The use of M-latency in the diagnosis of carpal tunnel syndrome

Hassan M. Ismail, *MD, FRCP.*

ABSTRACT

Objective: To study the use of M-latency (ML) as an electrodiagnostic parameter for diagnosis of carpal tunnel syndrome (CTS).

Methods: One hundred and one consecutive patients (77 females, mean age 42 years and 24 males, mean age 46 years) referred with a clinical diagnosis of CTS to the Neurodiagnostic laboratories at the King Fahd Hospital of the University, Al-Khobar, Kingdom of Saudi Arabia were evaluated between November 1999 and October 2000. Standardized nerve conduction studies on 191 hands, including 191 median and 108 normal ulnar nerves were performed.

Results: The results were categorized into 3 groups based on using (A) distal sensory peak latencies (DSL) ≥3.5 ms, (B) DSL <3.5 ms and (C) DSL <3.5 ms and ML <4.0 ms. The ML was significantly longer than the distal motor latency (DML) for the median nerves in groups (A) and (B) but not in group (C). There was no significant difference between ML and DML for the normal ulnar nerves in all 3 groups. By using the combined DSL <3.5 ms and ML ≥4.0 ms parameters, the diagnostic yield of 147 (77%) from group (A) increased by an additional 10 patients (5%) to reach 157 (82%).

Conclusions: The M-latency may be utilized as a more sensitive parameter than DML, in combination with DSL, for confirmation of CTS in symptomatic patients with borderline distal sensory latencies.

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Median neuropathy at the wrist, or carpal tunnel syndrome (CTS), is the most commonly diagnosed focal neuropathy worldwide.[1-5] The typical presentation, with nocturnal acroparesthesias in the distribution of the median nerve and pain that often awakes the patient from sleep[1,2,6,7] in addition to the positive signs of reduced sensation over the median nerve sensory distribution and presence of Phalen's and Tinel's signs, form the prerequisites for making the clinical diagnosis of CTS that predominantly affects women.[6,8] Several conditions were noted to predispose to CTS[9,10] including diabetes mellitus,[2,11] rheumatoid arthritis,[11,12] acromegaly,[13,14] myxedema,[15] hyperparathyroidism,[16] chronic renal failure[17] and positive family history.[18,19] Nerve conduction studies (NCS) are the test of choice for confirmation of the diagnosis by showing prolonged distal sensory, motor latencies, or both, of the median nerve[5,7] and also for objective evaluation of median nerve function after surgical treatment.[20] The use of magnetic resonance imaging (MRI) in patients with suspected CTS was recently evaluated and found to be of moderate diagnostic accuracy.[21] Combining the motor and sensory wrist-palm conduction studies increases the diagnostic yield of NCS.[22] The idea for conducting this study came from observing during NCS on patients referred with a clinical impression of CTS that on recording the F-waves the M-latency (ML) tends to be prolonged in confirmed cases of CTS. A literature survey on the usefulness of the M-latency in the diagnosis of CTS revealed no previous reports on M-latency, but the F-wave abnormalities were previously

From the Department of Neurology, King Fahd Hospital of the University, Al-Khobar, *Kingdom of Saudi Arabia*.

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Address correspondence and reprint request to: Dr. Hassan M. Ismail, PO Box 40152, Al-Khobar 31952, *Kingdom of Saudi Arabia*. Tel. +966 (3) 8966666. Fax. +966 (3) 8966770. E-mail: hismail@hospital.kfu.edu.sa

considered by Kuntzer.[23] A recent publication from the Kingdom examined the use of F-waves in early diagnosis of diabetic neuropathy.[24] In this study a group of consecutive patients with a clinical diagnosis of CTS were tested using F-wave recordings in addition to the standard recording of motor and sensory latencies to examine the value of measuring the ML as a useful electrodiagnostic parameter for the diagnosis of CTS.

