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THE VALUE OF CORONAL IMAGE IN DETECTING EXTRA SPINAL LESION IN MAGNETIC RESONANCE IMAGING OF THE SPINE

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Abstract

This study aimed to evaluate the clinical impact of coronal image of the spine at initial presentation for magnetic resonance imaging of the spine. Images were evaluated by two experienced radiologists, the added value of the additional sequence was assessed. Correlation was made with surgery or clinical follow-up at 3 months. We concluded that the coronal image of the spine is of great value in detecting extraspinal lesion in magnetic resonance imaging of the spine.

Introduction

Magnetic resonance imaging (MRI) is a test that uses a magnetic field and pulses of radio wave energy to make pictures. Given its lack of ionizing radiation, direct multilane capabilities, and superior soft-tissue contrast, MRI has replaced many conventional imaging techniques in detection of musculo-skeletal pathology. In many cases MRI gives different information about structures in the body than can be seen with an X-ray, ultrasound, or computed tomography (CT) scan. MRI also may show problems that cannot be seen with other imaging methods.

Bloch and Purcell independently discovered Nuclear Magnetic Resonance (NMR) in 1946 Six years later they were awarded the Nobel Prize for their achievements. Since then, the development of NMR spectrometers and NMR scanners has led to the opening up of whole new branches of physics, chemistry, biology and medicine[1].

Through the 1950s and 60s, NMR was primarily an analytic tool for chemists and physicists probing chemical structure configuration and reaction processes. The first human applications were proposed in 1967 by Jasper Johns who had measured signals from live animals. The first live human images were reported by Sir Peter Mansfield in 1976.Hand& thorax images were described in 1977 and the head and abdomen in 1978[2].

By 1983 continuous improvement in MR hardware and software had resulted in whole body imaging systems that were capable of producing high contrast images with spatial resolution of under 1 mm, in total imaging times of only a few minutes. 2. Magnetic resonance imaging MRI of the spine is a noninvasive procedure to evaluate different types of tissue, including the spinal cord, vertebral disks and spaces between the vertebrae through which the nerves travel, as well as distinguish healthy tissue from diseased tissue. MRI can look at the spine in the neck (cervical spine), upper back (thoracic spine), or lower back (lumbosacral spine). The entire spine can be seen in one series of pictures to find a tumor. More detailed pictures of one area may be taken.

The cervical, thoracic and lumbar spine MRI should be scanned in individual sections. The scan protocol parameter like e.g. the field of view (FOV), slice thickness and matrix are usually different for cervical, thoracic and lumbar spine MRI, but the method is similar[3] (fig.1-3).

Fig 1: Sagital T2 of the cervical spine used to evaluate foraminal stenosis

Fig 2: Parasagittal T2 lumbar spine

The standard views in the basic spinal MRI scan to create detailed slices (cross sections) are sagittal T1 weighted and T2 weighted images over the whole body part, and transversal (e.g. multi angle oblique) over the region of interest with different pulse sequences according to the result of the sagittal slices.

Additional views or different types of pulse sequences like fat suppression, Fluid Attenuation Inversion Recovery (FLAIR) or diffusion weighted imaging are created dependent on the indication[4].

Fig 3: Axial T2 the disks are best visualized in the axial images

Lumbar spine imaging requires a special spine coil. Often used whole spine array coils have the advantage that patients do not need other positioning if also upper parts of the spine should be scanned. Sagittal T1 and T2 weighted Fast Spin Echo (FSE) sequences are the standard views. With multi angle oblique techniques individually oriented transversal images of each intervertebral disc at different angles can be obtained[4].

Imaging protocols for the cervical spine includes sagittal T1 weighted and T2 weighted sequences with 3-4 mm slice thickness and axial slices; usually contiguous from C2 through T1. Additionally, T2 fat suppressed and T1 post contrast images are often useful in spine imaging[3].

Contrast enhanced MRI techniques delineate infections vs. malignancies, show a syrinx cavity and support to differentiate the postoperative conditions. After surgery for disk disease, significant fibrosis can occur in the spine. This scarring can mimic residual disk herniation[5]. Magnetic resonance myelography evaluates spinal stenosis and various intervertebral discs can be imaged with multi angle oblique techniques. 6 Cine series can be used to show true range of motion studies of parts of the spine[3].

Advanced open MRI devices are developed to perform positional scans in the position of pain or symptom (e.g. Upright TM MRI formerly Stand-Up MRI[3].

Optional coronal is not routinely used but if there is a Para spinal component it is beneficial. We believe that coronal images are of useful value in detecting extra spinal lesion in MRI of the spine.

Method

We present our experience of seven cases, 4 females and 3 males for whom coronal image of the spinal MRI was done in addition to Ti weighted and T2 weighted sagittal and T2 weighted axial images of the spine in all cases.

Case1

Male patient presented with persistent pain in the neck, radiate to the right upper limb. MRI of the cervical spine has been done. In sagittal Ti (Fig.4) there was a decrease in height and intensity of the cervical discs which is a feature of degenerative changes. In the coronal image there was a right sided Pancost tumor (Fig.5).

