Equine Veterinary Education

EQUINE VETERINARY EDUCATION
Equine vet. Educ. (2011) **23** (5) 231-234
doi: 10.1111/j.2042-3292.2010.00199.x

Case Report

Congenital kyphosis secondary to lumbar vertebral hypoplasia causing paraparesis in a Friesian foal

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Keywords: horse; kyphosis; myelography; vertebrae; malformation

Summary

A 5-day-old Friesian colt was presented with a history of severe bilateral pelvic limb weakness since birth. Clinical examination revealed a painful dorsal deviation of the spinous processes of the lumbar vertebrae, pelvic limb paraparesis and *grade 4/5* ataxia. Radiographic examination revealed kyphosis due to hypoplasia and malformation of the 5 lumbar vertebrae present. At myelography performed immediately after euthanasia, dorsal deviation of the myelographic contrast column was demonstrated at the level of T18–L4 with suspected spinal cord compression noticeable at L1. There was no lateral deviation of the spinal cord or scoliosis of the vertebrae visible.

Case details

A 5-day-old Friesian colt was presented to the Dierenkliniek Emmeloord with a history of severe pelvic limb gait abnormalities since birth. The mare foaled without any difficulties; however, the foal required assistance getting up and standing for the first time. After being guided in the right direction the foal was able to nurse on his own.

On examination, the foal was bright, alert and responsive. Temperature, pulse and respiration rate were within normal limits. Both thoracic and pelvic limbs were normally developed. Neurological examination revealed no cranial nerve abnormalities or thoracic limb deficits. Severe neurological deficits were seen bilaterally in the pelvic limbs. Pelvic limb abnormalities included symmetrical paraparesis, ataxia and conscious proprioceptive deficits. The foal had trouble walking, moved with a swaying motion and was not always able to correct the episodes of severe ataxia and would subsequently fall down. When the neck was flexed laterally the foal would fall down. Overall, the bilateral pelvic limb ataxia was graded *grade 4/5*. There was no evidence of urinary or faecal incontinence. The foal was not able to trot and bilateral synchronous pelvic limb movements ('bunny-hopping'), were not observed.

Examination of the foal's back revealed dorsal deviation of the spinous processes of the lumbar vertebrae. In addition, this area was painful when palpated. No skin defects were present.

Radiographic examination of the thoracolumbar vertebral column demonstrated kyphosis of the lumbar vertebrae due to malformation and hypoplasia of several lumbar vertebrae. The spinal column consisted of 7 normally developed cervical vertebrae, 5 sacral vertebral bodies but only 5 lumbar vertebrae. No complete overview of the thoracic vertebrae was available for evaluation.

Of the 5 lumbar vertebrae that were present, the first and second lumbar vertebrae were small and positioned dorsally to the eighteenth thoracic and third lumbar vertebra, with the first lumbar vertebra being the most dorsal. Both the first and second lumbar vertebrae were hypoplasic and had deformed vertebral bodies, previously reported as a dorsal hemivertebrae (Kirberger 1989a). Both vertebral bodies appeared to have no (epi)physes. These malformed lumbar vertebrae resulted in the kyphosis seen in this foal. The vertebral body of the third lumbar vertebra was smaller compared to the fourth and fifth lumbar vertebrae, had a deformed rounded shape, no cranial epiphysis and a small deformed caudal epiphysis, compatible with hypoplasia. In addition, this third lumbar vertebra was dislocated dorsally to the fourth lumbar vertebrae. The remaining (fourth and fifth) lumbar vertebrae had a morphologically normal appearance. Measurements made from the lateral radiographs showed a diameter of the vertebral canal of 15.4 mm at the level of the normally shaped T15. The diameter of the vertebral canal at the level of the first lumbar vertebra was 8.7 mm, at the level of the second lumbar vertebra this was 14.3 mm, at the level of the third it was 20.6 mm and at the

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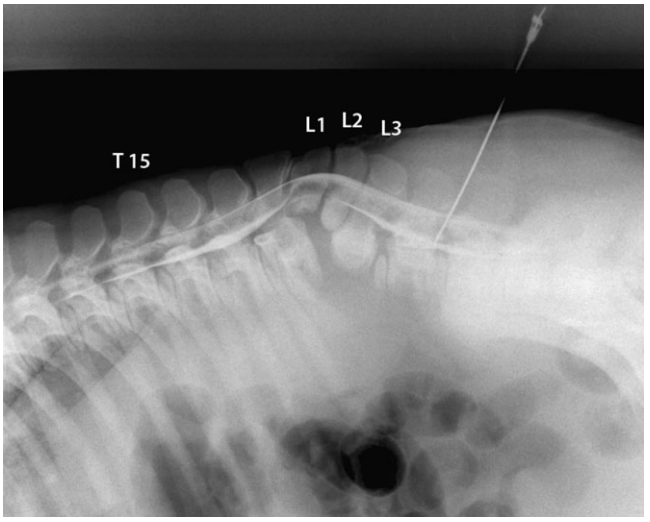

