International Journal of Scientific and Research Publications, Volume 7, Issue 9, September 2017 452
ISSN 2250-3153

Nerve conduction and surface electromyography of lower limbs of barbers: effect of anthropometric variables

Subedi P, Thakur D, Khadka R, Paudel BH

Department of Basic and Clinical Physiology, B.P Koirala Institute of Health Sciences, Dharan, Nepal

Abstract- Nerve conduction and surface electromyography of lower limbs of barbers: effect of anthropometric variables

Background: Nerve conduction studies (NCS) are conventionally performed with electromyography (EMG), which is electro diagnostic studies, provides a comprehensive evaluation of suspected nerve, muscle and/or neuromuscular impairment. Several studies had shown a significant effect of anthropometric variables on nerve conduction variables while their effects on surface EMG variables are hardly known.

Objectives: To study the effect of anthropometric variables on nerve conduction and surface electromyography variables of lower limbs in barbers.

Material and methods : This study was done on twenty six (age 38.12±8.21 years) consenting male barbers selected from Dharan municipality by a convenient sampling method. Anthropometric variables such as age, height, weight, BMI were recorded. Compound muscle action potential (CMAP) and sensory nerve action potential (SNAP) of peripheral nerves and bilateral gastrocnemius muscles of lower limbs were recorded using standard techniques in Neurophysiology Lab II, Department of Basic and Clinical Physiology, B.P Koirala Institute of Health Sciences, Dharan, Nepal. The data obtained were entered into MS Excel sheet and further analyzed using SPSS 11.5. Descriptive analysis was done for anthropometric variables while Pearson's correlation was applied between anthropometric and nerve conduction and surface electromyography variables.

Results : Anthropometric variables such as age, height and weight showed a significant relationship with NCS variables, but not with surface EMG variables. Height and weight showed a positive correlation with latencies of most of the nerves ($p<0.05$). Height showed a negative correlation with conduction velocities of right common peroneal and right sural nerves ($p<0.05$). Weight showed a negative correlation with left common peroneal conduction velocity ($p<0.05$). Anthropometric variables did not show any significant correlation with surface EMG variables.

Conclusion : Height and weight showed a significant effect on nerve conduction variables of most of the peripheral nerves. Nerve conduction variables significantly vary moreover with the height of a subject. Thus, adjustments for height must be considered while giving normal standard values.

Index Terms- anthropometric, nerve conduction studies, surface electromyography

Nerve conduction and surface electromyography of lower limbs of barbers: effect of anthropometric variables

I. Introduction

Nerve conduction studies (NCS) are the most sensitive and reproducible measure of peripheral nerve functions. These can define and quantities normal nerve activity.[1] These tests examine the state of rapidly conducting myelinated fibers in a peripheral nerve.[2] NCS are conventionally performed with electromyography (EMG), which are electro diagnostic studies; provide a comprehensive evaluation of a suspected nerve, muscle or neuromuscular impairment.[3] NCS is a part of electro diagnostic procedures that help in establishing the type and nature of the nerves by evaluating their function. NCS assesses three types of nerves: motor, sensory and mixed. Motor NCS includes the assessment of the compound muscle action potential (CMAP), whereas sensory NCS include the assessment of the sensory nerve action potential (SNAP) of the peripheral nerves in the upper and lower limbs. The median, ulnar, radial, common peroneal, tibial, and sural are the commonly examined nerves. Latency, amplitude and conduction velocity of CMAP and SNAP responses are measured. Minimum F wave latency of the late response is routinely measured.[4] Nerve conduction variables are affected by physiological and technical variables. Physiological variables such as age, height, gender, weight, body mass index (BMI), temperature affect conduction velocity. Diameter and myelination of the nerve fibers are strong physiological factors that affect NCV.[3]

Dilip et al showed a substantial positive correlation between height and F wave latencies of all motor nerves, except the left common peroneal nerve and with the SNAP latencies of the right radial and sural sensory nerves.[5] There is a significant slowing of conduction velocities and increase in sensory latencies with increasing age and more height.[6] Similarly, some other studies had shown a significant effect of anthropometric variables on nerve conduction parameters.[,7,8,9] However, the effect of age and other anthropometric variables on surface EMG parameters are hardly known.

