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Comparison of diagnostic indices of MRI and EMG in diagnosis of lumbar radiculopathy

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Original Article

Abstract

BACKGROUND: lumbosacral radiculopathy is one of the most common disorders that can be examined by neurologists. Electromyography (EMG) and magnetic resonance imaging (MRI) are used to inspect this disease; however, the application of MRI and EMG in patients with back pain is still under study. This study was designed and implemented to compare the diagnostic values of MRI and EMG in the diagnosis of lumbar radiculopathy.

METHODS: This was cross-sectional study which included 62 patients with suspected lumbosacral radiculopathy in a referral neurology clinic in Sanandaj, Iran, in 2009-2010. EMG was considered as the gold standard test. Inclusion criteria were being older than 20 years of age, and suffering from back pain or radicular pain in the lower limbs for more than four weeks. Data were entered into SPSS software and the diagnostic indices and agreement were calculated.

RESULTS: The percentage of agreement between MRI and EMG results were calculated as 80.6%. The sensitivity of MRI compared with EMG at different levels was calculated between 44.4% and 79.6% and its specificity was calculated between 46.1% and 94.3%. In total, sensitivity and specificity of MRI were 68.9% and 86.3%, respectively. The Lasègue's sign, used for detection of disc herniation, had the sensitivity, specificity, and positive and negative predictive value of 28.8%, 50%, 75%, and 11.9%, respectively.

CONCLUSION: MRI and EMG tests have no superiority over one another for the evaluation of lumbar radiculopathy and it is necessary to do both. The Lasègue's sign is also not an appropriate test for detection of lumbar spine disc herniation, and it is not helpful in diagnosing or ruling out the disease.

KEYWORDS: Radiculopathy, Magnetic Resonance Imaging, Electromyography

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Introduction

Prevalence of back pain varies from 12% to 33% in different societies. Its prevalence in a person's life can vary from 11% to 84%.[1,2] Lumbosacral radiculopathy is a complication in the lumbar nerve roots that leads to symptoms in the lower limbs and it is one of the most common disorders that is evaluated by neurologists.[3,4] Electromyography (EMG) can be used to diagnose lumbar radiculopathy; however, this test can diagnose the problem as long as the nerve root is physiologically affected. Instead, magnetic resonance imaging (MRI) can also detect lesions that have not caused physiological disorders in the nerve.[5] MRI can provide anatomical evidences and is useful in choosing a treatment process, but it could also have false positive results.[6-8] The effectiveness of MRI in the evaluation of patients with back pain is still controversial.[8] This study was designed and implemented to compare the

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diagnostic value of MRI and EMG in the diagnosis of lumbar radiculopathy.

Materials and Methods

This was a cross-sectional and descriptive-analytical study. Patients who suffered from back pain and radicular lower limb pain with paresthesia and motor-reflex deficit and who referred to the Neurology Clinic of Tohid Hospital between 2009 and 2010 were enrolled in the study.

Inclusion criteria were being older than 20 years of age, and suffering from back pain or radicular pain in the lower limb for more than four weeks. Exclusion criteria included diabetes, vasculitis, Guillain-Barré syndrome, motor neuron disease (MND), tumors, and metastases. First, samples were clinically examined by a neurologist and the result of Lasègue's sign was registered, and if necessary MRI was requested. MRI report was prepared by a radiologist and was entered into the questionnaires. Then, EMG/NCV (nerve conduction velocity) electrodiagnostic test was performed by a neurologist without the knowledge of the MRI result.

To determine radiculopathy in different muscles of lower extremity, EMG/NCV was performed on the sensory-motor nerves and lower limb muscles; based on the sum of NCV and EMG findings in the involved nerve roots, they were identified and were registered in the questionnaires. EMG was considered as the gold standard test. MRI was considered positive when disc herniation, bulging, protrusion, extrusion, degenerative joint disease (DJD), and Spondylolisthesis was observed with different grades. 73 patients who had inclusion criteria were evaluated, and 62 patients signed informed consent forms and were entered into the study.

