COMPARISON OF ELECTROMYOGRAPHY / NERVE CONDUCTION STUDIES AND MAGNETIC RESONANCE IMAGING IN DIAGNOSIS OF LUMBOSACRAL RADICULOPATHY

Waseem Iqbal, Nadeem Ahmad*, Tariq Mirza, Akhtar Waheed*, Aamir Waheed Butt*

Combined military Hospital Lahore, *Armed Forces institute of Rehabilitation Medicine Rawalpindi,

ABSTRACT

Objective: To compare EMG/NCS with MRI in diagnosis of lumbosacral radiculopathy.

Study Design: Cross-sectional comparative.

Place and Duration of Study: The study was carried out at Armed Forces Institute of Rehabilitation Medicine, for a period of six months, from January 2007 to June 2007.

Patients and Methods: Fifty consenting patients with clinical lumbosacral radiculopathy were included, they underwent MRI and NCS/EMG, and then both procedures were compared for diagnosis of radiculopathy.

Results: MRI and NCS/EMG had comparable sensitivity but MRI was less accurately correlated with clinical estimated level of radiculopathy.

Conclusion: Both NCS/EMG and MRI are time sensitive investigations which provide different information regarding the pathology. NCS/EMG reveal physiological etiology of radiculopathy, compared to MRI, which gives the anatomical information. Every patient with clinical lumbosacral radiculopathy should undergo NCS/EMG for confirmation of diagnosis. However, when anatomical lesion is suspected, or surgical intervention is planned, MRI should complement it.

Key Words: Electromyography, Magnetic Resonance Imaging, Radiculopathy.

INTRODUCTION

Lumbosacral radiculopathy is one of the most common radiculopathies seen in the electrodiagnostic setting[1]. The term lumbosacral radiculopathy is used to specifically describe pain and other symptoms like numbness, tingling, and weakness in legs that are caused by a problem with nerve roots[2]. This disease is often caused by pressure and impingement from a herniated disc or degenerative changes in the lumbar spine which cause irritation and inflammation of the nerve roots[3]. Radicular pain, weakness, loss of tendon stretch reflex, less commonly atrophy or fasciculation occur in myotomal patterns with lumbosacral root lesion[4]. Plain radiographs, myelography, enhanced or non-enhanced computerized tomography (CT) and nuclear imaging all are done to diagnose the causative agent. But Magnetic Resonance Imaging (MRI) is helpful in showing changes in signal intensity generated by the nucleus pulposus and occasionally, in adjacent vertebral bodies that can cause nerve root compression. However, the same types of MRI changes can be seen in lifelong asymptomatic individuals.[5] Nerve Conduction Studies/ Electromyography (NCS/ EMG) have been suggested as substitutes for or as a supplement to, imaging examinations.[6] While NCS include routine studies to evaluate peripheral nervous system status, several other methods are available to evaluate nerve root function. The specific studies include F wave latency, which reveal slowing of proximal motor conduction, and H reflex studies, which are particularly useful to examine afferent and efferent pathways of the S1 root[7], whereas EMG aims to identify the affected myotome. NCS/EMG studies are especially valuable in patients with negative findings at myelography or CT, or in patients with uncharacteristic clinical findings. In such patients, NCS/EMG assessment gives clues to nerve function and may reveal the site of the lesion[8].

This study was conducted to compare the two most commonly used methods in our setup for diagnosis of lumbosacral radiculopathy, to check the clinical utility of the modalities.

Correspondence: Maj Waseem Iqbal, Reheblitation Medicine Department, CMH Lahore Cantt

Received: 05 Oct 2010; Accepted: 31 Dec 2010

PATIENS AND METHODS

The study was carried out at Armed Forces Institute of Rehabilitation Medicine (AFIRM) Electrodiagnostic Department where Meditronics Diagnostics Keypoint ® version 5.0 EMG/NCS machine was used. MRI was carried out at affiliated Radiology Department equipped with Siemens ® Magnetom Symphony 1.5 tesla. The study was completed in six months from January 2007 to June 2007.A total of 50 consenting patients with signs and symptoms of lumbosacral radiculopathy were included in the study and sampling was carried out through Non Probability Convenience Sampling. Adult **p**atients with radicular signs and symptoms including dermatomal pattern of pain, sensory deficit, motor neurological deficits or segmental reflex loss were included.

Patients with symptoms in both upper and lower limbs spondyloarthropathies and peripheral nerve lesions were excluded.

Data Collection

After obtaining informed consent and permission from concerned authorities and Hospital Ethics Committee, a detailed history and thorough physical examination was carried out. A clinical diagnosis was established, and then MRI and NCS/EMG were performed.

