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ATLANTOAXIAL INSTABILITY IN A YORKSHIRE DOG - CASE REPORT

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Abstract

Atlanto-axial instability is a condition that primarily affects small breed dogs, especially toy breeds, with a higher prevalence in young animals. These abnormalities can secondarily cause neurological disorders such as cervical pain and tetraplegia. This study aims to highlight the challenges in diagnosing atlantoaxial instability due to multiple causes, using advanced imaging techniques. The study was conducted on a 1.3-year-old female Yorkshire Terrier presenting neurological signs suggestive of atlantoaxial instability. Radiographic examination, CT scans, and MRI were performed, confirming the diagnosis based on developmental/congenital abnormalities at the occipito-atlanto-axial level.

Key words: *Imaging Diagnosis; atlantoaxial instability; MRI; toy breed; CT.*

INTRODUCTION

Atlantoaxial instability represents a common cause of cervical pain and neurological disorders characterised by tetraplegia or paraplegia (Slanina, 2016). This condition was first reported in 1967, primarily affecting small breeds, especially toy breeds such as Yorkshire Terrier, Pomeranian, Miniature or Toy Poodle, and Chihuahua, with the highest prevalence in young individuals - over 50% of cases occurring in dogs under six months of age (Slanina, 2016; Cummings et al., 2018).

This condition may have congenital or acquired causes, often resulting from cervical trauma (Slanina, 2016). Congenital causes include aplasia or hypoplasia of the odontoid process, dorsal angulation or degeneration of the odontoid process, and the absence of ligamentous support. Additionally, incomplete ossification of the atlas is considered a predisposing factor in large breeds (Wheeler, 1992; Slanina, 2016). In congenital cases, symptoms appear before the age of two years and may progress to cervical hyperesthesia, ataxia, and severe tetraplegia.

Atlantoaxial joint instability frequently results in excessive flexion, leading to the dorsal displacement of the axis relative to the atlas and subsequent spinal cord injury. Clinical signs range in severity from neck pain to paralysis, depending on the degree of spinal cord compression and contusion caused by the displacement. In the most severe cases, this subluxation can cause respiratory failure and death. Neurological symptoms may develop either suddenly or gradually in individuals with atlantoaxial instability (Slanina, 2016; Aikawa et al., 2013).

Atlantoaxial instability is typically diagnosed using standard radiographs; however, advanced imaging methods such as computed tomography (CT) and magnetic resonance imaging (MRI) provide valuable supplementary details and assist in planning for surgical treatment (Slanina, 2016; Aikawa et al., 2013).

This case study highlights the challenges of diagnosing atlantoaxial instability using advanced imaging techniques.

MATERIALS AND METHODS

The study involved a 1.3-year-old female Yorkshire Terrier puppy displaying cervical pain and paraplegia. A suspected diagnosis of atlantoaxial luxation was established following a neurological examination, and a specialized imaging examination was recommended.

An EXAMION radiology device was used for the radiological examination. The animal was

positioned in right lateral recumbency, ensuring a mild flexion of the cervical region.
The computed tomography (CT) examination was performed using a General Electric (GE) Revolution Evo 64-slice system, with a transverse helical CT series at the level of the skull and cervical region, reformatted with the following algorithms: native-bone/soft tissue; post-contrast-bone/soft tissue.
For the magnetic resonance imaging (MRI) examination, a Siemens Magnetom system with a power of 1.5 Tesla was used. The imaging protocol consisted of T1-weighted Spin Echo (SE) and T2-weighted Fast Spin Echo (FSE) sequences, performed with the animal placed in sternal recumbency under general anaesthesia. (Neagu et al., 2018).
Premedication was administered intravenously with Butorphanol at a dose of 0.2 mg/kg, followed by induction using Propofol at 3-5 mg/kg IV. After intubation, anaesthesia was sustained with Isoflurane and 100% oxygen. A volume-cycled ventilator provided spontaneous breathing or intermittent positive-pressure ventilation (IPPV), delivering 12-15 breaths per minute to maintain an end-tidal CO_2 level between 35-45 mmHg.
Following induction, oxygen was initially administered at 2 L/min, with the anaesthetic vaporizer set to achieve a target end-tidal isoflurane level of 2.0% within 10 minutes. Once this concentration was stabilized, the oxygen flow was decreased to (500 + 10/kg) mL/min, and the isoflurane concentration was maintained at 1.5% for the remainder of the procedure to ensure adequate anaesthesia. (Tudor et al., 2019; Pavel et al., 2021).

RESULTS AND DISCUSSIONS

The study's patient is a 1.5-year-old female Yorkshire Terrier. The clinical examination revealed cervical hyperesthesia when moving the head and neck. The neurological examination identified paraplegia and delayed proprioceptive sensitivity in the hind limbs, but with normal reflexes and a preserved normal mental status.
As a result, the neuroanatomical localization was identified at the cervical spinal level. Based on the VITAMIND acronym, the potential aetiologies considered included inflammatory, traumatic, and degenerative causes. Following the neurological assessment, radiographic imaging and computed tomography of the cranio-cervical region were recommended to evaluate the osseous structures, along with magnetic resonance imaging to assess the degree of spinal cord involvement. Radiographic evaluation of the C1-C2 cervical region demonstrated an increased distance between the ventral arch of the atlas and the odontoid process, as well as a widened space between the dorsal arch of C1 and the spinous process of C2. It was not possible to determine whether spinal cord compression was present.