Frequencies and percentages were calculated after entering data into SPSS for Windows (version 11.5, SPSS Inc., Chicago, IL, USA). Chi-square and Fisher's exact tests were used to compare nerve root involvement between male and female participants. Then diagnostic indices together with 95% confidence intervals were calculated.

Results

37 participants were male (59.7%) and 25 (40.3%) were female. Their mean age was 40.5 ± 11 years. Using EMG as a diagnostic test, 8 patients (12.9%) had normal test results, and there was L3 involvement in 9 patients (14.5%), L4 involvement in 18 patients (29%), L5 involvement in 40 patients (64.5%), and S1 involvement in 49 patients (79%). No Significant difference was observed between the sexes regarding different levels of involvement (Table 1). In 10 cases (16.1%) involvement was observed at one level, in 31 cases (50%) at two levels, in 8 cases (12.9%) at three levels, and in 5 cases (8.1%) at four levels. In 6 patients (9.7%) MRI test result was reported normal. The percentage of MRI and EMG agreement was calculated as 80.6%. In total, sensitivity and specificity of MRI were 68.9% and 86.3%, respectively. The sensitivity and specificity of MRI compared with EMG at different levels (lumbar and sacral roots) were calculated from 44.4% to 79.6% and from 46.1% to 94.3%, respectively. Defect in 36 (31.3%) nerve roots were seen in EMG, but MRI had missed them; however, 18 impaired (13.6%) roots were seen in MRI but EMG had missed them. Compared with other levels, L5 and S1 had more cases of positive MRI but negative EMG (Table 2).

Table 1. Involvement of different levels based on electromyography (EMG) test in both sexes

Involvement level	Male	Female	Significance level
L3	6 (16.2%)	3 (12%)	0.72
L4	10 (27%)	8 (32%)	0.77
L5	23 (62.2%)	17 (68%)	0.78
S1	32 (86.5%)	17 (68%)	0.11

Based on Fisher's exact test, no significant difference was observed in the involvement level between the two sexes.

52 patients (83.9%) had disc herniation in the lumbar vertebrae. The Lasègue's sign, used for detection of disc herniation, had the sensitivity, specificity, positive and negative predictive value of 28.8%, 50%, 75%, and 11.9%, respectively, in comparison to MRI.

Table 2. Comparison of the diagnostic value (95% confidence interval) of magnetic resonance imaging (MRI) with electromyography (EMG) in different lumbar levels

Assessed level	MRI	EMG		Sensitivity	Specificity	Positive predictive value	Negative predictive value
		Positive	Negative				
L3	Positive	4	3	44.4	94.3	57.1	90.9
	Negative	5	50	(13.7-78.8)	(84.3-98.8)	(18.4-90.1)	(89-97)
L4	Positive	11	2	61.1	95.4	84.6	85.7
	Negative	7	42	(35.7-82.7)	(84.5-99.4)	(54.4-98.1)	(72.7-94.1)
L5	Positive	26	6	65	72.7	81.2	53.3
	Negative	14	16	(48.3-79.4)	(49.8-89.3)	(63.5-92.8)	(34.3-71.7)
S1	Positive	39	7	79.6	46.1	84.8	37.5
	Negative	10	6	(65.6-89.7)	(19.2-74.8)	(71.1-93.6)	(15.2-64.7)
Total roots	Positive	80	18	68.9	86.3	81.6	76
	Negative	36	114	(59.7-77.2)	(79.3-91.7)	(72.5-88.7)	(68.3-82.5)

MRI: Magnetic resonance imaging; EMG: Electromyography

Discussion

In the present study, the agreement between MRI and EMG was approximately 80.6%. MRI and EMG revealed 98 and 116 lesions, respectively. Approximately 13.6% of the MRI detected lesions were failed by EMG.

