Acta Scientiae Veterinariae, 2024. 52(Suppl 1): 937.

CASE REPORT
Pub. 937

ISSN 1679-9216

Intramedular Malignant Peripheral Nerve Sheath Tumor at C3 Level in a Dog

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ABSTRACT

***Background*:** Malignant peripheral nerve sheath tumors (MPNSTs) are rare sarcomas in domestic animals, originating from peripheral neural cells or cells associated with the peripheral nerve sheath. These tumors primarily occur in the peripheral nerves of the brachial plexus and may occasionally invade the spinal cord. Diagnosing MPNSTs is challenging owing to the primary clinical sign being progressive claudication, which can be of neurogenic or musculoskeletal origin. Thus, this study aimed to report a case of MPNST located at the C3 level in the vertebral canal, focusing on the clinical, imaging, and surgical aspects of the case.

***Case*:** A 9-year-old male mongrel dog, suffering from upper motor neuron tetraparesis, was treated for ataxia and nail dragging on the thoracic limbs. These symptoms later progressed to the pelvic limbs and eventually led to lateral decubitus. Myelotomography revealed a 2 cm neoplasm in the vertebral canal, compressing the spinal cord between the C2-C3 vertebral processes. The patient underwent decompressive surgery via a left dorsal approach to the vertebrae. A hemilaminectomy was performed between C2-C3, removing the laminar bone and exposing the spinal cord and nerve root of the segment. The mass, located in the nerve root region, was carefully separated from adjacent tissues, and removed. The tumor's histology was consistent with MPNSTs. The patient's neurological condition, which had been rapidly deteriorating, improved following spinal cord decompression surgery and mass extirpation. After a 3-day hospital stay, the patient was discharged for homecare. Five days post-surgery, the animal exhibited a return of neurological and ambulatory functions. The surgical procedure was the sole treatment method employed against this sarcoma. However, tumor recurrence was observed 270 days post-resection of the mass in the medullary canal. Given the unfavorable prognosis, the animal was euthanized.

***Discussion*:** Spinal cord tumors are categorized based on their location and segmentation relative to the spinal cord and dura mater. These categories include intramedullary, intradural-extramedullary, and extradural-extramedullary. Imaging tests such as magnetic resonance imaging (MRI) and computed tomography are more effective in locating and classifying spinal cord tumors than X-rays. Historically, myelography has been utilized to outline the subarachnoid space and ascertain the presence of spinal cord compression or expansion. However, MRI provides superior visualization. In this instance, tomography was employed to both verify the neoplasm compressing the spinal cord and to aid in surgical planning. Misdiagnosis of this condition as musculoskeletal claudication is common, leading to a delayed diagnosis of MPNSTs and an unfavorable prognosis. Hematological and biochemical tests are recommended for a general patient evaluation, but primary alterations in these tests are typically not present in patients with MPNSTs. Regarding treatment, total surgical resection of the neoplasm is most advised, as this malignant neoplasm is generally resistant to chemotherapy and radiotherapy. Given the rarity and progression of this disease, it is increasingly important to recognize the clinical signs specific to the case described, in order to establish the correct diagnostic methods and treatment protocols for each patient. Therefore, early diagnosis, grounded in a thorough clinical examination and supplemented by imaging tests, should be paired with aggressive surgical intervention. This approach aims to enhance the prognosis, quality of life, and survival rate of these patients.

Keywords: dog, neoplasm, sarcoma, neurology.

DOI: 10.22456/1679-9216.134744

Received: 2 September 2023 Accepted: 6 January 2024 Published: 12 February 2024

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INTRODUCTION

Peripheral nerve sheath tumors (PNSTs) represent a varied group of neoplasms. They can originate from Schwann cells or associated cells of the perineural sheath, leading to the formation of schwannomas and perineuriomas. Alternatively, they may arise from a combination of endoneurial, epineurial, or stromal fibroblasts, resulting in neurofibromas and malignant peripheral nerve sheath tumors (MPNSTs). The collective term PNSTs is used owing to the challenges in histologic differentiation and the overlapping biological behavior of these tumors [1].

