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RESEARCH ARTICLE

Influence of age, height, gender on median and ulnar nerve conduction study

Senthil Kumari K R[1], Umamaheswari Kannan[2], Aruna B Patil[3]

[1]Department of Physiology, Villupuram Medical College, Villupuram, Tamil Nadu, India, [2]Department of Physiology, ESIC Medical College and PGIMSR, Chennai, Tamil Nadu, India, [3]Department of Community Medicine, ESIC Medical College and PGIMSR, Chennai, Tamil Nadu, India

Correspondence to: Umamaheswari Kannan, E-mail: umamaheswarik89@yahoo.in

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ABSTRACT

Background: Nerve conduction studies (NCSs) is a test to measure the electrical activity in the nerve and used to measure nerve function disease progression. Physiological factors such as age, temperature, height, and gender are known to affect the nerve conduction velocity (NCV). Studies have reported different results with regard to these physiological factors affecting NCS. **Aims and Objectives:** To examine the influence of age, height, and gender on median and ulnar NCS. **Materials and Methods:** 103 healthy individuals of both sexes in the age group of 15-65 were included in the study. The neurophysiological study consisted of motor and sensory NCS of the ulnar nerve and median nerve using RMS EMG MKII equipment. **Results:** The correlation of age on the conduction velocities of median and ulnar nerve showed a significant negative correlation which suggests that as age advances the conduction velocity decreases. The correlation of height on the median and ulnar nerves did not show statistical significance. The influence of gender was analyzed using student *t*-test, in which the conduction velocities of median motor ($P = 0.007$), ulnar motor ($P = 0.01$), and sensory ($P = 0.05$) were faster in females compared to males. **Conclusion:** Age and gender have a significant role in influencing the nerve conduction parameters. We could not determine a definite relation of height and NCV. The present study adds substantial evidence that adjusting the nerve conduction parameters for physiological factors such as age and gender and will increase the diagnostic sensitivity and lays emphasis that an electrodiagnostic data should be created considering these variables.

KEY WORDS: Nerve Conduction Velocity; Median Nerve; Ulnar Nerve; Motor and Sensory Nerve

INTRODUCTION

Nerve conduction velocity (NCV) is a test to measure the speed and electrical activity in a nerve, and it is widely used to monitor nerve function over time, determine disease progression, assess the complications of treatment, as well as to identify the disease course. Nerve conduction studies (NCS) are safe and well tolerated. Results are routinely compared to normative values to discern abnormalities. For this reason, proper normative data are critical for valid interpretation.[1] Physiological factors such as age, temperature, height, and gender are known to affect the NCV. It is stated that fixing absolute thresholds without adjustment for age, sex, temperature, and height may result in false positive and false negative results. Strict control of temperature and measurement of anthropometric variables are required for a valid interpretation of nerve conduction outcomes.[2] Therefore, electrodiagnostic testing should control for the relevant covariates particularly age, sex, and anthropometric factors.[1] Nerve conduction varies across different age groups[3,4] and has been reported to have a negative correlation with aging. With regard to other physiological

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Table 1: Influence of gender on median, ulnar nerve latency, and conduction velocity (sensory and motor)

Nerve	Parameters	Females (mean±SD)	Males (mean±SD)	Significance
Median motor nerve	Latency	4.02±0.4	4.09±0.6	0.6
	Conduction velocity	58.4±2.8*	56.04±3.5	0.007
Median sensory nerve	Latency	2.4±0.3*	2.6±0.5	0.02
	Conduction velocity	59.8±5.8	59.3±7.7	0.21
Ulnar motor nerve	Latency	5.01±0.6	5.13±0.7	0.4
	Conduction velocity	51.7±4.2*	48.6±2.2	0.01
Ulnar sensory nerve	Latency	1.96±0.3	2.06±0.4	0.2
	Conduction velocity	61.5±6.8*	59.5±9.6	0.05

