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Original Research Article

Correlation of Electromyography and Magnetic Resonance Imaging as Modalities of Evaluation of Lumbar Intervertebral Disc Prolapse

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ABSTRACT

Introduction: Intervertebral disc prolapse (PIVD) accounts for majority of cases of low backache seen by an orthopaedician in clinical practice and is major contributor of functional disability. The diagnosis of a prolapse disc is clinical and can usually be made based upon compatible symptoms and examination findings. The most useful modalities in the evaluation of lumbosacral radiculopathy are MRI, CT, electromyography (EMG) and nerve conduction studies (NCS).
Aims and Objectives: Correlation of Electromyography and Magnetic Resonance Imaging as modalities of evaluation of lumbar intervertebral disc prolapse.
Materials and methods: Clinically and radiologically proved cases of PIVD were electrodiagnostically evaluated in the department of physiology in collaboration with department of orthopaedics, Pt. B.D Sharma PGIMS, Rohtak. Results obtained were statistically analysed using chi square test ($p<0.05$).
Results: EMG correlated significantly with MRI ($p<0.025$). Conclusion: EMG can be used as a diagnostic tool for PIVD patients.

Keywords: PIVD, MRI, EMG, electromyography.

INTRODUCTION

Lumbar radiculopathy refers to a pathologic process involving the lumbar nerve roots causing radicular symptoms into a lower extremity. Intervertebral disc disease and disc herniation are most prominent in otherwise healthy people in the third and fourth decades of life. [1,2] It accounts for majority of cases of low backache seen by an orthopaedician in clinical practice and is major contributor of functional disability. Clinical examination is the mainstay of diagnosis, to be correlated by plain radiographs, computed tomographs, magnetic resonance imaging and invasive radiography like myelography and discography. In the last decade, non-invasive radiography such as computed tomography and magnetic resonance imaging has taken the onus of diagnosis of prolapsed intervertebral disc. Magnetic resonance imaging is considered highly sensitive and specific test for diagnosing prolapsed intervertebral disc.

The diagnosis of a lumbosacral radiculopathy is clinical, and can usually be made based upon compatible symptoms and examination findings.

The sensitivities of CT and MRI are similar for compressive radiculopathies. [3]

EMG and NCS have a high diagnostic accuracy for radiculopathy when neurologic weakness is present for at least three weeks. [4]

Electromyography (EMG) is a technique for evaluating and recording the electrical activity produced by skeletal muscles. An electromyography detects the potential generated by muscle cells when these cells are electrically or neurologically activated. The signals can be analyzed to detect medical abnormalities, activation level and recruitment order or to analyze the biomechanics of movements. It can be recorded by needle electrodes or surface electrodes. Back pain is thought to be associated with increased and/or asymmetrical activity measured by electromyography. [5]

Aims and objectives

To correlate EMG and MRI as modalities of evaluation of lumbar PIVD and to see if, EMG results are comparable with costly investigation like MRI.

MATERIALS AND METHODS

The study was conducted in the Department of Physiology in collaboration with Department of Orthopaedics, Pt. B. D. Sharma PGIMS, Rohtak. The study included thirty clinically and radiologically confirmed patients, between 20 to 75 years of age of either sex with lumbar disc prolapse.

Inclusion criteria

Patients with prolapsed intervertebral discs at L4-L5 and L5-S1levels. Levels were confirmed by MRI and correlated with clinical findings.

Exclusion criteria

Patients of low back pain with causes other than prolapsed intervertebral disc like trauma, tumour, sprains, strains, infections, psychological pain, spondylolisthesis, facet joint degenerative arthropathy etc.

Subjects suffering from comorbid conditions like diabetes mellitus, chronic renal failure, myxoedema, Vit. B_{12} deficiency anemia, myopathy and chronic alcoholism were also excluded.

A written consent was taken from each subject enrolled for the study. Detailed history, general physical examination and neurological examinations were carried out. Pain, duration, severity, radiation and sensory symptoms- paraesthesia/ hyperesthesia were noted. All the clinically suspected cases underwent MRI study of LS spine and disc prolapse were evaluated as intraspongi-nuclear herniation, protrusion, extrusion and sequestration. Electromyographic study was done in Department of Physiology using an Aleron 401 model electromyography machine. Concentric needle electrode of a 24-26 gauge; bevelled tip exposed to give an oval recording area of 125×580 μm^2 was used. [5]

A bilateral study of paraspinal, tibialis anterior, extensor hallucislongus, vastuslateralis and vastusmedialis muscles was done. The study identified the patient by the presence of spontaneous activity in two or more muscles innervated by the same nerve root level but different peripheral nerves. Spontaneous activity referred only to fibrillations or positive sharp waves.

Recruitment of motor unit potentials (MUPs) was also recorded, in the above mentioned muscles.

Statistical analysis

The data hence obtained was statistically analysed by chi-square test using IBM SPSS Statistics for Windows, Version 20.0. Released 2011. Armonk, NY: IBM Corp. Significance of result was predicted based on p value with significance set at $p< 0.05$.