MRI Data:

The MRI was evaluated by radiologists without clinical data (history and clinical findings) for MRI diagnosis. Each scan was graded as radiculopathy with level of pathology or normal.

NCS/EMG Data:

Surface electrodes for NCS & Standard concentric needle were used for the EMG studies. Tibial and Peroneal for Motor, while Superficial Peroneal and Sural for sensory; were examined for amplitude, latency, and conduction velocity during NCS to rule out polyneuropathy or plexopathy. F-Wave and H-reflex were also performed.

The EMG was carried out as per protocol i.e one myotome above and one below the clinical suspected level. The abnormal studies were considered only if there was ongoing denervation (fibrillation potentials or positive sharp waves) or renervation (large potentials). Few cases also revealed pathology at more than one level, both the levels were included, but paraspinals examination was carried out for them for confirmation of diagnosis.

Statistical Analysis

Data was analyzed and continuous variables like age were presented by range and mean whereas categorical variables like gender, registration status, symptoms like pain, paresthesias, segmental reflex loss etc, were presented in terms of frequency and percentages. Clinical, MRI and NCS/EMG diagnosis were also presented in terms of frequency and percentages.

MRI and EMG results were compared by cross tabulation. Both MRI and NCS/EMG were also compared with clinical diagnosis by cross tabulation. Chi square test was used to determine the statistical significance. P value of less than 0.05 was taken as significant.

RESULTS

The study revealed the demographic data as age ranged from 19 to 79 years, with a mean of 42 years. Forty one patients (82%) were male and 9 (18 %) female; among the selected patients, 29 were from OPD and 21 indoor cases.

The clinical presentation is tabulated in Table 1, while clinical, MRI and NCS/EMG diagnosis is shown in Figure 1, 2 and 3 respectively. Overall, in clinical presentation, the commonest was impaired sensation with myotomal weakness in 15 patients (30%) followed by myotomal weakness which was found in 11 patients(22%).

On MRI, the commonest was normal which were found to be in 15 patients (30%), while commonest anomaly was L5 radiculopathy (Bilateral) which was seen in 7 patients (14%). On NCS/EMG, again the commonest finding was normal found in 17 patients (34%) whereas, the most frequently found radiculopathy was L5 (Left) which was seen in 8 (16%) patients. S1 (Right) was the second commonest finding (12%). Overall 35 (70 %) patients had MRI positive for radiculopathy while 33 (66 %) were positive for NCS/EMG. One important finding was that 32 patients (64%) had an EMG abnormality and 14

Table: Clinical Presentation of the cases

Clinical Signs & Symptoms	Frequency	Percent	Valid Percent	Cumulative Percent
Myotomal Weakness	11	22.0	22.0	22.0
Segmental Reflex Loss	4	8.0	8.0	30.0
Impaired Sensation+Myotomal Weakness	15	30.0	30.0	60.0
Impaired Sensation+Myotomal Weakness+Segmental Reflex Loss	8	16.0	16.0	76.0
Myotomal Weakness+Segmental Reflex Loss	5	10.0	10.0	86.0
Impaired Sensation+Segmental Reflex loss	7	14.0	14.0	100.0
Total	**50**	**100.0**	**100.0**	

