Original Article

Clinical utility of residual latency in ulnar neuropathy at elbow: Is there any correlation?

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Abstract

Background: Residual latency is the time difference between measured and predicted distal conduction time. We investigated ulnar nerve residual latency in patients with ulnar neuropathy at elbow for the possibility of its clinical utility.

Materials and Methods: In a cross-sectional study and based on the inclusion and exclusion criteria, ulnar nerve residual latency was calculated by using standard settings in 63 hands of patients who had signs and symptoms suggesting ulnar neuropathy at elbow and 94 healthy hands as the control group.

Results: Mean ulnar nerve residual latency for case and control groups were 1.82 ± 0.45 and 1.59 ± 0.54 ms, respectively, which showed a statistically significant difference ($P = 0.01$). There was no significant difference in mean ulnar nerve residual latency between males and females and also between right and left hands ($P > 0.05$). By considering different cut-off points, the sensitivity and specificity of a residual latency of 2.86 ms were 70% and 56%, respectively.

Conclusion: Ulnar nerve residual latency may reflect the effects of an axonal injury at elbow on distal ulnar motor fibers. So, its measurement may help in the diagnosis of ulnar neuropathy at elbow.

Key words: Normative values, residual latency, ulnar nerve, ulnar neuropathy at elbow

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INTRODUCTION

The most common methods for evaluating and confirming peripheral neuropathies, especially focal mono-neuropathies, are electrophysiological tests. Along with conventional nerve conduction studies (NCS), several indexes were introduced in patients with different types of peripheral neuropathies. Residual latency (RL) is one of these indexes, which is the difference between measured distal latency and calculated latency based on nerve conduction velocity (NCV) of the proximal segment. Some studies showed that RL maybe more sensitive than a routine NCS for early diagnosis of distal peripheral neuropathies.[1,2]

Cubital tunnel syndrome is the second most common peripheral nerve entrapment syndrome that may cause considerable pain and disability for patients.[3] Tests of motor conduction velocity at different sites along the ulnar nerve should be helpful in its diagnosis, especially NCV tests indicating decreased

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velocity across the elbow segment of the ulnar nerve.[4] Kaplan mentioned that RL is as effective and accurate as terminal latency measurements in determining the presence of a neuropathy distal to the wrist.[5] One study concluded that RL is a useful index to identify subclinical diabetic neuropathy and that electrophysiological changes that are obscured in routine nerve conduction study are present before the clinical manifestation.[6] Suh *et al*. performed a study to determine the reference values of RLs of motor nerves and to evaluate the early diagnostic value of RL. They evaluated the RL of four nerves, including ulnar nerve, and they also confirmed its usefulness as a diagnostic tool for early detection of diabetic neuropathy.[7]

A limited number of studies evaluated the normal values of ulnar RL (U-RL) and its clinical use in the diagnosis of peripheral neuropathies.[1,2,5,7] The purpose of this study is to determine the normal values of U-RL and examine its sensitivity and specificity in the diagnosis of ulnar nerve involvement at elbow (UNE) region.

MATERIALS AND METHODS

This cross-sectional study was carried out at an academic electrodiagnostic center between November 2011 and June 2013 on 63 hands of patients with UNE as the case group and 94 hands of healthy volunteers as the control group, after explaining the procedure to them and taking their written consent. Control group subjects did not have any signs or symptoms of neurologic abnormalities of upper extremities in their history and physical examination. Inclusion criteria for the case group were: patients who had a positive history of pain or paresthesia in one and one-half ulnar fingers and signs suggesting ulnar nerve involvement at elbow (Froment's sign, positive Tinel's sign posterior to medial epicondyle, decreased sensation over one and one-half ulnar fingers, weakness of hand intrinsic muscles). Patients who had any signs or symptoms suggesting other co-existent neurologic disorders such as cervical radiculopathy, ulnar neuropathy at wrist, hereditary polyneuropathies (e.g. Charcot–Marie–Tooth), acquired polyneuropathies (e.g. diabetic polyneuropathy), surgery, or local steroid injections in elbow region, and any scar formation or history of fracture at the sites of stimulation or recording were excluded from the study.

