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Medial thenar recording in normal subjects and carpal tunnel syndrome

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Abstract

Objective: Since little is known about the involvement of median nerve fibres to the medial thenar eminence in CTS, we determine the consistency of a motor response derived from a medial thenar motor (MTM) site. We then compare sensitivity and specificity of this novel site with other nerve conduction parameters in supporting a diagnosis of CTS.
Methods: The motor responses over the MTM with ulnar and median stimulation were determined in healthy subjects and patients with CTS. Sensitivity and specificity of 4 motor techniques (Abductor Pollicis Brevis (APB) and median MTM latency, 2nd Lumbricales to Interossei latency difference (2-LINT), APB to Adductor Digiti Minimi (ADM) latency difference, median MTM to ulnar MTM latency difference) and the median sensory distal latency in confirming CTS were calculated using the ROC method.
Results: 132 hands (68 CTS, 64 controls) were examined. All but one median and ulnar nerve stimulation (both in patients with CTS) resulted in negative MTM compound muscle action potentials. Sensitivity and specificity in diagnosing CTS were 79/97% (APB) 90/98% (median MTM latency), 88/97% (2-LINT), 85/97% (APB to ADM latency difference) and 75/95% (median MTM to ulnar MTM latency difference). Median sensory latency showed 89% sensitivity and 97% specificity.
Conclusions: Median and ulnar stimulation results in consistent motor responses at the medial thenar site. Median distal motor latency to MTM is frequently abnormal in CTS showing similar sensitivity and specificity to 2-LINT and median distal sensory latency.
Significance: The MTM site shows consistent responses to both median and ulnar stimulation. MTM distal latency can be considered a useful site for supporting a diagnosis of CTS.
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Keywords: Flexor Pollicis Brevis; Oppones pollices; Median motor latency; Carpal tunnel syndrome; Nerve conduction studies; 2-LINT; Abductor Pollices Brevis; Medial thenar muscles

1. Introduction

Carpal tunnel syndrome (CTS) is commonly confirmed by identifying abnormal median nerve conduction tests. These tests vary in their sensitivity and specificity in being able to demonstrate the abnormal median nerve function across the carpal tunnel (Jablecki et al., 2002). Although motor nerve conduction tests are traditionally thought to be less sensitive than sensory tests, recent adaptations of motor tests have shown these to be at least on a par with sensory tests (Chang et al., 2002). Motor tests have an advantage over sensory tests in that they are more persistently recordable in both severe CTS and the presence of additional polyneuropathy (Loscher et al., 2000). The most basic median motor test measures distal latency across the wrist to the Abductor Pollicis Brevis (APB) muscle which is located over the thenar eminence (Jablecki et al., 2002). This technique, although foundational and with very high specificity for diagnosing CTS, is known to suffer from poorer sensitivity. Possible reasons for this are the

Abbreviations: CTS, carpal tunnel syndrome; MTM, Medial thenar motor site; APB, Abductor Pollicis Brevis muscle; 2-LINT, 2nd Lumbricales to Interossei latency difference; FPB, Flexor Pollicis Brevis; ADM, Adductor Digiti Minimi; Hi-Ob scale, History-Objective; SNAP, sensory nerve action potential; CMAP, compound muscle action potential; ROC, Receiver Operator Curve

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relatively late involvement of the motor nerve fibres to the APB muscle in CTS and greater standard deviation of normals (Fitz et al., 1990). Increased sensitivity and specificity is dependent on consistent nerve fibre involvement over all degrees and stages of CTS and as little as possible variation in controls. These factors are thought to contribute to the high sensitivity and specificity of the 2nd Lumbricales to Interossei latency difference (2-LINT) motor comparator test which utilizes the motor latency difference of median and ulnar conduction to the 2nd lumbrical and interosseus muscles, respectively (Loscher et al., 2000). Little is known about the involvement of the medial thenar muscles in CTS. This is due to ambiguity surrounding the motor supply to the medial thenar muscles and its underlying muscles, the Flexor Pollices Brevis (FPB) and Opponens Pollicis (OP). Cadaveric studies show rates of 10–50% pure ulnar innervation but are confounded by using different anatomical classifications of the muscle (Ajmani, 1996; Day and Napier, 1961). We set out to investigate the consistency of median and ulnar motor responses when recording over the medial thenar region overlying the FPB and OP in patients with CTS. As this recording site with its dual median and ulnar innervation potentially forms the basis for an additional median to ulnar motor comparative latency test similar to the 2-LINT test we compare sensitivity and specificity of this novel site with other nerve conduction parameters in supporting a diagnosis of CTS.