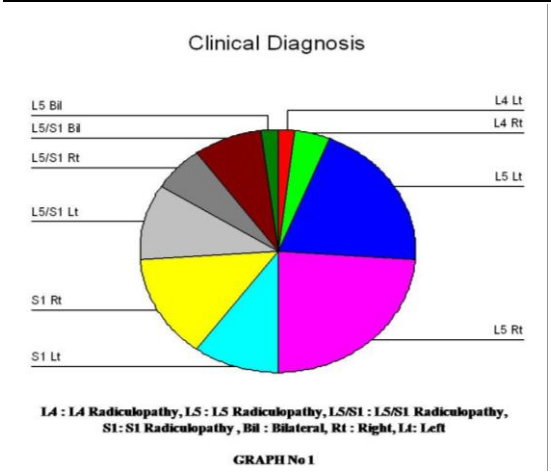

Fig.1: Showing clinical diagnosis

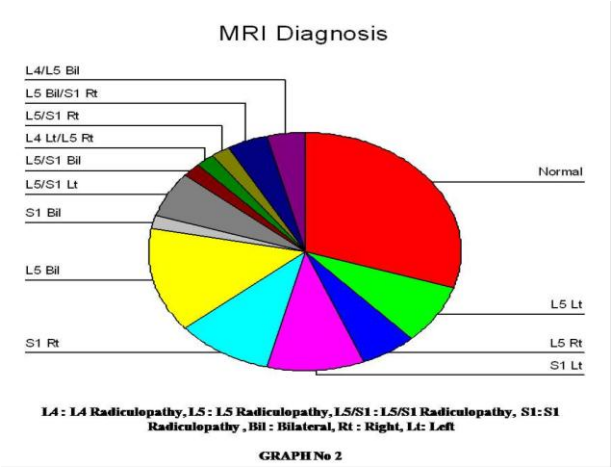

Fig. 2: Showing MRI diagnosis

patients (28%) had an MRI abnormality that correlated with the clinical level of radiculopathy. When both tests were compared with the clinical diagnosis, the sensitivity of NCS/EMG was 66% and that of MRI turned out to be 70%. Overall, both the tests agreed in 33 of the 50 patients (66%), with both normal in 5 and both abnormal in 28.

DISCUSSION

While no studies have been done comparing NCS/EMG and MRI in the diagnosis of lumbosacral radiculopathy, several have compared EMG with CT.[9,10] In patients with clinically suspected lumbosacral radiculopathy, EMG abnormalities have been reported in 48%,[11] and 81%,[12] of those patients with abnormal CT scans. In our patients with MRI abnormalities, we found NCS/EMG abnormalities in 66% of the patients, figures comparable to these prior studies. Overall, we observed that great agreement was found in both modalities in patients where clinical diagnosis was more evident. However, the likelihood that both studies would be positive was 66% (comparable to 66% positivity for NCS/EMG). When MRI was compared with the clinical findings; it was found to be only 28%. There are several potential factors contributing

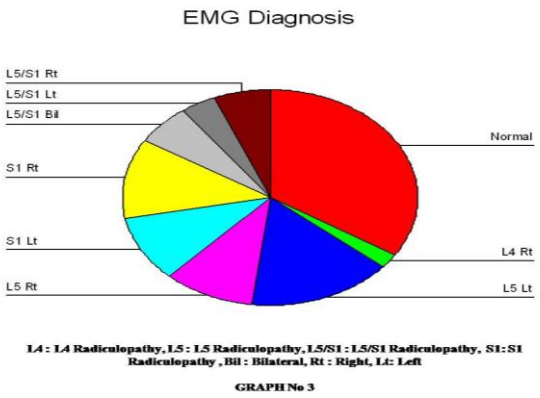

Fig. 3: Showing EMG Diagnosis

to the discrepancy between NCS/EMG and MRI findings that we found in our study. MRI is a means of radiological examination of the anatomic lesion, responsible for a clinical condition whereas NCS/EMG is a measure of the physiologic consequence of such pathology; each test is subject to limitations that affect its diagnostic value. One important factor affecting results of both NCS/EMG and MRI is the timing of the investigation. EMG changes of denervation e.g. fibrillations and positive sharp waves develop in the first week and may resolve (reinnervation i.e. large potentials) in few months time. Thus, NCS/EMG may be negative if performed before or after the

development of such changes[13]. Similarly, if the radiculopathy is mainly sensory in nature, NCS/EMG changes will still be absent. This likely explains our finding that NCS/EMG was abnormal in 66% of patients with demonstrable radicular features.

Similarly, the timing of the study and pathology also influence the diagnostic utility of MRI in radiculopathy. Modic studied patients with lumbar radiculopathy using serial MRI scans and showed substantial decreases in the size of large disc herniations over 6 months time.[9] Additional studies revealed the scans were found to be even negative.[14-17] However, in our study, the scans were not time bound so there may have been regressed/resolved pathology or may be non neurological etiology, a non-radicular etiology of pain, or mild nature of pathology.

Most of the MRI scans had at least one other abnormality at a second level or on the contralateral side. The fact that significant MRI abnormalities may not be clinically relevant is clear from prior studies of lumbar MRI in asymptomatic individuals.[18-23] Individuals over age 50 were two and a half times more likely to have more than one abnormality than younger individuals. In an earlier study, disc degeneration or bulging was seen in 35% of subjects between 20 and 39 years, and the frequency increased with the age.[23] These findings emphasize the importance of interpreting MRI abnormalities in the light of the clinical picture.

CONCLUSION

The study reveals that although both tests have comparable sensitivity, the clinical correlation of MRI is less accurate. In this study, it is also evident that both tests often give discordant results and thus provide different information. NCS/EMG provide a physiological measure, whereas MRI gives excellent anatomical detail of pathology. So when the conservative management of radiculopathy is considered, NCS/EMG should be performed and when surgical intervention is planned, in addition to the electrophysiological testing, MRI should also be done.