We performed nerve conduction recordings with Cadwell EMG machine, while maintaining the skin temperature between 32°C and 34°C at normal room temperature (mean: 25°C), and with surface stimulation and recording electrodes using standard instrument settings.[8]

With the subjects in supine position, compound motor action potential (CMAP) was obtained by supramaximal impulses from the abductor digiti minimi muscle (ADM) by stimulating ulnar nerve at wrist and also distal and proximal to medial epicondyle while the elbow was flexed to approximately 135°, with the forearm slightly supinated and arm abducted and externally rotated.[8,9] Then the forearm and across-elbow NCVs were calculated.

Criteria for ulnar nerve involvement at elbow were: (1) Across-elbow NCV <49 m/s; (2) above-elbow CMAP onset latency >9 ms; (3) a difference of 10 m/s or greater between the proximal and distal elbow-to-wrist segments.[10]

U-RL was calculated by the formula: U-RL = DML – (D/MNCV), where DML = ulnar distal motor latency (milliseconds), D = distal distance, i.e. distance from wrist stimulation site to CMAP recording site over ADM (millimeters), and MNCV = ulnar motor NCV (m/s).[1]

For all UNE patients, other NCS parameters including sensory studies and needle electromyography were also performed to establish the diagnosis of UNE.

Statistical analysis

For calculating the average values and standard deviation (SD), the statistical package for social sciences (SPSS) 20 (SPSS Inc., Chicago, IL, USA) was used. Independent Student's *t*-test was used for comparison of mean values among males and females of the control group and the averages NCS values of both groups. Sensitivity and specificity of variables were based on receiver operating characteristic (ROC) curve analysis. $P < 0.05$ were considered as statistically significant.

RESULTS

A total of 63 hands of UNE patients (52 women, 11 men) in case group and 94 hands of healthy people (79 women, 15 men) in control group were investigated. There was not any significant difference between the mean ages of case (45.22 ± 10.18 years) and control groups (44.48 ± 10.14 years) ($P > 0.05$). There was also no significant difference in the male/female ratios of the two groups ($P > 0.05$).

Normal values for U-RL for the control subjects, according to a standard deviation of ±2 (mean ±2SD), was found to be 1.59 ± 0.54 ms (range of 0.53–2.65

ms). In the case group it was 1.82 ± 0.45 ms (range of 0.94–2.75 ms), which showed a significant difference between the two groups (P = 0.01). There was no significant difference between mean forearm MNCV (P = 0.71) and DML (P = 0.06) of both groups.

Regarding gender, there was no significant difference in mean U-RL of normal subjects (P = 0.23) and also in UNE patients (P = 0.50) [Table 1]. Also, it was found that mean U-RL of right and left hands showed no significant difference (P = 0.87).

Using ROC curve analysis, the area under the curve was 64.1% [Figure 1]. Considering different cut-off points, the sensitivity and specificity for RL of 2.86 m were 70% and 56%, respectively.

DISCUSSION

Among several proposed factors regarding RL, the most consistent etiology is the tapering of the nerve distal to the wrist, and neuromuscular junction transmission delay has much less effect on this parameter.[5] Bae *et al*. compared RL and terminal latency index (TLI) with conventional electrophysiological studies and found that these parameters are useful indexes to identify subclinical diabetic neuropathy. The results also suggest that electrophysiological changes that are obscured in routine nerve conduction study are present before the clinical manifestation.[6]

Table 1: Comparison of mean of ulnar nerve RL among males and females in patients with ulnar neuropathy at elbow (patients) and normal subjects