Figure 1. Right lateral radiograph of the cranio-cervical junction showing an increased distance between the ventral arch of the atlas (C1) and the odontoid process, along with a widened space between the dorsal arch of C1 and the spinous process of C2

Computed tomography identified abnormalities at the atlantooccipital joint, including hypoplastic occipital condyles, mild dorsoventral elongation of the foramen magnum, and a slight ventral displacement of the atlas. At the atlantoaxial joint, findings included misalignment of the vertebral lamina characterized by significant widening of the space between the dorsal tubercle of C1 and the spinous process of C2 - partially corrected by positioning during imaging - as well as mild hypoplasia of the odontoid process
During the MRI examination at the C1-C2 level on the sagittal images of the occipito-atlanto-axial segment, an increase in the distance between the base of the C1 vertebra and the odontoid process can be observed. Additionally, an increase in the distance from the C1 dorsal arch to the C2 spinous apophyse is noted. There is also the disappearance of the T2 hyperintense

signal from the dorsal and ventral subarachnoid space, as well as spinal cord modifications such as dorsal deviation, along with compression. This is due to hypoplasia/aplasia of the dens or changes in its position.

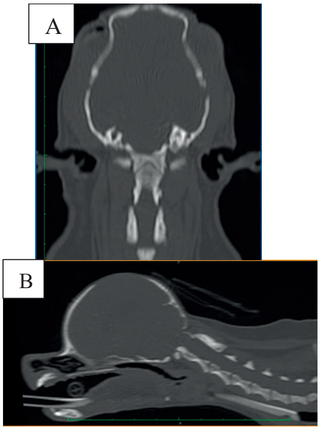

Figure 2. Dorsal (A) and sagittal (B) reconstructions of the cranio-cervical junction reveal hypoplastic occipital condyles, a mild dorso-ventral elongation of the foramen magnum, and a subtle misalignment of the atlas with ventral displacement. At the atlantoaxial joint, there is malposition of the vertebral lamina, characterized by significant widening of the space between the dorsal tubercle of C1 and the spinous process of C2, which spontaneously corrected with CT positioning. Additionally, a slight hypoplasia of the dens is noted

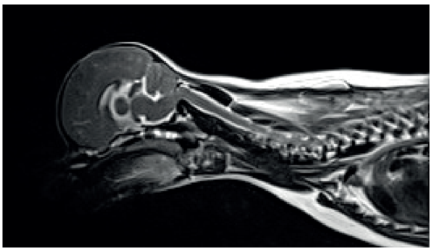

Figure 3. Sagittal image - C1-C2 segment - shows a noticeable widening of the space between the base of the C1 vertebra and the odontoid process. Additionally, an increased gap is evident between the posterior arch of C1 and the spinous process of C2. The T2 hyperintense signal is absent at both the dorsal and ventral subarachnoid levels. Furthermore, the spinal cord shows a dorsal displacement accompanied by compression

Atlantoaxial instability is a condition that tends to occur most commonly in small breeds, particularly Yorkshire, Pomeranian, Chihuahua, and Pekinese breeds (Cerda-Gonzales et al., 2010). A study published by Tudury et al. in 2018 highlighted that among toy breeds, the prevalence is highest in Yorkshire Terriers (30.30%), Poodles (21.21%), mixed-breed dogs (12.12%), and Miniature Pinschers (9.09%). However, it can also be found in large breeds such as Rottweilers (Wheeler et al., 2008). The age of affected animals ranges from 3 to 108 months, but 72.72% of affected animals were 12 months old or younger, indicating that this condition is more common in young animals, especially during the first year of life, as observed in the current study (Beckmann et al., 2010; Tudury et al., 2018). The primary causes are usually linked to congenital abnormalities of the C1 and C2 vertebrae, such as malposition of the vertebral lamina leading to an enlarged gap between the dorsal tubercle of C1 and the spinous process of C2, along with underdevelopment or absence of the odontoid process. Additionally, minor cervical traumas can trigger or worsen the symptoms of instability, leading to neurological changes (Seim, 2008; Stalin et al., 2014).

The diagnosis of atlantoaxial instability relies on the patient's medical history and neurological assessment. It is confirmed with the help of advanced imaging methods, which are particularly valuable as they allow evaluation of the angulation between the C1 and C2 vertebrae, identification of potential anomalies in this region, and, through MRI, assessment of the extent of spinal cord compression (Waschk et al., 2019; Stalin et al., 2014).

An essential indicator in diagnosing atlantoaxial instability is the widened space between the posterior arch of the atlas and the spinous process of the axis (Kealy & McAllister, 2005; Fernandez et al., 2010). Seim describes in 2010 that a space of over 4 to 5 mm between the C1 lamina and the dorsal spinous tubercle of C2 generally allows for the diagnosis to be established in small breed dogs. Despite the numerical values described by Seim (2008), these are imprecise due to the significant variability in the size of dogs, thus maintaining subjectivity.

The diagnosis through radiographic examination is recommended to be performed without general anaesthesia if the patients are cooperative, to avoid causing further spinal cord trauma through the head flexion manoeuvre

(Lorenz & Kornegay, 2006; Fernandez et al., 2010).

Radiographic and CT examinations are valuable techniques for diagnosing conditions localised to the bony structures, whether traumatic or congenital in nature. However, to confirm the diagnosis of spinal cord involvement, MRI remains the most valuable method (Stalin et al., 2014; Cerda-Gonzales et al., 2010).

The clinical signs presented in this study, the age of the animal, and the breed are consistent with previous studies on this topic.

CONCLUSIONS

Atlantoaxial instability predominantly affects dogs, particularly those of small and toy breeds, with Yorkshire Terriers showing the highest incidence. Clinical data are correlated with the neurological examination and supplemented with specialised imaging to confirm the diagnosis.

Radiology and CT examination are the most useful techniques for visualising the bony changes underlying atlantoaxial instability, while MRI helps determine the degree of spinal cord involvement.

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