International Journal of Research and Review
www.gkpublication.in E-ISSN: 2349-9788; P-ISSN: 2454-2237

Original Research Article

A Hospital-Based Retrospective Study of the Effect of Age and Gender on Median Nerve Conduction Study

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Received: 25/05/2016 *Revised: 30/05/2016* *Accepted: 04/06/2016*

ABSTRACT

Nerve conduction study (NCS) provides an objective and quantitative measure of nerve function. A number of physiological variables, including age and gender, are known to affect the results of NCS. The present study investigated the effect of age and gender on motor and sensory parameters of NCS of Median nerve, including F-wave study. Study of the NCS records of 49 patients revealed higher compound motor action potential (CMAP) amplitude and longer F-wave latency in males whereas females had higher sensory nerve action potential (SNAP) amplitude. Further, with increasing age, latencies became longer, amplitudes became smaller and conduction velocities became slower. Therefore, age and gender of a person should be taken into consideration while interpreting his/her NCS results.

Keywords: nerve conduction study, age, gender, median, F-wave, CMAP, SNAP.

INTRODUCTION

Advances in electronics enabled clinical assessment of peripheral nerve and muscle physiology in the mid-twentieth century, spawning a new neurologic specialty. [(1)] The main laboratory technique for the study of peripheral nerve function involves the transcutaneous stimulation of motor or sensory nerves and recording the elicited action potentials in the muscle (compound muscle action potential, CMAP) and the sensory nerve action potential or SNAP. [(2)] Nerve conduction studies measure the speed and strength of an electrical impulse conducted along a peripheral nerve. [(1)] Hodes and co-workers, in 1948, were the first to describe nerve conduction studies in patients and the techniques used currently are not much changed. [(2)] Typically, the impulse is generated using a bipolar stimulator placed on the skin surface over the anatomic course of the nerve being tested. The intensity and duration of this transcutaneous stimulus is gradually increased until all the available axons within that nerve are depolarised, sparking an action potential that travels down the nerve to the recording site. For sensory nerve conduction study, the recording electrodes are placed on the skin surface overlying the nerve (usually over a pure sensory branch) at some distance from the stimulation site. For motor nerve conduction study, recording electrodes are placed over the motor end-plate region of an innervated muscle. [(1)]

It is widely accepted that NCS parameters change with age. Several studies have shown an association between age and decreased sensory conduction velocity in normal individuals. [(3-7)] An association between aging and motor conduction velocity has also been reported. [(3-5,7-9)] Age has been reported to be inversely correlated with the amplitude of sensory and motor NCS. [(5,10)] The minimal latency of F-wave studies also increases with age in upper and lower limb studies. (11,12) As a result, many electro diagnostic laboratories have tables of normative data that are divided by age-groups. Gender has also shown to affect the results of NCS. (7,13 -15) Females have greater amplitude than males in median and ulnar sensory NCS. Henessey (14) et al found that there is no influence of gender for nerve conduction velocity and distal latency but the effect of gender is only significant and affects the sensory nerve potential amplitude. Since age and gender have been shown to influence the results of NCS including late response F-wave studies, the sensitivity and specificity of NCS will be decreased by using the same reference limit data in patients of different gender and age-group.

Objectives

With the above background, the present study was carried out with the following objectives.

1. To study the effect of age on median motor and sensory nerve conduction study.
2. To study the effect of gender on median motor and sensory nerve conduction study.
3. T0 study the effect of age and gender on minimal latency of median F-wave study.

MATERIALS AND METHODS

The study was carried out in the Electrophysiology laboratory, Dispur Hospitals, Guwahati. The period of study was from 1st August to 30th September, 2012. The study protocol was approved by the Institutional Ethics Committee. The clinical and electrophysiological records of patients who attended the electrophysiology laboratory for nerve conduction study during the study period were evaluated retrospectively. 125 patients were excluded from the study on the basis of the following

Exclusion criteria:

1. History of systemic disease-diabetes mellitus, hypothyroidism, systemic neurological disorder
2. History of neurological symptoms involving upper limbs
3. Neurological examination showing involvement of upper limb nerves

The remaining 49 patients (23 males and 26 females) were included in the study. The following electrophysiological parameters were studied:

1. Median motor NCS: Distal latency, Amplitude and CV
2. Median sensory NCS: Onset latency, Amplitude and CV
3. Median F-Wave study: Minimum latency