Primary neoplasms of the peripheral nerves can originate in the cranial and spinal nerves, as well as in the peripheral nerves or roots of the brachial plexus. Occasionally, these neoplasms infiltrate the medullary canal and compress the spinal cord. However, they can also affect other sites, including the liver, spleen, adrenal gland, skin, lungs, and eyes [3].

Clinical symptoms can differ based on the anatomical site of neoplasm growth[10]. While complementary imaging tests play a crucial role in tumor identification, definitive diagnosis is established through histopathological and immunohistochemical analyses [7].

Surgical excision is the preferred treatment method however, when tumors are inoperable, chemotherapy serves as a palliative treatment [3,7,10].

The objective of this study was to present a case involving a malignant neoplasm of the peripheral nerve sheath, situated in the C3 nerve root of the spinal cord within the C2-C3 segment of the vertebral canal. The clinical, imaging, and surgical facets of the case are discussed.

CASE

A 9-year-old, mixed breed, medium to large--sized male canine presented with tetraparesis for 15 days. The condition was characterized by ataxia and nail dragging on the thoracic limbs, which subsequently progressed to the pelvic limbs and evolved into lateral decubitus. Within 30 days, the animal experienced a total loss of movement. Upon the onset of the 1st clinical signs of the disease, the owner promptly sought veterinary assistance. The attending veterinarian prescribed prednisolone[1] [1 mg/kg, VO, SID, 7 days] and recommended an evaluation by a veterinary neurologist. The patient exhibited slight improvement within the initial 3 days of treatment, but the clinical signs subsequently intensified.

During the clinical-neurological examination, the patient was alert yet positioned in lateral decubitus. He exhibited tetraparesis, characterized by increased muscle tone and cervical spinal hyperesthesia. Normal spinal reflexes, postural reactions, and cranial nerves were observed. The patient-maintained control over micturition and stool but presented with a cold, swollen scrotum.

The laboratory tests, which included a full blood count, serum biochemistry, and renal function, all fell within the normal parameters for the species.

The animal was referred for a computed tomography examination of the cervical region, and myelotomography with contrast was conducted to accurately visualize the soft tissue lesion. Upon examination, a neoformation of soft tissues, isoattenuating the spinal cord, was observed within the vertebral canal (Figure 1). This neoformation, with partially defined boundaries, occupied a significant portion of the canal's left lateral and medial sections. It extended from the caudal epiphysis of C2, through the C2-C3 intervertebral foramen, to the cranial epiphysis of C3. This resulted in medullary flattening and compression, with attenuation and thinning of the contrast column, which was displaced from the left to the right. The average size of the neoformation was 1.0 × 1.0 × 1.0 cm. Additionally, the neoformation caused an enlargement of the left portion of the vertebral canal caliber and the left foramen between C2-3.

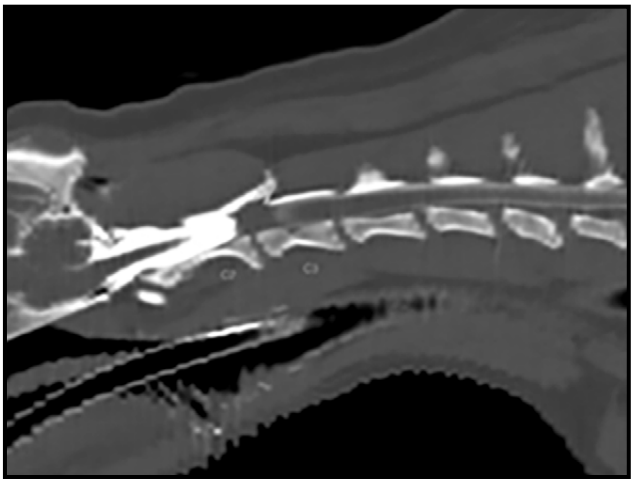

Figure 1. Myelotomography with contrast showing neoformation of soft tissues isoattenuating the spinal cord, with partially defined limits; these formations were located within the vertebral canal.

