ECRONICON OPEN ACCESS

EC ORTHOPAEDICS
Research Article

Importance of Magnetic Resonance Neurography (MRN) in Diagnosis of Neural and Soft Tissue Lesions Concomitant with Thoracolumbar Fractures

Tarek Aly*

Department of Orthopedic Surgery, Tanta University School of Medicine, Egypt

***Corresponding Author:** Tarek Aly, Department of Orthopedic Surgery, Tanta University School of Medicine, Egypt.

Received: August 12, 2021; **Published:** September 27, 2021

Abstract

Objective: Spine injuries are common and can be life-threatening if not recognised and treated promptly. MRI is frequently complementary studies in evaluation of spine trauma patients who were presented to us with variety of lesions and injuries. The aim of this study is to compare magnetic resonance imaging (MRI) versus magnetic resonance neurography (MRN) in evaluation of spine trauma.

Method: Current study included 39 patients. They all were presented with thoracolumbar spinal trauma and neurological deficits and were examined with MRI including MRN. Most affected with spine injuries.

Results: MRN revealed marked accuracy compared to MRI in assessment of nerve root avulsion, perineural oedema, small Extra-Dural hematoma and Para-spinal muscle abnormality.

Conclusion: MRN is valuable tool in diagnosing neural tissue pathology associated with spinal injuries with marked accuracy and sensitivity compared to MRI.

Keywords: *Spine; Thoracolumbar; MRI; MRN*

Introduction

Clinical examination and relevant imaging techniques such as magnetic resonance imaging (MRI), together with electrophysiological and other testing as needed, have traditionally been used to diagnose neurological abnormalities. Traditional MRI may successfully diagnose structural neurological abnormalities, but only to a certain extent, such as distinguishing peripheral nerves from surrounding soft tissues. MRN (magnetic resonance neurography) is a recent method that allows for greater peripheral nerve viewing [1]. MRN's technical skills in detecting fine structural detail of peripheral nerves are superior than MRI's. MRN outperforms regular MRI by employing a fluid-sensitive and fat-suppressed imaging procedure that distinguishes nerve tissue and allows pathologic alterations to be detected [2]. Despite its many benefits, MRN is currently an underutilised diagnostic tool in the examination of spinal injuries.

A very few articles have evaluated the utility of MRN from a surgical point of view. When compared to standard MRI, MRN has the ability to contribute crucial surgical information, such as imaging changes of nerve entrapment, nerve root injury, and better delineation of the neural anatomy [3-5]. This will assist surgeons in making decisions, resulting in fewer intraoperative difficulties and unneeded operations [6].

Role of MRN in evaluating the nerve roots injury in spinal trauma is not clearly understood. To our knowledge, no articles in English literature were found discussing this issue. In this research, we tried to elucidate the importance of MRN in assessment of nerve root condition in case of spine injuries.

Patients and Methods

This study included 39 patients, 22 males and 17 females, with thoracolumbar injuries. The age range was (19 - 62) years with mean age (41.33 ± 16.7). Inclusion criteria were patients with spinal trauma with neurologic manifestations. Patients with no neurological deficits or using devices incompatible with MRI were excluded from the study. Informed consent was obtained from all patients after full explanation of the benefits and risks. Full general, local and neurological examination was done to all patients.

Radiological examination to all patients included multi-detector computed tomography (MDCT) exams performed using a 164 multi-detector row CT scanner, magnetic resonance imaging (spine MRI) exams were performed using (1.5 Tesla closed magnet) and magnetic resonance neurography (MRN) using 3D coronal FIESTA (fast imaging employing steady-state acquisition Gradient echo).

The statistical analysis of the data was carried out using version 23 of the statistical package for social sciences (SPSS, Inc., Chicago, IL). The data is described in terms of mean, standard deviation, and frequency and proportion for quantitative data and frequency and proportion for qualitative data.

For qualitative data, the Chi square test was utilised. P is significant if less than.05 at confidence interval 95%.

Results

This study included 39 patients (22 male and 17 females) with age ranged from 19 to 62 years old with mean age (41.33 ± 16.7), they all were presented with spinal trauma and neurological deficits and were examined with: MDCT, MRI including our MRN technique (FI-ESTA and STIR) sequences. Most affected with spine injuries were male (54%) in comparison to females (46%).

The most common affected age group was 20 - 30 years (38%) followed by age group 40 - 50 (29%), then above 50 groups (25%).

The main mechanism of injury was road traffic accident in 19 patients (49%), 12 patients falling from height (31%), sport injuries (12%), trauma by falling objects (8%). The fracture type varied from burst fracture in 40% of patients, compression fracture in 32%, wedge fracture in 17%, and fracture dislocation in 11% of the studied patients. Five percent of the patients were presented with neurological manifestation without apparent MDCT radiological abnormalities.