*P<0.05 significance

Table 2: Correlation between age, height, and nerve conduction parameters

Nerve	Age		Height	
	Latency (correlation coefficient [r], *P* value)	Conduction velocity (correlation coefficient [r], *P* value)	Latency (correlation coefficient [r], *P* value)	Conduction velocity (correlation coefficient [r], *P* value)
Median motor	−0.061, 0.9	−409, 0.000*	0.070, 0.9	0.116, 0.26
Median sensory	−0.38, 0.000*	0.537, 0.000*	−0.08, 0.4	0.03,0.7
Ulnar motor	−0.016, 0.9	−0.098,0.33	−0.05, 0.6.	0.06, 0.55
Ulnar sensory	−0.350, 0.000*	−0.607, 0.000*	−0.07, 0.4	0.02, 0.8

*P<0.05 significance

factors, researchers have either observed a difference or no difference in NCS between males and females.[5,6] Studies relating height and NCV also report controversial results.[7,8] Due to the difference in the opinions of various studies, we aimed at investigating the median and ulnar nerve conduction (sensory and motor) velocity with relation to age, gender, and height of the individuals.

MATERIALS AND METHODS

This study was done at the Institute of Physiology and Experimental Medicine, Madras Medical College, Chennai after obtaining the Institute ethical committee clearance. 103 individuals of both sexes in the age group of 15-65 who volunteered to participate in the study were recruited. Informed written consent was obtained. Individuals with history of any neurological illness, diabetes mellitus, hypertension, thyroid disorders, alcoholics, smokers' obesity, and leprosy were excluded from the study. Dietary and personal history was ascertained. Detailed general examination and systemic examination was done. Individuals were made comfortable and the procedure properly explained. Any doubts were clarified. The neurophysiological study consisted of motor and sensory NCS of the ulnar nerve and median nerve. They were made to sit comfortably on a wooden stool, and NCS was done using RMS EMG MKII equipment. Temperature was maintained constant at 26 ± 20°C. Ulnar motor NCV was tested using surface electrode. The recording electrode was placed over the belly of abductor digiti muscle and the reference electrode distal to the active electrode. The stimulation points were at wrist crease, medial to flexor carpi ulnar tendon, and at ulnar groove of elbow. For median nerve, the recording electrode was placed close to motor point of abductor pollicis brevis and the reference electrode 3 cm distal to first metacarpo phalangeal joint. After recording from each stimulation site, the latency was measured from the stimulus artefact to the first negative deflection from the baseline. The length of the nerve segment was noted between the stimulating points. The conduction velocity was calculated by dividing the length of the nerve segment by the difference between proximal and distal latency. Ring electrodes were used to test the sensory NCV. For ulnar nerve, ring electrodes were placed at inter-phalangeal joint of fifth digit and stimulation done 3 cm proximal to distal crease at wrist. For median nerve, ring electrodes were used to test the sensory NCV with the recording electrode at proximal interphalangeal joint of index finger and the reference at distal inter-phalangeal joint of index finger. All recordings were done and data entered and analyzed using SPSS software version 19. Karl Pearson's correlation was used to assess the correlation between NCV, age and height. The effect of gender on NCV was analyzed using unpaired Student's *t*-test. The level of significance was considered statistically significant if $P < 0.05$.

RESULTS

103 individuals in the age group of 15-65 years were included in the study. Out of 103 individuals, 47 (45.3%) were females, and 56 (54.7%) were males. The difference in the number of males and females was not statistically

significant (P = 0.4). The mean age (females 35.8 ± 13.8, males 35.6 ± 15.3), Mean height (females 160 ± 5.5, males 160.5 ± 6.4). The influence of gender on NCV is shown in Table 1. Karl Pearson's correlation was used to study the correlation between age, height, and NCV (Table 2). The correlation of age on the conduction velocities of median motor, sensory, and ulnar sensory nerve shows a significant negative correlation which suggests that as age advances the conduction velocity decreases (Figures 1-3), respectively. The correlation of height on the median and ulnar nerves did not show statistical significance.

