

*Case Report*

**CONGENITAL THORACIC KYPHOSIS CAUSED BY HEMIVERTEBRA IN A PUG PUPPY**

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**Abstract**

Congenital spine deformation caused by vertebral malformation is reported in different brachycephalic dog breeds, but also in other large dog breeds. The most severe clinical signs are due to spinal cord compression. Depending on localisation of the lesion, clinical signs can manifest differently. A five-month-old pug was brought for autopsy to the Department of Forensic Veterinary Medicine, Faculty of Veterinary Medicine, University of Belgrade. The first clinical signs, including general weakness and difficulty to jump appeared when he was three and a half months old. They became more severe until the dog was four months old. Radiography and myelography showed severe kyphosis and spinal cord compression in the T8-T9 region. After euthanasia, an autopsy was performed. Pathomorphological examination showed severe deformation of the spine, kyphosis and a wedge-shaped T8 vertebra. Although, literature data indicates that clinical signs can be latent until five or six months of age, this case shows that even in young puppies, three to four months old, serious clinical signs can be present. This is of great clinical importance, not just for veterinarians, but also for brachycephalic dog owners and breeders.

**Key words:** hemivertebra, kyphosis, pug, pathomorphology, radiography

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## CASE PRESENTATION

Different types of vertebral malformations, including hemivertebra, butterfly vertebra, atlanto-occipital malformations, cervical spondylomyelopathy, spina bifida, transitional vertebra and block vertebra, are reported in various dog breeds (Forterre et al., 2015).

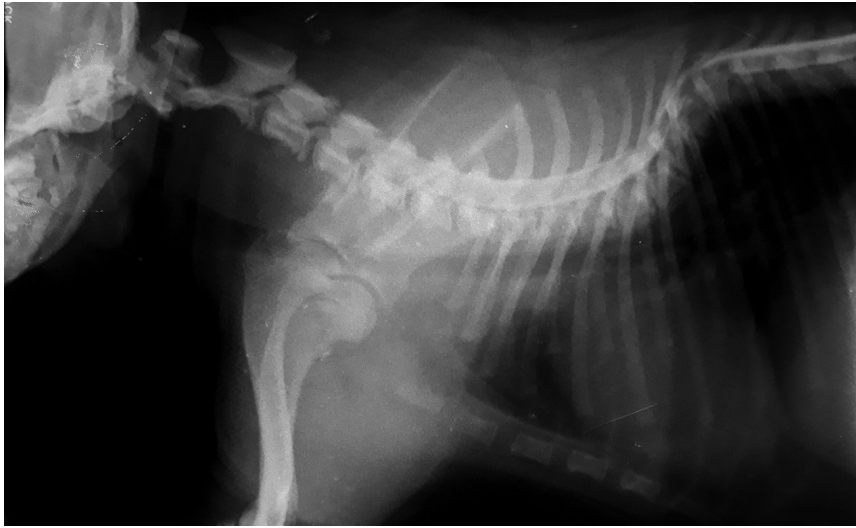
Hemivertebra is defined as a congenital spine malformation where only a portion of the vertebral body is present. It can be caused by hemimetameric displacement of somites, or it can be due to altered vascularisation and ossification of vertebra. This spine malformation can cause kyphosis (associated with dorsal hemivertebra), lordosis (associated with ventral hemivertebra), or scoliosis (most often associated with lateral hemivertebra), and these are commonly associated with compression on the spinal cord and related neurological problems (Sinowatz, 2010).

Although any breed can be affected, hemivertebra is a common abnormality in small brachycephalic screw-tailed breeds, such as English bulldog, French bulldog, Boston terrier and pug. This malformation can also be observed in Yorkshire terrier, West Highland white terrier, fox terrier, Pekingese and German pointer (Moissonnier et al., 2011; Schlensker and Distl, 2013; De Rycke and Saunders, 2017). Sex predisposition to this anomaly is not established, and it is thought to be a heritable disease that is autosomal recessive. About 60% of affected dogs show clinical signs of disease at less than a year old (Dewey et al., 2015). Depending on hemivertebra localisation, symptoms can vary, but they are always consequences of spinal cord pressure. The most common clinical signs are pelvic limb ataxia, paresis, loss of spinal reflexes, urinary incontinence, atrophy of the pelvic muscles and atomy of the pelvic limbs (Moissonnier et al., 2011; Aikawa et al., 2014).