RESULTS

Out of the 15 patients showing single disc involvement on MRI, electrodiagnostic study (electromyography) showed deficit in only 6 patients (40%). In the remaining 15 patients showing multiple disc involvement on MRI electrodiagnostic deficit was present in 12 patients (80%). This data represents that there is statistically significant association of electrodiagnostic

study with MRI on both single and multiple disc involvement with $p < 0.05$. (Table: I)

Table I: Deficit found on electro diagnostic study

n=30	Electro diagnostic Deficit			
Disc involvement	**Absent**	**Present**	**Total**	**Pearson Chi square**
Single	9	6	15	p<0.025*
Multiple	3	12	15	
Total	12	18	30	

*statistical significance (p<0.05)

Out of thirty MRI+ patients only 12 patients had decreased recruitment of motor unit potentials, while the remaining eighteen patients had normal recruitment. (Table: II)

Table II: Recruitment of motor unit potentials

n=30	Recruitment of motor unit potentials	
Total MRI+	Normal	Decreased
30	18	12

DISCUSSION

In the present study thirty patients were clinically, radiologically and neuro electrophysiologically investigated for lumbar prolapse intervertebral disc. Our study group comprised of clinically and radiologically confirmed patients of lumbar PIVD. Radiologically these patients were assessed by plain radiographs and magnetic resonance imaging (MRI). Radiological studies using MRI only revealed structural abnormalities, which may also be present in asymptomatic subjects or may be unrelated to the clinical findings. Electrodiagnostically, patients were assessed by performing electromyography. Electrodiagnostic study (EDX) including EMG, assesses the physiological and functional status of peripheral nervous systems rather than anatomical and structural evaluation, and provides information which is helpful in choosing appropriate therapeutic options. EDX revealed clinically relevant nerve dysfunction in patients whose radiological findings were normal or appeared to be irrelevant to the clinical findings. [6,7]

In present study only 40% patients with single disc and 80% patients with multiple discs involvement showed abnormal EMG. This data represented statistically significant association of electrodiagnostic study with MRI on both single and multiple disc involvement with $p<0.05$ (Table I). Conversely, in 60% patients with single disc and 20% patients with multiple disc involvement, electromyography was normal though MRI showed abnormality. This substantiates that electro diagnostic studies are more physiological and give better representation of functional status of an individual. Lee et al study showed that 22.1% of electro diagnostically positive [EDX (+)] patients were MRI negative [MRI (-)] and 46.8% of MRI (+) patients were EDX (-) thus supporting our study. They also compared specificity and sensitivity between root compression seen on MRI and radiculopathy seen on electro diagnostic study (EDX) using McNemar's test and concluded that in symptomatic patients EDX was significantly more correlated with clinical data than was MRI. [8] In our study all the 30 patients were MRI (+) and 6 of them were EDX (+) on single disc and 12 of them EDX (+) on multiple disc involvement. Coster et al reported that approximately 7% of the EDX (+) patients were MRI (-) and 26% of MRI (+) patients were EDX (-). [6] Johnson et al studied the distribution of electromyographic abnormalities in one hundred and eleven patients with lumbar radiculopathy and concluded that the relationship of electromyographic abnormalities to the motor radiculopathy is direct, accurate and specific. [9] Khatri et al had correlated the results of CT and EMG and observed that an abnormal EMG correlated better with radiculopathy than CT. [10]

In the current study 12 out of 30 MRI (+) patients were EDX (-). This discrepancy can be explained, as asymptomatic herniated disc are common finding on MRI in the normal population (25%) and therefore it is assumed that

within symptomatic patients a substantial number of herniated disc are asymptomatic too. [11,12]

Radiological studies using MRI only reveal structural abnormalities, which may also be present in asymptomatic subjects or may be unrelated to the clinical findings. This was confirmed by our present study where MRI showed prolapsed intervertebral disc but recruitment of MUPs were normal in 18 out of 30 patients (Table II). Although there were patients with decreased recruitment on EMG, which correlated significantly with radiological findings but EMG does not always correspond with MRI.

Similar results were obtained by Lauder et al in which they observed that tibialis anterior muscle was abnormal in 92% of radiculopathies at L4-L5 level, extensor hallucislongus muscle was abnormal in 87% of radiculopathies at L5 level, vastuslateralis muscle was abnormal in 100% of radiculopathies at multiple levels and vastusmedialis was abnormal in 54% patients when L3-L4 level and 17% when L4-L5 level were involved. [13] Dillingham et al observed that when paraspinal muscles with other four muscles were screened on EMG, 94% to 98% of lumbosacral radiculopathies were diagnosed. [14] In our study we also studied five muscles including paraspinals. Once a positive radiculopathy screening study is revealed the EMG examination can then be expanded to evaluate the specific radiculopathy level and exclude other diagnostic possibilities. [13]

The present study demonstrated the useful characteristics of electromyography. Firstly, a cheaper EMG gave significant results when compared to a manifold costly MRI investigation (a boon for a developing country like India). Secondly, EMG demonstrated a more significant correlation with poorer functionality of lower limb (evident by decreased recruitment in the tested muscles) than did MRI in the lumbar disc prolapse patients. This was explained by the fact that EMG abnormalities were dependent on the loss of motor axons. EMG was more correlated with the signs and symptoms of the patients and tells more about the physiological status of the nerves and muscles. It has higher specificity and lower level of false positivity and hence can play an important role in steering patients toward appropriate treatments. [15]

Limitations of the study

Skill of the physician performing and interpreting the study is the biggest factor in obtaining accurate results.