DISCUSSION

This study was conducted to investigate the influence of age, gender, and height on nerve conduction parameters. From our results, it is evident that age had a significant negative correlation to NCV. Females had a faster conduction velocity compared to males, and there was no significant relation of height to NCV.

Studies with regard to gender influencing the nerve conduction parameters have reported contradictory results. Soudmand et al.[7] observed that NCV and distal latency was not influenced much by gender, Saeed and Akram[5] reported that in the age range of 40-70 years there was no significant gender-related difference in the conduction studies of sural nerve. Whereas Robinson et al.[9] reported that women had significantly faster conduction velocities than men for all nerves except median motor. Aseem et al.[10] found a significant correlation between height and NCV in both genders. Comparing the gender difference in our study, females had a faster conduction velocity compared to males consistent with the above-mentioned findings. The effect of gender can be explained on the basis of difference in the anatomical and physiological factors and also the greater height and limb length in males. There was no significant difference in the height between males and females. Hence, this difference can be elucidated by the thicker subcutaneous tissue in males which interferes with the velocity.[11]

Rivner et al.[12] showed a negative correlation between height and the conduction velocities of the bilateral ulnar motor and left median sensory nerves. Huang et al.[13] performed motor NCS included median, ulnar, peroneal, and tibial nerve studies on 101 individuals in the age of 21-76 years whose height ranged from 144 to 175 cm and found a moderate correlation only with median SNCV. Thakur et al.[8] studied the influence of height on NC parameters on 5 nerves in 34 individuals of height 158 ± 10 cm, healthy adults of either sex and observed a significant correlation in amplitudes and only with ulnar motor NCV. Logically, taller individuals have longer conduction time of late response because of longer conduction distance. Whereas, Awang et al.[14] findings showed an absence of correlation between height and the median and sural NCV in 253 individuals in the age group of 20-60 years. Soudmand et al.[7] found no significant relationship between height and median nerve (both motor and sensory) NCV.

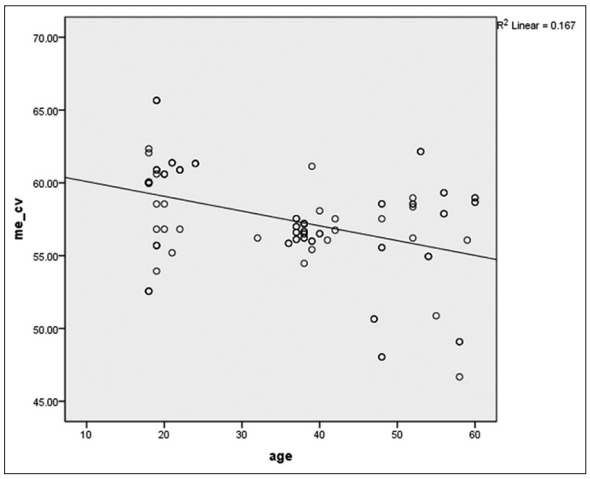

Figure 1: Correlation between age and median motor nerve conduction velocity ($P < 0.05$ significance)

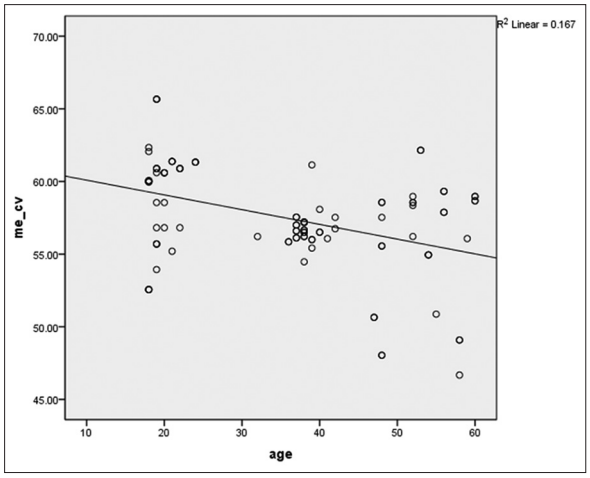

Figure 2: Correlation between age and median sensory nerve conduction velocity ($P < 0.05$ significance)

