Relation Between Pain Level and Morphological Changes of Median Nerve After Carpal Tunnel Release

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Abstract: Background: Carpal Tunnel Syndrome (CTS) is the most frequent peripheral nerve compression syndrome associated with medial nerve entrapment on the wrist. Objectives: to investigate the relation between pain level and morphological changes of median nerve after carpal tunnel release (CTR). Methods: 30 patients 4 males (133.3%) and 26 females (88.67%) with residual pain after 3 months of carpal tunnel release with mean age 36.8 ±8.1-year, mean duration of illness before surgery 2.3 ±1.5 year. Main Outcome Measure: included visual analog scale (VAS), sensory distal latency (SDL), median nerve cross sectional area (CSA). Results: The Pearson correlation coefficient (r) between (VAS and CSA) revealed that there was no correlation (p<0.05), As well as, there was no correlation (p<0.05) between (VAS and SDL) As well as, there was no correlation (p<0.05) between (VAS and SDL). Conclusion: the finding of that study revealed that change in the VAS is not consistent with change in CSA and change in the VAS is not consistent with change in SDL.

Key words: Carpal Tunnel Syndrome - Visual Analogue Scale - Cross-Sectional Area - Sensory Distal Latency

INTRODUCTION

Carpal Tunnel Syndrome (CTS) is the most common peripheral nerve compression neuropathy that accounts for about 90 % of all entrapment neuropathy [1]. Entrapment neuropathy is a chronic focal nerve compression caused by increased pressure inside non-flexible anatomical structure. CTS caused by median nerve entrapment at the level of the carpal tunnel. The estimated incidence of CTS in the United States is 3.4 % [2].

The measurement of Cross-Sectional Area (CSA) of the median nerve at the wrist is the commonly used ultrasonography method in CTS diagnosis. Also, ultrasound is used to assess anatomical and functional changes of the median nerve. Furthermore, the Power Doppler (PD) technique can be applied for the assessment of hyper vascularization of the median nerve thus helping in CTS classification [3].

Neuropathological testing is the most importantly test to assess the function of the nerve (nerve conduction studies for sensory and motor nerves and needle electromyography) helps to accurately localize the site of the lesion, assess its severity, gives an objective diagnosis and provide a basis for comparison between pre and post release state and recognize minimal deficits [4].

The diagnosis of Carpal Tunnel Syndrome done by clinical findings (Tinel’s sign test and Phalen’s sign test) and Electromyographic (EMG) studies [5]. Magnetic resonance imaging and ultrasonography ensure a non-invasive tool to view the median nerve and other anatomical structures in the carpal tunnel [6, 7].

Few studies investigated the relation between pain level and morphological changes of median nerve after carpal tunnel release, there for the purpose of the present study was to investigate the relation between pain level and morphological changes of median nerve after carpal tunnel release.
MATERIALS AND METHODS

Study Design: This was an observational cross-sectional study.

Participants: Thirty patients (4 males (133.3%) and 26 females (88.67%) with residual pain after 3 months of carpal tunnel release with mean age 36.8 ±8.1 year, mean duration of illness before surgery 2.3 ±1.5 year. The patients confirmed their agreement to participate in the study by signing an informed consent form. The inclusion criteria of this study included patients with a clinical and electroneuromyography diagnosis of carpal tunnel syndrome after exclusion of secondary causes. Same surgical technique was done for all the patients included in the study, with the classic, longitudinal access, anterior to the flexor retinaculum, with release of the flexor retinaculum, without median nerve micro neurolysis.

Outcome Measures: All the assessment procedures were done after 3 months from surgery.

Visual Analogue Scale (VAS): Pain is assessed by using VAS which is a 100mm calibrated line with zero representing no pain and 100 representing worst pain.

Nerve Conduction Studies (NCS): For CTS, a minimum of median motor response over the abductor pollicis brevis, median mixed nerve action potential and ulnar mixed nerve action potential recordings was performed. The median motor nerve conduction study was obtained by placing recording electrodes over the abductor pollicis brevis and stimulating the nerve 6.5 cm proximally at the wrist. Median and ulnar mixed nerve conduction studies were obtained by stimulating the nerves in the palm and recording 8 cm proximally over the respective nerves. A diagnosis of CTS was defined by a distal sensory latency of >3, 6 ms, or a distal motor latency of >4.3 ms, a median mixed nerve latency of >2.2 ms, or a difference between median and ulnar mixed latencies of > 0.4 ms. Distal median motor latency, median motor compound muscle action potential (CMAP) amplitude, median mixed nerve latency and median and ulnar mixed interlatency differences were recorded for all patients [8].

Median Nerve Ultra Sonography: Median nerve ultrasound images was obtained by. Gray-scale (GS) ultrasound and power Doppler ultrasound (PDU) were performed using a General Electric (GE) LOGIQ P5 machine. A high frequency broadband linear array transducer was used at 10-18 MHz. PDU settings were optimized to enhance the sensitivity for detecting synovial vessels. This setting resulted in a PRF around 500 Hz and in gains of 30 dB. Low wall filters were used. Ultrasonography was performed by one examiner (rheumatologist trained in peripheral nerves US) who was blinded to clinical data.