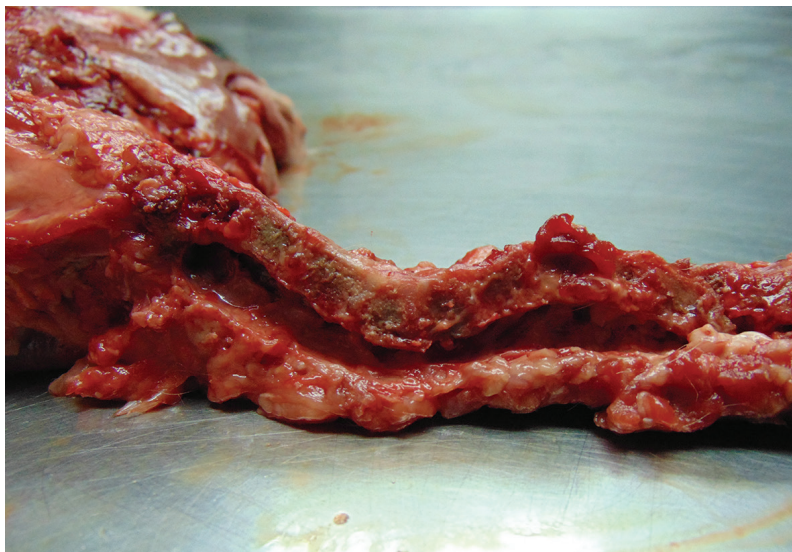
Diagnostic techniques include radiography, myelography, computed tomography (CT) and magnetic resonance imaging (MRI). The basic radiographs can provide evidence of bone malformation, while myelography can provide evidence of spinal cord compression (Dewey et al., 2015; De Rycke et al., 2017).

A euthanised five-month-old pug was brought to the Department of Forensic Veterinary Medicine, Faculty of Veterinary Medicine, University of Belgrade. The owner wanted to know the reason for the dog's bad *pre-mortem* health condition. The owner had obtained the dog at three months of age from the breeder. The first clinical signs appeared after two weeks, and they included difficulty jumping onto a bed, into the car and problems going up and down the stairs. In the next two weeks, clinical signs become more severe and pelvic limb weakness appeared. On neurological examination, the dog showed signs of paraparesis, severe pelvic limb weakness, pain in the thoracic region and deficit in responses to toe knuckling and hopping. Complete blood count and basic biochemistry were performed. All parameters were in the reference range. On X-ray imaging, the presence of vertebral abnormality and kyphosis in lateral view was diagnosed. In order to determine potential spinal cord compression, the veterinarian performed myelography. Myelography revealed marked

spinal cord compression in the T8-T9 region, with severe kyphosis and vertebral deformation (Figure 1). Due to the fact that the dog was just five months old, and surgery is suggested for dogs older than nine months, the veterinarian started medical treatment. Anti-inflammatory doses of prednisolone and pain-relieving drugs were prescribed. After a week of therapy, the dog's condition did not improve, and the owner decided to euthanise the dog.



**Figure 1.** Myelography finding: kyphosis and vertebral deformation caused by spinal cord compression in T8-T9 region



**Figure 2.** Pathomorphological finding: dorsal hemivertebra with consequential severe kyphosis in the region of T8-T9

At autopsy, after gross examination of the body, the whole sagittal section of the spine was examined closely and the median anatomic section was photographed. Gross examination of the mid-sagittal section of the thoracic vertebral column revealed dorsal hemivertebra with consequential severe kyphosis in the T8-T9 region and marked compression on the spinal cord (Figure 2, Figure 3).



**Figure 3.** Pathomorphological finding: wedge-shape of T8 vertebra

## DISCUSSION

It is considered that hemivertebra is the result of asymmetrical development or fusion of the two ossification centres of the centrum of one or more vertebral bodies. This leads to various kinds of vertebral body malformations (Jeffery et al., 2007). Deformations present in vertebral bodies are thought to be errors in embryonic/foetal development (Dewey et al., 2015). The most important reason for this condition in screw-tailed dogs is the fact that the tail is the effect of hemivertebra which is present in the coccygeal region (Jeffery et al., 2007). Hemivertebra can occur on one or more vertebrae in different parts of the spine (cervical, thoracic, lumbar), causing different clinical signs among affected dogs (Done et al., 1975; Moissonnier et al., 2011).

