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CASE REPORT
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# Radial Neuritis in a Dog: Diagnosis with Assistance of Acoustic Radiation Force Impulse (ARFI) Elastography

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## ABSTRACT

***Background*:** Neuritis is the inflammation of nerves and may be secondary to infection or autoimmune disease. It can affect any nerve of the brachial plexus, with the radial nerve being the most commonly affected in dogs, leading to clinical mononeuropathy. The diagnosis of radial neuritis is established based on clinical findings, electromyography, biopsy, and imaging techniques. In human medicine, Acoustic Radiation Force Impulse (ARFI) elastography, a non-invasive imaging technique, is employed to assess nerves, muscles, and tendons. This report aims to present a case of radial neuritis in a dog diagnosed with the assistance of ARFI elastography.

***Case*:** A 8-year-old neutered male mixed-breed dog was presented for clinical evaluation due to a 30-day history of lameness in the left thoracic limb with no history of trauma. The condition had not responded to previous treatment with anti-inflammatory and analgesic medications. On physical examination, lameness and proprioceptive deficit of the limb were observed. Hematological tests, as well as radiographs of the thoracic limb and cervical spine, revealed no significant abnormalities. B-mode ultrasonography showed a hypoechoic lesion with heterogeneous echotexture, approximately 1.0 cm in diameter, located in the region of the brachial plexus, suggestive of a nodular formation. Thickening of the dorsal nerve root adjacent to the nodule was also noted. ARFI elastography revealed that the nodular region was predominantly stiffer than the surrounding nerve tissue. Histopathological analysis of the radial nerve showed multifocal inflammatory infiltrates along its entire length, confirming the diagnosis of radial neuritis. The patient received analgesic and anti-inflammatory therapy and showed clinical progress, with improvement in lameness and reduction of the proprioceptive deficit.

***Discussion*:** There are few studies exploring ARFI elastography for the evaluation of peripheral neuropathies in veterinary medicine. In 2 cases of peripheral nerve sheath tumors in dogs, diagnosed with the aid of ARFI, the lesions exhibited areas of increased stiffness, and histopathology confirmed the diagnosis in both patients, as observed in the present case. The absence of a history of trauma in this patient further supported the diagnostic suspicion of an associated neoplastic process. In human medicine, affected nerves tend to exhibit thickening and decreased echogenicity, along with increased stiffness, which results from axonal neuropathy, demyelination, and replacement by connective tissue. Ultrasonographic evaluation of the peripheral nerves assisted in the diagnostic approach of this case, revealing thickening of the nerve branch and a suspected adjacent nodular lesion. The use of ARFI elastography provided valuable additional information for case management by indicating the increased stiffness of the nodular area. Magnetic resonance imaging (MRI) is a very useful tool for identifying peripheral nerve lesions, though it has some limitations, such as requiring sedation or anesthesia. In this context, the imaging modalities discussed in this study are more accessible, provide dynamic assessment, and do not require chemical restraint. Although rare, radial neuritis should be considered as a differential diagnosis in cases of persistent lameness and peripheral neuropathy in dogs, especially when associated with findings of increased stiffness on ARFI elastography, which stands out as a potential additional tool in the challenging diagnosis of canine mononeuropathies.

**Keywords:** mononeuropathy, nerve sheath, diagnostic imaging, veterinary neurology, brachial plexus.

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## INTRODUCTION

The brachial plexus is responsible for the innervation of the thoracic limbs, mediating both motor and sensory control, and includes the spinal nerves from C6 to T2 [2]. Peripheral nerve sheath tumors are the most commonly reported condition affecting the brachial plexus; however, inflammatory neuropathies should also be considered in the differential diagnosis [15].

Neuritis is the inflammation of nerves, generally secondary to infection or autoimmune disease. This condition can affect any nerve within the brachial plexus; however, in dogs, the radial nerve is most commonly involved, leading to clinical mononeuropathy [6].

The diagnosis of radial neuritis is established based on clinical findings, electromyography, nerve biopsies, and imaging techniques. Among imaging modalities, magnetic resonance imaging (MRI) is considered the gold standard for evaluating the brachial plexus [20].

ARFI (Acoustic Radiation Force Impulse) elastography is a tool that enables the evaluation of tissue deformability by measuring the wave velocity that returns to the assessed tissues [4,8]. In human patients, this technology has been employed as a non-invasive tool for the evaluation of nerves, muscles, and tendons [3]. This report aims to present a case of radial neuritis in a dog diagnosed with the assistance of ARFI elastography.

## CASE

A 8-year-old neutered male mixed-breed dog was presented for clinical evaluation at the Veterinary Hospital of the Federal University of Santa Maria (UFSM), with a 30-day history of lameness in the left thoracic limb and no previous history of trauma.

On physical examination, decreased proprioception in the left thoracic limb was observed, along with pain upon palpation of the caudal cervical region. Radiographies of the left scapulohumeral and humeroradial-ulnar joints, as well as the cervical spine (C1-T2 segment), were within normal limits. Hematological tests also showed no abnormalities, except for a slight elevation in alkaline phosphatase (156 IU/L, ref.: 7 - 115 IU/L).

