EDITOR'S CHOICE

Correlating Median Nerve Cross-sectional Area With Nerve Conduction Studies

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Purpose To determine whether there is a correlation between the cross-sectional area (CSA) of the median nerve, as measured using ultrasound, and the distal motor and/or sensory latencies as measured on nerve conduction studies.

Methods Patients with clinical signs and symptoms of carpal tunnel syndrome were prospectively enrolled in this study. Subjects underwent ultrasound measurement of the CSA of the median nerve at the carpal tunnel inlet by a fellowship-trained hand surgeon, followed by nerve conduction studies (NCS) by a certified electrodiagnostic technician who was blinded to the results of the ultrasound examination. Pearson correlations were performed to compare CSA and NCS.

Results Pearson correlation was $r = 0.57$ between CSA and distal motor latency and $r = 0.47$ between CSA and distal sensory latency. Correlation was $r = 0.81$ between distal motor latency and distal sensory latency.

Conclusions There is a correlation between CSA of the median nerve and NCS. Further research is necessary to determine which test correlates better with patient symptoms and function. *(J Hand Surg Am. 2016;41(10):958–962. Copyright © 2016 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Diagnostic II.

Key words Carpal tunnel syndrome, ultrasound, cross-sectional area, nerve conduction studies.

ASSH | Podium Presentation

CARPAL TUNNEL SYNDROME (CTS) is the most prevalent nerve compression syndrome of the upper extremity. Approximately 500,000 decompressions are performed annually,[1] with an estimated prevalence of 9.2% in women and 6% in men.[2] Given its ubiquity, an efficient confirmatory test is important for timely and accurate diagnosis and treatment.

Nerve conduction studies (NCS) are the most commonly used confirmatory test; however, there have been conflicting reports regarding their utility. Bland[3] determined that NCS was most predictive of subjective outcomes after carpal tunnel decompression. Fowler et al[4] found that patients with less severe CTS, based on NCS, experienced faster resolution of symptoms than did patients with more severe disease after decompression. In contrast, Braun and Jackson[5] found that the severity of CTS on NCS did not predict functional recovery or reemployment after carpal tunnel release. Smith[6] attributed the shortcomings of NCS to a lack of standardization, an absence of population-based reference intervals, and the lack of an accepted reference standard to allow calculation of sensitivity and specificity.

Because of the known shortcomings of NCS, our group had a significant interest in the use of musculoskeletal ultrasound for the diagnosis of CTS. Compression of the median nerve within the carpal tunnel results in swelling proximally and distally.

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Ultrasound can be used to document this swelling by measuring the cross-sectional area (CSA) of the median nerve. If the CSA exceeds a threshold cutoff value, the diagnosis is confirmed (similar to the distal motor latency exceeding an arbitrary cutoff value in NCS). Ultrasound offers a more efficient and cost-effective modality compared with NCS, with a reported sensitivity and specificity ranging from 57% to 98% and 51% to 100%, respectively.[7,8] The variation in diagnostic accuracy reported in the literature is a function of varying reference standards, patient populations, and cutoff values for the diagnostic tests.

Ultrasound measurements have moderate agreement among examiners of varying levels of experience[9]; in patients with clinical signs and symptoms of CTS, ultrasound can help confirm the diagnosis with better specificity and similar sensitivity compared with NCS.[10,11] Despite evidence that ultrasound is a reasonable alternative diagnostic test, there are few data regarding the correlation between ultrasound CSA and NCS latencies. It is unclear whether increasing severity of CTS on nerve conduction studies, as evidenced by increased latencies, correlates with increased severity on ultrasound, as indicated by increased swelling of the nerve. The purpose of this study was to determine whether there is a correlation between the CSA of the median nerve, as measured using ultrasound, and the distal motor and/or sensor latencies as measured on NCS.

MATERIALS AND METHODS

After we obtained institutional review board approval, we prospectively enrolled patients with clinical signs and symptoms of CTS (as determined by a fellowship-trained hand surgeon) in the study. The attending surgeons used no specific diagnostic algorithm; however, in general, patients were determined to have clinical signs of CTS if they reported numbness and tingling predominantly in the median nerve distribution, nocturnal symptoms, and positive provocative maneuvers (compression test or Phalen test). The following exclusion criteria were used: previous ipsilateral carpal tunnel release, diagnosis of cervical radiculopathy and/or peripheral neuropathy, diagnosis of thyroid disorder, or diagnosis of rheumatoid arthritis. Patients with diabetes mellitus were not excluded. Demographic information including age, sex, race, height, and weight was recorded.

Ultrasound measurement of the CSA of the median nerve at the level of the pisiform was performed by a fellowship-trained hand surgeon with extensive musculoskeletal diagnostic ultrasound experience. Ultrasound examinations were performed using a 15-6−MHz linear array transducer. The patient sat comfortably with the dorsal forearm resting on the examination table. The elbow was flexed 90° and the forearm was fully supinated. The fingers were in a resting position. The CSA was measured just inside the hyperechoic epineurium using the ellipse function, a function of the ultrasound machine software that places an ellipse over the area of interest and calculates the CSA inside the ellipse. This technique has been used in previous studies for this purpose.[9−13]

After the ultrasound examination was complete, patients were referred for NCS. The studies were performed within 4 weeks of the ultrasound examination. All NCS were performed according to the guidelines of the American Association of Neuromuscular and Electrodiagnostic Medicine by a certified electrodiagnostic technician or by a physician who was not involved in this study and was blinded to the protocol. No treatment or use of orthoses was performed between the ultrasound and the NCS. Median nerve CSA was compared with both distal sensory and distal motor latency using Pearson correlations. A correlation coefficient $r = 0$ was considered to be no correlation and $r = 1$ was considered to be a perfect correlation. Assuming $\alpha = .05$, $\beta = .20$, and an expected correlation of 0.3, a total sample size of 85 was required to determine whether the correlation coefficient differed from 0.

RESULTS

Our study examined 87 wrists in 52 enrolled patients (40 women and 12 men); 35 patients had both wrists studied. Mean age was 48.8 years (range, 18−86 years); mean height was 1.65 m (range, 1.65−1.88 m); mean weight was 88.9 kg (range, 58.0−177.0 kg); mean body mass index was 32.1 kg/m^2 (range, 20.7−57.00 kg/m^2); mean median nerve cross-sectional area was 10.9 mm^2; mean distal motor sensory latency was 4.9 ms; and mean distal sensory latency was 3.1 ms.

Pearson correlation (Figs. 1, 2) between CSA and distal motor latency was $r = 0.50$ ($P < .05$) and $r = 0.37$ ($P < .05$) between CSA and distal sensory latency. Pearson correlation between distal motor latency and distal sensory latency was $r = 0.74$ ($P < .05$) (Table 1).

DISCUSSION

Carpal tunnel syndrome is a clinical diagnosis made using a combination of signs and symptoms. Confirmatory