LUMBOSACRAL TRANSITIONAL VERTEBRA (LTV) IN CAT: A CASE REPORT

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Abstract

The observations of the study were focused on the lumbosacral region of the spine in cats in order to identify some peculiarities or abnormalities in the anatomical conformation regarding the number of the vertebra or other morphological aspects. For this purpose were analyzed the radiographs of the lumbosacral region of 63 feline patients of a veterinary clinic, both males and females, 1-9 years aged, which showed various symptoms, especially locomotor. The x-ray exam revealed sundries pathologies of the spine, but among them in a cat of European breed it was remarked an abnormal anatomical conformation of the lumbosacral spine consisting in the sacralization of the last lumbar vertebra. It was noticed that the last lumbar vertebra is fused with the first sacral one in a large degree, both vertebral bodies and the transverse processes being merged, the sacrum bone containing four sacral vertebra instead of three, as normally does. It was counted also three ventral sacral foramina, instead of two. The particular characteristics noticed conducted to the observation that the last lumbar vertebra represents in fact a lumbosacral transitional vertebra (LTV) which in cats occurs at a low rate.

Key words: cat, lumbosacral spine, sacralization, radiographs.

Along of the spine, the number of vertebrae differs from a region to another, but is relatively constant in a species. It is well known that the cervical region is the most constant, almost all the mammals having 7 cervical vertebrae (Brocal J. *et al*, 2018), few exceptions being known. The vertebral formula in domestic carnivores includes: 7 cervical vertebrae, 13 thoracic vertebrae, 7 lumbar vertebrae, 3 sacral vertebrae (fused, forming the sacrum bone) and a variable number (20-23) of caudal vertebrae (Coțofan V. *et al*, 1999; Konig H.E., Liebich H-G, 2010; Ferat-Postolache A. *et al*, 2021). Especially for the dogs, there are numerous studies which revealed that the last lumbar vertebra can be more or less fused with the first sacral vertebra, the process being named sacralization. It is reported also the lumbarization process when the first sacral vertebra is fused with the last lumbar vertebra, but in a lower rate. Lumbarization and sacralization produced similar abnormalities, so they were all considered together (Abutaher C.P., Avinash P.R., 2019; Deepa T.K., John M.K., 2014; Konin G.P., Walz D.M., 2010; Newitt L.M.A. *et al*, 2009). These processes can appear especially when exist a supernumerary vertebra in the lumbar region – 8LV, but also can occur when exist 7 lumbar vertebrae. This aspect is known as the lumbosacral transitional vertebra (LTV). It is considered a congenital anomaly and has morphological characteristics of both lumbar and sacral vertebrae (Damur-Djuric N. *et al*, 2006; Flückiger M.A. *et al*, 2009). Usually, these vertebrae have characteristics of both spinal segments, and they may be symmetrical or asymmetrical in morphology. Transitional vertebrae are considered to be an intermediate type of vertebra, formed due to the pelvis and vertebrae forming contact slightly cranial or caudal to their normal point of contact, resulting in the formative stimulus affecting the development of the transverse processes. It is postulated that if this contact is oblique, then asymmetry of the transitional vertebra will result (Newitt L.M.A. *et al*, 2009). These abnormalities can be clinically insignificant or can conduct to some pathologies of the spine, but not only (Damur-Djuric N. *et al*, 2006; Flückiger M.A. *et al*, 2006; Gong H. *et al*, 2020). If in dogs was reported a large incidence of LTV, especially in some breeds, in cats the presence of LTV is rare and there are no relevant studies in this way and for that we analyzed the morphology of lumbosacral region in cats to identify some of these abnormalities.

MATERIAL AND METHOD

The study included the cat patients of a veterinary clinic which presented various pathologies, especially locomotor symptoms. The animals were subjected to clinical examination and then to x-ray exam of the spine to identify the pathological process and for diagnosis. Were chosen those animals of whose lumbosacral spine was examined. The x-ray exam was realized in latero-lateral position and also, ventro-dorsal

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one. Were analyzed the radiographs of 63 cats, both males and females, 1-9 aged. A single animal, a cat of the European breed, 5 years, was identified with an abnormal anatomical conformation of the lumbosacral region and was selected for our observation.