The subjects were seated facing the examiner with their arms extended, their wrists resting on a flat surface, their forearms supine and their fingers semi extended. Transverse US of the median nerve from the distal forearm to the outlet of the carpal tunnel was performed. The carpal tunnel cross-sectional area (CSA) measurement was obtained at the level of maximal nerve shape change from the proximal to the distal carpal tunnel (between the pisiform bone and scaphoid tubercle) [9].

Statistical Analysis: Statistical analysis was conducted using SPSS for windows, version 23 (SPSS, Inc., Chicago, IL). The Pearson product-moment correlation was used to determine the strength and direction of a linear relationship between VAS, CSA and SDL. The alpha level was set at 0.05.

RESULTS

The Pearson correlation coefficient (r) between (VAS and CSA) revealed that there was no correlation (p<0.05). This means that change in the VAS is not consistent with change in CSA. As well as, there was no correlation (p<0.05) between (VAS and SDL). This means that change in the VAS is not consistent with change in SDL (Table 1 and Figs. 1 and 2).

DISCUSSION

Carpal Tunnel Syndrome (CTS) is the most frequent peripheral nerve entrapment syndrome, potentially leading to long-term pain and disability. The socio-economic impact of CTS is immense, given that it is responsible for up to 57% of all costs related to occupational upper extremity disorders [10, 11].

The current study was conducted to investigate the relation between pain level and morphological changes of median nerve after carpal tunnel release. Based on the finding of the present study, that there was no correlation (p<0.05), As well as, there was no correlation (p<0.05) between (VAS and SDL) As well as, there was no correlation (p<0.05) between (VAS and SDL).
Table 1: Correlations between VAS, CSA and SDL

<table>
<thead>
<tr>
<th>VAS</th>
<th>CSA</th>
<th>SDL</th>
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<tbody>
<tr>
<td>Pearson correlation coefficient (r)</td>
<td>-0.027</td>
<td>0.142</td>
</tr>
<tr>
<td>p-value</td>
<td>0.887</td>
<td>0.453</td>
</tr>
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</table>

Ultrasound imaging measure the cross-sectional area (CSA) and Power Doppler (PD) signals in the median nerve is a valuable tool for the diagnosis of CTS [3]. Ultrasound has an established role in the diagnosis of CTS to the extent that some authors assumed it can partially replace NCS. However, its ability in the detection of severity and grading CTS is still under debate [12].

Many authors considered NCS the main subjective test used in the diagnosis of CTS. Meanwhile, US can assess the anatomical and the pathological structure surrounding structures that may compress the median nerve [13]. Median-ulnar sensory latency difference is a very sensitive NCS method for the diagnosis of CTS but its value for prognosis prediction, however, is still not identified [14].

A few studies have investigated the outcome value of CSA in the setting of established CTS undergoing surgical decompression of carpal tunnel. These studies, however, are limited by small sample size, selection bias and short-term follow-up. Besides, the results of these
studies are contradictory: One study by Naranjo et al. [15] including 112 wrists found that patients with a large CSA at baseline had a better outcome after carpal tunnel surgery than those with a smaller CSA.

In contrast, Mondelli et al. [16] conducted a study of 67 patients and concluded that a smaller CSA was linked to better chance of patient prognosis after CTR, as measured by the Levine/Boston Questionnaire (BQ) and found a correlation between the degree of reduction of the cross-sectional area after surgery and improvement of symptoms and results of NCS.

The role of clinical factors and baseline NCS values for prediction of short- and long-term clinical outcomes of CTS patients is unclear as well. Some studies, reported a poorer outcome after CTR in patients with upper extremity functional limitations and normal NCS values at baseline [17, 18].

Bland et al. and Ibrahim et al. [19, 20] supported the finding of the present study, they found the baseline CSA was not a significant predictor of the clinical outcome after carpal tunnel release. Others observed that a shorter distal sensory latency was associated with a higher likelihood of improvement of paresthesia after CTR [21], on the other hand many studies, pointed out that neither clinical tests nor NCS parameters could reliably predict a response to treatment [22, 23, 24].

On the other hand, El Miedany et al. [25] conducted study on Seventy-eight patients with CTS and 78 asymptomatic controls were assessed and underwent ultrasonography of the wrists, they found significant correlations with NCS results, there was a significant negative correlation with median sensory and motor response amplitudes and a significant positive correlation with median sensory and motor responses latencies.

After carpal tunnel release by 3 months, the median nerve cross-sectional area at tunnel inlet was similar in patients reporting cure or great satisfaction and in those with slight or no improvement. Ultrasonography is of limited prediction value in assessment of patients with poor outcome after median nerve release [22].

Clinical symptoms recover rapidly after CTR but median nerve swelling takes several months for to decrease and clinical function to be retained, median nerve swelling might predict preoperative symptom severity and functional disabilities but that it does not predict postoperative prognosis. Furthermore, a postoperative reduction in median nerve swelling was not found to be associated with postoperative improvement [26].

El-Shintenawy et al. [27] contradicted with the finding of the present study in they found that there was a significant correlation between CSA and all electrophysiological parameters including the DML, sensory amplitude, sensory latency and SCV. In addition to Karadag et al. [28] found a positive correlation between the CSA and VAS.

REFERENCES


