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Assessment of Motor and Sensory Nerve Conduction and H – reflex in patients with Lumbosacral Radiculopathy – A Cross-Sectional Study in a Tertiary care center of Northeast India

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Abstract:
Background: *Lumbosacral Radiculopathy is a syndrome complex caused by compression or irritation of nerve roots in the lower back. Nerve conduction studies (NCS) are electrodiagnostic tests which are noninvasive, objective, and reproducible tool to assess the functional integrity of the nerve root. It can assess both the sensory and motor nerve function. NCV helps in confirmation of radiculopathy and determines the severity grading of axon loss or conduction. The H-reflex, a late response analogous to the monosynaptic stretch reflex, is particularly sensitive to S1 root dysfunction.*
Objectives: *1. To assess the Motor and Sensory Nerve Conduction in patients with Lumbosacral radiculopathy. 2. To assess the H-reflex in patients with Lumbosacral radiculopathy.*
Materials and Method: *A hospital based cross- sectional study was carried out among one hundred and sixty-four (164) Lumbosacral Radiculopathy patients attending Neurology OPD of AGMC & GBP Hospital. Following standard protocol motor and sensory NCS was conducted on tibial and sural nerve respectively. Data were recorded in a predesigned case study format and analyzed using SPSS 21. A p-value of <0.05 was considered statistically significant.*
Results: *Among one hundred and sixty-four (164) study participants 45% of them were female and 55% of them were male. In Motor nerve conduction, Mean of Right and left tibial conduction velocity was (44.82 ±4.91) m/s and (45.92±4.95) m/s respectively. Mean of Right and Left Sensory nerve conduction velocity of sural nerve was (61±11.84) and (62±13.12) as respectively. Mean of Right H- reflex Latency is (18.40±13.56) ms and mean of Left H- reflex latency is (17±13.87) ms.*
Conclusion: *NCS can be valuable tool in evaluating subjects with lumbosacral radiculopathy.*
Key words: *Lumbosacral radiculopathy, Motor Nerve conduction study, Sensory Nerve conduction study, conduction velocity, H – reflex.*

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I. INTRODUCTION

Lumbosacral Radiculopathy is a syndrome complex caused by compression or irritation of nerve roots in the lower back. This compression is mainly due to degenerative changes such as disc herniation, ligamentum flavum changes, facet hypertrophy, and spondylolisthesis, leading to the compression of one or more lumbosacral nerve roots. Symptoms typically like low back pain radiating into the lower extremities in a dermatomal pattern corresponding to the affected nerve root, numbness, weakness, and loss of reflexes. [1]

Electrophysiological techniques such as Nerve Conduction Velocity (NCV) studies serves as an essential diagnostic tool to evaluate the functional integrity of peripheral nerves. NCV measures the speed of action potential conduction via saltatory conduction in large myelinated axons of the peripheral nerve. So, it helps to diagnose the conditions like focal nerve entrapments, demyelinating mononeuropathy, axonal loss mononeuropathy, preganglionic lesions, and both demyelinating and axonal polyneuropathies.[2]

NCS are non-invasive, objective and sensitive test to establish an early diagnosis of slowing of conduction. NCS consists of Motor nerve conduction study, Sensory nerve conduction study, Late responses (F-wave and H reflex), Repetitive nerve stimulation. The sensory conduction can be measured orthodromically or antidromically**.** In orthodromic conduction, a distal portion of the nerve is stimulated and sensory nerve action

potential (SNAP) is recorded at a proximal point along the nerve. In antidromic sensory nerve conduction, the nerve is stimulated at a proximal point and nerve action potential is recorded distally.[3]

Motor nerve conduction studies of the common peroneal nerve and posterior tibial nerve can be useful to assess the patient lumbosacral radiculopathy. Late responses (like F-wave and H reflex) assess the proximal segments of the peripheral nerve fibers.[4] The H-reflex is a monosynaptic spinal reflex that assesses an afferent 1a sensory nerve and an efferent a motor nerve. The H-reflex is recorded most commonly over the gastrocnemius-soleus muscle complex, stimulating the tibial nerve. It is a sensitive (but less specific) marker of S1 radiculopathy, especially when the abnormality is unilateral.[5]

Very few studies have been conducted to evaluate the use of nerve conduction studies in the diagnosis and assessment of patients with lumbosacral radiculopathy. There is a need for more studies to be conducted to correlate the findings of the NCS in patients with lumbosacral radiculopathy. Especially in Northeastern part of India, no such studies have been conducted in patients with lumbosacral radiculopathy. Therefore, this study is taken up to assess the nerve conduction in patients with lumbosacral radiculopathy.

