are scarce. However, due to extensive literature affirming recurrence after surgical excision, it is extremely important to monitor the evolution of all affected patients and describe these cases to complement current literature and contribute to the therapeutic choices of veterinary professionals.

4 | Conclusions

The therapeutic approach based on surgical excision of the tumor with wide margins, followed by bedside electrochemotherapy, proved to be an effective local control treatment in this case.

Histopathological and immunohistochemical analysis played a fundamental role in confirming the diagnosis and supporting the selection of an optimal treatment modality. The absence of postoperative complications and the patient's favorable evolution reinforce the importance of early and appropriate surgical intervention in these cases. This study highlights the need for further studies to deepen our understanding of extraskeletal OSA in cats. Therefore, new research is required to improve therapeutic strategies and the clinical management of this condition, aiming for the best care and prognosis for patients.

5 | Conflict of Interest Statement

There are no conflicts of interest to be declared.

6 | Acknowledgements

The authors would like to thank the collaboration and organization of the Veterinary Surgery Study Group of Brazil (GECIVET-Brazil), an inter-institutional student initiative aimed at the development of Brazilian veterinary surgery.

7 | References

Almela, R. et al. Subcutaneous extraskeletal osteosarcoma in a metatarsal footpad in a cat. **Veterinary Dermatology**, 28(5): e129-514, 2017.

Andrade, S.A.F. Osteossarcoma canino. **Revista UNILUS Ensino e Pesquisa**, 6(10): 5-12, 2009.

Cavalcanti, J.N. et al. Osteosarcoma in dogs: clinical-morphological study and prognostic correlation. **Brazilian Journal of Veterinary Research and Animal Science**, 41: 299-305, 2004.

Craig, L.E.; Dittmer, K.E.; Thompson, K.G. Bones and Joints. In: Maxie, M.G. (ed). **Jubb, Kennedy & Palmer's Pathology of domestic animals**. v. 1. 6th ed. St. Louis: Saunders, 2016. p. 16–163.

Durham, A.C.; Popovitch, C.A.; Goldshmidt, M.H. Feline chondrosarcoma: a retrospective study of 67 cats (1987– 2005). **Journal of The American Animal Hospital Association**, 44: 124–130, 2008.

Ehrhart, N.P.; Christensen, N.I.; Fan, T.M. Tumors of the skeletal system. In: Vail, D.M.; Thamm, D.H; Liptak, J.M. **Withrow and MacEwen's small animal clinical oncology**. 6th ed. St. Louis: Elsevier, 2020. p. 524–564.

Farjanikish, G.; Dezfoulian, O.; Mohammadi, H. Metastatic giant cell osteosarcoma in a cat. **Veterinary Research Forum**, 9(3): 289-292, 2018.

Guim, T.N. et al. Aspectos epidemiológicos do OSA extraesquelético em cães. **Ciências Agrárias**, 40(6): 3089-3098, 2019.

Heldmann, E.; Anderson, M.A.; Wagner-Mann, C. Feline osteosarcoma: 145 cases (1990-1995). **Journal of The American Animal Hospital Association**, 36(6): 21-518, 2006.

Helm, J.; Morris, J. Musculoskeletal neoplasia: an important differential for lumps or lameness in the cat. **Journal of Feline Medicine and Surgery**, 14(1): 43–54, 2012.

Keith, G.T.; Keren, E.D. Tumors of bone. In: Meuten, D.J. (ed). **Tumors in domestic animals**. 5th ed. Ames: Wiley Blackwell, 2016. p. 356–424.

Martano, M.; Morello, E.; Buracco, P. Feline injection-site sarcoma: past, present and future perspectives. **The Veterinary Journal**, 188: 136-141, 2011.

Martins, T.M. et al. Adjuvant electrochemotherapy after debulking in canine bone osteosarcoma infiltration. **Artificial Organs**, 45(3): 309-315, 2021.

Miklavcic, D. et al. Electrochemotherapy: Avanços tecnológicos para tratamento eficiente baseado em eletroporação de tumores internos. **Medical and Biological Engineering and Computing**, 50: 1213-1225, 2012.

Nesi, G.; Pedemonte, E.; Gori, F. Extraskeletal mesenchymal chondrosarcoma involving the heart: report of a case. **Italian Heart Journal**, 1: 435–437, 2000.

Novaes, V.R.F. et al. Feline application/inflammation-associated sarcoma: Gross aspects and histomorphological. **Pesquisa Veterinária Brasileira**, 42: e07438, 2024.

Novosad, C.A. Principles of treatment for vaccine-associated sarcomas. **Clinical Techniques in Small Animal Practice**, 18(2): 7-115, 2003.

Oliveira, F.; Silveira, P.R. OSA em cães (revisão de literatura). **Revista Científica Eletrônica de Medicina Veterinária**, 4(11): 1-7, 2008.

Porcellato, I. et al. Feline Injection-Site Sarcoma. **Veterinary Pathology**, 54(2): 204-211, 2017.

Saba, C.F. Vaccine-associated feline sarcoma: current perspectives. **Veterinary Medicine** (Auckland, N.Z.), 12(8): 13-20, 2017.

Silveira, L.M.G. et al. OSA extra-esquelético no tecido subcutâneo de um cão: relato de caso. **Clínica Veterinária**, 11(64): 89-90, 2006.

Spugnini, E.P. et al. Combination of bleomycin and cisplatin as adjuvant electrochemotherapy protocol for the treatment of incompletely excised feline injection-site sarcomas: A retrospective study. **Open Veterinary Journal**, 10(3): 267-271, 2020.

Spugnini, E.P.; Baldi, A. Electrochemotherapy in Veterinary Oncology: State-of-the-Art and Perspectives. **Veterinary Clinics of North America: Small Animal Practice**, 49(5): 967-979, 2019.

Thompson, K.G.; Dittmer, K.E. Tumors of Bone. In: Meuten, D.J. (ed). **Tumors in domestic animals**. 5th ed. Ames: Wiley Blackwell, 2016. p. 356–424.

Verdes, J.M.; Menéndez, C.; Yamasaki, K. Subcutaneous extraskeletal chondroblastic osteosarcoma in a cat. **Journal of Feline Medicine and Surgery Open Reports**, 5(2): 2055116919875532, 2019.