RESULTS AND DISCUSSIONS

After the examination of the x-ray images of lumbosacral region, in a cat of common European breed, having 7 lumbar vertebrae, was observed that the last lumbar vertebra (7LV) is completely fused with the sacrum bone, being totally sacralized (*figure 1, 2, 3*).

From lateral view (*figure 1*) can be observed that the 7th lumbar vertebra is shorter, being almost entirely placed between the two iliac wings *(Ala ossis ilii)*, and is no evident intervertebral disk between its body *(Corpus vertebrae)* and the body of the first sacral vertebra (*Promontorium*) (N.A.V.). Ventro-dorsally (*figure 2, figure 3*) the same characteristics are evident, but also is visible that the transvers processes *(Processus transversus)* are shorter cranially and both are fused with those of the first sacral vertebra, being transformed in "wings". Because of this high degree of merging resulted another two large ventral sacral foramina *(Foramina sacralia ventralia)*, on each lateral side of the sacrum existing three such as foramina instead of two as in the normal sacrum bone (Cotofan V., 1999; Ferat-Postolache *et al*, 2021). Can be remarked the large contact between the iliac bones and the wings of the sacrum *(Ala sacralis)*, especially on the right side of the pelvic cavity. These characteristics make that the 7th lumbar vertebra to look more like a sacral vertebra. Due to these aspects we can talk about a case of transitional lumbosacral vertebra (LTV) in cat.

Figure 1. **European cat, 5 years – 7 lumbar vertebrae; the shortening and the sacralization of the last lumbar vertebra (L7) – no visible intervertebral disk; latero-lateral view**

Figure 2. **European cat, 5 years – 7 lumbar vertebrae; the shortening and the sacralization of the last lumbar vertebra (L7); ventro-dorsal view**

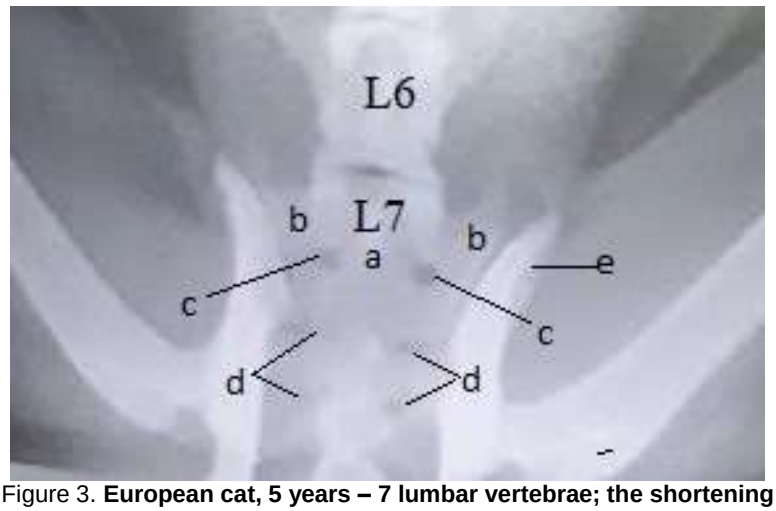

Figure 3. **European cat, 5 years – 7 lumbar vertebrae; the shortening and the sacralization of the last lumbar vertebra (L7); ventro-dorsal view – details: a-the body of the 7th lumbar vertebra; b-the transverse processes of the 7thLV-"wings"; c-"additional" ventral sacral foraminae; d-anatomical ventral sacral foraminae; e-iliac wing**

