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ROLE OF MINIMAL F-WAVE LATENCY IN THE ELECTRODIAGNOSIS OF POLYNEUROPATHY

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ABSTRACT

Background and Objective:
Polyneuropathy is a debilitating condition that causes damage to more than two peripheral nerves in the body. The objective of this research was to detect the role of minimal F-wave latency as compared with other nerve conduction parameters for the electro-diagnosis of polyneuropathies.

Methods:
In this descriptive, prospective cross-sectional study, 80 consecutive patients with clinical diagnosis of polyneuropathy (both acute and chronic) between July and December 2023, presenting to the Neurology Department at King Edward Medical University were enrolled. Patients with clinical diagnosis of cervical/lumbar radiculopathies, plexopathies, compressive myelopathy , neuromuscular junction diseases, motor neuron disorders, or localized neuropathies were excluded from this research. NCS and EMG were carried out using conventional procedure. The results were recorded in the predesigned pro forma along with the history and demographic information. Statistical software SPSS 25.0 was used for the analysis of the recorded data.

Results:
F-wave abnormality was detected in 57 (71.3%) for median nerve, 57 (71.3%) for ulnar nerve, 79 (98.7%) for tibial nerve and in 79 (98.7%) patients for peroneal nerve. Nerve-specific motor nerve conduction study (MNCS) abnormality was found in 47 (58.8%) for median nerve, 43/80 (53.8%) for ulnar nerve, 59 (73.7%) for tibial nerve and in 57(71.3%) patients for peroneal nerve. Nerve-specific sensory nerve conduction study (SNCS) abnormality was present in 43 (53.3%) for median nerve, 43 (53.3%) for ulnar nerve, 50 (62.5%) for sural nerve, and in 49 (61.3%) patients for superficial peroneal nerve. Overall rate of abnormality was 85% for F-wave minimal latencies in comparison with 64% for MNCS and 56% for SNCS.

Conclusion:
Minimal F-wave latency can be an effective diagnostic parameter for detection of polyneuropathy. This can facilitate in early detection and management of polyneuropathy.

Key words: Polyneuropathy, Motor nerve conduction study, Sensory nerve conduction study

INTRODUCTION

Polyneuropathy is the common peripheral nerve system disorder particularly among the ageing people and has approximated frequency of 5-8% depending on age related groups.[1] Polyneuropathy is a debilitating condition that causes uniform and consistent sensory symptoms consisting of pain, numbness, and paresthesia as well as muscular weakness, primarily throughout the distal portion of the bilateral arms and legs.[2] Polyneuropathies can be axonal, demyelinating, or of mixed types. Electrodiagnostics is extremely useful for diagnosis, treatment and outcome for patient with polyneuropathy. Basic aims for an electrophysiological evaluation for polyneuropathies is to differentiate between axonal degeneration and demyelinating cause, as clinical examination is less helpful to distinguish these two processes.[3]

Conventional sensory nerve conduction studies (SNCS) and motor nerve conduction studies (MNCS) are unable to examine the long proximal segments of nerves. Supramaximal stimulation of a peripheral nerve

generates F-wave/H-reflex as a late response, allowing assessment of conduction time along the full length of the motor axon, including the proximal segment.[4] Various studies have shown the role of different F-wave parameters (e.g. F wave minimal latency, F index, F/M ratio, chronodispersion) in evaluating polyneuropathy (PN) associated with diabetes mellitus.[5]

F-wave minimum latency is an effective electrodiagnostic parameter for evaluation of polyneuropathies.[6] Willison HJ et al. reported that tibial nerve F-wave minimum latency has shown earlier changes than sural SNAP or SNCS. Research indicates that tibial nerve minimal F-wave latency is the most sensitive predictor of polyneuropathies, especially in case of axonal polyneuropathy.[7]

This research aimed to investigate the sensitivity of minimum F-waves latency and its involvement in electrodiagnosis for demyelinating and axonal polyneuropathy. Minimal F-wave latency aids in accurate assessment of patients by providing early information about the severity and subclinical characteristics of nerve injury as compared with other conventional parameters. Incorporating a minimum F-wave latency in evaluation enhances diagnostic yield of polyneuropathy. Therefore objective of this study was to evaluate role of minimal F wave latency in early diagnosis of polyneuropathy.

METHODS

In this descriptive, prospective cross-sectional study, 80 patients with clinical diagnosis of polyneuropathy (both acute and chronic) between July and December 2023, presenting to the Neurology Department at King Edward Medical University were enrolled. Non-probability consecutive sampling was used. Patients from age 13 to 70 year with clinical diagnosis of polyneuropathy were selected. Patients with signs and symptoms of cervical/lumbar radiculopathy, compressive myelopathy, plexopathy, motor neuron disorders, or focal neuropathies were excluded from study. Patients with pacemaker and edema were also excluded from study. Ethical approval was obtained from Institutional Review Committee of King Edward Medical University (KEMU), Lahore with letter no. 394/RC/KEMU.

