

Closed spinal dysraphism in a 6-month-old mixed breed dog

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Abstract: The term spinal dysraphism defines an incomplete fusion or a bone defect that affects the neural structures of the spinal cord due to a neural tube malformation. A 6-month-old, male, mixed-breed dog, was evaluated for paraparesis, pelvic limb proprioceptive ataxia, faecal and urinary incontinence. A neurological examination indicated an L4-S3 spinal cord segment lesion. A thoracolumbar and lumbosacral spine magnetic resonance imaging was performed and a closed spinal dysraphism, with the presence of a lipomyelomeningocele, was detected. The magnetic resonance imaging showed an entire narrowing passage and a fibrous mass stemming from a wedge-shaped gap in the caudal region of the dorsal lamina of the L4 vertebra, leaving the spinal canal towards the skin surface in the region where the skin stigma was observed. A dorsal laminectomy was performed, the spinal cord was exposed, and the entire fibrous mass was excised. Three months postoperatively, the patient had a complete resolution of the urinary and faecal incontinence showing only a residual mild paraparesis, which remained six months after surgery. The surgical procedure resulted in the satisfactory recovery of the neurological signs.

Keywords: congenital malformation; lipomyelomeningocele; spina bifida

Spinal dysraphism defined as an incomplete fusion or defect of the bone and other neural structures of the spine due to a neural tube mal-

formation represents a spectrum of congenital anomalies classified into two subtypes: open and closed (Westworth and Sturges 2010).

Open spinal dysraphism, characterised by nerve tissue exposition through a defect in the meninges and/or vertebral column, is the most often diagnosed in the neonatal period. In closed spinal dysraphism (CSD), the resulting malformation is covered by the skin without exposure of the neural tissue (Rossi et al. 2006), and was reported in English Bulldogs, French Bulldogs, Collies, and Manx cats (Wilson et al. 1979; Plummer et al. 1993; Kopke et al. 2019). CSD can occur anywhere in the spine, but it is most commonly diagnosed in the lumbosacral area (Westworth and Sturges 2010).

Lipomyelomeningocele is a type of CSD and consists of a subcutaneous fibroadipose mass that intersects the lumbar fascia, causing a laminar spinal defect, displacing the dura and, in some cases, anchoring and infiltrating the spinal cord (Rossi et al. 2006).

Case description

A 6-month-old, male, mixed-breed dog, 8.8 kg, was presented with a 3-month history of progressive weakness in the pelvic limbs, ataxia and urinary and faecal incontinence. There was no history of trauma.

The neurological examination showed ambulatory paraparesis with decreased muscle tone, proprioceptive ataxia and proprioceptive deficits in the pelvic limbs. The nociception of both pelvic limbs was normal and the patellar reflexes were

decreased. The anal sphincter reflex and sensitivity were also diminished. The other segmental reflexes of the thoracic and pelvic limbs were normal. These findings indicated an L4-S3 spinal cord lesion.

Upon palpation, a mass of soft consistency was observed in the L4 spinous process region. The dorsal midline region also had skin and hair changes, characterised by a 0.5-cm diameter, circular hypopigmentation lesion with a changing hair direction (Figure 1).

Palpation of the head revealed an open frontoparietal fontanelle. The orthopaedic examination detected a grade IV medial patellar luxation in the right pelvic limb. The complete cell blood count (CBC) and biochemistry profile were unremarkable.

Radiographs of the thoracolumbar, lumbosacral spine and pelvic limbs were obtained. They showed a radiolucent wedge in the caudal region of the dorsal lamina of the L4 vertebra and a medial patellar luxation in the right pelvic limb with varus deviation and an external rotation of the distal femur. The ultrasound of the caudal lumbar region showed a hyperechoic structure in the subcutaneous region suggestive of a fat deposition due to its echogenicity.