REFERENCES

1. Yaar I. The logical choice of muscles for the needle-EMG evaluation of lumbosacral radiculopathy. J Electromyogr Kinesiol. 2006; 16(2):205-13.
2. Govind J. Lumbar radicular pain. Aust Fam Physician. 2004; 33(6):409-12.
3. Benoist M. The natural history of lumbar disc herniation and radiculopathy. Joint Bone Spine. 2002; 69(2):155-60.
4. Dubuisson D. Nerve root damage and arachnoidits. In: Wall PD, Melzack R, editors. Text Book of Pain. 2nd ed. Edinburgh: Churchill Livingstone; 1989.544-65.
5. Jarvik JG, Deyo RA. Diagnostic evaluation of low back pain with emphasis on imaging. Ann Intern Med. 2002; 137(7):586-97.
6. Nardin RA, Patel MR, Gudas TF, Rutkove SB, Raynor EM. Electromyography and magnetic resonance imaging in the evaluation of radiculopathy. Muscle Nerve. 1999; 22(2):149-50.
7. Levin KH. Electrodiagnostic approach to the patient with suspected radiculopathy. Neurol Clin. 2002; 20(2):397-421.
8. Fisher MA.Electrophysiology of radiculopathies.Clin Neurophysiol. 2002; 113(3):317-35.
9. Modic MT, Masaryk T, Boumphrey F, Goormastic M, Bell G. Lumbar herniated disk disease and canal stenosis: prospective evaluation by surface coil MR, CT and myelography. AJR. 1986; 147: 757–65.
10. Modic MT, Ross JS, Obuchowski NA, Browning KH, Cianflocco AJ, Mazanec DJ: Contrast-enhanced MR imaging in acute lumbar radiculopathy: a pilot study of the natural history. Radiology .1995; 195: 429–35.
11. Haldeman S, Shouka M, Robboy S. Computed tomography, electrodiagnostic and clinical findings in chronic workers' compensation patients with back and leg pain. Spine. 1988; 13: 345-50.
12. Wu Z, Tsai C, Yang D, Chu F, Chang T: Electrophysiologic study and computed tomography in diagnosis of lumbosacral radiculopathy. Chin Med J. 1987; 39:119–25.
13. Preston DC, Shapiro BE. Electromyography and Neuromuscular Disorders.3rd ed. Philadelphia. Elsevier; 2005. Chapter 7, Basic overview of electromyography; p 163-7.
14. Bozzao A, Gallucci M, Masciocchi C, Aprile I, Barile A, Passariello R. Lumbar disk herniation: MR imaging assessment of natural history in patients treated without surgery. Radiology .1992;185: 135–41.
15. Bush K, Chaudhuri R, Hillier S, Penny J. The pathomorphologic changes that accompany the resolution of cervical radiculopathy. A prospective study with repeat magnetic resonance imaging. Spine. 1997; 22: 183–6.
16. Komori H, Shinomiya K, Nakai O, Yamaura I, Takeda S, Furuya K. The natural history of herniated nucleus pulposus with radiculopathy. Spine. 1996; 21: 225–29.
17. Krieger AJ, Maniker AH.MRI-documented regression of a herniated cervical nucleus pulposus: a case report. Surg Neurol .1992; 37: 457–59.
18. Jensen MC, Brant ZMN, Obuchowski N. Magnetic resonance imaging of the lumbar spine in people without back pain. N Engl J Med. 1994; 331: 69-73.
19. Weishaupt D, Zanetti M, Hodler J, Boos N. MRI of the lumbar spine: Prevalence of intervertebral disc extrusion and sequestration, nerve root compression and plate abnormalities, and osteoarthritis of the fact joints in Asymptomatic Volunteers. Radiology – 1998; 209:661-6
20. Boos N, Rieder R, Schade V, Spratt KF, Semmer N, Aebi M. 1995 Volvo Award in clinical science: The diagnostic accuracy of MRI, work perception, and psychosocial factors in identifying symptomatic disc herniations. Spine.1995; 20: 2613-25.
21. Boos N, Semmer N, Elfering A, Schade V, Gal I, Zanetti M, et al. Natural history of individuals with asymptomatic disc abnormalities in MRI: Predictors of low back pain-related medical consultation and work incapacity. Spine. 2000; 25:1484-92.
22. Boden SD, Davis DO, Dina TS, Patronas NJ, Wiesel SW. Abnormal Magnetic-Resonance Scans of the Lumbar Spine in Asymptomatci Subjects. J Bone Joint Surg .1990; 72:403-08
23. Fraser RD, Sandhu A, Gogan WJ. Magnetic resonance imaging findings 10 years after treatment for lumbar disc herniation. Spine. 1995: 15; 20(6):710-14.