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Effects of gender and age on median and ulnar nerve sensory responses over ring finger

Murat Alemdar *

Health Directory of Sakarya Province - Sakarya Sağlık Müdürlüğü, Valilik C-blok, 54290, Camili-2, Adapazarı, Sakarya, Turkey

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ABSTRACT

Objective: To analyze the effect of gender on median nerve (MN) and ulnar nerve (UN) sensorial responses over ring finger (RF).

Materials and methods: Results of individuals admitted to our ENMG laboratory between June 2011 and March 2012 for nerve conduction studies (NCSs) were retrospectively analyzed. Sensory NCSs were performed by standard antidromic technique.

Results: Totally, 112 normal recordings belong to 100 patients were included. Mean antidromic sensory conduction velocity of MNs (wrist-to-second finger) or UNs (wrist-to-fifth finger) was not different between two genders. Mean sensory nerve action potential (SNAP) amplitude of MN from second finger was also not different between two genders. However, mean SNAP amplitude of UN from fifth finger was higher in females. In RF's sensorial response studies; mean peak latency of MN was similar between females and males (3.05 ± 0.25 ms *vs.* 3.14 ± 0.29 ms, $p = 0.111$), whereas one of UN was shorter in females (2.86 ± 0.22 ms *vs.* 3.04 ± 0.31 ms, $p = 0.001$). MN to UN latency difference to RF was greater in females than males (0.19 ± 0.15 ms *vs.* 0.10 ± 0.16 ms, $p = 0.007$). Mean SNAP amplitude of MN and UN were both higher in females than males (17.9 ± 7.1 μV *vs.* 14.1 ± 5.5 μV, $p = 0.011$ and 18.5 ± 8.0 μV *vs.* 12.9 ± 6.1 μV, $p = 0.0009$, respectively). All data of NCSs were re-analyzed after adjustment for age, and obtained findings regarding effect of aging are also included.

Conclusion: Gender has a prominent effect on RF's sensorial responses. Normative values regarding them should be prepared with adjustment for gender.

1. Introduction

Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy in upper limb caused by focal compression of median nerve in the carpal tunnel. The prevalence of symptomatic and electrophysiologically confirmed CTS is about 3% among females and 2% among males (Atroshi et al., 1999). Nerve conduction studies (NCSs) are essential for confirming and following up the disease (Aulisa et al., 1998; Graham, 2008; Aygül et al., 2005; Premoselli et al. 2006; Karsidag et al., 2007). The neurophysiologic severity of CTS could be staged according to abnormalities on NCS (Stevens, 1997; Aulisa et al., 1998). Antidromic electrophysiological techniques in which stimulating impulses are generated in a direction opposite to the physiological neurotransmission are given preference to the orthodromic techniques since they are easier to apply (Tackmann et al., 1981).

Transcarpal sensory or transcarpal sensory and motor conduction abnormalities of median nerve in the presence of normal ipsilateral ulnar nerve conduction are the main indicators of CTS in a NCS (Stevens, 1997). Traditionally used transcarpal median nerve conduction tests in detection of CTS are; wrist-digit II distal sensory peak latency (DSPL), wrist-digit II sensory conduction velocity (SCV), wrist-palm SCV, wrist-abductor pollicis brevis (APB) muscle distal motor latency (DML) and forearm motor conduction velocity (MCV). These parameters showed wide range of sensitivity and specificity in previous researches (Jablecki et al., 1993; Stevens, 1997; Aulisa et al., 1998; Chang et al., 2002; Atroshi et al., 2003; Demirci and Sonel, 2004; Schrijver et al., 2005; Chang et al., 2006). Because the sensory fibers compose the outer layers of the median nerve in its topographical anatomy, sensorial signs occur in earlier stages of the nerve compression in carpal tunnel than motor weakness. Therefore, abnormalities in sensory responses of median nerve exist before ones in motor responses in CTS. Many previous researches revealed that transcarpal median sensory NCSs had higher sensitivities than motor NCSs (Buchthal et al, 1974; Loong, 1977; Kuntzer, 1994; Seror, 1995). However, 8–25% of the sensory distal latencies in symptomatic hands may still be normal (Cioni et al., 1989; Séror, 1993; 1995).