Magnetic resonance imaging (MRI) (Vet-MR, 0.25 Tesla; ESAOTE, Génova, Italy) of the brain, thoracolumbar and lumbosacral spine were performed. The MRI showed the entire narrowing spinal canal and a fibrous mass stemming from a wedge-shaped gap in the caudal region of the dorsal lamina of the L4 vertebra, leaving the spinal canal towards the skin surface in the region



Figure 1. Photograph of the dog's lumbosacral region. Note the skin changes (arrow) present in the dorsal midline

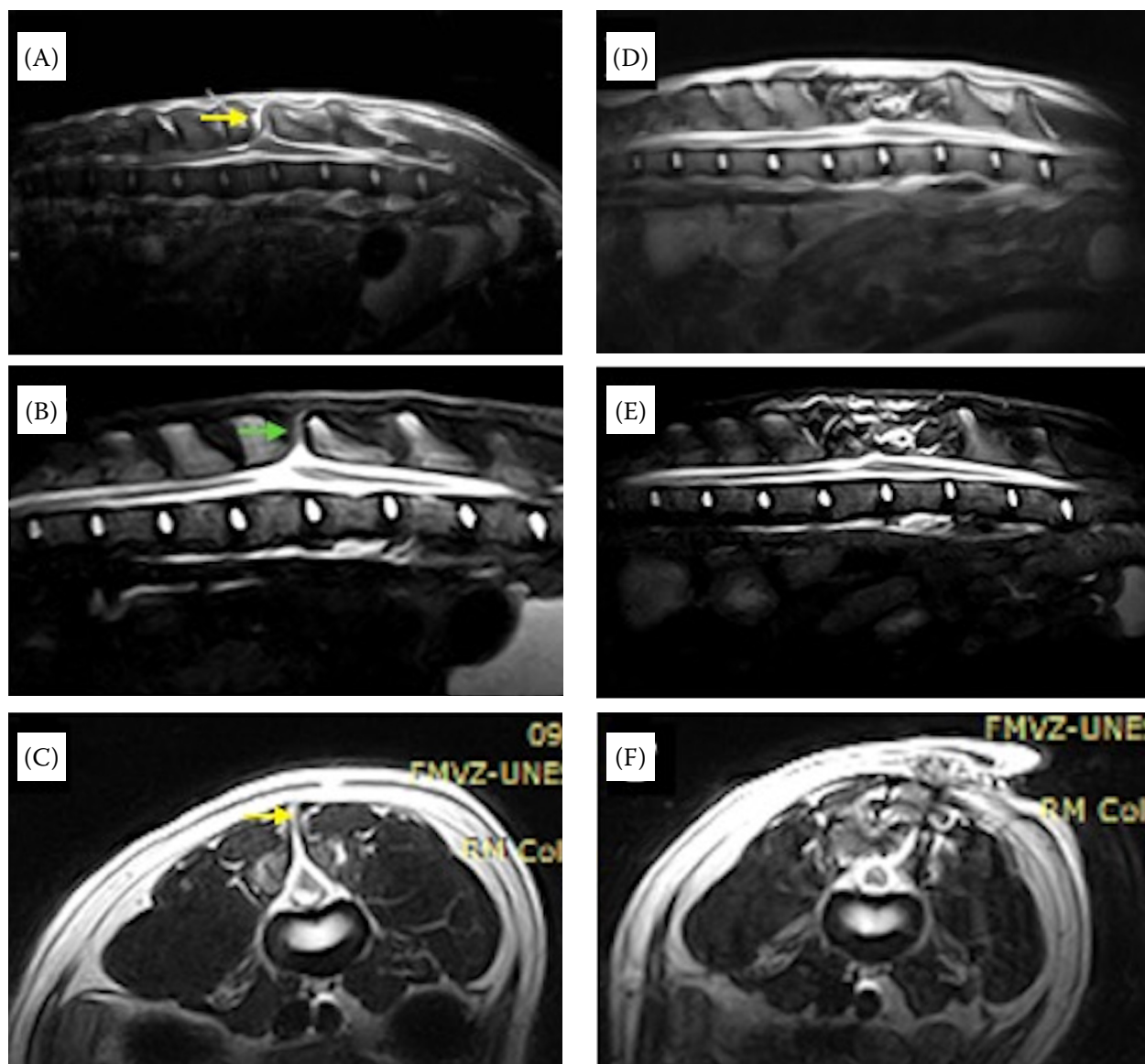


Figure 2. Sagittal T2-weighted MRI (A) and transversal T2-weighted MRI (C) of the thoracolumbar spine showing a defective closure of the spinal canal at the L4 vertebrae, through which a fibroadipose mass protrudes (yellow arrow) toward the epidermis. Sagittal STIR-weighted MRI (B) of the thoracolumbar spine showing a defective closure of the spinal canal at the L4 vertebrae with the suppressed adipose tissue (green arrow) compatible with lipomyelomeningocele. Follow up sagittal T2-weighted MRI of the thoracolumbar spine showing a complete resection of the lipomyelomeningocele. Follow up sagittal (D) and transversal (E) T2-weighted MRI (F) and sagittal STIR-weighted MRI of the thoracolumbar spine showing a complete resection of the lipomyelomeningocele

where the skin stigma was observed (Figure 2). These findings were suggestive of lipomyelomeningocele. The brain MRI ruled out other congenital anomalies. Computed tomography (CT) scans (SCT-7800CT; Shimadzu, Kyoto, Japan) of the thoracolumbar, lumbosacral spine and pelvic limbs were also conducted. The lumbosacral spine CT allowed a three-dimensional reconstruction of the L4 dorsal lamina deformation, previously detected

by the radiographs. Similarly, a pelvic limb CT was performed in order to plan the surgical correction of medial patellar luxation (Figure 3).

The patient underwent inhalational anaesthesia after 8 h of fasting and was positioned in sternal recumbency. Ceftriaxone (Ceftrion; Redson Pharmaceuticals, Ahmedabad, India), 30 mg/kg, i.v., was given before induction. The thoracolumbar and lumbar regions were aseptically prepared.