MRN revealed marked accuracy compared to MRI in assessment of nerve root avulsion, perinural edema, small Extra-dural hematoma and Para-spinal muscle abnormality (Table 1). MRI was able to detect 57.8% of the soft tissue lesions with sensitivity of 58% while the ability of MRN technique was 90% using with sensitivity of 91%.

Lesion	MRI Finding	MRN Findings	P value
Nerve root avulsion	1 (2%)	11(22%)	0.002*
Perineural edema	0(0%)	23 (46%)	<0.001*
Small Extra-dural hematoma (less than 5 mm)	1(2%)	13 (26%)	<0.001*
Para-spinal muscle abnormality	6 (12%)	33 (66%)	<0.001*
SP cord contusion	15 (30%)	16 (32%)	1.000
SP cord edema	14 (28%)	15 (30%)	1.000
Traumatic disc herniation	9 (18%)	15 (30%)	0.070
Pseudo-meningocele	3 (6%)	5 (10%)	0.500
Vascular injury	0 (0%)	3 (6%)	0.250

Table 1: *Soft tissue lesions and frequencies of identification by MRI and MRN findings (n = 39).*
**Significant P value.*

Discussion

In patients with negative CT tests but a high index of suspicion for injury, MRI is the modality of choice for assessing extra-osseous spinal lesions such as epidural hematomas and ligamentous disruption.

Peripheral nerve imaging is useful primarily because clinical findings sometimes are misleading and nerve conduction studies are usually non-specific. A recent MRI method called magnetic resonance neurography (MRN) enables for thorough anatomic and pathologic viewing of peripheral nerves. It offers a substantial advantage over traditional structural MRI in terms of being able to distinguish neural tissue from the surrounding soft tissue [1].

On the short-T1 inversion recovery images with background suppression images, normal nerve tissue displays an isointense to mildly hyperintense signal on MRN. On T2-weighted imaging, nerve injury causes an increase in signal intensity that approaches that of fluid [7]. In the instance of neuropraxia, T2-weighted imaging reveals hyperintensity and expansion of the nerve, with no signs of discontinuity. The MRN results in axonotmesis will be similar to those in neuropraxia, with individual nerve fascicles enlarging. The disruption of the fascicular pattern can range from minor to total, with or without fascicular expansion or evident contrast enhancement; nonetheless, at least modest T2 hyperintensity is frequently present. A complete detachment of nerve tissue can be detected on MRN, followed by fibrosis and granulation tissue on T2-weighted imaging over time in neurotmesis [8,9]. In addition to mechanical deformation of the nerve or complete discontinuity, perineural oedema or fibrosis might be detected.

MRN allows for the identification of the injured section of the nerve(s) as well as the detection of underlying disease. This helps the accuracy of surgical decision making. Some injuries, such as neuropraxia, can heal on their own, while others require more invasive treatments, such as surgical neurolysis or nerve repair and grafting. Also, MRN is capable of delineating peripheral nerve regeneration and degeneration, which can be useful for following an injury over time or monitoring the progress of surgical reconstruction postoperatively [10-13]. Both neuropraxia and axonotmesis have a good prognosis in terms of functional recovery without surgical interventions. Neurotmesis is the most severe type of injury, and without surgical treatment, regeneration is exceedingly unlikely, hence MRN should be considered for presurgical planning [14,15].

Most of the searched literature was concerned with brachial plexus injuries or non-traumatic lumbosacral plexus pathologies. To our knowledge, this is the first study to add some knowledge regarding the importance of magnetic resonance neurography in evaluation thoracolumbar spinal trauma with neurological deficits.

This study comprised 39 patients (male and female); in terms of gender, males were the most frequently afflicted by spinal injuries, which is consistent with the published literature [16,17], which shows that young and middle-aged people are the most commonly impacted.

Soft tissues such as those found in spinal cords, tiny extradural hematomas, disc herniations, para-spinal muscles, spinal canal compressions, and ligament injuries can all benefit from MRI with MRN (FIESTA and STIR sequences) [18].

MRI is useful for determining the prognosis and treatment of trauma patients, especially when there are incomplete or increasing neurological impairments and severe pain. The current study indicates that MRI with MRN detects soft tissue injuries with high precision, implying that its usage may improve patient prognosis by allowing them to get prescribed therapies sooner [19].

In this study, MRN was able to detect spinal cord edema, paraspinal muscles high STIR signals and perineural edema in patients with completely normal conventional MRI with persistent neurological manifestations after spinal trauma.