Methods. All consecutive patients referred with the clinical diagnosis of CTS to the neurodiagnostic laboratory at King Fahd Hospital of the University (KFHU), Al-Khobar, Kingdom of Saudi Arabia between November 1999 and October 2000 were evaluated electrophysiologically by the author. The KFHU is a referral tertiary care hospital for the entire Eastern Province with an estimated population of 3 million. The nerve conduction studies were performed using standardized techniques[25-28] on a Nicolet Spirit Electromyography system (Nicolet Instrument Corporation, Madison, Wisconsin, United States of America). The measurements were carried out at room temperature. Supramaximal percutaneous constant current electrical stimuli were applied to the median nerve at the wrist with the anode 8 cm from the proximal surface-recording electrode over the abductor pollicis brevis muscle for the median nerve and the abductor digiti minimi for the ulnar nerve. Antidromic sensory recording from digit 2 was used with stimuli applied 14 cm proximally at the wrist. The same conduction distances and protocol were used for the ulnar nerve motor and F-wave measurements. The data were divided into 3 sets based on the median distal sensory peak latency (DSL): (A) DSL ≥3.5 ms, (B) DSL <3.5 ms and (C) combined DSL <3.5 ms and ML <4.0 ms. In the 3 groups matching measurements obtained for the ulnar nerve DML and ML were taken as controls for the median data. The data were tabulated into a standard database file and analyzed using the Statistical Package for Social Sciences.

Results. A total of 101 patients, 77 females with a mean age of 41.7 years (range 23 to 67 years) and 24 males with a mean age of 46 years (range 23 to 75 years) formed the study group. The total number of hands tested was 191 including 191 median nerves and 108 ulnar nerves. **Figure 1** shows a DML on a standard motor conduction velocity record from a median nerve (A) and the corresponding F-wave record indicating the M-latency from the same patient. **Table 1** shows the results of nerve conduction studies for the median and ulnar nerves categorized into the 3 groups. The total number of matched ulnar nerves in each group ranged from 47% in group C to 55% of the number of median nerves in group A. Group A includes 147 (77%) median nerves with confirmed CTS based on median nerve DSL ≥3.5 ms. In this group, the ML was significantly longer than the DML (p<0.001). The comparable results for 81 matched ulnar nerves from patients in this group showed no significant difference between the mean values of ulnar DML and ML. Group B shows the results of 44 presumed normal median nerves based on DSL <3.5 ms. The prolongation of the mean ML in this group compared to the mean DML was highly significant (p<0.001). The comparable mean ML and DML values for the matched ulnar nerves in this group (n=32) showed no significant difference. Group C includes 34 normal median nerves based on combined DSL <3.5 ms and ML <4 ms compared to 16 matched ulnar nerves. In this group, there was no significant difference between the mean DML and ML for both the median and ulnar nerves.

Discussion. The use of NCS to confirm the diagnosis of CTS is the well-established test of choice.[7] However, various electrodiagnostic techniques