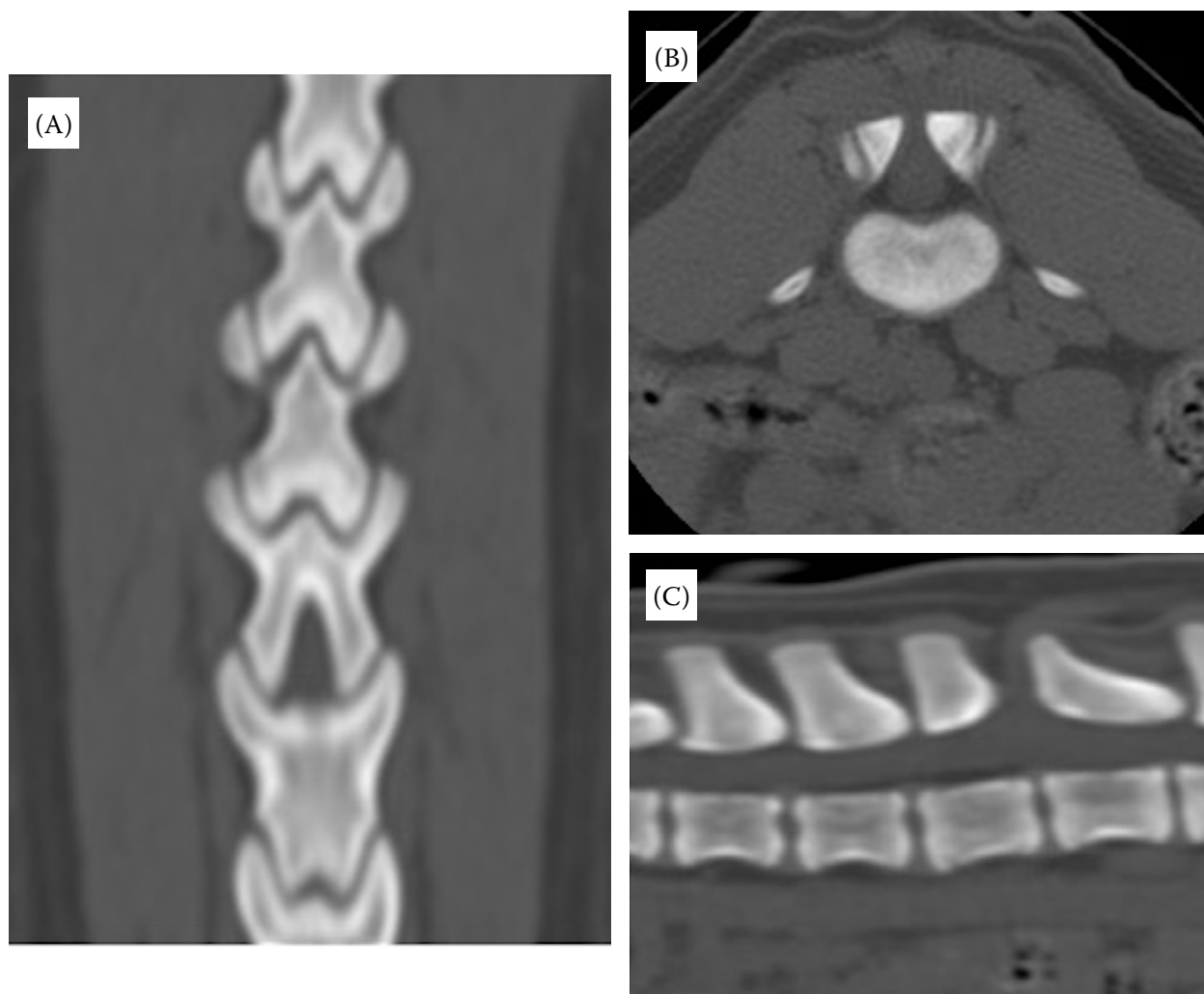


Figure 3. Dorsal (A), transversal (B) and sagittal (C) plane of the lumbosacral spine CT showing the incomplete fusion of the caudal L4 dorsal lamina

A blunt dissection through the deep layers of the skin revealed a subcutaneous fibroadipose mass protruding from the lumbodorsal fascia through the laminar defect of the L4 vertebra. This mass adhered to the dura while infiltrating and anchoring the spinal cord (Figure 4).

After performing the dorsal laminectomy, the spinal cord was exposed. A durotomy was performed, and the mass along the entire path was excised, fixed in formalin and sent for a histopathological examination. The durotomy incision was sutured with a 6-0 polypropylene suture (Prolene; Ethicon Inc, Somerville, NJ, USA) using a simple interrupted pattern. The histopathological analysis revealed a lipoma associated with the fibrocartilaginous tissue.