In this study, FIESTA combined with conventional MR imaging (MRN) detected 11 patients with nerve root avulsion, 33 patients with paraspinal muscle abnormalities and 23 patients with perineural edema. This agree with the published literature as in Launay., *et al*. [20] who mentioned that conventional MRI combined with FIESTA was able to detect non-visualized nerve root and pseudomeningocele in (90%) of his patients and paraspinal muscle edema in 5 patients (25%).

Conclusion

The spine is susceptible to a variety of stable and unstable injuries. Injury to this region is associated with substantial morbidity and mortality, depending on the type of trauma. MRI is complementary studies in evaluation of the spine trauma patients who were presented with variety of lesions and injuries. MRI can assess occult injuries when MDCT is normal. FIESTA combined with conventional MRI and MRN sequences depicted nerve segments in greater detail and provided important information about the relationship of the nerves to nearby structures, it provided submillimetric spatial resolution and high contrast resolution between cerebrospinal fluid and solid structures, allowing the reconstruction of elegant multiplanar images that highlight the injured nerves. MRN showed higher accuracy and sensitivity in detecting the soft tissue lesions concomitant with thoracolumbar spinal fractures.

Bibliography

1. Filler AG., *et al*. "Application of magnetic resonance neurography in the evaluation of patients with peripheral nerve pathology". *Journal of Neurosurgery* 85 (1996): 299-309.

2. Newhart H., *et al*. "The Incremental Value of Magnetic Resonance Neurography for the Neurosurgeon: Review of the Literature". *World Neurosurgery* 122 (2019): 331-341.

3. Howe FA., *et al*. "Magnetic resonance neurography". *Magnetic Resonance in Medicine* 28 (1992): 328-338.

4. Filler AG., *et al*. "Magnetic resonance neurography". *Lancet* 341 (1993): 659-661.

5. Chhabra A., *et al*. "MR neurography: past, present, and future". *AJR American Journal of Roentgenology* 197 (2011): 583-591.

6. Chhabra A., *et al*. "Impact of high resolution 3 tesla MR neurography (MRN) on diagnostic thinking and therapeutic patient management". *European Radiology* 26 (2016): 1235-1244.

7. Petchprapa CN., *et al*. "MR imaging of entrapment neuropathies of the lower extremity. Part 1. The pelvis and hip". *Radiographics* 30 (2010): 983-1000.

8. Sunderland S. "A classification of peripheral nerve injuries producing loss of function". *Brain* 74 (1951): 491-516.

9. Seddon HJ., *et al*. "Rate of regeneration of peripheral nerves in man". *The Journal of Physiology* 102 (1943): 191-215.

10. Chhabra A., *et al*. "High-resolution 3T MR neurography of the brachial plexus and its branches, with emphasis on 3D imaging". *AJNR: American Journal of Neuroradiology* 34 (2013): 486-497.

11. Bergmeister KD., *et al*. "Improved diagnostics and therapeutic decision making in traumatic peripheral nerve lesions using MRneurography". *Handchirurgie, Mikrochirurgie, Plastische Chirurgie* 50 (2018): 232-240.

12. Dailey AT., *et al*. "Magnetic resonance neurography of peripheral nerve degeneration and regeneration". *Lancet* 350 (1997): 1221-1222.

13. Simon NG and Kliot M. "Diffusion weighted MRI and tractography for evaluating peripheral nerve degeneration and regeneration". *Neural Regeneration Research* 9 (2014): 2122-2124.

14. Thawait SK., *et al*. "High-resolution MR neurography of diffuse peripheral nerve lesions". *American Journal of Neuroradiology* 32 (2011): 1365-1372.

15. Mautner VF., *et al*. "Assessment of benign tumor burden by whole-body MRI in patients with neurofibromatosis 1". *Neuro-Oncology* 10 (2008): 593-598.

16. Bagley LJ. "Imaging of spinal trauma". *Radiologic Clinics of North America* 4 (2006): 1-12.

17. D'Alise MD., *et al*. "Magnetic resonance imaging evaluation of the cervical spine in the comatose or obtunded trauma patient". *Journal of Neurosurgery* 91 (1999): 54-59.

18. Giuliano V., *et al*. "Soft tissue injury protocol (STIP) using motion MRI for cervical spine trauma assessment". *Emergency Radiology* 10 (2004): 241-245.

19. Hadley MN and Walters BC. "Introduction to the guidelines for the management of acute cervical spine and spine cord injury". *Neurosurgery* 72.3 (2013): 5-16.

20. Launay F., *et al*. "Pediatric spinal cord injury without radiographic abnormality: a meta-analysis". *Clinical Orthopaedics and Related Research* 433 (2005): 166-170.

Volume 12 Issue 10 October 2021