

Lumbar Radiculopathy – Incremental Value of Magnetic Resonance Neurography over Non-Contributory Magnetic Resonance Imaging

Dear Editor,

Lumbar radiculopathy is defined in terms of symptoms (including pain and paraesthesia) and signs (including weakness) in the distribution of a spinal nerve root. Compression of the nerve root, possibly leading to inflammation, is a common aetiology. Magnetic resonance imaging (MRI) is the preferred imaging modality used for evaluation of patients with lumbar radiculopathy. It serves as a useful adjunct to electrodiagnostic testing, which include electromyography (EMG) and nerve conduction studies. MRI has been shown to provide excellent inter-observer agreement for the diagnosis of nerve root compression in patients with radiculopathy.¹ However, a management dilemma frequently occurs when a patient with clinical features of radiculopathy has normal or non-contributory MRI findings. In this article, we report a patient with Parkinson's disease who presented with features of lumbar radiculopathy and subsequently underwent MRI lumbar spine examination, which was inconclusive. The final diagnosis was made using high resolution magnetic resonance neurography (MRN) of the lumbosacral plexus, which employed 2-dimensional (2D) and isotropic 3D imaging sequences.

Case Report

A 78-year-old male, previously diagnosed with Parkinson's disease, presented to the clinic with progressive gait disturbance. He had a history of twisting his back 1 week prior and thereafter, developed left leg weakness and radicular pain radiating from his back to his groin and left hip. On examination, there was weakness on left hip flexion, left knee extension and absence of left knee jerk. Left lumbar radiculopathy was clinically suspected to be the cause of his gait dysfunction, but progression of his Parkinson's disease could not be ruled out as being responsible for the above findings. MRI of the lumbar spine performed outside reported multilevel disc herniations and was inconclusive of nerve compression.

MRN was performed on 3.0T MR scanner (Achieva, Philips, Best, Netherlands) using 2D axial T1W, axial T2W Dixon, 3D SHINKEI (nerve-sheath signal increased with INKed rest-tissue RARE Imaging) and diffusion tensor imaging (DTI) techniques. The study showed an extruded paracentral disk fragment arising from L3-L4 disc space on the left, extending inferiorly into the spinal canal behind the L4 vertebral body (Fig. 1), and small disc herniations at other levels. The mass effect was clearly depicted on

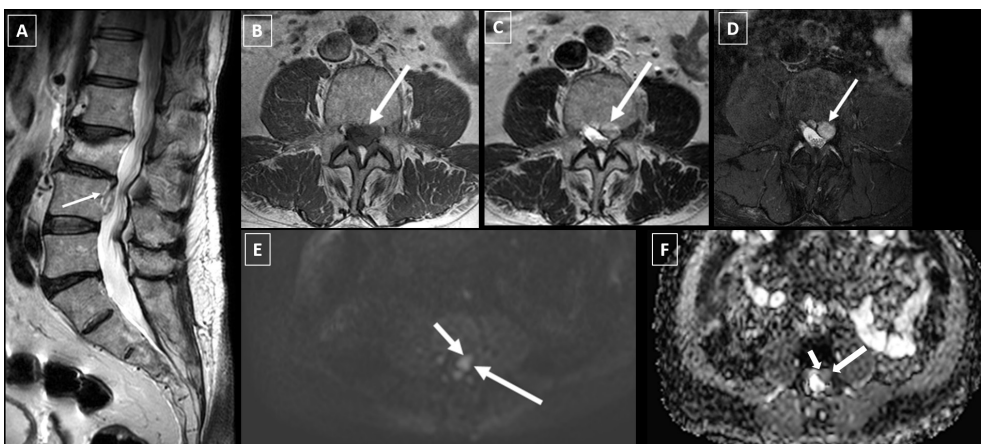


Fig. 1. Sagittal LS spine (A), axial de field of view T1 W (B), T2 Dixon fat and water images (C, D) demonstrate the extruded disc at L3-4 level (arrows) compressing the thecal sac and the left preganglionic nerve root at this level. Notice smaller disc herniations at other levels. Axial DTI (b value 600, E) and ADC images (F) confirm the effacement of the left preganglionic traversing nerve root (small arrow) at this level by the disc fragment (large arrow).

ADC: Apparent diffusion coefficient; DTI: Diffusion tensor imaging

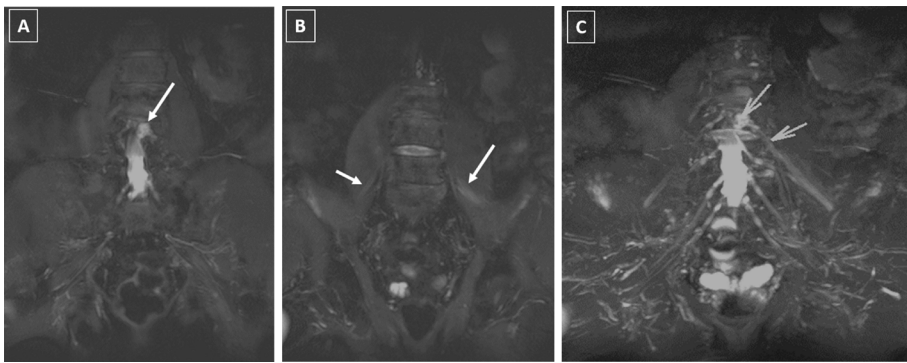


Fig. 2. Coronal 3D SHINKEI images (A, B) and MIP image (C) demonstrate the extruded disc at L3-4 level as crotch filling between the thecal sac and the preganglionic nerve segment (arrow in A) compressing the thecal sac and the left preganglionic nerve root at this level. Notice the swollen left femoral nerve in the iliopsoas groove due to intraneural and perineural oedema (large arrow) as compared to the normal right nerve (small arrow) in B. Maximum intensity projection image (C) shows the disc (upper arrow) and the abnormal left femoral nerve (lower arrow) in 1 slab.