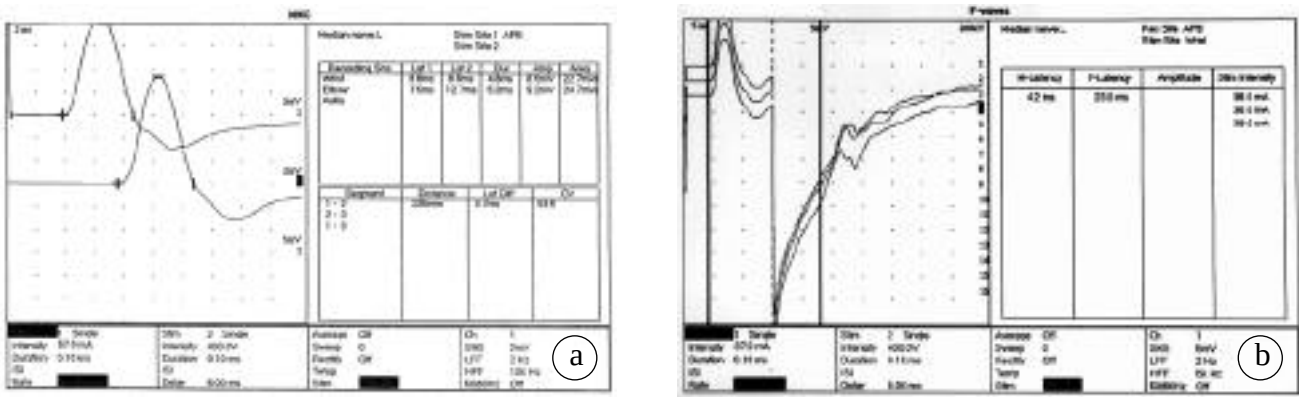

Figure 1 - Records of **a)** distal motor latency and **b)** M-latency for the median nerve from one patient. MNC - motor nerve conduction, Lat 1/2 - Latency 1/2, F-latency - F-wave Latency.

Table 1 - Results of nerve conduction studies for the median and ulnar nerves categorized into 3 groups based on measurements of DSL, DML and ML.

Groups	Mean DML ± SD	Mean ML ± SD	*p* value
A. If DSL ≥3.5 ms			
Median nerve (N=147)	4.75 ± 1.53	5.06 ± 1.67	<0.001
Ulnar nerve (N=81)	2.35 ± 0.29	2.24 ± 0.44	0.070
B. If DSL <3.5 ms			
Median nerve (N=44)	3.1 ± 0.24	3.38 ± 0.39	<0.001
Ulnar nerve (N=22)	2.34 ± 0.31	2.43 ± 0.36	0.169
C. If DSL <3.5 ms and ML <4			
Median nerve (N=34)	3.2 ± 0.35	3.31 ± 0.34	0.065
Ulnar nerve (N=16)	2.29 ± 0.32	2.24 ± 0.35	0.141

DSL - distal sensory peak latencies, ML - M-latency, DML - distal motor latency, SD - standard deviation

have been utilized to increase the sensitivity of the test and improve the diagnostic yield.[5] The usefulness of late responses such as the F-wave in the diagnosis of CTS was previously attempted but found to be less sensitive and of limited value.[23,29] Peripheral neuroimaging using MRI nerve imaging has recently been evaluated.[21,30] Although the search for innovative diagnostic techniques is important, the cost of these new techniques in general will be too high and the availability scarce. Thus, it may be more practical to consider improving, if possible, the diagnostic yield of the available gold standard neurodiagnostic techniques. In the present study prolongation of the median DSL (≥3.5 ms) formed the more sensitive electrophysiological parameter[23] for confirmation of CTS in 147 median nerves (77%) in group A. The use of DSL reference value of <3.5 ms alone for normality of median nerve studies as shown in group B resulted in mean ML that is significantly longer than the mean DML compared to non-significant difference for the matched ulnar nerves in the same group. In group C the combined use of DSL <3.5 ms and ML< 4.0 ms has increased the number of confirmed CTS by another 10 patients to a total of 157 (82%). This increase arose from those patients with borderline DSL for example 3.4 ms that is essentially counted as normal. The diagnostic yield has, therefore, improved by 5%. The remaining population of median nerves in group C with DSL <3.5 ms and ML < 4.0 ms showed no significant difference between the means for ML and DML which is comparable to the results of the normal ulnar nerves in the 3 groups. Hence, the median nerve data in group C indicates the truly normal median nerve population, which you would expect from, control median nerve data obtained from a group of matched healthy subjects. The non-significant difference between the mean ML and DML for the matched normal ulnar nerves in the 3 groups lends validity to the significant differences obtained for the median nerve measurements in groups A and B as the technical protocol for the measurements of latencies in both nerves was the same. Thus, a median nerve ML value ≥4 ms coupled with a borderline DSL <3.5 ms mitigate for establishing a diagnosis of CTS whereas a DSL <3.5 ms and ML <4.0 ms exclude this diagnosis.

Carpal tunnel syndrome is the most common focal neuropathy in neurological practice. The use of a simple NCS battery of tests that is easily applicable and sensitive to increase the diagnostic yield particularly in early symptomatic patients is desirable. The present study is an attempt in this direction drawing the attention to the possibility of using the ML as an added parameter to the DSL in confirming CTS diagnosis.

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