As the ring finger has dual innervations, CTS causes a digital sensory 'splitting' on this finger which is one of the most useful clinical finding in distinguishing it from a radiculopathy or a diffuse polyneuropathy (Loong, 1977). This dual innervation

* Tel.: +90 532 2032744.
E-mail address: dr.alemdar@gmail.com

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pattern is also helpful in electrophysiological diagnosis of CTS. Comparing median and ulnar nerve conduction to the ring finger suggested as a valuable technique in providing an easily performed and rapid technique for screening an early median nerve entrapment at the wrist. Median to ulnar nerve comparative sensory NCSs of ring finger have been well studied for the diagnosis of CTS in last three decades (Johnson et al., 1981; Cioni et al., 1989; Jackson and Clifford, 1989; Uncini et al., 1989; Charles et al., 1990; Uncini et al., 1993; Padua et al., 1999; Chang et al., 2006; Leblebici et al. 2008; Uzar et al., 2011). In particular, median to ulnar nerve DSPL difference on ring finger have been reported as a much more sensitive tool than commonly used traditional methods (Johnson et al., 1981; Jackson and Clifford, 1989; Charles et al., 1990; Uncini et al., 1993; Stevens, 1997; Jablecki et al., 2002; Atroshi et al., 2003; Schuhfried et al., 2004). The greater sensitivity of this method comparing with traditional ones was explained by the funicular topography and consequent greater susceptibility of the cutaneous fibers to the compression, as these fibers are clumped superficially in the anteroulnar portion of the median nerve just beneath the transverse ligament at the distal carpal tunnel (Uncini et al., 1993).

In ring finger studies, median and ulnar DSPLs should be determined on the ring finger over identical distances from the wrist. In 1981, Johnson et al. researched the usage of comparing the median and ulnar nerves' DSPLs to the ring finger with antidromic stimulation on 14 cm proximal to the recording electrodes in electrodiagnosis of CTS. They reported that 74 hand studies of 37 normal adults, all, revealed a recordable response in ring finger upon stimulation of the median and ulnar nerves. Comparing the median nerve's DSPL to ring finger with the ulnar nerve's one to the same finger, the difference was 0.3 ms or less in 93% of these hands. In 18 cases of CTS, this difference ranged from 1 to 2.1 ms. Uncini et al. (1989) reported comparing median to ulnar latencies from ring finger as the most sensitive method to make the diagnosis of CTS in their study on 42 hands with clinical evidence of CTS and 43 control hands. In 1993, Seror reported that ring finger's median to ulnar sensory DSPL difference had a sensitivity of 98%, and considerable efficacy in CTS cases with completely normal conventional nerve conduction tests. More recently, Leblebici et al. (2008) also researhed the same issue, and found that ring finger latency difference had sensitivity of 89.2% and specificity of 82.8% in diagnosis of CTS. Similarly, Aygül et al. (2009) revealed the ring finger latency difference as a more sensitive technique than other conventional nerve conduction tests in their clinical research that contain extensive NCSs of 225 hands. All of these studies revealed the value of ring finger test in detection of CTS, and it should be used whenever there are clinical signs of CTS but traditional NCS are normal or borderline. Therefore, the normative data charts regarding the ring finger's conduction values have a particular importance in electrodiagnosis of CTS.

