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DIAGNOSTIC METHODS: EDITORIAL

The use of electrodiagnostic studies and musculoskeletal sonography in carpal tunnel syndrome

Carpal tunnel syndrome is the number one reason for referral to electrodiagnostic practices and can be considered as the most common peripheral focal mononeuropathy (Preston and Shapiro, 2013; Katirji, 2007). Carpal tunnel syndrome is simply an injury to the median nerve at the wrist where the nerve can face a potential entrapment in the tunnel that is formed by the carpal bones.

Differential diagnosis of carpal tunnel syndrome from C6–C7 radiculopathy and, less often, brachial plexus injuries may be challenging particularly in very mild or early cases (Preston and Shapiro, 2013). According to CPG on CTS adopted by American Academy of Orthopaedic Surgeons (AAOS), there is no one gold standard test to diagnose CTS (Management of Carpal Tunnel Syndrome Evidence-Based Clinical Practice Guideline, 2016). Using nerve conduction studies (NCS), electromyography (EMG) and neuro-ultrasound will offer the best combination of tests that help in diagnosing and classifying the severity of the condition.

Para-nodal demyelination of the median nerve at the wrist is the early underlying pathology in CTS (Katirji, 2007). Focal slowing across the wrist and increased distal latencies of sensory and motor portions are common (Katirji, 2007). Reduced amplitude of the median sensory nerve action potential (SNAP) at the wrist compared to the palm can be the only early sign in CTS cases implying a possible conduction block and myelin sheath compromise (Tan, 2004). Assessing the electrical stability of the membrane of Abductor pollicis brevis muscle using needle EMG helps to identify moderate to severe cases where possible axonal loss of the median nerve may occur(Fig. 1). Quantifying the percentage of possible axonal loss may be obtained by comparing the compound muscle action potential (CMAP) of the affected nerve to the unaffected opposite nerve.

A reasonable scheme, out of many, to be considered when it comes to classifying the severity of the syndrome is GEHS neurophysiological system (Greathouse et al., 2016). Prolonged sensory latencies, present sensory response, and normal motor latencies are considered a mild injury (Tan, 2004; Greathouse et al., 2016). Add to the previous prolonged motor latencies will be considered as a moderate injury (Tan, 2004; Greathouse et al., 2016). Reduced motor amplitudes and/or signs of axonal loss and denervation on EMG can be considered as a severe injury (Tan, 2004; Greathouse et al., 2016).

In general, electrophysiologic evaluation should be focused toward showing the focal neuropathy, or the conduction block of the median nerve at the wrist, ruling out the rare proximal median nerve injury and excluding brachial plexus and cervical radiculopathy injuries (Preston and Shapiro, 2013).

The AAOS CPG rates NCS 2 out of 4 and all physical signs combined (Phalen's, Tinel's etc.) as 4 out of 4 (Management of Carpal Tunnel Syndrome Evidence-Based Clinical Practice Guideline, 2016). American Association of Neuromuscular and Electrodiagnostic Medicine (AANEM) CPG for NCS/EMG mentioned that specific NCS methods are "valid and reproducible clinical laboratory studies" (Practice Parameter for Electrodiagnostic Studies in Carpal Tunnel Syndrome, 2002) and "confirm a clinical diagnosis of CTS with a high degree of sensitivity (>85%) and specificity (95%)." (Practice Parameter for Electrodiagnostic Studies in Carpal Tunnel Syndrome, 2002).

Using neuro ultrasound, one can visualize and measure the diameter of the median nerve at the carpal tunnel. Swelling of the median nerve and loss of the honeycomb appearance on the ultrasound image indicate possible positive findings toward diagnosing the syndrome. Measuring the size of the median nerve, the vast majority of the studies suggest a cutoff of 0.09–0.12 cm^2 as a sign of a carpal tunnel syndrome (Jacobson, 2013) (Fig. 2).

Measuring the median nerve at the carpal tunnel area and comparing it to the pronator quadratus area can be of a great value. A difference of median nerve area of more than 2mm (Katirji, 2007) may diagnose the syndrome with an accuracy of 99% (Jacobson, 2013) (Figs. 2 and 3).

The validity and reliability of the test are accepted and recommended by the CPG adopted by AAOS and were given 2 out of 4 (Management of Carpal Tunnel Syndrome Evidence-Based Clinical Practice Guideline, 2016). The American Association of Neuromuscular and Electrodiagnostic Medicine (AANEM) issued an evidence based guideline for MSKUS diagnosing CTS (Cartwright et al., 2012). Recommendation1 is "neuromuscular ultrasound measurement of median nerve cross-sectional area at the wrist may be offered as an accurate diagnostic test for CTS (Level A)" (Cartwright et al., 2012) and it was based on consistent class 1 and 2 evidence.