Case2

Male patient presented with persistent pain in his neck, radiated to the left upper limb. MRI of the cervical spine has been done. Ti weighted, T2 weighted sagittal and T2 weighted axial images revealed abnormal signals returning from C4 and C7 vertebrae with compression on the left nerve roots (Fig.6&7). The coronal T2 weighted image showed mass at the left mid-zone of the lung which is most probably the primary lesion (Fig.8).

Cases 3,4&5

Two females and one male patients underwent MRI of the dorsal spine sagittal T1 and T2 with axial images showed abnormal marrow signal intensity within two adjacent vertebral bodies, with accompanying cortical bone destruction and abnormal extradural soft tissue causing cord compression which are highly suggestive of tuberculous spondylitis. The Coronal T2 weighted image revealed bilateral psoas abscess. (Fig. 9 & 10).

Case 6

Female patient had MRI of the lumbar spine, the sagittal T2 showed a decrease in height and hyper intensity of the disk at the level of L1-L2 with extruded disc material causing spinal cord compression. But MR coronal mylography revealed polycystic kidney as shown in Fig. 11.

Case 7

Female patient presented with backache and right sided sciatica. Standard MRI sequences of the spine were done. T2 sagittal and axial images showed heterogeneous intensity mass (Fig.12 & l3). But the coronal image revealed large irregular outlined heterogeneous mass more on the right side of the posterior aspect of the sacrum as demonstrated in Fig.14.

Discussion

The role of magnetic resonance imaging for the evaluation of the spine is expanding rapidly. In addition to being noninvasive, MRI offers high soft-tissue contrast and multiplanar imaging capability.

Standard anatomy of the spine may be found in anatomy and radiology textbooks. However, there are aspects of spinal anatomy that are of particular importance to MRI. The structure and Orientation of the facet joints and their relationship to the neural foramina receive relatively little attention in standard anatomic works, but they are of great importance in evaluating nerve root compression syndromes. Similarly, the relationships between the cross-sectional diameters of the spinal canal, the subarachnoid space, and the spinal cord assume a great deal of significance when evaluating patients with signs or symptoms of spinal stenosis. Changes in the configurations and composition of the spinal cord will become increasingly important to the radiologists as it becomes possible to identify and distinguish spinal cord grey and white matter. Degenerative syndromes of the spinal cord may be more thoroughly evaluated once MRI permits identification of the specific regions or structures of the cord in which the tissue loss has been most severe[7].

MRI examinations of the spine usually include a Ti weighted spin-echo and a T2 weighted spin-echo and/or a gradient-echo sequence[8].

Paramagnetic contrast agents are used to enhance soft tissue lesions. The contrast sensitivity of MRI provides a unique means to assess the intervertebral disc, and MRI is rapidly becoming the method of choice for evaluation of disc disease. It is also very sensitive and accurate in the detection of osteomyelitis of the spine. MRI has improved the evaluation of failed back surgery syndrome, and the administration of gadolinium diethylene trimene pent acidic acid helps to differentiate post surgical scar Trom recurrent disc herniation. MRI is an unparalleled tool for the detection and evaluation of intramedullary lesions including syringomyelia, gliomas, hematomas, and lesions associated with dysraphism. It is also useful in many extramedullary intradural processes[8].

MRI showed the disk space abnormalities and extension of the inflammatory process to best advantage in the coronal plane. This plane demonstrated in one image the spinal localization and the Para vertebral extension of the inflammation[9].

Screening of the entire cord in a patient with a deformity is best accomplished with sagittal and coronal (as needed) T1 weighted images.

These images allow assessment of the cord for compression, tethering, syrinx, enlargement, and Arnold-Chiari malformation. Coronal images are particularly helpful in patients with prominent curves or in those with vertebral anomalies. Additionally, coronal images may be useful in assessing patients with suspected diastematomyelia[10].

Gleeson TG et al[11] determined the value of coronal oblique turbo Short Taw Inversion Recovery (STIR) imaging of the sacruin and sacroiliac joints at routine MR imaging of the lumbar spine. They concluded that, routine coronal STIR imaging of the sacrum as part of lumbar spine MR1 improves assessment of patients presenting with low back pain or sciatica in only a small number of patients. Nineteen out of 260 patients (7.3%) abnormalities were identified at coronal STIR imaging. in 7 of 260 patients (2.7%) the pathology was identified in the sacrum thought to account for back pain altering the diagnosis made on the standard sequences. These diagnoses were sacroiliitis (n=2), sacral stress fracture (n=1), degenerative sacroiliac joints (n=1), degenerative accessory articulation between the lumbar spine and the sacrum (n=1), Tarlov cyst of nerve root (n=1) and retroverted uterus causing sciatic pain (n1). We concluded that Coronal image of the spine is of great value in detecting extra spinal lesion. In few cases when it is requested by the radiologist or the surgeon, it will change the line of treatment and decrease the patient suffering.

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