There are a limited number of reports analyzing the effect of gender on NCSs in the literature (Bolton and Carter, 1980; Stetson et al., 1992; Robinson et al., 1993; Hennessey et al., 1994; Tan and Tan, 1995; Huang et al., 2009; Fujimaki et al., 2009). However, to the best of our knowledge, there is not any study researching the effect of gender and /or age on median and ulnar nerve sensory responses on ring finger. In this study, we aimed to determine whether the gender and/or age of the subject affects the median and ulnar nerves' DSPLs, sensory nerve action potential (SNAP) amplitudes and median to ulnar nerve DSPL difference on comparative sensory NCSs of ring finger.

2. Methods

Population of this study is composed of the subjects who were referred to electroneuromyography (ENMG) laboratory of Toyotasa First Aid and Traumatology Hospital for upper limb's NCS in-between June 2011 and March 2012. The author was the sole ENMG practitioner in our center; therefore all subjects were examined by him. All of ENMG result reports in-between June 2011 and March 2012 were analyzed retrospectively. History and clinical findings (such as presence of recurring nighttime or activity-related numbness, presence of positive Tinnel/Phalen's test, sensory or motor deficits) of each subject were noted on the first page of his/her ENMG result report. Only the data belong to the hands with completely normal neurological examination and ENMG study were included.

The exclusion criteria were:

(1) Any positive findings for entrapment neuropathy on history and/or clinical findings of the patient (e.g. presence of recurring nighttime or activity-related numbness, presence of positive Tinnel/Phalen's test, any sensory or motor deficits).
(2) History of carpal or cubital tunnel release operation in studied limb.
(3) Any sign of plexopathy, cervical radiculopathy or polyneuropathy.
(4) Abnormalities in NCS presuming spinal cord, root, peripheral nerve, neuro-muscular junction or muscle diseases.

Normative values used for median and ulnar NCSs used in our laboratory were as follows: orthodromic median nerve wrist to APB muscle motor latency <4.20 ms, antidromic median nerve wrist to digit II segment SCV >44.0 m/s, orthodromic median nerve forearm motor conduction velocity >49 m/s, and median nerve F wave latency to APB muscle <29.0 ms, orthodromic ulnar nerve wrist to abductor digiti minimi muscle (ADM) motor latency <3.30 ms, antidromic ulnar nerve wrist to digit V segment SCV >44.0 m/s, orthodromic ulnar nerve forearm motor conduction velocity >49 m/s, orthodromic ulnar nerve across-elbow motor conduction velocity >44 m/s, ulnar nerve F wave latency to ADM <29.0 ms, and antidromic median to ulnar nerve DSPL difference from 4th finger <0.5 ms.

The nature of electrophysiological process was explained to the subjects before the studies. They sit on a padded table with the upper limb supported. All of the studies were performed in a warm room with the temperature maintained at 26–28 °C. If necessary, the limb was warmed with infrared lamp to maintain the temperature of 30 °C or over. The intercathodal distances were measured with an anthropometer. All subjects were studied by using a Neuro-MEP (Neurosoft company, Ivanovo, Russia) ENMG tool. The electrophysiological study was conducted according to the American Association of Electrodiagnostic Medicine (AAEM) practice guidelines.

NCS were performed using standard techniques of supramaximal percutaneous stimulation with a constant current stimulator and recording surface electrodes. The median motor nerve was examined by stimulating it on wrist and antecubital fossa. The nerve was stimulated with bipolar surface electrodes and the recording was carried out over the belly of APB muscle with surface electrodes. Median sensory NCSs were performed by stimulating it on wrist and recording the responses from digit II and digit IV, antidromically. Motor conduction studies of the ulnar nerve were performed by stimulating it on wrist and ulnar groove in elbow by bipolar surface electrodes. The motor responses were recorded over ADM muscle with surface electrodes. Ulnar sensory NCSs were performed by stimulating it on wrist and recording the responses from digit IV and digit V, antidromically.

Only the hands with completely normal neurological examination and ENMG study were included. Among them, as they had a lesser count, the number and sides of the limbs belong to males were detected. Then, three age and side matched limbs belong to females were included for each one belong to a male.