DORSAL ULNAR CUTANEOUS NERVE CONDUCTION

Reference values

Solange G. Garibaldi¹, Anamarli Nucci¹

ABSTRACT - We investigated the reference values of the dorsal ulnar cutaneous nerve (DUC) sensory nerve conduction (SNC) in 66 healthy individuals. Measurements were processed using stimulating electrodes positioned between the ulnar bone and the flexor carpi ulnaris muscle, 11-13 cm proximal to the active electrode recording. Superficial recording electrodes were placed on the fourth intermetacarpal space. The mean sensory conduction velocity (SCV) in males was 63.7 – 0.16 x age ± 3.36 m/s and in females was 57.7 ± 3.37 m/s. The mean sensory nerve action potential (SNAP) amplitude in males was 19.5 ± 10.7 µV and in females was 24.6 ± 5.8 µV. The mean SNAP duration was 0.96 ± 0.13 ms. No significant differences regarding the DUC-SCV, distal latency, and SNAP duration or amplitude were found between both sides of the same subject. The amplitude of the SNAP was higher in females than males. The effects of age on DUC-SCV were distinct for each gender.

KEY WORDS: dorsal ulnar cutaneous nerve, nerve conduction, reference values, age, height, sex, temperature.

The dorsal ulnar cutaneous nerve (DUC), a branch of the ulnar nerve, leaves the main ulnar trunk approximately at the junction of the medial and distal thirds of the forearm¹, then it takes a dorsal position at the wrist and continues on the dorsomedial region of the hand². The purposes of studying the DUC sensory nerve conduction (SNC) include distinction between proximal and distal ulnar nerve lesions³⁻⁵, identification of isolated lesions of this nerve branch⁵⁻⁶, and investigation of the dorsomedial hand innervation⁶⁻⁷.

The DUC is vulnerable to laceration, blunt trauma, and compression injury due to its superficial position⁸. In addition, determination of the DUC-SNC is helpful to confirm or rule out proximal lesions of the ulnar nerve. Lesions of the ulnar nerve at the level of the elbow and wrist are highly frequent in clinical practice, and include trauma, compression, tumor, bone deformity, and occupational neuritis⁹⁻¹⁰.

In studies of nerve conduction, the reference values indicate the probability that one given result is obtained from a normal subject or not¹¹. Both technical¹² and physiologic¹¹,¹³ factors may influence the reference values. The aim of this study was to determine the reference values of the DUC-SNC considering several variables such as age, gender, height, and temperature, to increase the diagnostic sensitivity and specificity of this test.

¹MD., PhD., Department of Neurology, Campinas University (UNICAMP), Campinas SP, Brazil.

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Dra. Solange Garcia Garibaldi - Departamento de Neurologia, FCM-UNICAMP - Caixa Postal 6111 - 13083-970 Campinas SP - Brasil. FAX 5519 788 7990.
METHOD

Subjects

Sixty-six healthy individuals (33 male and 33 female) were included in this study. Data are given as mean and standard deviation. Males were between 20 and 80 years (45 ± 18) and females were between 16 and 66 years (43 ± 16). In males, the height ranged from 158 cm to 188 cm (170 ± 0.07), whereas in females, the height ranged from 152 cm to 173 cm (162 ± 0.05). All subjects were right handed. In all cases, neurological diseases, systemic illness or disorder affecting the central or peripheral nervous systems, occupational exposure to forceful or repetitive hand exertions, anomalous dorsomedial hand innervation, drug exposure, or ulnar nerve lesions, have been ruled out. In addition, all subjects underwent detailed evaluation for signs and symptoms of peripheral neuropathy, sural and ulnar nerve conduction, and H-reflex.

Dorsal ulnar cutaneous nerve sensory conduction study

The study of nerve conduction was performed on both hands in all subjects by the same investigator (SGG), using the Nikon Kodhen electromyography (Neuropack four, Japan) and Nikon Kohden surface electrodes (NM-312S, NM-522S, and MN-430S).

We used the standard antidromic technique of supramaximal percutaneous nerve stimulation and surface recording proposed by Jabre. The arm was externally rotated and abducted at 45°. Stimulating electrodes were positioned between the ulna bone and the tendon of the flexor carpi ulnaris muscle, 11 to 13 cm proximal to the recording electrode. Superficial recording electrodes were placed on the fourth intermetacarpal space, with 3 cm distance between electrodes (Fig 1). The skin temperature was measured on the dorsal part of the hand using a Digi-Sense Thermistor (Cole-Parmer Instrument Company, USA). The skin temperature was maintained at 32°C to 33.5°C during the entire period. A bandpass of 20Hz to 3kHz, a base time of 2ms/division, and a sensitivity of 10µV/ division were used. Skin impedance was reduced to less than 5Ω. Sensory nerve action potential (SNAP) amplitude was measured from the baseline to the negative peak. Sensory distal latency (SDL) was measured from the point of stimulation to the onset of negative deflection. SNAP duration was measured from the onset of the negative deflection to the first baseline crossing. Terminal sensory conduction velocity (SCV) was calculated by dividing the distal distance by the SDL.