Given the suspicion of some pathology affecting the left brachial plexus, an ultrasonographic study of the axillary region was requested. Initially, in B-mode, a diffuse thickening of the nerve root was observed, along with a focal thickening with poorly defined margins, nodular appearance, hypoechoic and heterogeneous echotexture, measuring approximately 1.0 cm in diameter, suggesting a plexus-associated nodular formation (Figure 1).

ARFI elastography of the nodule was performed using a qualitative approach, classifying the lesion according to the elastogram's color scale. In the present study, areas of low stiffness appeared in dark yellow and red, moderate stiffness was indicated by green, and high-stiffness regions were represented in blue. A predominance of stiff tissue (blue coloration) was observed in the nodular region and the adjacent nerve branch when compared to the surrounding tissue (Figure 2).

Cytology was inconclusive due to the low cellularity of the sample. A follow-up histopathological analysis revealed multiple areas of mild to moderate inflammatory infiltrate in the radial nerve, mainly composed of macrophages and a moderate number of lymphocytes and plasma cells. These findings established a definitive diagnosis of multifocal lymphoplasmacytic neuritis and perineuritis of the radial nerve. The patient received a non-steroidal anti-inflammatory and opioid analgesics. During treatment and follow-up, the dog showed improved limb support, with resolution of proprioceptive deficits and other related neurological signs.

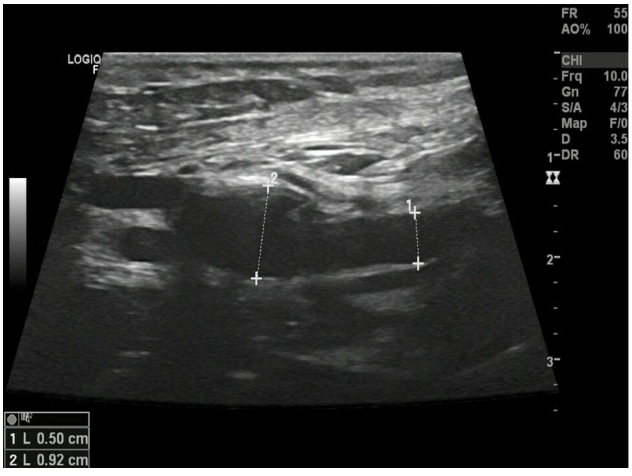


**Figure 1.** B-mode ultrasonography of the brachial plexus of a dog, in a longitudinal plane. Diffuse thickening is noted in the nerve root (caliper 1 = 0.50 cm) and a focal thickening area (caliper 2 = 0.92 cm) with heterogeneous echotexture and poorly defined margins, suggesting the presence of a nodulation.

