A congenital numerical anomaly of 8 lumbar vertebrae in dogs: a case report

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Abstract. This paper is a case report of an 8LV in dog, in which anamnesis, clinical, and radiological aspects are presented. A half-breed female dog of 6 years old and 13 kilos in weight was presented in August 2020 at the Medical Clinic of Veterinary Faculty of Iași. Considering the moderate difficulty in walking, ventrodorsal and lateral lumbar spinal radiographs were performed. Although it was not the primary aim, the lumbar vertebrae was counted, using as a reference point the last thoracic one. The radiographic investigations revealed a diagnosis surprise, a supernumerary lumbar vertebra, namely 8LV. This was not considered the cause of the difficulty reported in walking, a diagnosis of herniated disc being established by other imaging examinations. However, after 20 physiotherapy sessions that involved the usual procedures of action on the regional muscles, the dog recovered significantly. We consider the 8LV with congenital support and a selection against it and other vertebrae malformations is recommended.
Key Words: spine development, abnormalities, supernumerary vertebrae.

Introduction. In the anterior to posterior direction, the axial skeleton in mammals consists of seven morphological types of vertebrae, regionalized as cervical, thoracic, lumbar, sacral, and caudal (Zhu et al 2012). In dogs, the normal vertebral column consists of seven cervical, 13 thoracic, seven lumbar, 3 fused sacral, and a variable number of 20 caudal vertebrae, depending on the breed (Moeser & Wade 2017).

An interesting variant in vertebral differentiation is represented by the presence of an eighth lumbar vertebra (8LV), reviewed to be a normal type development that is rarely clinically significant (Moeser & Wade 2017). In some cases, due to the fact that the supernumerary L8 vertebra presents common morphological features to both lumbar and sacral vertebrae, it is associated as a Transitional Lumbo-Sacral Vertebra (TLSV), also named Lumbo-Sacral Transitional Vertebra (LSTV) (Pollis et al 2011), although, typically, the last aspect refers to the forming of an abnormally vertebra as a result of the fusion between the last normal lumbar vertebra and the first normal sacral vertebra (Abutaher & Avinash 2019; Damur-Djuric et al 2006; Gong et al 2020). In this regard, the morphology of the newly formed vertebra varies considering its process of formation, by sacralization, when the last lumbar vertebral body fuse to the sacrum, or by lumbarization, when the first sacral segment fuse to the lumbar vertebra. However, Moeser & Wade (2017) reviewed the suggestion that the 8LV have to be considered as a part of the TLSV complex, taking into account its size and morphology.

There is a scarcity of information on the 8LV development since, as previously reviewed, there seems to be of no clinically significant importance. It is undoubtedly a congenital condition, being also produced under the action of teratogenic substances, as Bailie et al (1986) reported in the case of supernumerary vertebrae for 67% of Beagle pups whose moms received 25 mg acetohydroxamic acid kg^{-1} day^{-1}, as a urease inhibitor used for the treatment of infection-induced struvite urolithiasis, from the onset of proestrus until parturition. Fialová et al (2014) reviewed TLSV as a hereditary condition, without a clearly elucidated type of inheritance for this disease.

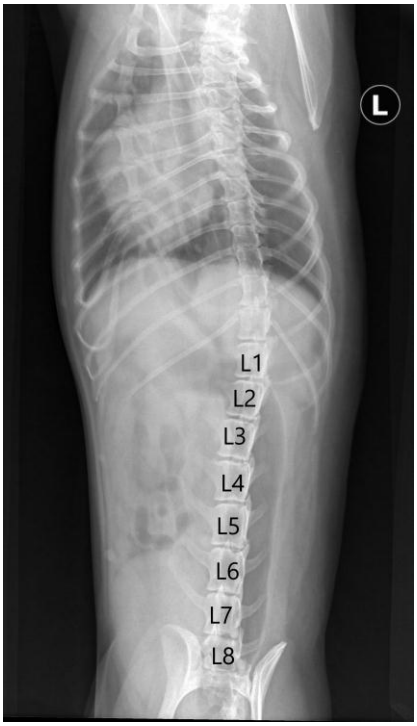
The 8LV insignificant clinically importance is in opposite with that of TLSV, which often was associated with canine hip dysplasia (CHD) and may lead to Cauda Equina Syndrome (CES) (Damur-Djuric et al 2006; Flückiger et al 2009; Gong et al 2020; Kuricová et al 2018). There was reported a probability of eight times more chances to develop CES on a background of TLSV (Flückiger et al 2006). Although TLSV was directly reported at a higher prevalence in German Shepherd Dog (GSD) (3.5-40%) compared to other breeds (Damur-Djuric et al 2006; Komsta et al 2015; Wigger et al 2009) or indirectly, taking into account the probability of eight times more chances that GSD to develop CES compared to other breeds (Flückiger et al 2006), not all the time this fact was confirmed, since Gong et al (2020) reported the highest frequency in Pugs, followed by Jack Russell Terrier, Yorkshire Terrier, Chihuahua, French Bulldog, and on the 15th position, the GSD. Although Gong et al (2020) reported no gender association for TLSV, Morgan et al (1999) found transitional vertebral segments more frequently in Labrador retriever females than in males. Taking into account the subsequent CES, males dogs were reported with double fold chances to develop it than females (Flückiger et al 2006). Hip dysplasia was reviewed at a 5 times higher risk of development in GSD when comparing with Rottweilers, Labrador Retrievers, and Golden Retrievers, in some cases the TLSV conferring a chance through the weakening of the sacroiliac attachment (Komsta et al 2015). When referring to CES, this is a result of the stenosis of the lumbosacral vertebral canal (in accordance to the premature intervertebral disk degeneration in the lumbosacral segments) and subsequent compression of the cauda equine nerve roots. The GSD seems to be the most affected breed and generally for Degenerative Lumbo-Sacral Stenosis (DLSS), as reviewed by Ondreka et al (2013) and Worth et al (2013).

