Clinical Commentary

Radiography of the cervical vertebrae

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The congenital occipitoatlantoaxial malformations (OAAM) have been recognised as an uncommon cause of para- and tetraparesis in man, cattle, horses, sheep and very rarely dogs and cats (de Lahunta et al. 1989; Schmidt et al. 1993). The condition is caused by toxic insults or abnormal genetic programming affecting early mesenchymal development and resulting in the abnormal pattern of occipital bone and cervical vertebral formation. In horses it is most common in Arabian foals and horses and Standardbreds. The disease is sporadically reported in other breeds particularly Morgan horses and is known to have a familial basis in Arabians. The report by Griffin et al. (2007) suggests that it may also be heritable in Saddlebred horses.

Occipitoatlantoaxial malformations classically consist of an asymmetric fusion of the first cervical vertebra to the occiput, and frequently involve ventral luxation of the dens of the second cervical vertebra. Clinical presentations range from foals dead or ataxic at delivery to showing progressive signs of ataxia when a few months old. Abnormal neck movement and reduced flexion at the atlanto-occipital joint in the absence of neurological signs, as described for the 3 foals in the paper by Griffin et al. (2007) is a somewhat unusual presentation.

Foals suspected to be ataxic should be examined using a systematic neurological examination. It is imperative that the lesion is correctly localised since, for example, Arabian foals with cerebellar atrophy resemble animals with spinal cord disease. The former would, however, be expected to lack signs of paresis and are usually characterised by intention tremors most prominent in the head. The examination in foals is very similar to that performed in adult horses; however, a few developmental differences should be borne in mind: the head in foals normally adopts a noticeably more flexed angle at the atlanto-occipital joint than it does in adults. Also, neonatal foals lack a menace response despite normal vision and may still show primitive (crossed extensor) limb reflexes.

The most common cause of spinal cord disease in young foals is trauma, and a fracture of the cervical vertebral column can have identical signs to those found in OAAM. The dens (odontoid process) of the axis can become separated as a consequence of an hyperflexion injury, such as a somersaulting fall, with foals under 6 months of age vulnerable to separation at the cranial physis of the axis. It is important to distinguish a spinal cord lesion caused by trauma from one secondary to a malformation of the cervical vertebrae, such as cervical vertebral malformation or OAAM, as there are differences in prognosis.

Griffin et al. (2007) demonstrate that a clinically significant lesion may be incompletely assessed if radiographs are obtained in one plane only. All radiographs represent a 3-dimensional structure in the form of a 2-dimensional image and to compensate for the omitted information at least 2 views at right angles to each other are usually required. Frequently, more than 2 views are required for a full examination of, for example, a carpus or fetlock joint. Although the described foals all showed abnormalities of the atlanto-occipital joint on lateral views, lateral luxation or subluxation will always be better appreciated on a view obtained at right angles to the direction of luxation. In cases of trauma, transverse fractures may be hard to detect on lateral views and require ventrodorsal or dorsoventral views for accurate assessment.

In all 3 cases in this report the ventrodorsal views of the cervical vertebral column were obtained with the foals standing and not sedated. Manual restraint was used to maintain the skull and neck in position. Considerable care must be taken when performing such procedures to ensure that none of the handlers are inadvertently exposed to radiation. Gloves and gowns containing lead must be worn and it should be noted that these protect against scattered radiation only, and will be penetrated by the primary beam. Cassette holders would provide additional protection and the use of sedation in all but the most cooperative or depressed foals would facilitate neck extension and improve visualisation of the atlanto-occipital joint.

In the adult horse it is usually only possible to obtain lateral views of the cervical vertebrae, and heavy sedation is required to prevent the horse moving as the x-ray machine and cassette are manoeuvred into place. Ventrodorsal or dorsoventral views of the cranial cervical vertebrae can be attempted in the heavily sedated horse, with head and neck maximally extended, but the procedure risks damage to the radiography equipment and inadvertent exposure to personnel. General anaesthesia is used for all myelographic studies in horses and this method doubtless produces radiographs of improved...
quality, but at the risk of further spinal cord compression during recovery. In addition, general anaesthesia allows the use of flexed lateral views to assess the dynamic nature of any compressive lesion with myelography, or subluxation, although care should be taken not to increase any spinal cord compression. When conscious, raising the head of such cases frequently exacerbates the clinical signs (Mayhew et al. 1978; Rosenstein et al. 2000).

In the 3 foals described in this case report the luxation occurred secondary to congenital malformation at the atlanto-occipital joint. Differential diagnoses for the described clinical signs in foals include other rare occipitoatlantoaxial malformations as described by Mayhew et al. (1978), vertebral osteomyelitis and cervical trauma with fracture of the occipital bone, atlas and/or axis. The dens of the axis can become separated as a consequence of an hyperflexion injury, such as a somersaulting fall, with foals under 6 months of age particularly vulnerable to separation at the cranial physis of the axis. Confirming the diagnosis in these cases also requires radiography. Fractures of the axis and atlas may occur in adult horses, with the severity of the clinical signs ranging from mild neck pain to severe ataxia, depending on the degree of spinal cord compression.

The optimal imaging modalities to assess atlanto-occipital lesions are computed tomography (CT) and magnetic resonance imaging (MRI), as the cross-sectional nature of the images and the possibility of 3D reconstruction allow visualisation of the exact position of the bones, identification of fractures and diameter of the vertebral canal. MRI has the additional advantage of excellent soft tissue resolution, allowing assessment of the spinal cord and nerve roots for compression and other pathology of the neural tissue and the integrity of the surrounding soft tissues such as ligaments and joint capsules. With atlanto-occipital subluxation or luxation, damage to the ligaments connecting both the atlas and the axis to the occiput is likely, and this should be apparent on MRI. The disadvantage of both modalities is that they are not generally available and require general anaesthesia with the inherent risks.

In dogs, radiographic examination of the atlanto-occipital articulation and cranial cervical vertebral column includes a ventrodorsal and lateral projection with support of the nose to avoid rotation, performed under general anaesthesia. Congenital occipitoatlantoaxial malformation was diagnosed using radiography in a Saint Bernard puppy (Watson and de Lahunta 1989) and atlanto-occipital luxation has been reported secondary to road traffic accidents. In one dog with traumatic atlanto-occipital subluxation a CT examination using myelography confirmed subluxation and spinal cord compression and ruled out associated fractures (Steffen et al. 2003). Atlantoaxial instability, which occurs mostly in small and toy breed dogs, is caused by hypoplasia or agenesis of the dens, nonfusion of the separate centre of ossification of the dens to the axis, absence of the ligaments of the dens or secondary to trauma. Radiographic evaluation in small animals would include lateral, ventrodorsal and oblique projections (if necessary). An open-mouth rostrocaudal projection may be performed, but due to neck hyperflexion, carries the risk of exacerbating existing cord compression.

References