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*SHORT COMMUNICATION*

# ASSESSMENT OF NERVE CONDUCTION STUDY TO ESTABLISH MOST COMMON ELECTROPHYSIOLOGICAL PREDICTOR OF LUMBOSACRAL RADICULOPATHY AMONG RADIOLOGICALLY DIAGNOSED L5S1 NEURAL FORAMINA COMPRESSION CASES

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**Abstract :** Magnetic resonance imaging (MRI) and electromyography (EMG) are complimentary investigations in diagnosis of lumbosacral radiculopathy (LSR). With changing pattern of S1 electrodiagnosis by H-reflex study measures, electrophysiological studies were conducted to establish most common electrophysiological predictors of LSR in MRI diagnosed L5S1 neural foramina compression subjects. Fifty subjects, with definite L5S1 neural foramina compression underwent electrophysiological evaluation and the data was analyzed using established electrodiagnostic criteria. Reduced H/M ratio in combination with absent H response was evident in 74 nerves. H-reflex study was abnormal in 88% subjects. Study concluded that, H/M ratio if used with other H-reflex study variables may be most common predictor of LSR.

**Key words :** nerve conduction study lumbosacral radiculopathy H/M ratio

## INTRODUCTION

MRI and needle EMG are complimentary investigations for the diagnosis of lumbosacral radiculopathy (LSR) (1). EMG is most validated electrodiagnostic test for LSR (2). In radiculopathies involving sensory root and with reinnervation in the muscle, spontaneous activity is absent (3). Hence EMG remains normal with clear structural nerve root compromise (4). Routine nerve conduction studies (NCS) of lower limb is more likely to be preserved except for severe LSR with axonal degeneration. Late

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responses (F and H waves) show prolonged latencies in L5S1 radiculopathy. F waves seem to be less affected as compared to soleus H-reflex study (5). Recently, H-reflex amplitude asymmetry was observed as earlier indicator of S1 nerve root involvement as compared to H wave latency (6). With above background, electrophysiological data from fifty MRI diagnosed LSR subjects with definite L5S1 neural foramina compression was obtained to establish most common electrophysiological predictor of LSR in these subjects. An attempt was also made to assess diagnostic accuracy of NCS variables in LSR.

## SUBJECTS AND METHOD

Fifty subjects in the age range 25 to 60 years with history of chronic low back pain and definite evidence of L5S1 neural foramina compression on MRI with unilateral or bilateral involvement were randomly selected for this study. Subjects with the history of diabetes mellitus, other neuromuscular disorder were excluded from the study. Selected subjects underwent nerve conduction study during August 2007 to January 2009 on EMG-EP machine in clinical neurophysiology laboratory at a rural hospital in central India. An approval from Institutional Ethics Committee was obtained. Informed consent was taken from all the subjects.

### Electrophysiological studies

Standard techniques by Preston DC et al were adopted for all the NCS measures under study (7). Electrophysiological studies considered for evaluation were bilateral tibial and peroneal NCS, F wave studies, soleus H-reflex studies and sural sensory NCS. Tibial and peroneal motor conductions were performed by supramaximal stimulation at ankle. Sural SNAPs were obtained by stimulating at calf and recording from lateral malleolus. H-reflex was recorded from soleus muscle by subliminally stimulating tibial nerve in popliteal fossa. Needle EMG was not done in any participant.

### Electro diagnostic (EDX) criteria

We adopted lower and upper cut off values from Shin J Oh et al to label motor, sensory, H wave and F wave abnormalities (8). EDX criteria for Soleus H-reflex abnormalities were (Any one) Absent H waves, Prolonged H wave latencies > 31.93 ms, Inter-side difference > 2 ms and H/M ratio < 0.2.

### Statistical analysis

Data was approached in three ways. Firstly, we considered nerve (n=100) as a unit for expression of results. Secondly, we analyzed data from individual subjects (n=50) to assess contribution of motor, sensory and H-reflex abnormalities for diagnosis of LSR. Finally, Fisher exact test (2-tailed) was applied to compare the diagnostic accuracy of tests between fifty LSR present and fifty LSR absent cases. Statistically significant difference was set at P value < 0.05. Sensitivity, specificity, PPV, and NPV were calculated for MNC, SNC, F wave and H wave study.

## RESULTS

Data from 50 subjects (27 male and 23 female) in age range 25 to 60 years with average age, height and weight;

TABLE I : Electrophysiological predictors of LSR and its frequency of abnormalities in 100 nerves.

| *Predictors of LSR* | *Abnormal response* | *Absent response* | *Total number of abnormalities (n=100)* |
|---|---|---|---|
| Tibial DML | 16 | 03 | 19 |
| Peroneal DML | 25 | 01 | 26 |
| Tibial CMAP | 08 | 03 | 11 |
| Peroneal CMAP | 14 | 01 | 15 |
| Tibial CV | 11 | 03 | 14 |
| Peroneal CV | 13 | 01 | 14 |
| Tibial F-Min Latency | 12 | 03 | 15 |
| Peroneal F-Min Latency | 12 | 13 | 25 |
| Sural SNAP | 13 | 08 | 21 |
| Sural CV | 17 | 08 | 25 |
| H wave Latency | 14 | 45 | 59 |
| H/M Ratio | 29 | 45 | 74 |

Note: Abnormal response means CMAP/SNAP elicited with values above or below, upper or lower limits of normal respectively. Absent response means response not elicited at all. CMAP=Compound muscle action potential, SNAP=sensory nerve action potential, DML= distal motor latency, CV = conduction velocity, H/M ratio = ratio of maximum H wave amplitude to maximum M wave amplitude, LSR-Lumbosacral radiculopathy.