In dogs, the presence of LTV is more frequent than in cats, in particular German Shepherd being over-represented, leading to a suggestion that there may be a genetic predisposition to these abnormalities (Breit S. *et al*, 2003; Larsen J.S., 1977). In LTV, the vertebral bodies demonstrate varying morphology, ranging from broadened transverse process to complete fusion (Konin G.P., Walz D.M., 2010). These variations are affected by gender, developmental factors and race. It has been proved that this anomaly is seen to affect males more than females (Deepa T.K., John M.K., 2014). The LTV is considered a congenital anomaly, which occurs in various species of animals and in humans (Flückiger M.A. *et al*, 2006) and its presence can be clinically significant. In addition, a hereditary predisposition to LTV has been suggested (Damur-Djuric N. *et al*, 2006; Morgan J.P., 1999; Morgan J.P. *et al*, 1993; Morgan J.P. *et* al, 1999; Morgan J.P. *et al*, 2000; Wigger A. *et al*, 2009). The condition of the presence of LTV is known to predispose dogs to develop DLSS (degenerative lumbosacral stenosis) in dogs (Ondreka N. *et al*, 2013) and can lead to premature degeneration of the lumbosacral junction and cauda equina syndrome (CES). This aspect was particularly observed in German Shepherds (Flückiger M.A. *et al*, 2006; Flückiger M.A. *et al*, 2009; Morgan J.P. *et al*, 1993). There was reported that the dogs with an LTV were eight times more likely to develop CES than dogs without an LTV and German Shepherd dogs were eight times more likely to develop CES compared with other breeds. The same studies highlighted that the male dogs were twice as likely to develop CES than females. Dogs with an LTV develop CES 1-2 years earlier than dogs without an LTV (Flückiger M.A. *et al*, 2009). Asymmetric LTV types may lead to pelvic misalignment beyond the vertical axis, causing a unilateral load increase on the hip joint, which results in detrimental development of the hip joint (Damur-Djuric N. *et al*, 2006; Larsen J.S., 1977; Flückiger M.A. *et al*, 2009). Cauda equina syndrome is reported in cat (Hurov L, 1985; Hardie E.M. *et al*, 2002) but not in association with lumbosacral transitional vertebrae (Newitt A. *et* al, 2008). In cats, the studies identified no specific breed dispositions, but numbers identified in all breeds were low, so this cannot be entirely excluded. However, morphology between different breeds does not vary in the cat, unlike in dogs, and hence despite the fact that a number of breeds were used, these data are likely to be valid for the feline population as a whole (Newitt *et al*, 2009). Some studies (Newitt *et al*, 2009) described congenital abnormalities at all levels in the feline spine, predominantly transitional vertebrae, and found no association between transitional vertebrae and clinical signs. Newitt *et al.* (2008) examined the congenital (46 cases) and non-congenital abnormalities (154 cases) of the lumbosacral spine. The transitional vertebrae were the most common abnormality, being identified four cases of sacralization of L7 and 1 case of lumbarization of S1, but LTV was observed also in other regions of the spine as in the case of the thoracolumbar or sacrocaudal junction and the studies concluded that there is no evidence of association with clinical signs. Newitt *et al.* (2009), in a study that included 114 cats, identified 14 cases of LTV with a different morphology and found no significant differences in prevalence of spondylosis or hip abnormalities between all cats with lumbosacral transitional vertebrae and the control group and no association between the presence of a lumbosacral transitional vertebra and spondylosis and there

was no association between hip disease (osteoarthritis or hip dysplasia) and the presence of a transitional vertebra. Still, the study of Harris *et al*. (2018) on 13 cats with lumbosacral stenosis, revealed that despite lumbosacral stenosis is a rare spinal condition in cats, lumbosacral transitional vertebrae can be considered a risk factor for its development. In this way, seven cats (53.8%) were diagnosed with lumbosacral transitional vertebrae. In the control population of 405 cats, 24 (5.9%) were diagnosed with lumbosacral transitional vertebrae. Results indicated that lumbosacral transitional vertebrae were significantly more prevalent in cats with lumbosacral stenosis compared with the control feline population. Development of clinical signs of lumbosacral stenosis in cats with lumbosacral transitional vertebrae (mean 10.8 years) was not significantly different from that of cats without lumbosacral transitional vertebrae (mean 12.7 years). Likewise, there was no significant influence of breed or sex on the occurrence of lumbosacral transitional vertebrae.

CONCLUSIONS

As in dogs, LTV can appear in cats, but in a lower rate. The conformation of LTV in cats is also variable, in our case being present a high degree of fusion between the last lumbar vertebra and first sacral one. There are few studies that reveal the pathological implication of LTV in cats.

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