In this report, a young pug puppy was suspected of having spine malformation caused by hemivertebra. As literature data suggest, this breed and other brachycephalic breeds are predisposed to vertebral deformation (Moissonnier et al., 2011; Schlensker and Distl, 2013). The clinical signs in this dog appeared when the dog was just three and a half months old, which is earlier than described in other cases (Jeffrey et al., 2007; De Rycke et al., 2017). Neurological signs indicated upper motor neuron damage involving

the T3-L3 spinal cord region. Clinical signs reported in our case, i.e. general weakness, pelvic limb weakness and mild back pain were also described in earlier studies (Aikawa et al., 2014; Dewey et al., 2015; De Rycke et al., 2017). Our dog did not have signs such as hyperesthesia, urine incontinence and disk extrusion described in the literature (Dewey et al., 2015). Regarding the severity of the clinical signs, age and progress of disease and poor results of symptomatic therapy, surgery was not recommended. Based on all these facts, the veterinarian proposed euthanasia. The owner, understanding the dog's poor condition, decided to euthanise the puppy. Surgical management can be challenging, although there is a small number of described cases of dogs treated with fixation using pins and PMMA (polymethylmethacrylate) with good outcomes reported in 11/12 dogs (Aikawa et al., 2007; Jeffery et al., 2007).

This paper reports a five-month-old pug with neurological signs such as pelvic limb weakness, paraparesis, pain in the thoracic region and deficit in responses to toe knuckling and hopping, as described in the literature (Moissonnier et al. 2011; Aikawa et al., 2014). The puppy did not have any previous history of any trauma or vertebral infection. Radiological and morphological examination revealed vertebral malformation in the form of dorsal hemivertebra. Hemivertebra led to consequential severe kyphosis in the T8-T9 region and marked compression on the spinal cord, as described by other authors (Dewey et al., 2015; De Rycke et al., 2017).

It can be concluded that even in severe cases of kyphosis caused by hemivertebra, clinical signs cannot be seen in the first two to three months of a puppy's life. The most important reason for that is the ossification of the vertebra. It is of great importance to advise veterinarians and breeders of brachycephalic dogs to perform screening during the first months of each puppy's life, so this malformation is diagnosed on time.

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### **Authors contributions**

DD participated in design of the study and writing the manuscript; DM performed necropsy and wrote the manuscript; DD performed clinical examination and helped to draft manuscript; VN conceived of the study and participated in its design. All authors read and approved the final manuscript.

### **Competing interests**

The authors declare that they have no competing interests.

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## KONGENITALNA KIFOZA U TORAKALNOM DELU KIČME USLED PRISUSTVA HEMIVERTEBRE KOD ŠTENETA MOPSA

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### Kratak sadržaj

Kongenitalne deformacije kičme uzrokovane malformacijama na vertebraama javljaju se kod različitih brahicefaličnih rasa, ali se mogu javiti i kod velikih rasa pasa. Najteži klinički simptomi se javljaju usled kompresije kičmene moždine. U zavisnosti od lokalizacije lezije, simptomi se mogu različito manifestovati. Leš mopsa starosti pet

meseci donešen je zbog obdukcije na Katedru za sudsku veterinarsku medicinu, Fakulteta veterinarske medicine Univerziteta u Beogradu. Prvi klinički simptomi, u vidu opšte slabosti i poteškoća pri skakanju, javili su se kada je štene bilo staro tri i po meseca. Simptomi su u četvrtom mesecu postali mnogo ozbiljniji. Nativno rendgensko i mijelografsko snimanje pokazalo je uznapredovali stepen kifoze i kompresije kičmene moždine u T8-T9 regionu kičme. Nakon eutanazije, pas je obdukovao. Patomorfološki nalaz ukazao je na ozbiljnu deformaciju kičme, izraženu kifoza i klinast oblik T8 pršljena. Iako literaturni podaci ukazuju da klinički simptomi mogu biti nezapaženi sve do pet ili šest meseci starosti, ovaj slučaj pokazuje da čak kod mlade štenadi, starosti tri do četiri meseca, mogu biti prisutni ozbiljni simptomi. Ova činjenica je od velikog značaja, ne samo za veterinare, već i za odgajivače i vlasnike brahicefaličnih rasa pasa.

**Ključne reči:** hemivertebra, kifoza, mops, patomofologija, rendgenografija