Thus, we aimed to evaluate the impact of anthropometric factors like age, sex, height, weight, BMI on nerve conduction and surface EMG variables as well. As such, appropriate adjustments may be considered while finding normal values.

II. Material and methods

Electrodiagnostic studies are powerful tools used to objectively examine the physiologic status of a peripheral nerve and muscles. NCS evaluates motor and sensory parameters of the nerve and surface EMG evaluates the electrical activity in the muscles. In motor NCS, bilateral common peroneal and tibial nerves while in sensory NCS, bilateral sural nerves were assessed. Surface EMG of bilateral gastrocnemius muscles was recorded.

We conducted the study at Neurophysiology Lab II of BPKIHS. Twenty six healthy male barbers of 20-50 years from Dharan municipality were selected by a convenient sampling method. Those barbers with history of diabetes, neuropathy or neuromuscular disorder were excluded. Subjects were explained about the study procedure in detail and informed written consent was taken before the electrophysiological test. Anthropometric, NCS and surface EMG variables were studied.

Both NCS and surface EMG of lower limbs were recorded using Digital Nihon Kohden (NM-420S, H36, Japan). Both tests were performed by placing the participants in lying down position.

Recording of motor NCS: [3]

The stimulator with water soaked tips was used for nerve stimulation. The stimulating electrodes were placed on the skin overlying the nerve at two sites along the course of a nerve. The recording and reference electrodes were placed over the muscle supplied by the nerve being tested using a belly tendon montage i.e. active electrode placed on the center of the muscle belly and the reference electrode placed distally, over the tendon of the muscle. The ground electrode was placed between stimulating and recording electrodes. The current of stimulator was initially set to zero, then gradually increased with successive stimuli. A CMAP appeared that grew larger and larger with the increasing current. When current was increased to the point that CMAP was no longer increasing in size the current was increased by another 20% to ensure supra maximal stimulation. For each nerve, latency, and amplitude of CMAP were recorded. The trace was stored and the stimulating electrode moved proximally to a second stimulation site. Distance between the two sites was measured and fed into the machine for calculation of nerve conduction velocity (NCV).

For the recording of F waves of motor nerve, the stimulator was placed at the distal site of stimulation with cathode facing proximally. Minimum, maximum and mean latencies of F waves were recorded.

Recording of sensory NCS: [3]

Antidromic method of stimulation was employed for sural sensory nerve. Twenty stimuli were averaged. Onset latency, SNAP amplitude and NCV were recorded.

Recording of SEMG: [10]

Surface EMG of bilateral gastrocnemius muscles was done. The skin over the muscle was cleaned with a Skin Pure gel. The electrodes were placed on the skin area and secured by a tape. Active electrode was placed on the center of the muscle belly and a reference electrode was placed distally, over the tendon of the muscle. Ground electrode was also placed on the limb. The electrode diameter was about 12 mm and kept 20 mm apart on the muscle to be tested.

The sensitivity and the speed were kept at 100 microvolt and 10 milliseconds per division respectively. Motor unit action potentials (MUAPs) were assessed for its frequency, amplitude and duration manually according to the machine calibration.

The data were entered into MS Excel and analyzed by SPSS 11.5 version.

III. Results

As data were normally distributed, Pearson's correlation was applied for correlating anthropometric variables with NCS and surface EMG variables. Anthropometric variables such as age, height, weight showed a significant relationship with NCS but not with surface EMG variables.