CONCLUSION

As electrodiagnostic study in patients with lumbosacral prolapse intervertebral disc significantly correlate with magnetic resonance imaging in diagnosing patients, represents better clinical/physiological picture, can be used as a diagnostic tool to establish management protocols and prevent unnecessary interventions. Moreover, EMG could also be used to identify the level of disc involvement in patients of radiculopathy. [15,16]

ABBREVIATIONS:

MRI: magnetic resonance imaging,
CT: computed tomography

REFERENCES

1. Svensson HO, Andersson GB. Low-back pain in 40- to 47-year-old men: work history and work environment factors. Spine (Phila Pa 1976). 1983 Apr; 8(3):272-6.
2. Svensson HO, Andersson GB. The relationship of low-back pain, work history, work environment, and stress. A retrospective cross-sectional study of 38- to 64-year-old women. Spine (Phila Pa 1976). 1989 May; 14(5):517-22.
3. Bischoff RJ, Rodriguez RP, Gupta K et al. A comparison of computed tomography-myelography, magnetic resonance imaging, and myelography in the diagnosis of herniated nucleus pulposus and spinal stenosis. J Spinal Disord. 1993 Aug; 6(4):289-95.
4. Hsu PS, Armon C, Levin K. Lumbosacral radiculopathy:

Pathophysiology, clinical features, and diagnosis. Uptodate [Internet]. 2011 Jan [cited 2011 Jan]; [about 30 p.]. Available from: http://scholar.google.co.in/ scholar url?hl=en&q=http://www.physiologie. unimainz.de/physio/mittmann/ThalFallZ 3.pdfsa=X&scisig=AAGBfm0qyxHxKf lyI7MuNRCHOy9hfWL6A&oi=scholar r&ei=MTARU6yeIsiMrQeOu4CIBw&v ed=0CCUQgAMoADAA

5. Kamen G. Electromyographic Kinesiology. In: Robertson DGE, Hamill J, Caldwell GE, Kamen G, editors. Research Methods in Biomechanics. Champaign, IL: Human Kinetics Publ.; 2004.
6. Coster S, de Bruijn SF, Tavy DL. Diagnostic value history, physical examination and needle electromyography in diagnosing lumbosacral radiculopathy. J Neurol. 2010 Mar; 257(3):332-7.
7. Haig AJ, Geisser ME, Tong HC et al. Electromyographic and magnetic resonance imaging to predict lumbar stenosis, low-back pain, and no back symptoms. J Bone Joint Surg Am. 2007 Feb; 89(2):358-66.
8. Lee JH, Lee SH. Physical examination, magnetic resonance imaging and electrodiagnostic study of patients with lumbosacral disc herniation or spinal stenosis. J Rehabil Med. 2012 May 22; 44:845-50.
9. Johnson EW, Melvin JL. Value of electromyography in lumbar radiculopat hy. Arch Phys Med Rehabil. 1971 Jun; 52(6):239-43.
10. Khatri BO, Baruah J, Mc Quillen MP. Correlation of electromyography with computed tomography in evaluation of lower back pain. Arch Neurol. 1984 Jun; 41(6):594-7.
11. Jensen MC, Brant-Zawadzki MN, Obuchowski N et al. Magnetic resonance imaging of the lumbar spine in people without back pain. N Engl J Med. 1994 Jul 14; 331(2):69-73.
12. Boden SD, Davis DO, Dina TS et al. Abnormal magnetic-resonance scans of the lumbar spine in asymptomatic subjects. A prospective investigation. J Bone Joint Surg Am. 1990 Mar; 72(3):403-8.
13. Lauder TD, Dillingham TR, Huston CW et al. Lumbosacral radiculopathy screen. Optimizing the number of muscle studies. Am J Phys Med Rehabil. 1994 Nov-Dec; 73(6):394-402.
14. Dillingham TR, Lauder TD, Andary M et al. Identifying lumbosacral radiculopathies: an optimal electromyographic screen. Am J Phys Med Rehabil. 2000 Nov-Dec; 79(6): 496-503.
15. Haig AJ, Tong HC, Yamakawa KS et al. The sensitivity and specificity of electrodiagnostic testing for the clinical syndrome of lumbar spinal stenosis. Spine (Phila Pa 1976). 2005 Dec 1; 30(23):2667-76.
16. Van Rijn JC, Klemetso N, Reitsma JB et al. Symptomatic and asymptomatic abnormalities in patients with lumbosacral radicular syndrome: Clinical examination compared with MRI. Clin Neurol Neurosurg. 2006 Sep; 108(6):553-7.

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