The Difference In Sensory Latency Of Median-Radial Nerves In The Diagnosis Of Carpal Tunnel Syndrome

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Abstract

**Background:** Electro-diagnosis plays an important role in the diagnosis of carpal tunnel syndrome (CTS); there are multiple tests available each with different sensitivity and specificity. **Objective:** This study aims to test the sensitivity and specificity of median-radial sensory latency comparison for diagnosing patients with early CTS. **Methods:** Hundred patients diagnosed clinically as having CTS with negative ordinary nerve conduction study were included in the study and tested for sensory nerve responses of median and radial nerves recorded from thumb and the difference between measured latency was measured. These patients are matched to 100 normal healthy volunteers. **Results:** The study found that the values of median sensory and motor latencies show statistically significant difference between patients and control. Also median sensory latency recorded from thumb finger was prolonged in comparison to that of radial nerve recorded from the same finger. Median-radial sensory latency comparison reveal high sensitivity (85%) and specificity (92%). **Conclusion:** Median-radial sensory latency comparison is helpful in the early diagnosis of CTS and is considered as complimentary part in the electro-diagnosis of CTS.

**Keywords:** Sensory latency, Carpal tunnel syndrome, median-radial sensory comparison.

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Introduction

Carpal tunnel syndrome (CTS) is focal compression or entrapment of median nerve at the wrist beneath the flexor retinaculum which form the roof of carpal tunnel. It is the most commonentrapment neuropathy with estimated prevalence is 3% between women and 2% between men\(^1\).
Typically, CTS presented with parasthesia, numbness, pain and weakness in the distribution of median nerve at the hand, on examination doctor see positive Tinel’s sign and Phalen’s test, and, in extreme cases, thenar muscle atrophy. It is considered the most common source of referral to electromyography laboratory. Electrodiagnosis is considered as extension of clinical examination and is used to prove the clinical diagnosis of CTS. The diagnosis is usually suspected on the basis of characteristic symptoms and signs and ascertained by electromyographic studies. There are many electrodiagnostic techniques developed to diagnose CTS with different sensitivity and specificity and accordingly there is no consensus regarding the most accurate and reliable technique for the diagnosis. There are multiple studies that report the use of comparison of sensory responses is more sensitive than the use of median nerve latency alone in diagnosing CTS. It is agreed that sensory nerve fibers have larger proportion of myelinated fibers than motor one and based on that these fibers have higher metabolic demands and thus are more liable to ischemic damage. In CTS, focal entrapment of median nerve by flexor retinaculum thought to cause both ischemic and mechanical damage to median nerve fibers. This will lead to dysfunction of myelin sheath and disruption of nodes of Ranvier and eventually slowed conduction across that nerve segment and this is the hallmark of electro-diagnostic findings in CTS.

This study aims to find the sensitivity and specificity of median-radial sensory latency comparison in the early diagnosis of CTS.

Materials and Methods

Study design and patients
This case control study included 100 patients with age group of 36±10; consisting of 14 males and 86 females. These patients werematched to 100 healthy volunteers with the same age and sex distributions. The study was done in the period of January 2015 to January 2019. The patients presented with classical signs and symptoms of carpal tunnel syndrome like acroparasthesia, pain and weakness of hand. These patients undergo routine nerve conduction studies of median and ulnar nerves by testing both sensory and motor responses supplemented by F-wave testing. Patients with negative results on ordinary nerve conduction study were included in the study and were tested by comparison method between median and radial sensory nerves. The test was done by placing ring recording electrode on the thumb finger and median nerve stimulated at the wrist between the tendons of palmaris longus and flexor carpi radialis muscles; while radial nerve was stimulated over the lateral radius bone. The distance between recording and stimulating electrode was kept for both nerves 11 cm. Latency is defines as the time from the application of stimulus to the initial deflection from baseline and is measured in millisecond for motor responses and sensory responses. The measured latency of median nerve was subtracted from that of radial nerve and the result was then compared between patients and controls.

Statistical analysis
The statistical calculations were performed using statistical package for the social sciences version 24 (SPSS, IBMCompany, Chicago, USA), with Fisher’s exact test to evaluate the differences between the study groups; differences were accepted at a level of significance of 0.05. Mean ± standard deviation was done for quantitative measures and compared between patients and control. ROC curve was used to find sensitivity and specificity of the test.

Results

Demographic data
The demographic data of patients and controls is shown on table 1 and show that most of the patients were female and in their middle ages. The duration of symptoms was relatively short (5 months as average).

Table 1: Demographic data of study group.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Patient</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>36±10</td>
<td>30±8</td>
</tr>
<tr>
<td>Sex (female/male)</td>
<td>201/39</td>
<td>188/52</td>
</tr>
<tr>
<td>Duration of symptoms (months)</td>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>

Nerve conduction study findings

The results of motor and sensory nerve responses of both median and ulnar nerves are shown in table 2 and 3 and it clearly indicate that the results of motor and sensory latency of median nerve show statistically significant difference from that of control. On the other hand, ulnar motor and sensory parameters show no significant difference between patients and control. Table 4 shows median-radial sensory latency comparison and it demonstrate that the median nerve recorded from thumb finger reveal prolonged sensory latency when compared to radial nerve recorded from same finger and that at 0.4 ms difference in sensory latency between the two nerves, there is high sensitivity and specificity in diagnosing CTS. Also figure 1 show receiver operator characteristic (ROC) curve to demonstrate the sensitivity and specificity of median-radial sensory latency difference recorded from thumb finger.