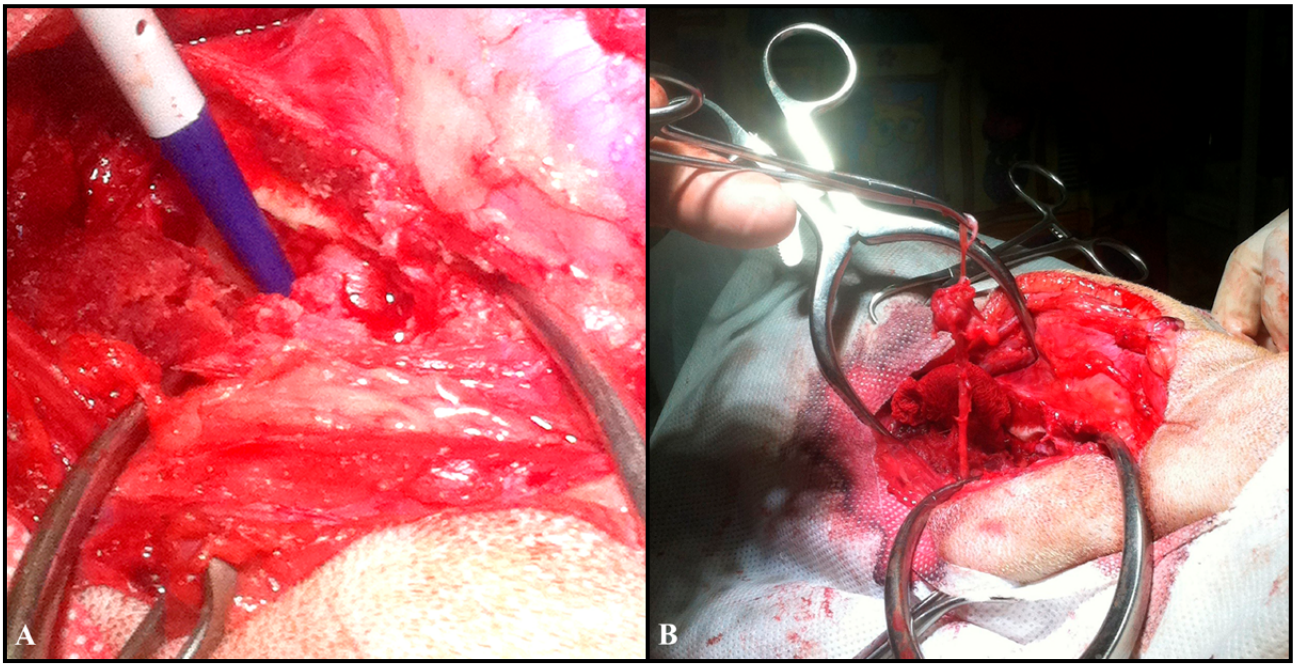

Figure 2. A- Hemilaminectomy was performed between C2-C3 to expose the spinal cord and nerve root of the segment. B- The mass was found in the C3 nerve root region and was carefully separated from adjacent tissues and excised.

The dog was referred for surgery. The operation commenced with a left dorsal approach to the vertebrae, involving an incision of the median raphe to cut through the superficial cervical muscles and laterally retract them. A hemilaminectomy was executed between C2-C3, which involved the removal of the laminar bone, thereby exposing the spinal cord and nerve root of the segment. The mass was discovered in the C3 nerve root region. It was meticulously separated from the surrounding tissues and excised (Figure 2 A and B).

The mass was preserved in 10% formalin before being sent for histopathological examination. Upon microscopic inspection, nerve structure was identified, accompanied by the proliferation of elongated cells with indistinct borders. These cells exhibited a sparse to moderate amount of eosinophilic fibrillary cytoplasm, oval to elongated nuclei with finely stippled chromatin, and 1 to 2 distinct variable nucleoli. Mild anisocytosis and anisokaryosis were also observed. A single mitotic figure was noted per 2.37 mm^2 area. The morphological diagnosis indicated a grade I soft tissue sarcoma, suggesting a MPNST.

The animal was hospitalized for a duration of 3 days. Throughout this time, dexamethasone[2] [2 mg/kg - IV, SID], dipyrone[3] [25 mg/kg - IV, BID], ceftriaxone[4] [30 mg/kg - IV, BID], and tramadol[5] [4 mg/kg - IV, TID] were administered. Approximately 24 h post-surgery, the patient exhibited signs of tetraparesis improvement, demonstrating voluntary limb movements. By the subsequent day, the patient regained walking ability, albeit with persistent ataxia. On the 3rd day, the patient was discharged, with a continuation of the treatment prescribed for homecare. However, the steroidal anti-inflammatory drug was substituted with the non-steroidal carprofen[6] [2.2 mg/kg - SID, 4 days], while the dosages of tramadol[5] and dipyrone[3] were maintained for an additional 3 days.