Table 1: Anthropometric variables

	Age (yrs)	**Height (m)**	**Weight (Kg)**	**BMI (Kg/m^2)**
Mean±SD	38.12±8.21	1.65±0.07	63.73±8.93	23.15±2.41

Table 2: Correlation of anthropometric variables with NCS variables

NCS Variables	**Anthropometric variables**	**Pearson's Correlation**	**P value**
RTPLat (ms)	Height	0.587	**0.003**
RTDLat (ms)	Height	0.487	**0.016**
RTDAmp (mv)	Height	0.109	0.612
RTNCV (m/s)	Height	-0.307	0.144
LTDLat (ms)	Height	0.326	0.12
LTDAmp (mv)	Height	0.042	0.844
LTNCV (m/s)	Height	-0.197	0.356
RCPPLat (ms)	Height	0.562	**0.004**
RCPNCV (ms)	Height	-0.570	**0.004**
RSOL (ms)	Height	0.415	**0.04**
RSAmp (µv)	Height	-0.094	0.663
RSNCV(m/s)	Height	-0.414	**0.04**
LSOL (ms)	Height	0.351	0.093
LSAmp (µv)	Height	0.159	0.457
LSNCV (m/s)	Height	-0.35	0.094
LTFmin (ms)	Height	0.673	**0.001**
RTFmin (ms)	Height	0.526	**0.008**
LCPFmin (ms)	Height	0.555	**0.03**
RCPFmin (ms)	Height	0.49	0.054
RTPLat (ms)	Weight	0.432	**0.03**
RTPAmp (mv)	Weight	-0.199	0.352
RTNCV (m/s)	Weight	-0.19	0.374
LCPPLat (ms)	Weight	0.399	0.053
LCPPAmp (mv)	Weight	-0.043	0.843
LCPNCV (m/s)	Weight	-0.445	**0.02**
RCPPLat (ms)	Weight	0.44	**0.03**
RCPPAmp (mv)	Weight	-0.123	0.567
RCPNCV (m/s)	Weight	-0.404	0.05
LTFmin (ms)	Weight	0.424	**0.03**
RTFmin (ms)	Weight	0.454	**0.02**

LCPFmin (ms)	Weight	0.564	**0.03**
RCPFMin (ms)	Weight	0.466	0.06
RTPLat (ms)	LL	0.570	**0.04**
RTPAmp (mv)	LL	-0.072	0.737
RTNCV (m/s)	LL	-0.344	0.1
LCPPLat (ms)	LL	0.411	**0.04**
LCPNCV (m/s)	LL	0.347	0.096
RCPPLat (ms)	LL	0.678	**0.001**
RCPPAmp (mv)	LL	-0.013	0.951
RCPNCV (m/s)	LL	-0.700	**0.001**
LSOL (ms)	LL	0.382	0.065
LSAmp (µv)	LL	0.109	0.613
LSNCV (m/s)	LL	-0.480	**0.01**
RSOL (ms)	LL	0.511	**0.001**
RSAmp (µv)	LL	-0.654	0.768
RSNCV (m/s)	LL	-0.566	**0.004**
LTFmin (ms)	LL	0.618	**0.001**
LCPFmin (ms)	LL	0.656	**0.01**
RTFmin (ms)	LL	0.500	**0.01**
RCPFmin (ms)	LL	0.694	**0.003**

†ms- millisecsonds, m/s- meter/ second, RTPLat- right tibial proximal latency, RTDAmp- right tibial distal amplitude, RTNCV- R right tibial nerve conduction velocity, LTDLat- left tibial distal latency, LTDAmp- left tibial distal amplitude, LTNCV- left tibial nerve conduction velocity, RCPPLat- right common peroneal proximal latency, RCPNCV- right common peroneal nerve conduction velocity, RSOL- right sural onset latency, RSAmp- right sural amplitude, RSNCV- right sural nerve conduction velocity, LSOL- left sural onset latency, LSAmp- left sural amplitude, LSNCV- left sural nerve conduction velocity, LTFMin- left tibial F wave minimum latency, RTFMin- right tibial F wave minimum latency, LCPFMin- left common peroneal F wave minimum latency, RCPFMin- right common peroneal F wave minimum latency

