Study of usefulness of sensitivity of F wave latency measurement in the diagnosis of diabetic polyneuropathy

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Abstract
Diabetic polyneuropathy is one of the more commonly observed complication due to Diabetes Mellitus and is characterized by a combined axonal loss and demyelinating sensorimotor peripheral neuropathy. Nerve conduction studies are considered one of the most sensitive indices of the severity of neuropathy. In the present work, an attempt has been done to evaluate the usefulness of sensitivity of F wave latency in the diagnosis of diabetic polyneuropathy.

Keywords: F wave latency, diabetic polyneuropathy
1.0 Introduction
Non insulin dependent diabetes mellitus is frequently asymptomatic and the reported prevalence of diabetic neuropathy varies from less than 5 to 60% [1, 2]. Diabetic patients have a 12 times higher risk of amputations when compared with non-diabetic subjects, due to diabetic neuropathy [3]. However, the progression of neuropathy can be reduced by early detection and intervention [4]. Diabetic polyneuropathy is characterized by a combined axonal loss and demyelinating sensorimotor peripheral neuropathy. Nerve conduction studies, primarily nerve conduction velocities are considered one of the most sensitive indices of the severity of neuropathy [5]. Nerve conduction tests are used to localize lesions and to describe the type and severity of the pathophysiologic process, including alterations in function that are not recognized clinically. To investigate this condition, nerve conduction studies with the determination of latency and velocity, are commonly used as they are considered to be the most sensitive, reliable, noninvasive, and objective means. In Type-2 diabetic patients, decreased Nerve Conduction Velocity (NCV) is probably one of the earliest neuropathic abnormalities and is often present even at diagnosis. Many authors reported that F wave determinations in diabetic patients are very reliable. As a consequence, the diagnostic sensitivity of the minimum F-wave latency was compared with other standard nerve conduction parameters such as motor nerve conduction velocity, amplitude of compound muscle action potentials and distal latency. In the present work an attempt has been made to evaluate the usefulness of sensitivity of F wave latency in the diagnosis of diabetic polyneuropathy.

2.0 Material and Methods
This was a prospective study. All the consecutive patients of type 2 Diabetes Mellitus (DM) from 1st January to 30th June were included. All subjects gave their informed consent prior to the study. Individuals with a diagnosis of endocrine disorders or any other disease capable of causing polyneuropathy, chronic renal failure, chronic liver disease, chronic alcoholic, carcinoma, infections and critical illness, a family history of inherited neuropathies or, history of lumbar or cervical radiculopathy as well as using medications which could cause polyneuropathy were excluded. A neurologic examination was done by the same physician. All patients underwent a detailed neurological examination of both the extremities and were included in the study who had sensory symptom in the form of paresthesia or dysesthesia symptoms or reduced vibratory sense below knee or reduced / absent ankle jerk.

Nerve Conduction Velocity Measurement
Nerve Conduction Velocity (NCV) measurements were made using the standard RMS EMG EP machine. Nerve conduction studies of the bilateral median, ulnar, tibial and peroneal nerves are performed with surface recording, using the standardized technique.

- DML (Distal Motor Latency): onset latency of on-muscle compound action potential (CMAP).
- CMAP Amplitude: CMAP peak to peak amplitude.
- FWL (F-wave Latency): mean of individual latencies from each F-wave set. Number of latencies is the minimum of 20 and number of F-waves detected in 40 F-wave traces (not all F-wave traces will have F-wave).

The latencies were measured from the onset of the action potential and the amplitudes were measured peak to peak. The nerves were stimulated using 0.1-ms electric pulses with a supra maximal intensity to elicit the maximum amplitude of CMAPs. For F wave response 20 stimuli were given at a frequency of 1/s. An F wave defined as an action potential of an amplitude exceeding 20microvolt and a latency within a reasonable range for the investigated nerve,
excluding spurious voluntary activity. The minimum F wave latency defined as shortest latency to the onset of first deflection from the baseline. In total 240 motor nerves of 30 diabetic patient (60 limbs) were studied.

**Statistical Analysis**

Statistical analysis was performed using SPSS, version 10 and EPI INFO V 5.01a program. Data with normal distribution were expressed as mean ± S.D. X² test and Student’s t-test were applied to compare frequencies and means respectively. Correlation between variables for the total group of subjects was tested using Pearson correlation analysis. A 2-tailed P value<0.05 was considered as statistically significant.