II. Aims & Objectives

1. To assess the Motor and Sensory Nerve Conduction in patients with Lumbosacral radiculopathy. 2. To assess the H-reflex in patients with Lumbosacral radiculopathy.

III. Materials and Method

Study type: Observational study

Study design: Hospital based Cross- sectional study

Study duration: January 2024 to November 2024

Study area / location: Department of Physiology in collaboration with Department of Neurology, Agartala Govt. Medical College (AGMC).

Study population: One hundred and sixty-four (164) adult patients between the age group of 30 to 70 years with Lumbosacral Radiculopathy attending Neurology OPD of AGMC & GBP Hospital.

Inclusion criteria for cases:

1. Age group of 30-70 years

2. Lumbosacral Radiculopathy: (AAPT Criteria)[6]

a. Pain radiating from Lumbar region to the leg in one or more dermatomal distributions of the Lumbosacral Nerve routes.
b. Pain on most days for atleast 3 months and atleast half of the days in past 6 months.
c. Presence of Neurological Signs (Sensory deficit, Weakness, reflex changes) or symptoms (eg. Paresthesia) in the anatomical distribution of the painful route territory.
d. Exclusion of Non – Spinal causes of radicular pain (eg. Diabetic Neuropathy)

3. Co-operative & willing to participate in the study.

Exclusion criteria for cases:

1. Patients with electrolyte imbalance

2. Patients with Diabetes Mellitus, Thyroid disease

3. History of prior spinal surgery

Sampling procedure: Convenient sampling

All the lumber radiculopathy patients attending neurology clinic who will fulfill the inclusion and exclusion criteria during the study period of study were included.

Study tools:

- Stadiometer: Bioplus; height -200cm

- Weight Machine (Mechanical EQ-BR -9201): Brand- Equinox, Weight Limit- 130kg
- 2/4 Channel portable RMS EMG.NCV.EP machine
- Case study format

Study procedure:

All the study subjects were selected consecutively during the study period following the inclusion and exclusion criteria. The data were collected from the Lumbosacral radiculopathy patients attending Neurology OPD of AGMC & GBP Hospital, during the study period.

All the participants were personally subjected to detailed history regarding name, age, sex, occupation, socioeconomic status, educational status, medical history and clinical features etc. These findings were recorded in a predesigned and pretested standard questionnaire. Blood sugar level, thyroid level and other laboratory findings were recorded from previous and current medical documents. Written informed consent was obtained from all the participants. Complete general physical and systemic examination was performed.

1. Age: Was recorded from birthdays to the nearest completed years.

2. Standing height: Height of the subjects was measured barefooted in centimeters to the nearest 0.1 cm.

3. Weight: Weight of the subject was recorded to the nearest 0.1kg.
4. NCS: The nerve conduction recordings were performed using RMS EMG.NCV.EP machine. The subjects were allowed to lie down on a couch and relax fully to ensure good recordings. The area of the skin was cleaned thoroughly with spirit to remove dirt, dead cells and grease. The cup or disc electrodes (Ag-AgCl) of 1 cm diameter filled with conducting jelly was fixed on the skin of recording area with transpore tape. These electrodes were connected to the oscilloscope through the preamplifier. After 10 min of rest and adaptation to the laboratory environment, electrodiagnostic tests were performed following the standard procedures.

The recordings were performed with standard equipment settings: sensitivity 5 mV/division, sweep speed 5 ms/division, stimulus duration 0.2 ms, low-frequency filter 10 Hz, high-frequency filter 5 kHz, using supramaximal strength of stimuli. In motor NCSs, the tibial nerve was stimulated at least at two points along its course. The active surface electrode was placed on the muscle belly innervated by the nerve, while the reference electrode was positioned distally on the tendon. The Sensory NCS was performed for Sural nerve. The sural nerve was stimulated at the lateral calf at a distance of 14 cm and recorded at the lateral malleolus. The H reflex study was recorded at the soleus muscle and stimulated at the popliteal fossa of the tibial nerve.

Data analysis: Data were analyzed using SPSS 20. Descriptive statistics and other suitable statistical tests were used as per applicability. Data were expressed in terms of mean and standard deviation. A probability value less than 0.05 were considered as significant.

IV. Results

One hundred and sixty-four (164) Lumbosacral Radiculopathy patients participated in the study. Demographic variables of the study participants are described in Table 1. 45% of them were female and 55% of them were male as shown in Figure 1. In the tibial motor nerve conduction study, mean distal latencies were 3.32 ± 0.76 ms (right) and 3.63 ± 0.84 ms (left); mean CMAP amplitudes were 11.69 ± 4.43 mV (right) and 11.46 ± 4.50 mV (left); mean conduction velocities were 44.82 ± 4.91 m/s (right) and 45.92 ± 4.95 m/s (left) as mentioned inTable 2.As shown in Figure 2, the conduction velocity on the right side is reduced by 7%, and on the left side by 3%. For Sural Sensory Nerve Conduction Study (SNC), the mean onset latency of the right sural nerve was 1.99 ± 0.40 ms, and that of the left sural nerve was 2.01 ± 0.43 ms. The mean amplitude of sensory nerve action potential (SNAP) was 22.92 ± 11.87 µV on the right and 22.93 ± 12.18 µV on the left. The mean sensory nerve conduction velocity (SNCV) was 61 ± 11.84 m/s on the right and 62 ± 13.12 m/s on the left as described in table 3. H-Reflex for Tibial Nerve, the mean H-reflex latency of the right tibial nerve was 18.40 ± 13.56 ms, while that of the left tibial nerve was 17.00 ± 13.87 ms. 60-65% are having normal latency and 35-40% are having abnormal/delayed latency as shown in Figure 3 & 4.

Variable	Mean	±Std. Deviation
Age (yrs)	49.57	±11.78
Height (cm)	153.68	±5.45
Weight (kg)	58.49	±9.00

Table 1: Demographic variables of the participants

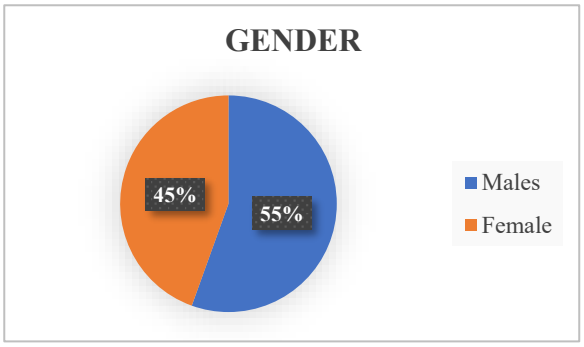


Fig.1: Gender distribution among study participants

VARIABLE	Mean	±Std. Deviation
R T LAT (ms)	3.32	±0.76
R T AMP (Mv)	11.69	±4.43
R T CV (ms)	44.82	±4.91
L T LAT (ms)	3.63	±0.84
L T AMP (Mv)	11.46	±4.50
L T CV (ms)	45.92	±4.95

Table 2: Mean and Std. deviation of MNCS Parameters

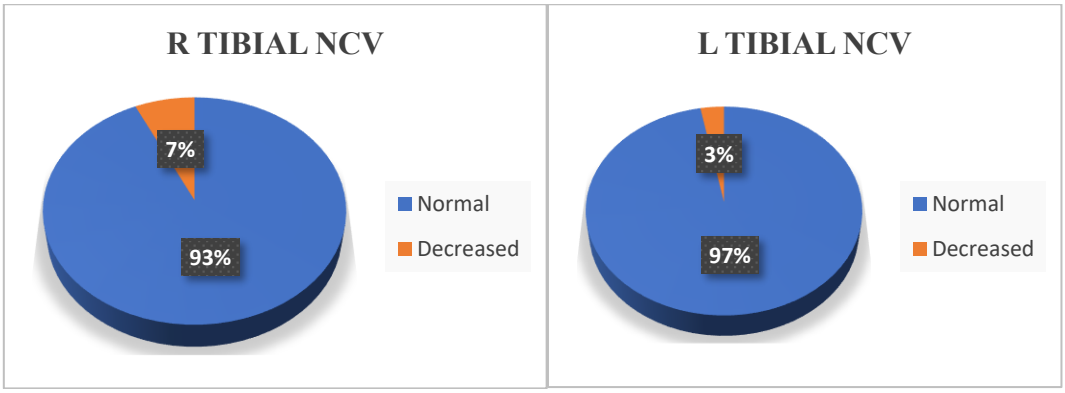
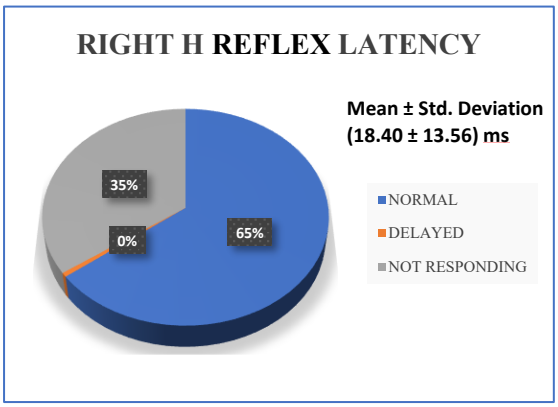