Data analysis

Nerve conduction measurements were correlated with age, height, sex, and temperature using the least squares regression analysis. Group data were compared using the Student t-test. A p-value <0.05 was considered significant.

Fig 1. Dorsal ulnar cutaneous nerve. Location for active (Ra) and reference (Rr) recording electrodes and stimulus site (S) for dorsal ulnar cutaneous nerve evaluation.
RESULTS

Nerve conduction velocity

There was a significant decrease in SCV associated age in males. The linear regression line for SCV versus age had a slope corresponding to a decrease of 0.16 m/s per year, SCV = 63.7 – (0.16 x age) ± 3.36 m/s (R² = 0.41). In contrast, no differences were found in SCV versus age in females, SCV = 57.7 ± 3.37 m/s. In addition, there were no evidences of significant differences in SCV between the right and left sides (p = 0.13).

Sensory nerve action potential amplitude

The mean amplitude of the SNAP was 19.5 ± 10.7 µV in males and 24.6 ± 5.8 µV in females. No significant differences (p=0.55) in the SNAP amplitude were observed between the right and left sides.

Sensory distal latency

There was an increase of SDL associated with age in males. The slope of linear regression line for SDL versus age corresponded to a change of 0.006 ms per year in males, SDL = 1.9 + 0.006 x age ± 0.23 ms (R² = 0.30). In contrast, the pattern of SDL in females was not altered with age, SDL=2.05 ± 0.13 ms. No differences were found in the SDL (p = 0.82) between the right and left sides.

Sensory nerve action potential duration

A similar mean SNAP duration of 0.96 ± 0.13 was found in both males and females. In addition, no significant differences (p = 0.63) were found in the SNAP duration between the right and left sides.

DISCUSSION

This study reports the effects of age, height, sex, and temperature upon the DUC-SNC. We found a reduction in SCV of 1.6m/s per decade associated with increased age in males. In addition, an increase in the SDL of 0.06 ms per decade was observed in males. However, neither amplitude nor duration of the SNAP of the DUC was altered by age. In contrast to the results found in males, age appears not to affect the DUC nerve conduction in females. However, the mechanisms modulating the distinct effects of age upon DUC nerve conduction between males and females remain unclear.

The influence of age on nerve conduction has long been described. The negative effects of age on nerve conduction are thought to be the result of several factors, including reduced number or diameter of nerve fibers, altered distance between the nodules of Ranvier, and a greater incidence of segmental demyelination in individuals over 65 years.

In contrast to our findings, previous study did not find any significant correlation between age and SDL or amplitude of the SNAP of the DUC. The causes for these controversial results are unknown.

In this study, the analysis of the DUC nerve conduction was not influenced by height. Our findings are in agreement with Oliveira who also demonstrated an absence of correlation between the reference values of the DUC and height. However, Stetson et al. observed a consistent negative correlation between the SNAP amplitude and SCV in other sensory nerves, including the median, ulnar, and sural nerves. In addition, a positive correlation was found in the SDL of the median, ulnar, and sural nerves.

We found the mean SNAP amplitude of the DUC larger in females than in males. Conversely, Oliveira did not find any differences in duration, SDL, SCV, and amplitude of the DUC between males and females. The majority of previous studies in sensory nerves also observed greater SNAP amplitude in females than in males. The mechanisms underlying the association between gender and SNAP amplitude in sensory nerves are not clear. However, Trotjaborg et al. suggested that women have better conductance properties than men due to a thicker subcutaneous layer.

We did not find an association between body temperature and SCV, SNAP amplitude or duration, and SDL of the DUC. Whereas studies in other sensory nerves observed a decrease in the SCV, an increase in the SDL, and an increase in the SNAP amplitude when the temperature is reduced. Our findings of absence of effects of temperature on the DUC nerve conduction are probably the result of narrow temperature variation allowed during the entire test as part of our method of investigation.

CONCLUSIONS

The findings obtained in this study indicate that the reference values in the study of the DUC nerve conduction regarding the SCV and SDL should be adjusted according to the age in males, whereas the SNAP amplitude of the DUC should be adjusted according to the gender. In addition, the maintenance of body temperature at 32°C to 33.5°C throughout the exam prevented the negative effects of temperature variability on nerve conduction. Failure to adjust normal DUC nerve conduction values for these factors decreases the diagnosis specificity and sensitivity of the described measures, and may result in misclassification of individuals.
REFERENCES