Gender	Number	U-RL (mean)	SD	*P*
UNE patients				
Female	52	1.82	0.42	0.50
Male	11	1.89	0.41	
Normal subjects				
Female	79	1.56	0.55	0.23
Male	15	1.75	0.42	

SD: Standard deviation, U-RL: Ulnar nerve RL, UNE: Ulnar neuropathy at elbow

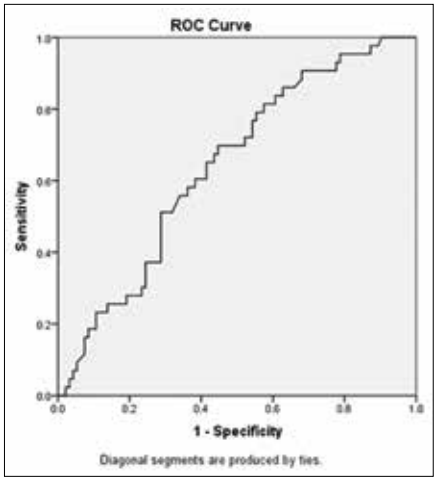

Figure 1: Receiver operating characteristic (ROC) curve for residual latency of ulnar nerve

Conflicting results have been obtained in several studies which investigated RL as an electrodiagnostic parameter for early diagnosis of distal peripheral neuropathies.[1,2,5,6] Most of these studies investigated its clinical utility in the diagnosis of carpal tunnel syndrome (CTS).[1,11-14] Kaplan *et al*. concluded that in a recent onset of CTS, prolonged RLs may be the only abnormality.[1] Kraft *et al*. have mentioned that RL determination is especially useful in confirming early or mild CTS and should be calculated in patients in whom the syndrome is suspected.[11] Uzar *et al*. found that the sensitivity and specificity of median RL and median distal motor latency are similar and it is not superior to traditional NCS.[12] Another study indicated that although RL had high sensitivity, its specificity was low.[13] However, in a recent study we found that in mild cases of CTS in which traditional NCS shows abnormalities only in sensory studies, RL may better demonstrate the effect on median nerve motor fibers.[14]

There are limited studies which investigated the normal values of U-RL.[5,7] Suh *et al*. found a normal value of 1.53 ± 0.24 ms for the U-RL,[7] but in our study it was 1.59 ± 0.54 ms and Kaplan obtained 1.7 ± 0.5 ms as the normal value.[5] This variability may be because of different methods, effect of temperature, or the number of normal subjects.

We did not find any relationship between gender and RL values either in case or in control groups; but a study found that these values decreased significantly in females as compared with males.[15]

To the best of our knowledge, this cross-sectional study is the first attempt to evaluate the clinical utility of RL in the diagnosis of UNE. Although the previous studies examined the utility of RL in the diagnosis of distal peripheral neuropathies, surprisingly we found significant differences between mean of U-RL values in two groups. So, the results of the present study demonstrated that RL may also be involved in a more proximal nerve injury. Of course, it is hard to determine the origin of the increased U-RL in patients with UNE, but this finding may reflect the effects of an axonal injury at elbow on distal ulnar motor fibers; consequently, its efficacy in evaluating UNE may serve as a potentially diagnostic measurement. This finding indicates that it may help the examiner to produce a more accurate and consistent diagnosis, although in order to identify the axonal injury to nerve fibers and exclude other potential abnormalities,

electromyography of the affected upper limb is essential.

Trying to find a reasonable cut-off point for the diagnosis of UNE we evaluated different values for ulnar RL and finally the sensitivity and specificity for the RL value of 2.86 ms were 70% and 56%, respectively, but based on ROC curve analysis, the area under the curve for RL was only 64.1%.

CONCLUSION

In this preliminary study, we found that U-RL may help in the diagnosis of UNE; however, this finding needs further investigations by comparing RL and other nerve conduction study parameters, especially in patients with ulnar nerve entrapment at wrist and more proximal nerve involvements and also in subjects with cervical radiculopathy.

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