Table (2): Findings of motor NCS of the studied nerves

<table>
<thead>
<tr>
<th>Variable</th>
<th>Patients</th>
<th>Controls</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median DML (ms)</td>
<td>3.4±0.4</td>
<td>2.5±0.2</td>
<td>0.00</td>
</tr>
<tr>
<td>Amplitude (mv)</td>
<td>9±2.4</td>
<td>6.1±1.1</td>
<td>0.00</td>
</tr>
<tr>
<td>CV (m/s)</td>
<td>60±5.7</td>
<td>58±4</td>
<td>0.89</td>
</tr>
<tr>
<td>Ulnar DML (ms)</td>
<td>2.2±0.3</td>
<td>2.1±0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Amplitude (mv)</td>
<td>10.1±2</td>
<td>9.8±2.2</td>
<td>0.5</td>
</tr>
<tr>
<td>CV (m/s)</td>
<td>61±10</td>
<td>61±9</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Table (3): Findings of sensory NCS of the studied nerves

<table>
<thead>
<tr>
<th>Variable</th>
<th>Patients</th>
<th>Controls</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median DSL (ms)</td>
<td>2.4±0.3</td>
<td>1.9±0.1</td>
<td>0.00</td>
</tr>
<tr>
<td>Amplitude (µv)</td>
<td>42±22</td>
<td>36±12</td>
<td>0.1</td>
</tr>
<tr>
<td>Ulnar DSL (ms)</td>
<td>1.7±0.17</td>
<td>1.7±0.16</td>
<td>0.9</td>
</tr>
<tr>
<td>Amplitude (µv)</td>
<td>47±16</td>
<td>46±18</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Table (4): Median-radial sensory latency comparison recorded from thumb in both patients and control

<table>
<thead>
<tr>
<th>Latency difference</th>
<th>Patients</th>
<th>Controls</th>
<th>P-value</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7±0.3</td>
<td>0.3±0.3</td>
<td>0.000</td>
<td>85%</td>
<td>92%</td>
<td></td>
</tr>
</tbody>
</table>
Discussion

There are many electrodiagnostic methods used to assist the diagnosis of CTS, but there is no agreed method to be considered as the gold standard for the diagnosis. These tests are based on examining the motor and sensory conduction studies of median nerve to establish the presence of focal compressive lesion of median nerve. Then, the results obtained from these conduction studies are matched with commonly used reference data determined from published charts or developed by the laboratory itself\(^9\). The sensitivity of these tests is low (about 49-84\%) and significant number of the patients is normal if we apply these tests alone, so more sensitive comparative studies are developed which compare the sensory and motor conduction studies of median nerve across the carpal tunnel to other nerves in the same hand like ulnar and radial nerves that does not cross through the carpal tunnel\(^10\). These tests are highly sensitive (95\%) and specific (99\%)\(^11\) and offer the use of the patient as his own control which eliminate the effects of varying temperature, age and superimposed diseases on the results. There are many reference nerves that help in the diagnosis of CTS. Comparison of motor and sensory conduction of ulnar nerve is widely studied with variable results\(^12\)-\(^16\). In this study radial nerve was used as a reference comparison with median nerve to diagnose CTS. Thumb finger receive dual sensory innervation from both median and radial nerves with median nerve supply the palmar aspect and radial nerve supply the dorsal aspect of the finger. Accordingly, testing the sensory latency of median versus radial nerves supplying the thumb offers an easy method for diagnosing CTS. Also it is very important in cases of coexistent ulnar neuropathy due to trauma or entrapment at the elbow. The study found that the sensitivity of median vs radial sensory latency difference was 85\% while the sensitivity was 92\% at a value of 0.4 msec. Reports from other studies gave widely different values like Andary et al 90\%\(^12\), Cassvan et al.
The reason for the found differences between the current study and the previous literatures may be related to following possibilities; the studied group has minimal nerve entrapment reflected as normal ordinary motor and sensory conduction studies of median nerve. While other studies select patients with variable severities and this affect the resulting sensitivity and specificity of the test. Other explanations maybe related to differences in patients characteristics like ethnic group, height and age group distribution. Other causes of controversy in results are the presence of other factors or causes of nerve lesion like structural lesions or ischemic pathology. Limitations of study are few and include lack of gold standard test for CTS and also further studies with larger sample size are needed to confirm the results.

**Conclusion**

Median-radial sensory latency comparison is helpful in the early diagnosis of CTS and is considered as complimentary part in the electro-diagnosis of CTS.

**Conflict of interest**

None of the authors have any conflicts of interest relevant to this research subject.

**Ethical Approval**

Ethical Committee of the Babylon health directorate approved the study. All patients’ consents were taken before inclusion in the study.

**References**


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