Eight days post-procedure, the patient returned to the clinic for suture removal and a post-surgical assessment. The animal exhibited normal gait, postural responses, and spinal reflexes. The owner was advised to continue oncological treatment but opted against it. Approximately 270 days following the surgery, the patient developed tetraparesis again. Given the poor prognosis, the decision was made to euthanize the animal.

DISCUSSION

Spinal cord tumors are categorized based on their location and segmentation in relation to the spinal cord and dura mater. These categories include intramedullary, intradural-extramedullary, and extradural-extramedullary. Extramedullary tumors constitute 85% of spinal cord neoplasms, while intramedullary tumors make up the remaining 15% [7,9]. In a particular study,

the identified tumor was classified as intramedullary--extramedullary, located in the C3 nerve root within the C2-C3 segment of the vertebral canal. Nerve sheath tumors and meningiomas are most commonly classified as intramedullary-extramedullary. However, meningiomas are more prevalent in the cervical region compared to nerve sheath tumors [2].

Imaging tests, including magnetic resonance imaging and computed tomography, are more effective than X-rays in locating and classifying spinal cord tumors. X-rays do not reveal soft tissue tumors in the spinal cord. Historically, myelography has been employed to outline the subarachnoid space and ascertain the presence of spinal cord compression or expansion. However, MRI provides superior visualization in nearly all spinal tumor cases [2]; however, this test is not widely accessible in several regions of Brazil, as was the case in this instance. Tomography was utilized both to confirm the presence of the neoformation compressing the spinal cord and to aid in surgical planning.

The animal's clinical signs, including difficulty in movement and progression to tetraparesis, are indicative of PNSTs. A study evaluating 34 dogs with meningiomas and PNSTs revealed that clinical signs varied from single limb lameness to tetraparesis/hemiparesis, contingent on the tumor's location [7].

Cases of MPNSTs are more prevalent in middle-aged to elderly dogs, particularly in medium to large breeds [3], as exemplified by the patient in this study.

Malignant peripheral nerve sheath tumors are categorized as soft tissue sarcomas because of their slow growth, locally invasive behavior, high likelihood of recurrence, and low to moderate metastatic potential. Differentiating this type of neoplasm from others, such as hemangiopericytoma, fibrosarcoma, malignant fibrous histiocytoma, and leiomyosarcoma, is crucial. This is because, in many instances, the histological patterns are similar, rendering immunohistochemistry indispensable for the definitive diagnosis of the existing tumor type [4]. In this particular case, the immunohistochemistry examination could not be conducted owing to the tutor's financial constraints.

The condition is often misdiagnosed as musculoskeletal claudication, leading to a delayed diagnosis of MPNSTs and an unfavorable prognosis. Early diagnosis and treatment are crucial for enhancing survival rates in animals [6]. In the case of the animal studied, a definitive diagnosis was established 30 days following the onset of forelimb lameness. This timely diagnosis likely contributed to the positive clinical outcome observed post-surgery for tumor removal.

Hematological and biochemical tests are typically utilized for a comprehensive patient evaluation. However, primary alterations in these tests are not commonly observed in patients with MPNSTs.

The most recommended treatment for this malignant neoplasm, known for its resistance to chemotherapy and radiotherapy, is total surgical resection. No chemotherapy or radiotherapy protocol has proven effective for MPNSTs [6]. The patient in this case underwent surgical treatment to excise the mass. If the neoplasm invades the medullary canal, a laminectomy or hemilaminectomy, coupled with duratomy and rhizotomy, is necessary to alleviate spinal cord compression and remove the tumor [5]. In this instance, the tumor was partially removed through hemilaminectomy, which also served to decompress the spinal cord. However, complete removal of the neoplasm was not achieved. Following the recurrence of clinical symptoms of ataxia and subsequent tetraparesis, indicative of potential tumor recurrence, the dog was euthanized.