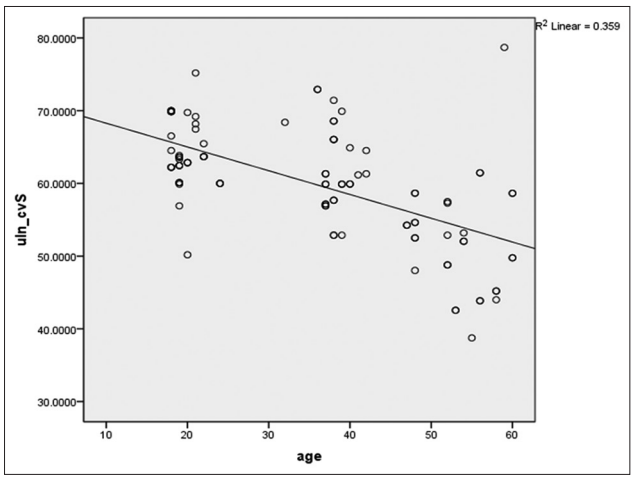

Figure 3: Correlation between age and ulnar sensory nerve conduction velocity ($P < 0.05$ significance)

Analyzing the correlation between height and NCV in our study, we did not observe a significant correlation. The average height of the study population was 148-180 cm. Perhaps the reason for this finding would be the lesser number of individuals in the above average height group of >170 cm. Aging is a process that is often accompanied by physiological changes such as slowing in muscle contractility, alteration in muscle metabolism and neuromuscular junction, and reduction in NCV. Age had a significant negative correlation with NCV. Similar results have been observed by many investigators. Tong et al.[15] studied the ulnar sensory CV and it was shown that there was a significant and substantial decline in values of sensory NCV with increasing age in men, whereas, Awang et al.[14] reported that only median motor conduction velocity showed a significant reduction with increasing age and concluded that there is no significant effect of age on NCVs except for median motor conduction velocity. Our results show a significant correlation between age and NCV of both median and ulnar nerves. Age has definite effects on duration of nerve conduction parameters both motor and sensory. Different nerves have different timing of aging. Without adjustment for age, the sensitivity and specificity of NCS will decrease when using the same reference data in patients with different age.[16] There are many cross-sectional studies that have estimated the reduction in NCV ranging between 0.13 m/sec and 0.22 m/sec[17] these also point to the fact that aging has a definite effect on the NC parameters. Cai and Zhang[18] reported in their study that the conduction velocity in a newborn is approximately 50% of adult values and progressively increase, reaching the adult value at the age of three. There is an accelerated rate of decline in total number of muscle fibers commencing at the age of 25 years thereby affecting the conduction velocity. It has also been noted that there is a reduction in isometric and dynamic voluntary strength at the seventh decade of life. There is also an average reduction of about 20-40% in maximal isometric strength in various muscles compared to adults. All these observations provide substantial evidence that there is a decrease in number of nerve fiber, a reduction in fiber diameter and changes in the fiber membrane ultimately affecting the NCV.

While performing NCS, values have to be adjusted for physiological factors such as age, gender, and height which will increase the diagnostic sensitivity.

LIMITATIONS

We could not ascertain a definite relation to height and NCV. Further studies are required on larger population with taller and shorter individuals than the average height individuals to study the effect of height on NCV.

CONCLUSION

From our results, we conclude that age and gender has a significant role in influencing the nerve conduction parameters. The present study adds substantial evidence that adjusting the nerve conduction parameters for physiological factors such as age and gender and will increase the diagnostic sensitivity and lays emphasis that an electrodiagnostic data should be created considering these variables.

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