Neonatal Spinal Ultrasound Imaging - A Pictorial Review from The Royal Liverpool Children Hospital, Alder Hey, Liverpool

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Learning objectives

The learning objectives of this pictorial review are to demonstrate to radiologists, particularly radiology registrars in training, the ultrasound appearances of the normal neonatal spine and to illustrate a range of congenital and acquired pathologies with MR correlation where appropriate.
Background

Ultrasound is highly effective in assessing the neonatal spine and its contents. The lack of ionising radiation, ease of use at the bedside and high resolution images provided by the available high frequency linear transducers, are all features unique to ultrasound which make its use invaluable. Furthermore, comparative studies have shown that ultrasound images of the neonatal spine are of superior diagnostic quality to MR images, making ultrasound an even more attractive investigative tool.
Imaging findings OR Procedure details

As with all other imaging modalities, in order to recognise the appearance of various intraspinal pathologies on ultrasound imaging, one must have a comprehensive knowledge of the anatomy of the normal neonatal spine.

When conducting an ultrasound of the spine one of the first features to note is the level at which the conus terminates (Figure 1). It is generally accepted that the conus in neonates, children and adults is most commonly located at the L1/2 vertebral level with a conus level of L2/3 also reported as being within normal limits. A conus at L3 is indeterminate since this could represent a normal conus which happens to be in a low lying position. However, an associated pathology such as a filar lipoma cannot be excluded in patients with such a low lying conus. The general echogenicity of the spine and conus should also be examined. Next, the appearance and thickness of the filum terminale is interrogated; the filum terminale is considered to be thick when it measures 2mm or more in calibre. Due to the effects of gravity the filum should lie towards the dependent portion of the spinal canal. Vertebral segmentation is also specifically noted (Figures 2, 3, 4). Ultrasound permits good quality images of all of the above features due to the incompletely ossified, predominantly cartilaginous posterior elements of the spine in neonates.

A sacral (pilonidal) dimple is a congenital indentation in the skin over the sacral region of the spine which may be associated with overlying cutaneous stigmata (hairy patch or capillary haemangioma). In a minority of cases, a sacral dimple indicates the presence of an underlying spina bifida and it is for this reason that neonates with this clinical finding are referred for an ultrasound of the spine. When scanning this group of patients, a tract connecting the soft tissue dimple to the spinal canal is sought. In the case presented here the dimple was found to be in continuity with the coccygeal tip (Figure 5, 6).

Tethering of the spinal cord may present with a spectrum of clinical signs and symptoms including lower limb weakness and bladder/bowel dysfunction. When the cord is 'tethered', the cord and filum appear immobile and taut and the conus is low lying, generally at a level caudal to the L3 vertebra (Figures 7, 8, 9, 10). An underlying cause for tethering is subsequently sought. In the case we present, the conus is noted to terminate at the L5 vertebra where it is tethered posteriorly by a small echogenic mass, representing an intraspinal lipoma (Figure 11). On dynamic imaging, the dorsal nerve roots showed absence of the normal cerebrospinal fluid pulsations. An MR of the spine was subsequently performed which revealed the presence of a high signal lesion on T1 weighted images, consistent with the ultrasound finding of an intraspinal lipoma (Figure 12 13).
A thickened filum terminale is represented by a diameter greater than 2mm (Figures 14, 15, 16). This observation in the neonate is associated with the presence of a tethered spinal cord, fibrolipomas and cysts of the filum.

We present a case of a patient who was referred for an ultrasound of her spine due to the presence of a sacral dimple. A dorsal dermal sinus tract was not identified, however, incidental excess extradural fat was noted in the spinal canal (Figures 17, 18, 19, 20). In adults, spinal epidural lipomatosis is most often associated with exogenous steroid therapy and endocrinopathies, such as Cushing's syndrome. In neonates, however, this condition is likely to be of the rare idiopathic form, but should not be mistaken for pathology.

Congenital vertebral anomalies refer to abnormalities in vertebral shape and segmentation. Varieties include fused vertebrae, hemivertebrae, butterfly and transitional vertebrae. In the majority of cases such anomalies are clinically insignificant. However, they occasionally cause instability, scoliosis and may be a feature of a wider syndrome, such as the VACTERL syndrome. In our case, the patient was diagnosed with jejunal atresia and a congenital heart condition. She was subsequently referred for an ultrasound of the abdomen and spine for exclusion of VACTERL associations. On scanning the lower lumbar spine, fusion of two adjacent vertebrae was noted (Figure 21).
Images for this section:

**Fig. 14:** Normal Spine

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**Fig. 12:** Normal Spine

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Fig. 11: Normal Conus

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Fig. 13: Normal Filum Terminale

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Fig. 1: Sacral Dimple

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Fig. 2: Sacral Dimple

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Fig. 4: Tethered Cord

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**Fig. 10:** Tethered Cord

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Fig. 3: Tethered Cord

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Fig. 5: Tethered Cord

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Fig. 6: Tethered Cord with Intraspinal Lipoma

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**Fig. 20:** Tethering of the cord and filar lipoma; T1 weighted MRI imaging

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**Fig. 21:** Tethering of the cord and filar lipoma; T1 weighted MRI imaging

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Fig. 9: Thickened Filum Terminale

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Fig. 8: Thickened Filum Terminale

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Fig. 7: Thickened Filum Terminale

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Fig. 16: Epidural Lipomatosis

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Fig. 17: Epidural Lipomatosis

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Fig. 18: Epidural Lipomatosis

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Fig. 19: Epidural Lipomatosis

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Fig. 15: L4/5 vertebral body fusion

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Conclusion

Sonography is an invaluable tool which provides a safe, swift and thorough assessment of the neonatal spinal canal and its contents, whilst providing the clinical radiologist with images which compare favourably with those acquired at MRI.
References


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