2. Methods

This prospective cross sectional study was carried out at the Neurology Diagnostic Laboratory, National University Hospital, Singapore. The protocol for this study was reviewed and approved by the Hospital Institutional Review Board. The study concurs with the principles of the ethical principles of the Helsinki declaration.

Patients were recruited when referred to our laboratory for the evaluation of a possible Carpal Tunnel Syndrome. After informed consent, patients were prospectively included into the study when a clinical diagnosis of Carpal Tunnel Syndrome (CTS) could be established. As the presence of two or more primary symptoms hand sensory symptoms makes a diagnosis of carpal tunnel syndrome highly likely (Wilder-Smith et al., 2006), we diagnosed Carpal Tunnel Syndrome when two or more primary symptoms hand sensory symptoms were present. Primary hand symptoms were: nocturnal paresthesias causing the patient to awaken from sleep, shaking, wringing or trick movements of hands which relieve symptoms, pain/paresthesias with hand grip or use of force with hand and sensory symptoms in digits 1, 2, 3 or split 4th digit or any combination thereof. Exclusion criteria were predominant neck symptoms. Neck symptoms were regarded as predominant if the patient graded symptoms from the neck more severe than from the hand. The standardised semi-quantitative clinical History-Objective (Hi-Ob) scale was used in every person to assess the CTS severity (Giannini et al., 2002). This was administered in the same fashion to all subjects by a technician trained in administering the Hi-Ob scale. Administration was unblinded. The Hi-Ob scale is divided into 5 grades of severity and integrates symptoms with clinical features. Stage 1 represents the mildest form of CTS with only nocturnal paresthesia, with the next step, stage 2, being paresthesia also occurring at day time in the absence of objective sensory deficits. Stage 3 is defined by median nerve sensory deficit in the presence of diurnal or nocturnal predominant symptoms. Stage 4 includes atrophy and/or motor weakness of median innervated thenar muscles. Stage 5 is applied in the presence of complete atrophy or plegia of median innervated thenar muscles. The severity of nerve conduction abnormality studies was rated using the Bland scale which is divided into 6 grades: grade 1 shows no evidence of CTS, grade 2 minimal, grade 3 mild, grade 4 moderate, grade 5 severe and grade 6 extreme CTS (Bland, 2000). Controls were obtained from healthy hospital staff (age matched) with no evidence of neuropathy based on the history and clinical examination.

2.1. Nerve conduction tests

Nerve conduction tests were performed using a two channel EMG machine (Medlec Synergy; Oxford instruments, UK) with the patient examined whilst lying down. The person performing nerve conduction was not blinded to the clinical status. The following settings were used: Sensory Nerve Conduction: Low Filter – 20 Hz, High Filter – 2 kHz, Sensitivity – 10 μV (micro Volt), Sweep duration – 15 ms. For Motor Nerve Conduction: Low Filter – 3 Hz, High Filter – 10 kHz, Sensitivity – 5 mV, Sweep duration – 50 ms. Using a no touch infrared skin thermography (Exergen; Infrared temperature scanner, USA), the patient's skin temperature was measured at the palmar wrist crease and a minimum temperature of 30 °C was required before proceeding with measurements.

Monopolar surface recording electrodes (TECA Accessories; Oxford Instruments, UK) and bipolar hand held surface stimulating electrodes were used to obtain the sensory nerve action (SNAP) and compound muscle action potentials (CMAP). The sensory and motor recording techniques were orthodromic and the belly tendon, respectively (Jablecki et al., 2002).

2.2. Median digit III sensory distal latency

The SNAP of the median digit 3 sensory branches was evoked by ring electrode stimulation over the third proximal phalanx and recorded at the level 2 cm proximal to proximal wrist crease (distance 14 cm). The onset latency of the SNAP was used for analysis.

2.3. Median APB distal motor latency

The APB active electrode was placed over the belly of the APB muscle on a line drawn between the volar aspect

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