All patients were assessed clinically and NCS/EMG were performed. Informed written consent was taken from all patients. All the patients fulfilling the inclusion criteria of acute and chronic neuropathy were included. Electro-diagnostics were performed using surface recordings at temperature of 37 C using the Nihon Kohden (Neuropack® X1 MEB-2300 EMG/NCV/EP) Measuring Desktop System and standard methodologies.[8] F-wave minimum latency was measured for medial, ulnar, peroneal, and tibial nerves. Routine motor study for the median, ulnar, peroneal, and tibial nerves were performed. Routine sensory nerve study for the median, ulnar, superficial peroneal and sural nerves were also performed. Electro-diagnostic results, clinical examinations, and demographic information were recorded on a pre-designed form. In the upper extremity, when the median or ulnar nerves are stimulated at the wrist, the F response usually occurs at a latency of 25 to 32 ms. In the lower extremity, when the peroneal or tibial nerves are stimulated at the ankle, the F response usually occurs at a latency of 45 to 56 ms.[8], Abnormal CMAP or SNAP amplitudes were defined as less than 75% of the reference values.[9]

Statistical software SPSS 25.0 was used for the analysis of the recorded data. Qualitative data like gender were represented as frequency/percentages. Quantitative data like age, minimal F wave delay were represented as mean/standard deviation.

RESULTS

Eighty patients were examined with electro-diagnostic testing with a mean age of 42.9±15.9. Out of which 46 patients (57.5%) were males and 34 patients (42.5%) were females.

Table 1 shows overall rate of abnormality in the studies population for F-wave minimal latencies, MNCS and SNCS.

Table 1: Rate of abnormalities detected in F-wave minimal latencies, motor nerve conduction studies and sensory nerve conduction studies

EDX results of 80 patients with polyneuropathy	
Abnormal F-wave latency	68/80 (85%)
Abnormal MNCS	51/80 (64%)
Abnormal SNCS	46/80(56%)

EDX= Electrodiagnostic, MNCS= motor nerve conduction studies, SNCS= sensory nerve conduction studies

F-wave abnormality was detected in 57 (71.3%) for median nerve, 57 (71.3%) for ulnar nerve, 79 (98.7%) for tibial nerve and in 79 (98.7%) patients for peroneal nerve. MNCS abnormality was found in 47 (58.8%) for median nerve, 43/80 (53.8%) for ulnar nerve, 59 (73.7%) for tibial nerve and in 57(71.3%) patients for peroneal nerve. SNCS abnormality was present in 43 (53.3%) for median nerve, 43 (53.3%) for ulnar nerve, 50 (62.5%) for sural nerve, and in 49 (61.3%) patients for superficial peroneal nerve.

Out of 80 patients, polyneuropathy was predominantly demyelinating in 40 cases, predominantly axonal in 30 cases, and 10 cases were of mixed variety.

DISCUSSION

Several researches have used F-wave minimum latencies to assess peripheral neuropathies. We compared minimal latencies of F-wave to various nerve conduction parameters in polyneuropathy. F-wave minimum latency differs from traditional MNCS in that it measures time of conduction over the whole length of motor axons, rather than only brief distal portions. This advantage enables study of a longer course, accumulating all segmental anomalies, whereas each segmental examination may not disclose a clear abnormality.[10] F-waves are more sensitive in identifying early neuropathies because they influence the whole nerve segment, including the proximal segment.

Weisman et al. reported comparable sensitivity and specificity of 78.6% and 63% for tibial F wave latency and 74% & 70% for peroneal F wave latency.[11] Research conducted by Ramanathan S et al, proved that although sural SNAP or SNCS abnormalities were commonly associated with neuropathies, tibial nerve F-wave minimum latency had a substantially greater incidence.[12] In a study conducted by Jerath NU et al, minimal F-wave latency abnormality rate was 96.9% in comparison with rate of abnormality for NCS that was 77%.[13]

Another study showed that prolonged F wave minimal latency were found in 73.87% of median nerve compared to 69% of ulnar nerve in upper limb, 72.72% of peroneal nerve and 68.96% of tibial nerve in lower limbs.[14] These results are different from our study which showed more prolonged F wave latency especially in tibial nerve i.e 98%. Dupuis et al. (2019) found that bilateral nerve conduction studies, including F-wave measurements, significantly enhanced the diagnostic accuracy for distal symmetric polyneuropathy.[15]

Past researches revealed that tibial nerve minimal f-wave latency was the most sensitive predictor of diabetic polyneuropathy.[16] This finding is consistent with our results. Our study shows that minimal F-wave latency test is more sensitive in detecting early neuropathy compared to standard NCS. The tibial nerves had the highest number of F-waves minimum latency abnormality, followed by peroneal nerve, median nerve, and ulnar nerve. This indicates that tibial F-wave minimum delay is a reliable indicator of early neuropathy. Abnormality of F-waves can reveal neuropathy of peripheral nerves before traditional CMAPs and SNAPs testing, and might be the first marker of early polyneuropathy.

Limitations:

This study was single-centered with a small sample size. Minimal F wave latency was used, other F wave parameters like chronodispersion, F/M ratio were not assessed. Only patients who were sent to the neuro-electrophysiology lab were included in study.

CONCLUSION

When assessing patients for polyneuropathy, minimum F-wave latency is a more reliable parameter than SNCS and MNCS, especially minimal F-wave latency of tibial nerve. This can facilitate in early detection and management of polyneuropathy.

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Areeba Qaiser; data collection, data analysis, manuscript writing, manuscript review
Safia Bano; concept, data collection, data analysis, manuscript writing, manuscript review
Muhammad Imran Khan; data interpretation, manuscript writing, manuscript review
Ahsan Numan; concept, manuscript revision

All the authors have approved the final version to be published and agree to be accountable for all aspects of the work.