Ten days postoperatively, the patient was in good general condition. However, the proprioceptive

ataxia and deficits in the pelvic limbs remained, and the owner reported improvement in both the faecal

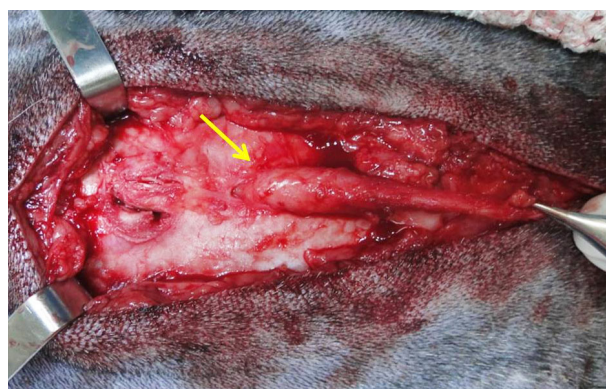


Figure 4. Intraoperative photograph. Observe the subcutaneous fibroadipose mass that crosses the lumbodorsal fascia through the laminar defect of the L4 vertebra (arrow)

and urinary incontinence. Thirty days after surgery, partial improvement of the pelvic limb ataxia occurred, while the faecal incontinence was entirely resolved, with only sporadic episodes of urinary incontinence. A follow-up MRI of the thoracolumbar and lumbosacral spine was performed for the postoperative evaluation, and the complete resection of the lipomyelomeningocele was confirmed (Figure 2).