3D coronal SHINKEI sequence, which also showed the inflamed left femoral nerve demonstrating intraneural and perineural oedema (Fig. 2). Maximum intensity projection (MIP) oblique-angled reconstructed images created from MRN dataset on an independent work station showed the entire extent of the left femoral neuropathy and contralateral normal femoral nerve (Fig. 3). The left femoral neuropathy was qualitatively quite conspicuous on the DTI image with effective vascular suppression due to diffusion effect and the nerve showed higher apparent diffusion coefficient ($ADC = 1.3 \times 10^{-3} \text{ mm}^2/\text{s}$) and lower fractional anisotropy ($FA = 0.2$) values as compared to the contralateral nerve ($ADC = 1.1 \times 10^{-3} \text{ mm}^2/\text{s}$, $FA = 0.45$).

Discussion

The lumbosacral (LS) plexus pathologies can be a significant source of neuropathic pain with radiculopathy versus plexopathy or underlying systemic condition, such as

Parkinson's disease, thus posing a diagnostic challenge to the clinician, as in this case, due to deep location of the nerves and variable regional innervation. Classically, the diagnosis of LS radiculopathy is evaluated using electrodiagnostic testing and MRI of the lumbar spine. The high sensitivity of MRI combined with high specificity of electrodiagnostic tests often provide very good complementary information.² However, not infrequently, a diagnostic dilemma occurs if the MRI findings are inconclusive, e.g. in older patients with significant disc disease at multiple levels.³ MRN can provide incremental value over electrodiagnostic tests and MRI in such cases as illustrated by this case.

MRN of the LS plexus includes sagittal and axial T2W imaging of the LS spine but replaces the conventional sagittal T1W and STIR imaging sequences by axial T1W and axial T2 fat-suppressed imaging with wider field of view encompassing the whole abdomen and pelvis with in-plane resolution of 0.5 mm and slice thickness of 4 mm. Coronal 3D inversion recovery-based variable flip angle sequence also allows a comprehensive coverage of the whole abdomen and pelvis with 1.5 mm isotropic resolution, thereby enabling high resolution multiplanar depiction of normal and abnormal peripheral nerves.⁴ 3D SHINKEI imaging and DTI provide nerve selective imaging with effective vascular suppression.⁵ MRN thus provides direct objective evidence of the cause (disc) and its effect (thecal sac and nerve root compression) along with depiction of the whole extent of the neuropathy corresponding to the side of symptoms (Fig. 3). MRN in addition, allows comprehensive assessment of the lumbar spine, pelvis, sacroiliac joints, hips and regional muscles, thereby not skipping over the incidental findings or neuropathy at other or contralateral levels.⁶ For example, in this case, there were no other nerve abnormalities to suggest plexopathy. The regional muscles were not atrophied and there was no other mass lesion.

The MRN with DTI imaging protocol takes approximately

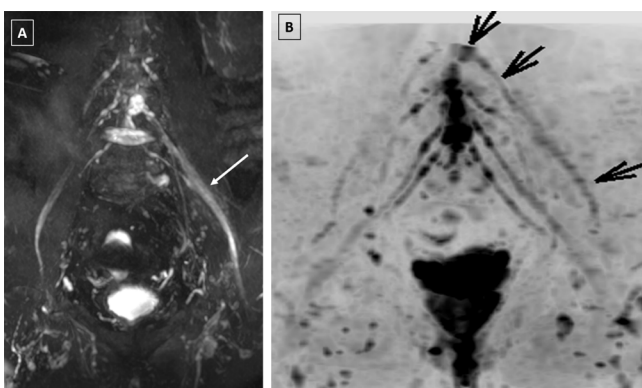


Fig. 3. Coronal anterior oblique angle reconstructed 3D SHINKEI MIP image along the femoral nerve axis at 26° (A) and DTI trace MIP image (B) demonstrates the full extent of the left femoral neuropathy (arrows). DTI: Diffusion tensor imaging; MIP: Maximum intensity projection

45 minutes on 3T scanner using front XL torso coil linked to spine coils in the back, while normal spine MR imaging takes about 30 minutes on 3T scanner. Conventional LS MR imaging should not be replaced with MRN of LS plexus on a routine basis, since it takes longer to acquire and read MRN examinations. However, the incremental value of MRN over the conventional spine MRI examinations is important to appreciate and MRN exams should be considered in the setting of non-contributory MRI in radiculopathy patients.

Conclusion

MRN of the LS plexus provides incremental value in the evaluation of patients with clinically suspected radiculopathy and non-contributory lumbar spine MRI. It can delineate the aetiology and provide direct objective evidence of neuromuscular pathology.

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