Table 3: Correlation of with anthropometric variables with surface EMG variables

Surface EMG variables	Anthropometric variables	Pearson's correlation	P value
LGAOA	Height	-0.055	0.799
LGFOA	Height	0.184	0.39
LGAOR	Height	-0.07	0.745
LGFOR	Height	0.145	0.499
RGAOA	Height	-0.14	0.514
RGFOA	Height	0.026	0.903
RGAOR	Height	-0.043	0.842
RGFOR	Height	-0.043	0.842
LGAOA	Weight	-0.216	0.311
LGFOA	Weight	0.255	0.228
LGAOR	Weight	-0.207	0.331
LGFOR	Weight	0.229	0.281
RGAOA	Weight	-0.267	0.208
RGFOA	Weight	0.274	0.195
RGAOR	Weight	-0.24	0.259
RGFOR	Weight	0.373	0.073

IV. Discussion

Our study showed a positive correlation of the right tibial and right common peroneal proximal latencies with height and a significant negative correlation with right common peroneal conduction velocity. Right sural onset latency is positively correlated with height while conduction velocity was negatively correlated. The lower limb length showed a positive correlation with latencies of most of the nerves while a negative correlation was noted with right common peroneal conduction velocity and bilateral sural sensory conduction velocities. Length of a nerve depends upon the height of an individual thus, taller persons showed longer latencies and velocity depends upon latency, hence longer the latency, slower is the conduction velocity.

Similarly, a significant positive correlation was found between height and F wave latencies of all motor nerves tested except the right common peroneal nerve. Most of the studies showed a direct relationship of latencies with a height of an individual. Peioglou HS et al and Lin KP et al found a strong positive correlation between the F wave latencies and height.[11,12] Likewise, in a study done by Puksa et al the minimal latency of the F wave was found to increase with height in studies on the upper and lower limbs. [13]

Rivner MH et al found that height was positively correlated with the latencies of the sural, peroneal, tibial and median nerves.[14] It showed a negative correlation with the conduction velocities of the bilateral ulnar motor and the left median sensory nerves. Takono et al supported the possibility of an inverse correlation of the conduction velocity of the ulnar nerve with height.[15] Saaed et al found an increase of the latency of sural sensory nerve with increasing height.[16]

A negative correlation between distal fiber diameter and height may best explain both decreased conduction velocity and amplitude. Campbell proposed that a decrease in diameter occurs abruptly at a given distance from the cell body. [17] Our results duplicated those of others who have found a strong negative correlation between height and either sural or peroneal conduction velocity.

In brief, this study explores the effect of anthropometric variables on nerve conduction study parameters of the motor and sensory nerves. Our study findings are along with many other previous reports. Clinical recognition of this height effect on NCS parameters is important, otherwise an individual with mildly slowed peripheral nerve conduction velocity solely related to tall height may be considered as abnormal.

Likewise, F wave minimum latencies were found to be positively correlated with weight for most of the tested nerves. There were positive correlation of weight with proximal latencies of right tibial and common peroneal nerves, meanwhile weight showed a negative correlation with left common peroneal conduction velocity. Buschbacher et al showed that individuals with higher body weights have longer latencies of median, peroneal, tibial F wave, and H-reflex studies compared to those with lower body weights. [18] Increase in weight means an increase in subcutaneous fat, thus, increased amount of fat can cause compression of peripheral nerves resulting in slower conduction, resulting in an increase in latency and a slower conduction velocity.

V. Conclusion

Height and weight showed a significant correlation with the nerve conduction parameters of most of the peripheral nerves. Thus, adjustments for height and weight must be considered while giving normal standard values.

Acknowledgment

I would like to acknowledge all the subjects those who participated in the research. Also, I would like to acknowledge Mr. Shyam Choudary for his technical support and Mrs. Manju Lamsal for her moral support, encouragement and kind help.

References

[1] Soliman A. Diabetic neuropathy. e Medicine Journal. 2002;3(3):1-12

[2] Hendriksen P, Oey P, Wieneke G, Bravenboer B, van Huffelen A. Subclinical diabetic polyneuropathy: early detection of involvement of different nerve fibre types. Journal of Neurology, Neurosurgery & Psychiatry. 1993;56(5):509-514.