The patient was monitored monthly for six months. At three months postoperatively, the dog had a complete resolution of the urinary and faecal incontinence while only a residual mild paraparesis remained at six months.

DISCUSSION

In humans, axial lumbosacral cutaneous symptoms are present in 50% to 80% of the cases, which may include sacrococcygeal dimples, dermoid sinus, haemangioma, lipoma, areas of hyper- or hypopigmentation, hair tufts, and caudal appendages (Rossi et al. 2006; Sewell et al. 2015; Blount et al. 2019). This dog had both skin and hair alterations in the dorsal midline, characterised by a circular hypopigmentation lesion with a 0.5 cm diameter and changing hair direction, as shown in Figure 1.

Congenital dermoid sinuses are cutaneous paths lined by stratified squamous epithelium that establish communication between the skin and deeper structures (Kiviranta et al. 2011). In this case report, the biopsy sample sent for the histopathological analysis revealed no stratified squamous epithelium inside the mass, unlike a dermoid sinus, and a lipoma associated with a fibrocartilaginous tissue was observed, confirming the lipomyelomeningocele type lesion.

In humans, CSD is commonly associated with hydrocephalus and a Chiari II malformation (Rossi et al. 2006; Blount et al. 2019), although this dog did not have any of these conditions. There are few reports of hydrocephalus associated with myelomeningocele in dogs (Wilson et al. 1979; Westworth and Sturges 2010).

Spinal radiographs are of little use to investigate the CSD due to its low specificity (Sewell et al. 2015). In humans, an ultrasound is the frontline exam used to investigate the disease, because it is fast, inexpensive, innocuous, and does not require anaesthesia (Chern et al. 2012). The ultrasound and

MRI correlated well, but an ultrasound is only a screening test that requires an MRI confirmation (Sewell et al. 2015).

Although the radiographs showed a fusion failure in the caudal portion of the L4 dorsal lamina, it was not possible to visualise the lipomyelomeningocele. The CT scan enabled a three-dimensional reconstruction of the lumbar segment of the spine and showed the spinal malformation more accurately. The MRI was essential to support the diagnosis, due to the parenchyma and spinal cord lesion site evaluation, and the continuity of the meninges protruding through the bone defect of the L4 dorsal lamina heading towards the epidermis. A postoperative MRI is advised to rule out any immediate surgical complications in the first few weeks and, in some cases, it is also recommended after one year, based on the clinical symptoms, to exclude the re-anchoring of the bone marrow by the scar (Valentini et al. 2013). In this case report, the dog underwent an MRI 30 days after the surgery.

The clinical evolution of a CSD is variable and often unpredictable (Westworth and Sturges 2010). In this case, the clinical signs and their evolution from birth to 6 months of age were compatible with the tethered cord syndrome. These signs appear while the animal is growing, as the pathological fixation of the medullary cone causes traction, resulting in the distortion of the spinal anatomy and ischemic lesions (Ricci et al. 2011; De Decker et al. 2015).

The ideal time to perform the procedure is controversial, but several studies have shown improvement in motor function and urological signs with an early surgical intervention (Valentini et al. 2013; Song et al. 2014). In this case, a dorsal laminectomy, an intradural exploration and a lipomyelomeningocele resection have been shown to be effective to decompress and release the spinal cord.

The post-operative evolution of this dog was satisfactory and corroborated with Shamir et al. (2001) who reported that an intradural surgical exploration might be essential to improve or preserve the neurological signals of patients with lipomyelomeningocele.

In conclusion, spinal radiography, an ultrasound, and a CT scan are essential tools to identify and characterise the condition, as well as an MRI to support the lesion type, providing the appropriate information for the surgical plan. In this dog, the surgery resulted in a satisfactory clinical recovery.

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Conflict of interest

The authors declare no conflict of interest.

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