43.4±9.3 yrs, 159.4±9.4 cm and 56.8±9.9 kg respectively were analyzed. Table I illustrates electrophysiological predictors and it's frequency of abnormalities in 100 nerves. H-reflex was not elicited in 45 nerves. Among elicited 55 responses, H wave latency was prolonged in 14 nerves and abnormal H/M ratio in 28. In four nerves inter-leg latency difference of > 2 ms was recorded. Table II illustrates distribution of percentage of abnormality in 50 LSR and 50 healthy subjects. Out of 50 LSR subjects, H wave abnormality was evident in 35 subjects when only H latency and absent H wave responses were considered, whereas 44 subjects when H/M ratio was added to former two variables. Table III shows diagnostic sensitivity, specificity, PPV and NPV of EDX tests. H-reflex study with inclusion of H/M ratio with existing variables increases diagnostic sensitivity of test by 88%.

Table II : Distribution of motor, sensory, F wave and H wave study abnormalities among healthy and L5S1 radiculopathy subjects.

| *Electrophysiological study* | *No. of subjects with abnormality among Healthy group (n=50)* | *No. of subjects with Abnormality among L5S1 radiculopathy group (n=50)* | *Fisher-Exact test (two-tailed) P value* |
|---|---|---|---|
| Motor Nerve conduction study | 09 (18) | 34 (68) | <0.0001 |
| Sensory nerve conduction study | 04 (08) | 23 (46) | <0.0001 |
| F wave study | Nil | 20 (40) | <0.0001 |
| H-wave study (Latency prolonged+Absent wave) | 01 (2) | 35 (70) | <0.0001 |
| H wave study (Latency prolonged+Absent wave+H/M ratio <0.2) | 06 (12) | 44 (88) | <0.0001 |

Note - Values in parenthesis indicate percentage.

Table III : Diagnostic sensitivity, specificity, positive predictive value, and negative predictive value of EDX studies.

| *EDX study* | *Sensitivity* | *Specificity* | *PPV* | *NPV* |
|---|---|---|---|---|
| MNCS | 64% | 82% | 79% | 71% |
| SSNCS | 46% | 92% | 85% | 63% |
| F wave study | 40% | 100% | 100% | 62% |
| H-reflex study (H latency+absent response | 70% | 98% | 97% | 76% |
| H-reflex study (H-latency+Absent response+<0.2 H/M ratio | 88% | 88% | 88% | 88% |

EDX - Electrodiagnostic, MNCS - Motor nerve conduction study, SSNCS - Sural sensory nerve conduction study, H/M ratio - ratio of maximum H wave amplitude to maximum M wave amplitude.

## DISCUSSION

EMG and NCS play important role in the evaluation of LSR. Routine motor and sensory conductions remain normal in LSR. EMG remains mainstay for electrodiagnosis in these subjects. In recent times role of late responses in diagnosis of LSR has been extensively studied. Role of tibial and peroneal F wave study may be controversial in L5S1 radiculopathy. H-reflex study has contributed mainly in S1 sensory nerve root dysfunction, even in chronic low back pain subjects without clinical neurodeficit (9).

In present study MNC were abnormal in 68% of subjects, which is significantly higher than observed by Berger AR et al (36.2%) (10). This observation may be attributed to the fact that if root compression is severe and chronic then segmental demyelination with preserved axonal integrity like scenario of LSR may progress to axonal degeneration (3). Herniated intervertebral discs are common cause of cervical and lumbosacral radiculopathy. Sensory nerve conduction (SNC) studies are normal in nerve root injuries sparing dorsal root ganglion as disc herniations are distal to it (11). Presence of abnormal sural SNC studies in 23 subjects suggests that either lesion was postganglionic or with severe axonal degeneration secondary to severe and chronic compression of nerve roots. Whereas in 27 subjects, normal sural SNC suggests lesions were preganglionic.

Late responses provide objective evidence of L5 and S1 nerve root compression (12). We observed F wave study abnormalities in 40% subjects similar to a previous study, thus exhibiting the limited role in LSR diagnosis (10).

We observed abnormalities in 70% subjects when H latency prolongation and absent response was used. Other criteria, H/M ratio when added to former two, abnormality was evident in 88% subjects. This was statistically verified by applying Fisher exact test among disease present and absent cases (P value $< 0.0001$) and calculating diagnostic sensitivity (88% as against former criteria with only 70%) as shown in table III. H/M ratio provides an easy estimate of motoneuron pool activation, and therefore excitability (13). Among enlisted electrophysiological predictors of LSR, H/M ratio was most frequently abnormal (74%) although we used 0.2 as lowest cut off value. Observation was corroborative with the findings by Dhand UK et al, where use of H/M ratio increased sensitivity of H-reflex study in the diagnosis of S1 radiculopathy among low back pain patients with or without neurodeficit corresponding to S1 radical (14). We believe that present study established H/M ratio as most common predictor of LSR among all NCS variables in absence of EMG findings.

### Conclusion

Present study concluded that using H/M ratio in combination with other H-reflex study variables, NCS alone may be an excellent electrodiagnostic tool to establish L5S1 radiculopathy.

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