Finally, using diagnostic tools such as nerve conduction studies, electromyography, and neuro ultrasound help the diagnostician to accurately identify and classify the carpal tunnel syndrome. One study in AANEM CPG for CTS MSKUS showed

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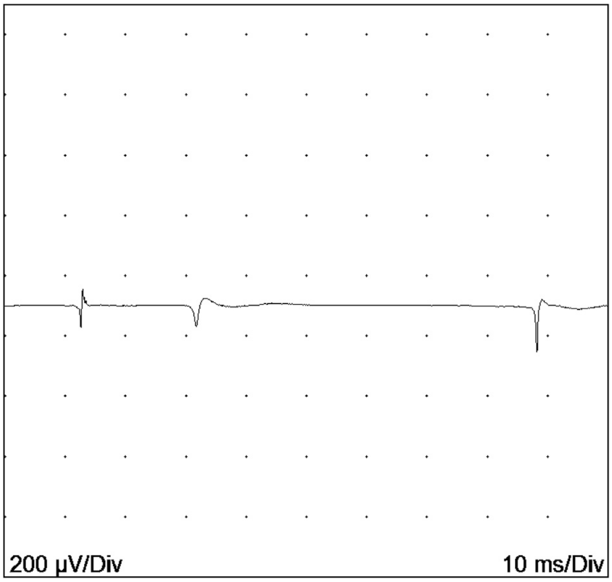

Fig. 1. Positive sharp waves and fibrillation potentials detected by needle EMG marking electrical instability of the membrane of the abductor pollicis brevis muscle and possible denervation process.

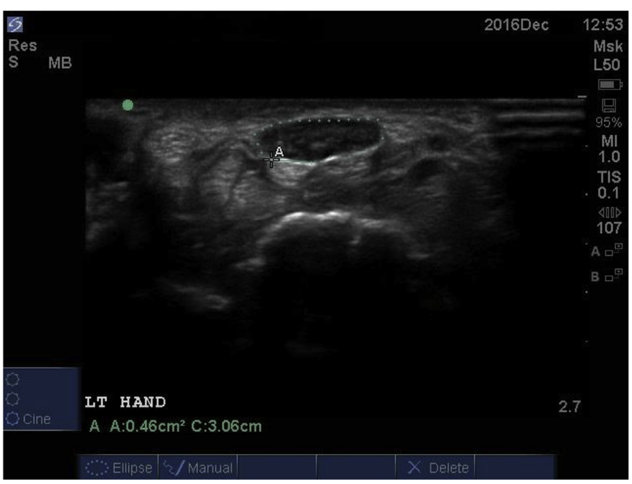

Fig. 2. Loss of the honeycomb appearance of the median nerve at the wrist and significant increase of the nerve diameter to reach up to 0.46 cm^2.

100% sensitivity and 92.5% specificity when combining neuro ultrasound and NCS/EMG in diagnosing CTS (Cartwright et al., 2012). Proper diagnosis, understanding, and analysis of a medical condition can lead to a proper management and hence a better

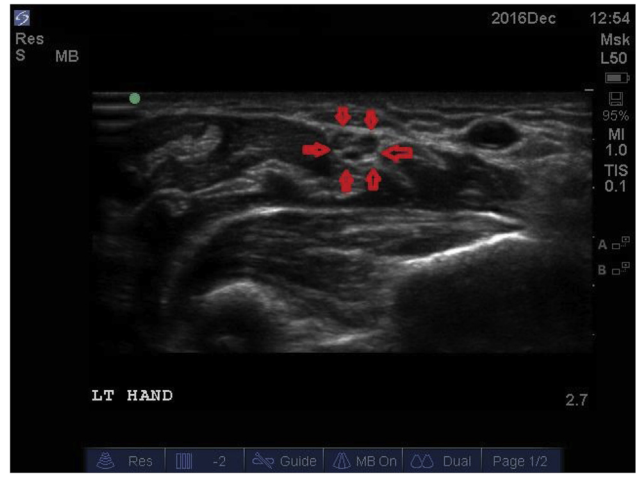

Fig. 3. Median nerve at the area of the pronator quadratus. The image was taken for the same patient in Fig. 2. Significant reduction of the nerve diameter that is more than 2 mm (Katirji, 2007) difference.

patient care can be achieved.

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