[3] Preston D Shapiro B. Basic Nerve Conduction Studies, Electromyography and Neuromuscular disorders. Boston: Butterworth Heinemann; 1998.

[4] Misulis KE, Head TC. Nerve conduction study and electromyography. In “Essentials of Clinical Neurophysiology” 3rd Ed. Pioli SF (eds). Butterworth- Heinemann 2003;987.

[5] Thakur D, Jha S, Pandey N, Jha C, Bajaj B, Paudel B. Influence of height on the nerve conduction parameters of the peripheral nerves. Journal of Clinical and Diagnostic Research. 2011;5(2):260-263.

[6] Falco F, Hennessey W, Goldberg G, Braddom R. Standardized nerve conduction studies in the lower limb of the healthy elderly. American Journal of Physical Medicine & Rehabilitation. 1994;73(3):168-174.

[7] Normal motor nerve conduction velocity amongst Chinese in Taiwan. Formos Med Assoc. 1978;77:394-401.

[8] Wa Z, Chu F. H reflex and F response- A study of 50 normal adults. Chin Med Journal. 1982;29:271-7.

[9] Lin K, Chan M, Wu Z. Nerve conduction studies in healthy Chinese: correlation with age, sex, height and skin temperature. Chin Med J. 1993;29:271-7.

[10] Pal G, Pal P. Textbook of Practical Physiology. 3rd ed. India: University Press; 2010.

[11] Peioglou-Harmoussi S, Howel D, Fawcett P, Barwick D. F-response behaviour in a control population. Journal of Neurology, Neurosurgery & Psychiatry. 1985;48(11):1152-1158.

[12] Lin KP, Chan MH, Wu ZA. Nerve conduction studies in healthy Chinese: correlation with age, sex, height and skin temperature. Zhonghua Yi Xue Za Zhi (Taipei). 1993 Nov; 52(5):293-7.

[13] Puksa L, Stålberg E, Falck B. Reference values of F wave parameters in healthy subjects. Clinical Neurophysiology. 2003;114(6):1079-1090.

[14] Rivner M, Swift T, Malik K. Influence of age and height on nerve conduction. Muscle & Nerve. 2001;24(9):1134-1141.

[15] Takano K, Kirchner F, Steinicke F, Langer A, Yasui H, Naito J. Relation between Height and the Maximum Conduction Velocity of the Ulnar Motor Nerve in Human Subjects. The Japanese Journal of Physiology. 1991;41(3):385-396.

[16] Saeed S, Akram M. Impact of anthropometric measures on sural nerve conduction in healthy subjects. J Ayub Med Coll Abbottabad. 2008;20(4):112-4.

[17] Campbell W, Ward L, Swift T. Nerve conduction velocity varies inversely with height. Muscle & Nerve. 1981;4(6):520-523.

[18] Buschbacher R. Body mass index effect on common nerve conduction study measurements. Muscle & Nerve. 1998;21(11):1398-1404.

Authors

First Author - Dr. Priza Subedi, Assistant Professor, B.P Koirala Institute of Health Sciences, Dharan, Nepal, priza.subedi@bpkihs.edu
Second Author - Dr. Dilip Thakur, Additional Professor, B.P Koirala Institue of Health Sciences, Dharan, Nepal, dilip7bp@gmail.com
Third Author – Dr. Rita Khadka, Additional Professor, B.P Koirala Institute of Health Sciences, Dharan, Nepal, rita.khadka@bpkihs.edu
Fourth Author – Dr. Bishnu Hari Poudel, Professor, B.P Koirala Institute of Health Sciences, Dharan, Nepal

Correspondence Author: Dr. Priza Subedi, Assistant Professor, Basic and Clinical Physiology, B. P Koirala Institute of Health Sciences, Dharan, Nepal, Email- priza.subedi@bpkihs.edu Phone- 025-525555, Ext- 2471 (Office), Mobile- 977-9860314201