To date, a major locus for congenital vertebral malformations failed to be found although, based on mice studies, were hypothesized and genotyped human genes as *DLL3, PAX1, SLC35A3, WNT3A, T* (or *Brachyury*), *TBX6* (Ghebranious et al 2008; Giampietro et al 2005, 2006). For example, Ghebranious et al (2008) reported a variant in human *T* gene (also known as a transcription factor essential to mesodermal development), c.1013C>T, with Ala338Val change at the protein level, which seems to increase the risk for congenital vertebral malformations. Into another study, Giampietro et al (2005) reported mutations in human *PAX1* gene to be associated with vertebral malformations [for example, a CCC(Pro) to CTC (Leu) change at amino acid 410 and a CCA(Pro) to CTA (Leu) change at amino acid 413]. In 2006, Giampietro et al sequenced the *DLL3* gene in human patients with congenital vertebral malformations and found an association of G to A missense mutation in a heterozygous individual that changed glycine to arginine at codon 269 for a T5-T6 vertebrae block. However, such pathology is distantly related to that investigated in this paper and genetic associations in dogs were not found by us in the studied literature.

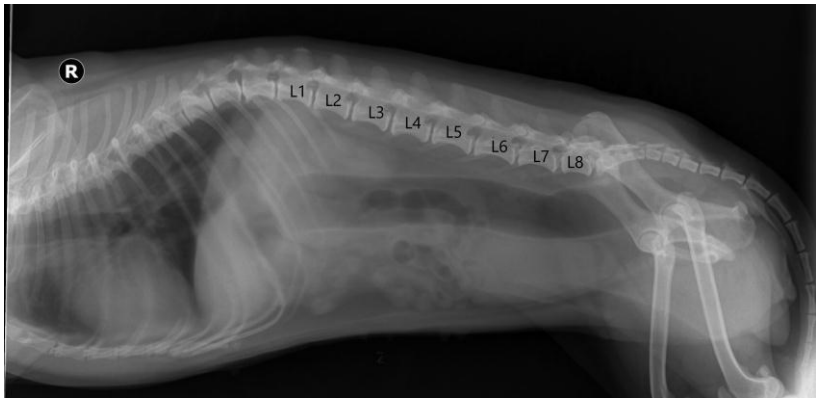
This paper is a case report of an 8LV in dog, in which anamnesis, clinical, and radiological aspects are presented.

Material and Method. This report is based on a case study of a half-breed female dog of 6 years old and 13 kilos in weight, which was presented in August 2020 at the Medical Clinic of Veterinary Faculty of Iași. Considering the moderate difficulty in walking, ventrodorsal and lateral lumbar spinal radiographs were performed. Although it was not the primary aim, the lumbar vertebrae was counted, using as a reference point the last thoracic one.

Results and Discussion. The radiographic investigations of a half-breed female dog investigated for moderate difficulty in walking revealed a diagnosis surprise, a supernumerary lumbar vertebra, namely 8LV (Figure 1).



A.



B.

Figure 1. Radiographs of a dog with 8LV. (A) Ventrodorsal view; (B) Lateral view.

This variant of lumbar spine development is an interesting one, spectacular even, but it cannot be considered the cause of the difficulty reported in walking, a diagnosis of herniated disc being established by other imaging examinations. However, the patient was considered recoverable, and special care and physiotherapy were recommended. After applying 20 physiotherapy sessions that involved the usual procedures of action on the regional muscles, the dog recovered significantly. Through this, we confirmed its lack of pathological involvement in the walking quality being, as Moeser & Wade (2017) reviewed, a kind of normal development without significant clinical importance. Even so, as an interesting genetic condition may be considered, without a clear background established and with just several supposed loci investigated for related conditions in mice and humans (Ghebranious et al 2008; Giampietro et al 2005, 2006).

Conclusions. An 8LV case was reported in a 6-years old female dog, without affecting its clinical status. A moderate difficulty in walking was diagnosed, but it was an effect of herniated intervertebral disc. We assumed a genetic predisposition of this special type of spine development, but there is a scarcity of genetic information in dogs, some loci being tested in mice and genotyped in humans. However, a selection against 8LV and other vertebrae malformations in recommended in veterinary practice, since a major locus of influence was not established yet and also the type of inheritance for other assumed involved loci.

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