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Diagnostic imaging of lumbosacral disease

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Diagnostic imaging of degenerative lumbosacral stenosis (DLSS) has been challenging until the introduction of computed tomography (CT) and magnetic resonance imaging (MRI).

Former methods included survey radiography, stress radiography, myelography, epidurography, transosseous and intravenous venography, discography, scintigraphy and linear tomography1.

Survey radiography gives an overview of the anatomic situation (e.g., presence or absence of transitional vertebrae) and allows the evaluation of signs of degenerative disease. Its main disadvantages include poor soft tissue contrast, superimposition and positional artifacts. Stress radiography can demonstrate movement or instability, but is affected by the same limitations.

Myelography can only be used if the dural sac is reaching into the sacrum which may end anywhere between L6 and the sacral vertebrae. Furthermore, it will not demonstrate compressions originating in the dorsal, lateral or foraminal compartments.

Epidurography outlines the epidural spaces at the lumbosacral junction. Sensitivity is low for lesions obstructing less than 50% of the vertebral canal.

Discography of the lumbosacral disk could help delineate the borders of the disk and demonstrate herniations. In combination with epidurography, it has been proposed as a rather accurate method for demonstrating cauda equine compression2. However, it is an invasive method and fails to demonstrate lateral and foraminal compressions.

Osseous and intravenous venography could be used to demonstrate space-occupying lesions at the lumbosacral junction. They are rather difficult to perform and can be false positive due to incomplete venous sinus filling and variations in sinus configuration.

All these methods have in common that they were used to diagnose cauda equine compression by evaluating indirect signs such as space-occupying effects or demonstration of disk herniation or spondyloarthritides. It was not possible to directly visualize the nerves of the cauda equina.

This limitation was finally overcome by the introduction of CT and MRI. Both are cross-sectional imaging methods finally enabling direct visualization of nearly all relevant anatomic structures3-6. CT is an excellent method for evaluation of bone and to some extent soft tissues. It allows visualization of nerves— as long as they are surrounded by fat. Direct evaluation of the intervertebral disk is possible and absence or presence of herniation and the resulting degree of cauda equine compression can be determined. Common bony pathologies such as spondyloses, hypertrophic/osteoarthritic facet joints and foraminal stenosis can be easily evaluated.

Intravenous application of iodinated contrast media allows identification of vasculature, aids in the differentiation between inflammatory, degenerative or neoplastic disease and can help delineating nerves in case of compression. Since the introduction of multislice helical CT soft tissue contrast has improved and with the acquisition of very thin slices (1 mm and below) high quality multiple planar reconstructions became possible and allow to adapt slice orientation for optimal visualization of the desired structure (e.g., along the nerves). 3D reconstructions can further help understanding the situation and aid in planning of surgical treatment.

The main disadvantage of CT is still the rather poor soft tissue contrast. Especially in presence of compressive material delineation of neural structures can become difficult to impossible.

MRI instead provides excellent soft tissue contrast. It allows to evaluate and grade disk degeneration and disk herniation. The nerves of the cauda equina can be easily identified and followed along all their course. MRI is sensitive for detecting changes in fluid content of tissues, so apart from anatomic information it can show to some extent pathophysiologic changes such as nerve swelling, edema and neuritis. Usually T1 weighted, T2 weighted and a fat suppressed sequence in different planes are recommended to examine the lumbosacral junction. 3D sequences allow multiplanar reconstructions to adapt slice orientation to the structures of interest. Intravenous application of gadolinium based contrast media can improve nerve delineation and help characterizing pathology.

Whereas High Field MRI (field strength of 1 Tesla and more) usually provides better signal to noise ratio, the diagnostic accuracy of Low Field MRI (up to 0.5 T) appears to be similar7.

The main disadvantage of MRI is the limited capability to delineate bony surfaces. In cases of irregular spondylosis differentiation between intervertebral disk, spondylosis

References


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or just fibrous tissue can be difficult. Also osteochondrotic lesions of the sacrum can more easily be evaluated with CT.

The decision whether MRI or CT should be the method of choice in evaluation of lumbosacral disease in dogs and cats still needs to be answered. When compared with each other there was good correlation between MRI and CT and only moderate correlation with surgery.

Modern multislice helical CT scanners are much faster than MRI and provide sufficient soft tissue contrast to visualize most relevant structures. Mainly pathologies affecting the nerve roots – such as primary or secondary neuritis – can still be better evaluated with MRI. MRI is also considered superior in detecting not degenerative disease like inflammation or neoplasia.

Interestingly in human medicine there are not that many studies comparing the diagnostic accuracy of MRI and CT for lumbosacral stenosis. However actual recommendations prefer MRI over CT due to its better soft tissue contrast and the lack of ionizing radiation.

In veterinary practice the most important criterium for choosing one of these modalities will be its availability.

It should be kept in mind that results of both CT or MRI imaging studies of lumbosacral disease do not have a high correlation with clinical signs or prognosis. Rather severe nerve compressions can give rather low symptoms and small compressions can lead to severe clinical signs.

The results of all imaging exams have always to be evaluated in the light of the clinical signs.

References