Considering the infrequent occurrence and progression of this disease, it is imperative to closely monitor the clinical symptoms presented in the case under discussion. This will facilitate accurate diagnosis and the development of a tailored treatment protocol for each patient [8]. The prognosis for animals afflicted with MPNSTs is generally poor, particularly when the medullary canal is invaded. This is because such tumors are seldom diagnosed solely on the basis of clinical observations [8].

Therefore, early diagnosis, which relies on comprehensive clinical examinations and imaging tests, should be coupled with aggressive surgical intervention. This approach aims to enhance the prognosis, quality of life, and survival rates of these patients.

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***Acknowledgements*.** This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001. This research was also financially supported by Fundação de Amparo à Pesquisa e Inovação do Espírito Santo - FAPES.

Declaration of interest. The authors report no conflicts of interest. The authors alone are responsible for the contents and writing of the paper.

REFERENCES

1 **Aragosa F., Caterino C., Della Valle G., D'aquino I., Costanza D., Cantile C. & Fatone G. 2021.** Extradural Peripheral Nerve Sheath Tumour at T7 Level in a 2-Year-Old Dog. *VCOT Open*. 04(01): e41-e46. DOI:10.1055/s-0041-1731438.

2 **Bagley R.S. 2010.** Spinal Neoplasm in Small Animals. *Veterinary Clinics of North America - Small Animal Practice*. 40: 915-927. DOI:10.1016/j.cvsm.2010.05.010.

3 **Besalti O., Caliskan M., Can P., Vural S.A., Algin O. & Ahlat O. 2016.** Imaging and surgical outcomes of spinal tumors in 18 dogs and one cat. *Journal of Veterinary Science*. 17(2): 225-234. DOI:10.4142/jvs.2016.17.2.225.

4 **Costa R.C. 2016.** Neoplasias intracranianas, espinais e de nervos periféricos. In: Daleck C.R., De Nardi A.B. & Rodaski S. (Eds). *Oncologia em Cães e Gatos*. 2.ed. São Paulo: Roca, pp.517-531.

5 **Giraud L., Lezmi S., Gomes E. & Cauzinille L. 2020.** A rare case of malignant vagus nerve sheath tumor presenting with multiple cranial nerve dysfunction in a dog. *The Canadian Veterinary Journal.* 61: 1049-1054. PMID: 33012818; PMCID: PMC7488372.

6 **Jark P.C., Ferreira M.G.P.A., Ramos C.S. & Pascoli A.L.C.R. 2016.** Sarcomas de Tecidos Moles cutâneos e subcutâneo em cães. In: Daleck C.R., De Nardi A.B. & Rodaski S. (Eds). *Oncologia em Cães e Gatos.* 2.ed. São Paulo: Roca, pp.517-531.

7 **Lacassagne K., Hearon K., Berg J., Séguin B., Hoyt L., Byer B. & Selmic L.E. (2018).** Canine spinal meningiomas and nerve sheath tumours in 34 dogs (2008-2016): Distribution and long-term outcome based upon histopathology and treatment modality. *Veterinary and Comparative Oncology*. 16(3): 344-351. DOI:10.1111/vco.12385.

8 **Martins B.C., Martins G.C., Horta R.S., Moreira M.V.L., Rocha L., Nagem A.P. & Ecco R. 2015.** Aspectos clínico-patológicos da neoplasia da bainha de mielina no plexo braquial com infiltração do canal medular em um cão. *Acta Scientiae Veterinariae.* 43: 83.

9 **Pancotto T.E., Rossmeisl J.H., Zimmerman K., Robertson J.L. & Werre S.R. 2013.** Intramedullary Spinal Cord Neoplasia in 53 Dogs (1990-2010): Distribution, Clinicopathologic Characteristics, and Clinical Behavior. *Journal of Veterinary Internal Medicine*. 27(6): 1500-1508. DOI:10.1111/jvim.12182.

10 **Silva C.M.O., Caldeira F.M.C., Melo E.G., Ocarino N.M., Silva A.E., Guedes R.M.C., Lavalle G.E. & Serakides R. 2007.** Tumor maligno da bainha de nervo periférico em cães: relato de três casos. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia.* 59(3): 679-684.