Fig 1: Left-right lateral view of the lumbar vertebrae. Lumbar myelography has been performed. Here the needle is positioned at the L4–5 site with the needle tip placed in the ventral vertebral canal. In live horses, the optimal site for needle insertion during myelography is the lumbosacral site. Kyphosis of the lumbar vertebrae due to malformation of several lumbar vertebrae is visible. Dorsal deviation of the spinal cord and suspected compression of the spinal cord at L1 is noticeable.

level of the fourth vertebral body, the canal diameter was 20.5 mm. These measurements did not take into account any magnification factors due to the distance between the spine and the film. The vertebral body of the eighteenth thoracic vertebra was of normal size and shape but the caudal physis was not clearly visible.

Due to the severity of the pelvic limb paraparesis and radiographic abnormalities, a grave prognosis was made and the foal was humanely subjected to euthanasia. Immediately *post mortem* a myelogram was performed (**Figs 1** and **2**). Ten ml of hyperosmolar ionic contrast medium (ioxithalamate, Telebrix 35, 350 mg/ml)[1] was injected into the subarachnoid space by lumbar punction between the 4th and 5th lumbar vertebrae. In this case the choice of contrast medium was based on costs, since only nonionic contrast medium should be used for *in vivo* myelography; hyperosmolar ionic contrast media are contraindicated and may result in spasms, seizures, hyperthermia and respiratory depression (Roux and Deschamps 2007). The contrast medium was easily injected and myelography showed good distribution of contrast in the cranial and caudal directions. At the level of T18–L4, a dorsal deviation of the myelographic columns outlining the spinal cord was visible (**Fig 1**). Both dorsal and ventral contrast columns were thinned with the ventral contrast column barely visible. Maximum attenuation of the ventral contrast column was present at the level of L1. The dural diameter (the distance between the most dorsal outline of the dorsal contrast column and the most ventral outline of the ventral contrast column) was 8.6 mm at the level of L1 and 11.6 mm at the level of T15. Based on measurements of dorsoventral dural diameter performed

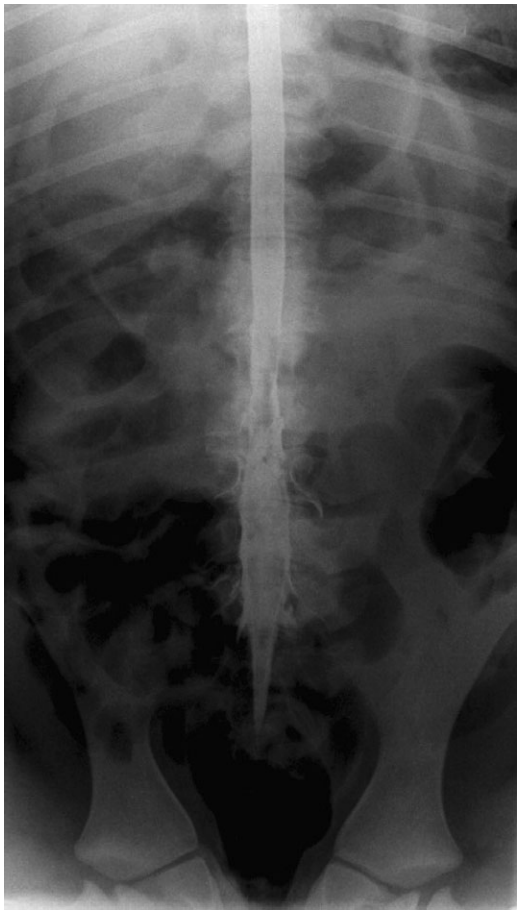

Fig 2: Ventrodorsal view of the lumbar vertebrae. Attenuation of the left and right lateral contrast columns and reduction in mediolateral dural diameter, consistent with compression of the spinal cord is present. No lateral deviation of the spinal cord or scoliosis of the vertebrae is visible.

at other vertebral sites (Van Biervliet *et al*. 2004), a 35% reduction of dural diameter, such as measured here at the level of L1, is highly suggestive of compression of the spinal cord. In addition, ventrodorsal radiographs showed attenuation of the left and right lateral contrast columns and a 28% reduction (12.2 vs. 9.5 mm) in mediolateral dural diameter, also suggestive of compression of the spinal cord. No lateral deviation of the spinal cord or scoliosis of the vertebrae was visible (**Fig 2**). There was no indication of duplication of the spinal cord or vertebral body elements, such as is sometimes seen in spina bifida.

Histopathology of the spinal cord was not undertaken.