**3.0 Results and discussion**

Present study was carried out on 30 diagnosed patients of type 2 diabetes comprised of 24 males and 8 females with their age ranging from 40 years to 60 years. BMI of more than 25 was seen in 11 patients (36.66%) of which 7 were males and 2 females. Tingling was the most common symptom (38%), followed by numbness (22), and burning feet (16%). The result of motor nerve conduction studies, including F-waves, is shown in Table-1. The minimum F wave latency had a larger Z score than the MCV of the median, ulnar, peroneal or tibial nerves and was larger than z score for the amplitude of the CMAP in all the four motor nerve (Table-1). There was a significant correlation between the minimum F wave latency and MCV in all the four motor nerve. The bivariate correlation coefficients were γ = - 0.41 (p<0.05), γ = - 0.757 (p<0.05), γ = - 0.759 (p<0.05) and γ = - 0.74 (p<0.05), for the median, ulnar, peroneal and tibial nerve, respectively.

**Table-1: Data of various parameters**

<table>
<thead>
<tr>
<th>Z score</th>
<th>Median (mean±SD)</th>
<th>Nerve</th>
<th>Tidal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distal Latency</td>
<td>4.14±0.96*</td>
<td>3.08±0.45*</td>
<td>5.19±0.79*</td>
</tr>
<tr>
<td>Amplitude</td>
<td>7.87±3.62*</td>
<td>7.26±3*</td>
<td>4.07±2.28*</td>
</tr>
<tr>
<td>NCV</td>
<td>32.62±3.65*</td>
<td>31.76±3.22*</td>
<td>42.96±8.62*</td>
</tr>
<tr>
<td>F wave latency</td>
<td>43.05±8.70</td>
<td>50.02±5.59</td>
<td>55.52±8.48</td>
</tr>
</tbody>
</table>

Diabetic neuropathy is a nerve degenerative disease characterized by axonal degeneration, nerve fiber demyelination, and a reduction in the number of medium-to-large diameter nerve fibers, particularly in peripheral nerves. Currently, the factors recognized in the pathogenesis of diabetic neuropathy are metabolism, vascular insufficiency, loss of growth factor trophism, and autoimmune destruction of small unmyelinated nerves (C fibers) in a visceral and cutaneous distribution. The main features responsible for complication of diabetic neuropathy are the degeneration of nerve fibers and grossly diseased blood vessels that supply those nerve fibers. It is estimated that about 60% of type-I diabetics and 50% of type-II diabetics have diabetic polyneuropathy (DPN), either symptomatic or asymptomatic. Nerve conduction studies (NCS) have a key role in the assessment of DPN [6]. Lehtinen et al [7] had reported that clinical diabetic neuropathy is not common at diagnosis of Type-2 diabetes but disturbances in peripheral and autonomic nerve function a noted by electrophysiological and cardiovascular reflex method are often present at that stage. In this study, we found that in patient with diabetic neuropathy, the minimum f wave latency was a more sensitive indication of nerve conduction abnormalities than either MCV or the amplitude of motor nerves in the upper and the lower extremities. F waves were first defined in 1950 by Magdalery and McDougal on foot muscles. F waves are one of the late responses generated following the M response by supramaximal electrical stimulation of peripheral motor nerves. It is generated by
firing of anterior horn motor neurons following antidromic propagation of the stimulus on the motor nerve [8]. The utility of F-waves has been demonstrated in multiple clinical applications, including detection of lumbosacral radiculopathy, early detection of axonal and demyelinating polyneuropathies and monitoring of changes in the motor neuron pool and central nervous system [9].

The main advantage of F-wave methodology has been in the detection of peripheral neuropathies in which F-waves may show clinically significant and measurable changes even before conventional nerve conduction studies are informative. This is because the slowing of nerve conduction is maximized by F waves traveling for long distances over the entire length of the nerve. Different patterns of F-wave abnormality have been demonstrated in patients with various peripheral nerve disorders, as well as in diabetic neuropathy [10]. Although F-response latency was considered a sensitive indicator of peripheral neuropathy, amplitude and duration in ulnar nerve F response were the other sensitive parameters for the detection of mild diabetic neuropathy in type 1 diabetes [11,12].

4.0 Conclusion

Our study implies the utility of F waves as the earliest indicator for peripheral neuropathy when neither the DML, amplitude or nerve conduction velocity are not helpful. We also stress upon that nerve conduction studies are incomplete without F wave and they are very useful in early detection of diabetic polyneuropathy.

References: