Arq Neuropsiquiatr 2002;60(2-B):349-352

DORSAL ULNAR CUTANEOUS NERVE CONDUCTION

Reference values

Solange G. Garibaldi[1], *Anamarli Nucci*[1]

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.

Condução nervosa do nervo cutâneo ulnar dorsal: valores de referência

RESUMO - Investigamos os valores de referência da condução nervosa sensitiva do nervo cutâneo ulnar dorsal em 66 indivíduos normais, por técnica de condução nervosa antidrômica. A velocidade de condução sensitiva (VCS) média, em homens foi 63,7 – 0,16 x idade ± 3,36 m/s e nas mulheres 57,7 ± 3,37 m/s. A amplitude média do potencial de ação nervoso sensitivo (PANS) em homens foi 19,5 ± 10,7 μV e nas mulheres foi 24,6 ± 5,8 μV. A duração média do PANS foi 0,96 ± 0,13 ms. A dominância manual não interferiu nos valores da VCS, latência distal, amplitude e duração do PANS. Nas mulheres a amplitude do PANS foi maior do que nos homens. Os efeitos da idade na VCS foram distintos para cada sexo.

PALAVRAS-CHAVE: nervo cutâneo ulnar dorsal, condução nervosa, valores de referência, altura, idade, sexo, temperatura.

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 forearm[1], then it takes a dorsal position at the wrist and continues on the dorsomedial region of the hand[2]. The purposes of studying the DUC sensory nerve conduction (SNC) include distinction between proximal and distal ulnar nerve lesions[3-5], identification of isolated lesions of this nerve branch[5,6], and investigation of the dorsomedial hand innervation[6,7].

The DUC is vulnerable to laceration, blunt trauma, and compression injury due to its superficial position[8]. 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 neuritis[9,10].

In studies of nerve conduction, the reference values indicate the probability that one given result is obtained from a normal subject or not[11]. Both technical[12] and physiologic[11,13] 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.

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

Received 26 September 2001. Accepted 10 December 2001.

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[3]. 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.

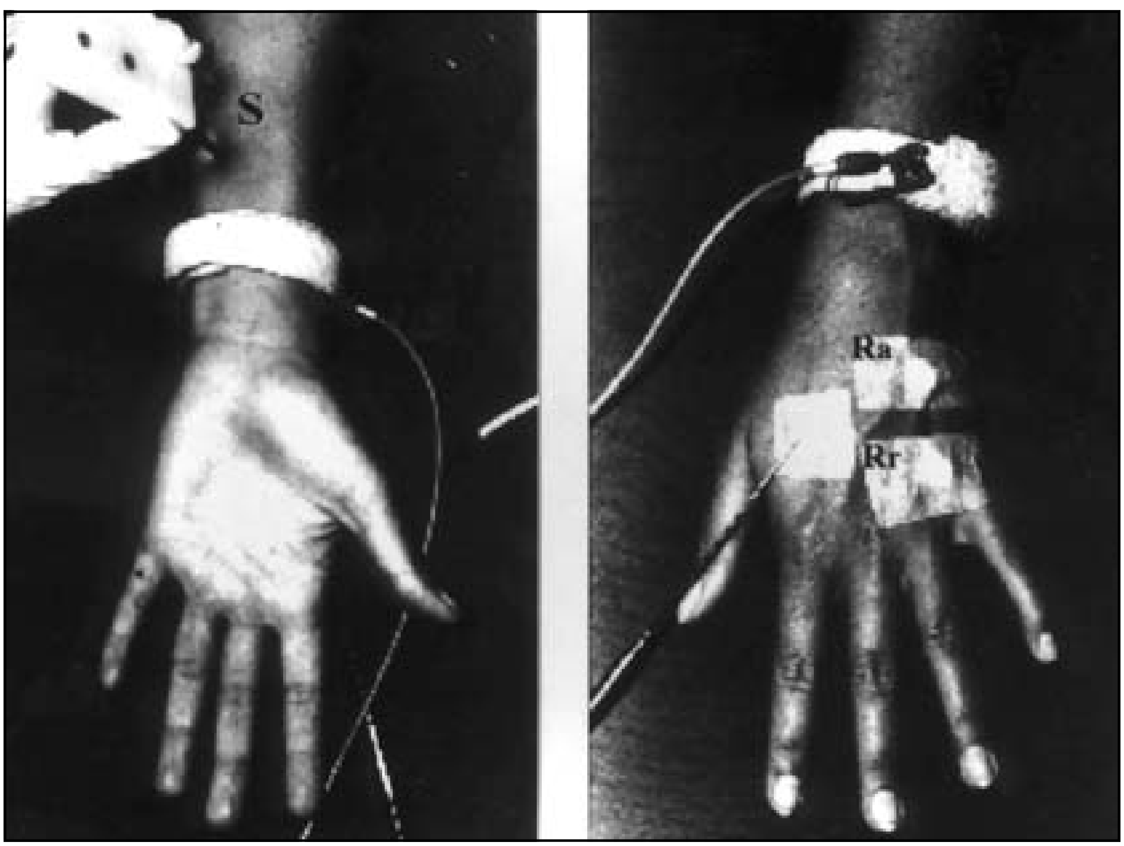

Fig 1. Dorsal ulnar cutaneous nerve. Location for active (Ra) and reference (Rr) recording electrodes and stimulus site (S) for dorsal ulnar cutaneous nerve evaluation.

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 ($R^2 = 0.41$). 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 ($R^2 = 0.30$). 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 potencial 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[14-16]. 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[14,16], altered distance between the nodules of Ranvier, and a greater incidence of segmental demyelination in individuals over 65 years[15]. In contrast to our findings, previous study[5] 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[17] who also demonstrated an absence of correlation between the reference values of the DUC and height. However, Stetson et al.[18] 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[18].

We found the mean SNAP amplitude of the DUC larger in females than in males. Conversely, Oliveira[17] 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[19-22]. The mechanisms underlying the association between gender and SNAP amplitude in sensory nerves are not clear. However, Trojaborg et al.[22] suggested that women have better conductance properties than men due to a ticker 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[18,22-24], an increase in the SDL[18,25,26], and an increase in the SNAP amplitude[24,27] 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

1. Kaplan EB. Variation of the ulnar nerve at the wrist. Bull Hosp Joint Dis 1963;24:85-88.
2. De Wulf, Razemon JP. Séqueles des fracture du poignet: rapport à la société belge d'orthopédie. Acta Orthop Belg 1968;34:118-119.
3. Jabre JF. Ulnar nerve lesions at the wrist: new technique for recording from the sensory dorsal branch of the ulnar nerve. Neurology 1980;30:873-876.
4. Olney RK, Wilbourn AJ, Miller RG. Ulnar neuropathy at or distal to the wrist.Neurology 1983;33(Suppl.2):185.
5. Hoffman MD, Mitz M, Luisi M, Melville BR. Paired study of the dorsal cutaneous ulnar and superficial radial sensory nerves. Arch Phys Med Rehabil 1988;69:591-594.
6. Peterson AR, Giuliani MJ, Mchugh M, Shipe CC. Variations in dorsomedial hand innervation: electrodiagnostic implications. Arch Neurol 1992;49:870-873.
7. Spindler HA, Felsenthal G. Radial sensory conduction in the hand. Arch Phys Med Rehabil 1986;67:821-823.
8. Dawson DM, Hallet M, Millender LH. Ulnar nerve entrapment at the wrist. In Entrapment neuropathies. Boston: Little, Brown & Co, 1983:123-140.
9. Shea JD, Mcclain EJ. Ulnar nerve compression syndromes at and below the wrist. J Bone Joint Surg [Am] 1969;51A:1095-1103.
10. Olney RK, Hanson M. Ulnar neuropathy at or distal to the wrist. Muscle Nerve 1988;11:828-832.
11. Campbell WW, Robinson LR. Deriving reference values in electrodiagnostic medicine. Muscle Nerve 1993;16:424-428.
12. Kimura J. Principles and pitfalls of nerve conduction studies. Ann Neurol 1984; 16:415-429.
13. Lang HA, Forsström J, Björkqvist SE, Kuusela V. Statistical variation of nerve conduction velocity. J Neurol Sci 1977; 33:229-241.
14. Mayer RF. Nerve conduction studies in man. Neurology 1963;13:1021-1030.
15. Lascelles RG, Thomas PK. Changes due to age in internodal length in the sural nerve in man. J Neurol Neurosurg Psychiatry 1966;29:40-44.
16. Kemble F. Conduction in the normal adult median nerve. Electromyography 1967;7:275-288.
17. Oliveira ALCRD. Estudo do potencial de ação sensitivo do ramo cutâneo dorsal do ulnar e dos nervos mediano e ulnar em uma população normal. Tese, Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo. Ribeirão Preto, 1995.
18. Stetson DS, Albers JW, Silverstein BA, Wolfe RA. Effects of age, sex, and anthropometric factors on nerve conduction measures. Muscle Nerve 1992;15:1095-1104.
19. Casey EB, Le Quesne PM. Digital nerve action potentials in healthy subjects, and in carpal tunnel and diabetic patients. J Neurol Neurosurg Psychiatry 1972;35:612-623.
20. Felsenthal G. Median and ulnar muscle and sensory evoked potentials. Am J Phys Med 1978;57:167-182.
21. Falco FJE, Hennessey WJ, Braddom RL, Goldberg G. Standardized nerve conduction studies in the upper limb of the healthy elderly. Am J Phys Med Rehabil 1992; 71:263-271.
22. Trojaborg WT, Moon A, Andersen BB, Trojaborg NS. Sural nerve conduction parameters in normal subjects related to age, gender, temperature, and height : a reappraisal. Muscle Nerve 1992;15:666-671.
23. Ludin HP, Beyeler F. Temperature dependence of normal sensory nerve action potentials. J Neurol 1977;216:173-180.
24. Denys EH. The influence of temperature in clinical neurophysiology. Muscle Nerve 1991;14:795-811.
25. Soudmand R, Ward LC, Swift TR. Effect of height on nerve conduction velocity. Neurology 1982; 32:407-410.
26. Rivner MH, Swift TR, Crout BO, Rhodes KP. Toward more rational nerve conduction interpretations: the effect of height. Muscle Nerve 1990;13:232-239.
27. Lang HA, Puusa A. Dual influence of temperature on compound nerve action potencial. J Neurol Sci 1981;51:81-88.