Fig.2: Motor Nerve Conduction velocity among study participants

VARIABLE	Mean	±Std. Deviation
R S Onset LAT (ms)	1.99	±0.40
R S AMP Mv	22.92	±11.87
L S Onset LAT (ms)	2.01	±0.43
L S AMP (Mv)	22.93	±12.18
R SNCV	61	±11.84
L SNCV	62	±13.12

Table 3: Mean and Std. deviation of SNCS Parameters



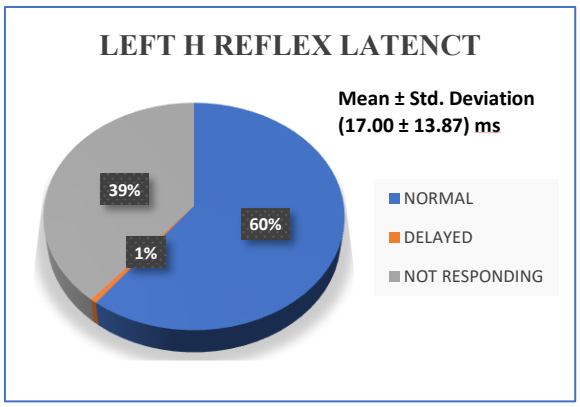


Fig.3: Right H reflex latency among study participants **Fig.4: Left H reflex latency among study participants**

V. Discussion

The present study assessed the motor and sensory nerve conduction parameters along with H-reflex in patients diagnosed with lumbosacral radiculopathy. A total of 164 patients participated, with a slight male predominance (55%), consistent with previous study findings by Nafissi et al., indicating a higher incidence of radiculopathy among males due to occupational and mechanical strain factors.[7]

In the tibial motor nerve conduction study, the mean distal latency and amplitude were within near-normal limits, whereas the conduction velocity showed a mild reduction of 7% on the right and 3% on the left side. This finding suggests early or partial axonal involvement and demyelination, as has been reported by Ghugare et al., who also observed reduced conduction velocity as a sensitive indicator of nerve root compression in lumbosacral radiculopathy, particularly at the L5–S1 level.[8]

The sural sensory nerve conduction study demonstrated preserved latency and amplitude in most patients, with mean sensory conduction velocities of 61 ± 11.84 m/s (right) and 62 ± 13.12 m/s (left). This relative sparing of sensory fibers may reflect the fact that radiculopathy primarily affects the motor roots rather than the distal sensory axons, which is consistent with findings by Nafissi et al. and Talinga et al..[7,9]

In another studies, Tsao (2007) described the H-reflex as a sensitive but less specific electrophysiologic marker for S1 radiculopathy, reporting absent or asymmetrically reduced amplitudes in up to 80–89% of confirmed cases. He further noted that prolonged latency alone is an insensitive indicator, as focal slowing may be obscured by the long segment of the reflex arc.[5] And Parui et al. evaluated multiple H-reflex parameters—including latency, amplitude, and H/M ratio—and found that H-reflex latency prolongation was statistically significant and positively correlated with MRI-confirmed S1 root compression, indicating that latency can reflect functional conduction delay in radicular lesions.[10]

When compared with these findings, the results of the present study are both statistically and clinically significant. Although a smaller proportion of patients (35–45%) showed delayed or absent H-reflex compared with Tsao's report, this difference likely reflects variations in chronicity, selection criteria, and the diagnostic thresholds used. Importantly, our study significantly correlates with the findings of Parui et al., as both demonstrate that H-reflex latency prolongation can serve as an early electrophysiologic indicator of S1 radiculopathy, even in cases where sensory conduction velocity remains normal.

Radiculopathy is a disorder affecting the nerve roots. It is mainly due to the compression of the nerve root from a structural lesion and also secondary to an infection, tumor, or surrounding tissue inflammation. Damage to the nerve roots and nerve fibers alter the nerve conduction through these fibers which are detected by Nerve Conduction Studies.

VI. Conclusion

Motor NCS can be a valuable tool in evaluating subjects with lumbosacral radiculopathy.

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