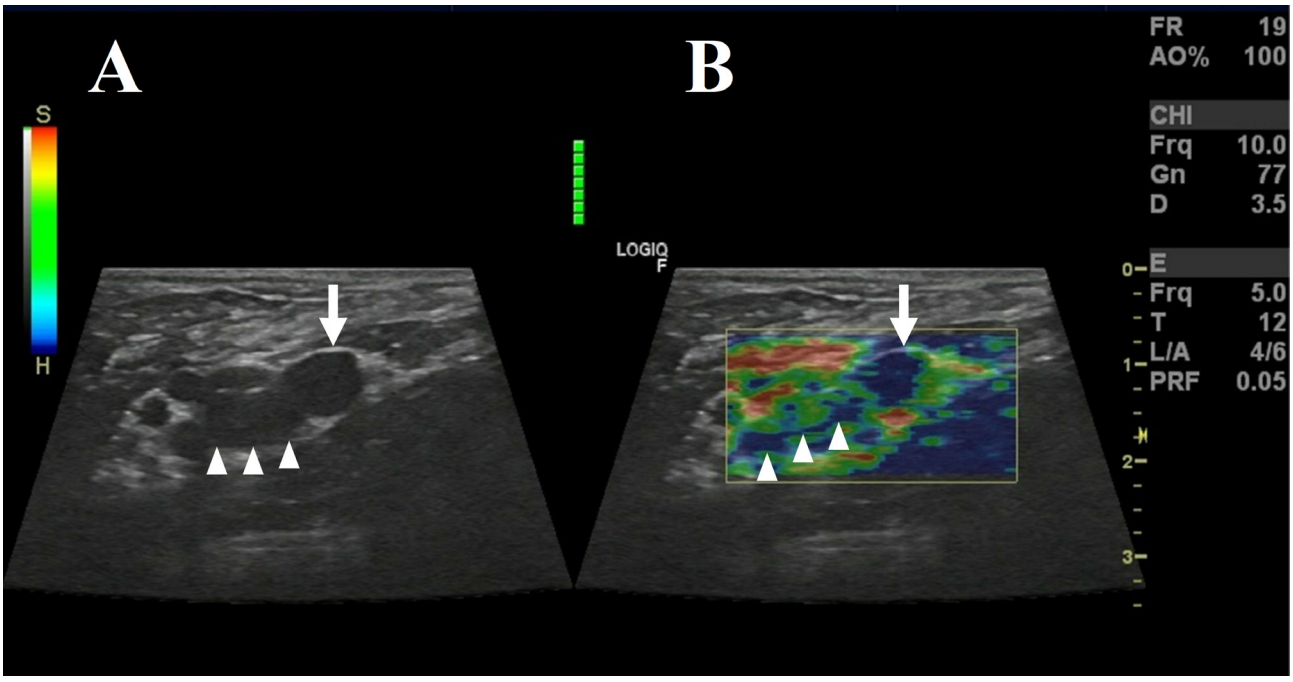


**Figure 2.** B-mode ultrasonography and ARFI elastography of the brachial plexus of a dog, in a transverse plane. The color scale displays tissue stiffness from soft to rigid (red to blue). A- In B-mode, thickening, asymmetry, and a hypoechoic appearance of the nerve branch (arrowheads) are visualized, along with the adjacent nodulation (arrow). B- The elastogram shows blue areas (greater stiffness), mostly in the region of the nodulation (arrow) and the nerve branch (arrowheads).

## DISCUSSION

There are few studies exploring ARFI elastography for the evaluation of peripheral neuropathies in veterinary medicine. Cruz *et al*. [5] reported 2 cases of peripheral nerve sheath tumors in dogs, diagnosed with the aid of ARFI. The lesions described by the authors exhibited areas of increased stiffness, and histopathology confirmed the diagnosis in both patients, as observed in the present case.

A study described a case of radial neuritis in a cat presenting with subacute weakness in both thoracic limbs, unilateral lameness, muscle atrophy, and paresis, in which MRI was the diagnostic tool employed [10].

The clinical manifestation of chronic lameness, as observed in the present patient, may be associated with a range of differential diagnoses, including cervical intervertebral disc disease, brachial plexus disorders (such as avulsion, neoplasia, and neuritis), cervical spondylomyelopathy, and myopathies such as polymyositis [15]. Neuritis has been reported as a secondary condition in cases of disc extrusion [15], foreign body migration [7,21], viral infection [9], and other infectious processes [11].

The brachial plexus is one of the primary sites for peripheral nerve neoplasms and a common target of traumatic injuries. Neoplastic lesions commonly involve the formation of palpable masses associated with severe pain and may be associated with changes in intervertebral foramina and lytic bone lesions; however, such findings are observed in only 50% of affected patients [16]. This was not detected in the present case. The absence of a history of trauma in this patient further supported the diagnostic suspicion of an associated neoplastic process.

The diagnosis of radial neuritis can be challenging. The suspicion is based on clinical findings, including the evaluation of the contralateral limb [12]. In this case, the definitive diagnosis was confirmed by histopathological analysis of the nerve, as described in previous studies [20]. The same authors emphasized the value of imaging techniques such as ultrasonography, with or without MRI, for a dynamic assessment.

Ultrasonographic evaluation of the peripheral nerves assisted in the diagnostic approach of this case, revealing thickening of the nerve branch and a suspected adjacent nodular lesion. The use of ARFI elastography provided valuable additional information for case management by indicating the increased stiffness of the nodular region within the nerve branch. Brachial plexus tumors commonly present as solid lesions, typi-

cally hypoechoic with heterogeneous echotexture and exhibiting distinct vascularization patterns [4].

Similar to findings in studies with human neuritis, B-mode ultrasonography revealed thickening and decreased echogenicity of the affected nerve [1]. The same authors highlighted the possibility of diffuse nerve branch thickening due to inflammation, which was observed in the present case, along with a focal and nodular area of marked thickening.

When compared to B-mode imaging, ARFI elastography provides greater contrast between nerve structures and surrounding tissues when used to evaluate peripheral nerves of the brachial plexus and the sciatic nerve [18], as demonstrated in the present case. In human peripheral neuropathies of various etiologies, the affected nerves typically exhibit increased stiffness, which results from axonal neuropathy, demyelination, and replacement by connective tissue [22].

MRI is a very useful tool for identifying peripheral nerve lesions, such as cases of neuritis [10,14,17], though it in studies with human neuritis some limitations, such as requiring sedation or anesthesia. In this context, the imaging modalities discussed in this study are more accessible, provide dynamic assessment, and do not require chemical restraint.

In human patients, ultrasound has become an increasingly common tool for assessment of peripheral nerves [13], as it provides valuable information about nerve microstructure [19,22]. In the same context, elastography images can improve the non-invasive evaluation of changes in nerve composition [22].

Although rare, radial neuritis should be considered as a differential diagnosis in cases of persistent lameness and peripheral neuropathy in dogs, especially when associated with findings of increased stiffness on ARFI elastography.

ARFI elastography evaluation can be considered a complementary tool to B-mode ultrasonography for assisting in the challenging diagnosis of canine peripheral nerve lesions. It is a non-invasive exam that can aid in the establishment of differential diagnoses and can distinguish appropriate therapeutic approaches for primarily inflammatory lesions and neoplastic processes.

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

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