In the early stages of the lesion, MRI may show lesions that EMG fails to report. However, as an alternative, EMG can indirectly detect inflammatory lesions and nerve root stretches which cannot be examined by MRI. Therefore, with respect to the high agreement of MRI and EMG, in case of EMG failure, using MRI for an accurate diagnosis in the nerve root lesions instead of using more invasive approaches seems to be beneficial. On the other hand, MRI could be useful alone in mild cases to predict and prevent formation of larger physiopathologic lesions.

In a prevalence study involving patients with abnormal EMG radiculopathy, 84% of patients had radiculopathy symptoms.[3] In a study by Koushan et al., abnormalities in EMG and MRI were reported as 89% and 93%, respectively.[9] It seems that selecting patients based on clinical criteria is a reasonable choice and clinical findings are quite valuable.

Prevalence of radiculopathy in lumbar vertebrae increases from top to bottom. L1 radiculopathy is rare and L5 radiculopathy is the most common.[10] In another study, L5 was the most common involved root.[11] In the present study, people who had clinical symptoms for over 4 weeks were evaluated. Higher incidence of involvement in S1 in our study could possibly result from the presence of cases with more severe disease, and association with the deformities related to the L5/S1 including changes in DJD, Spondylolisthesis, discopathy, and pressure on the S1.

In the study by Koushan et al.,[9] the percentage of agreement was 88% and it was 61% in the study by Reza Soltani et al.[11] Probably, the agreement increases as the severity of the disease increases.[11] Therefore, it is expected that different agreement levels be observed in different studies based on patient type and severity of the disease. Although MRI and EMG results are roughly consistent, each of these tests provides different information.[10,12] Type of patients and their clinical symptoms affect MRI outcome.[9,13]

As MRI can detect disorders that have not caused pressure or defect in nerve roots, we expected to observe high sensitivity in MRI, but the result was different. However, in several previous studies, the sensitivity of MRI, compared with electrodiagnostic tests, was reported from 50% to 64% based on the type of patients.[14-16] In our study, we selected EMG as the gold standard, while EMG is not a complete gold standard and its sensitivity, compared with clinical symptoms, is reported from 55% to 86%.[12,14,16,17] In the study by Koushan et al., the sensitivity and specificity of MRI were 27.3% and

96.5%, respectively.[9] Other studies showed that MRI is the main tool for assessing the vertebra structure and the nerves involvement regions; therefore, performing MRI together with electrodiagnostic tests can be very useful in understanding how to treat complications.[9,18] Some other studies have also shown the superiority of MRI and electrodiagnostic test over one another.[11] Hence, in Lumbar radiculopathy cases both tests are needed.

In addition, one of the possible causes of the low sensitivity of MRI in this study could be the lumbar radiculopathy caused by another radiculitis existing in the province or in our patients. Inflammatory causes can be associated with normal MRI. MRI can detect special complications which need surgery, and in primary examinations MRI is better than CT scan since it can detect inflammations, intra vertebra pathologies, and vascular problems. It may also have a high rate of false-positive results.[10] It is suggested that the causes of lumbar radiculopathy be studied with high precision and the causes of inflammatory back pain be determined.

The most common presentation of lumbar radiculopathy is the pressure on nerve root caused by the disc herniation between the vertebrae which had a prevalence of 83.5% in our study.[10] In other studies, the prevalence of lumbar disc herniation and dislocation in people with radiculopathy have been reported from 65% to 88%.[3,19] This shows that MRI is important for assessing the disc of people with radiculopathy and can facilitate choosing the treatment method. Moreover, Lasègue's sign result cannot be trusted as diagnostic test or screening tool in confirming herniation of lumbar vertebral disc.

Conclusions

Though it seems that MRI has higher specificity and sensitivity for detection of disk herniation, for diagnosis of lumbar roots lesions EMG is the method of choice. However, MRI and EMG tests have no superiority over one another for the evaluation of lumbar radiculopathy and it is necessary to do both. The Lasègue's sign is also not an appropriate test for detection of lumbar spine disc herniation, and it is not helpful in diagnosing or ruling out the disease.

Conflict of Interests

Authors have no conflict of interests.

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