Discussion

Although there are a number of reports on congenital vertebral developmental abnormalities and malformations in the cervical (Wilson *et al*. 1985; Rosenstein *et al*. 2000; Nixon 2002; Bell *et al*. 2007) and thoracic regions (Lerner and Riley 1978; Jeffcott 1980; Kirberger and Gottschalk 1989b; Ryan *et al*. 1992; Harmelin *et al*. 1993; Doige 1996; Johnson *et al*. 1997; Wong *et al*. 2005, 2006) this is, as far as

the authors are aware, the first report in the literature, that describes a congenital lumbar vertebral malformation in the horse that resulted in kyphosis and apparent lumbar spinal cord compression with accompanying neurological deficits. In addition, this report demonstrates the feasibility of using myelography for studying distal vertebral column and spinal cord anatomy in foals.

Of the vertebral malformations, ones in the cervical vertebral column occur most frequently and include occipitoatlantoaxial malformations (Rosenstein *et al*. 2000; Rush 2006; Bell *et al*. 2007) and malformations of the other cervical vertebrae that usually result in clinical signs of cervical vertebral myelopathy (Nixon 2002; Rush 2006). In contrast, thoracolumbar vertebral abnormalities usually do not result in neurological abnormalities (Denoix 2005) and lumbosacral vertebral malformations were, in fact, found to occur commonly in a study examining vertebral columns of 36 Thoroughbred racehorses (Haussler *et al*. 1997). Another large study by Jeffcott (1980) showed that in 15 out of 443 horses (2.9%) with disorders of the thoracolumbar vertebral column, conformation defects were present with evidence of scoliosis, lordosis or kyphosis. Kyphosis was demonstrated in 4 of the 15 horses; however, the exact location of the kyphosis was not reported. In all 4 horses the malformation had a developmental origin. Two of these patients were without obvious clinical signs. The other 2 were associated with orthopaedic problems in the pelvic limbs. Kyphosis associated with painful orthopaedic problems in the pelvic limbs like osteochondrosis has also been reported by Butler *et al*. (2000).

In addition to occipitoatlantoaxial malformations, other abnormal vertebrae that occur in the equine vertebral column include hemivertebrae, which are wedge-shaped vertebral bodies (with the vertebral body apex pointing dorsally, ventrally or medially) that result in kyphosis (dorsal deviation of the vertebrae), lordosis (ventral deviation) or scoliosis (lateral deviation). These result from a failure during the formation of the primordial vertebrae or a defect in the ossification of the vertebral body. In horses they have been observed in the cervical and thoracic vertebral column, whereas in other species the T7 and T9 sites are most commonly affected (Wong *et al*. 2005; Rush 2006). Another type of vertebral malformation is the occurrence of block vertebrae that result from incomplete separation of the vertebral bodies or arches, or both. Generally they are stable and do not cause clinical signs. Most frequently affected sites in man and animals are at C2 and C3 (Rush 2006). The most commonly occurring congenital vertebral malformation is the presence of transitional vertebrae; these are vertebral bodies with morphological characteristics of multiple sites of the vertebral column, for example thoracic and lumbar or lumbar and sacral vertebrae (Haussler *et al*. 1997).

In the case described here, we performed myelography directly after euthanasia by injection of ioxithalamate inadvertently between the 4th and 5th lumbar vertebrae. In live foals, it is recommended to use the lumbosacral site for cerebrospinal collection or myelography. Palpable landmarks are the caudal borders of both *tuber coxae*, caudal edge of the spinous process of L6, cranial edge of the spinous process of S2 and cranial edge of both *tuber sacrale*. The needle passes through the skin, thoracolumbar fascia, interarcuate ligament, dorsal *dura mater* and arachnoid, dorsal arachnoid space and *conus medullaris*. The needle tip is placed in the ventral subarachnoid space. (Mayhew 1989). Although it is expected that the *conus medullaris* would be penetrated during this procedure, at the L4–L5 site it is preferable to avoid spinal cord penetration.

The fact that gross *post mortem* and histology of the spinal cord were not available precluded confirmation of spinal cord compression; however, given the symmetric vertebral bone abnormalities, kyphosis and apparent cord compression and in the absence of skin defects, split vertebral bodies or duplication of the spinal cord, other lesions that may produce comparable clinical signs, for example myelodysplastic lesions such as syringomyelia (expanding cyst in the central cord) and/or diplomyelia (duplication of parts of the spinal cord; spina bifida) seem unlikely. Evaluation of criteria to diagnose compression of the spinal cord from myelograms showed that in the cervical vertebral column, reduction of the dural diameter by 20% or more at the C6–7 site was highly specific and sensitive for compression (Van Biervliet *et al*. 2004) and, although there is no literature that evaluates this criterion in the neonatal lumbar vertebral column, the measured reduction of dural diameter in the case reported here was much larger, namely 35%.

Although vertebral body malformations may occur without clinical signs of neurological disease, this foal had clinical signs suggestive of compressive myelopathy as a result of severe lumbar kyphosis. This report demonstrates that in other, less obvious situations, it is possible to use myelography for the assessment of the vertebral column and the spinal cord. In foals with neurological deficits of the pelvic limbs only, careful examination of the thoracolumbar radiographs is indicated and myelography can be helpful in depicting spinal cord anatomy.

Manufacturer's address

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