NCS was conducted using the Nicolet Viking machines. All studies were performed with surface recordings and stimulations. For median motor NCS, the recording electrode was placed close to the motor point of abductor pollicis brevis and the reference electrode 3cm distal to the first metacarpophalangeal joint. The median motor nerve was stimulated at the distal wrist and proximal elbow sites for each subject. The values of distal motor latency, CMAP amplitude and nerve conduction velocity was included for statistical analysis in the study. The distal motor latency was the time in milliseconds from the stimulus artefact to the first negative deflection of compound motor action potential (CMAP). The amplitude of CMAP was measured from baseline to the negative peak (base-to-peak). The conduction velocity was calculated by measuring the distance in millimetre between the proximal and distal points of stimulation which is then divided by the latency difference in milliseconds. NCV is expressed as metre/second. Median sensory NCS was carried out using antidromic stimulation. The median sensory nerve was stimulated at the wrist 3 cm proximal to the distal wrist crease and recorded at the second digit (Index finger). For each subject, the value of onset latency, sensory nerve action potential (SNAP) amplitude and conduction velocity were included for statistical analysis of the study. The onset latency was the time from the stimulus to the initial negative deflection of the baseline for a biphasic SNAP or to the initial positive peak for a triphasic SNAP (Reference.no16) SNAP amplitude was measured from the baseline to the negative peak. Conduction velocity is calculated by dividing the distance (millimetre) between the stimulating and recording sites by the onset latency (milliseconds) and expressed in metre/second. Median F-wave study: The Stimulation and recording sites were the same as those for median motor NCS except that the cathode was placed distally. Results were based on the tracing of supramaximal stimulations. 10 artefact-free responses were recorded. Data of minimal latency of F-wave study were included for statistical analysis.

Statistical analysis

The data were tabulated as mean ±SD. The subjects were divided into 4 age-groups: 36-45yrs, 46-55yrs, 56-65 yrs and >65 yrs. In each age group the mean± SD of the NCS parameters was calculated using MS Excel. The correlation coefficient(r) was calculated between age and the NCS parameters. The degrees of correlation was graded into low (r<0.29); Moderate (0.29≤r≤0.5) and substantial (r≥0.5).

RESULTS

The mean age of the study subjects (n=49) was 55.73± 11.80 years. The mean age of the male subjects (n=23) was 58.87±12.20 years and that of the female subjects (n=26) was 52.96±10.80 years. Table 1shows the values of the electrophysiological parameters of the study in the study subjects.

Table 1: Electrophysiological parameters (Mean±SD) of Median nerve conduction study of study subjects

Study parameter		Males	Females	Total
Motor	Latency (ms)	3.46±0.47	3.29±0.51	3.37±0.49
	Amplitude (µv)	8.25±2.39	6.98±2.08	7.58±2.31
	Conduction velocity (m/s)	54.80±5.57	55.27±5.35	55.05±5.43
Sensory	Latency (ms)	2.75±0.30	2.67±0.34	2.70±0.32
	Amplitude (µv)	23.70±11.37	27.71±14.77	25.83±13.37
	Conduction velocity (m/s)	49.98±5.84	46.75±5.58	48.27±5.90
Fwave	Latency (ms)	27.52±1.85	25.52±1.86	26.46±2.10

Table 2: Age-wise distribution of the electrophysiological parameters (Mean±SD values) among the study subjects

Study parameter		36-45 yrs	46-55 yrs	56-65 yrs	>65 yrs
Motor	Latency (ms)	3.13±.52	3.40±0.60	3.45±0.41	3.41±0.53
	Amplitude (µv)	7.80±1.28	7.30±2.63	7.69±2.74	7.64±1.86
	Conduction velocity (m/s)	57.78±5.76	56.0±5.74	54.57±4.69	51.90±4.23
Sensory	Latency (ms)	2.41±0.23	2.72±0.31	2.76±0.31	2.85±0.29
	Amplitude (µv)	35.22±17.98	28.57±10.50	21.50±11.55	19.75±9.36
	Conduction velocity (m/s)	51.67±5.35	48.90±6.31	47.83±5.61	44.90±4.41
F wave	Latency (ms)	25.05±1.99	26.04±1.83	26.67±1.43	28.04±2.43

The subjects were divided into 4 age groups: 36- 45 years, 46-55 years, and 56-65 years and >65 years. It was seen that with increasing age, latencies became longer, amplitudes became smaller and conduction became slower.Table2 shows the age –wise distribution of the electrophysiological parameters among the study subjects.

The Pearson correlation coefficient (r) was calculated to study the degree of correlation between age and the various parameters of median nerve conduction study. Table3 shows the values of the correlation coefficients of the electrophysiological parameters with age. A strong positive correlation(r=0.509) was found between age and F-wave latency.

Table 3: Correlation coefficients of various electrophysiological parameters with age

Study parameters		Correlation coefficient (r)
Motor	Latency	0.183
	Amplitude	-0.053
	Conduction velocity	-0.362*
Sensory	Latency	0.081
	Amplitude	-0.424*
	Conduction velocity	-0.381*
F wave	Latency	0.509**

(* Moderate correlation, ** Strong correlation)

DISCUSSION

Effect of gender

The present study found that the CMAP amplitude was higher in males compared to females, SNAP amplitude was higher in females compared to males and F-wave latency was longer in males compared to females. Motor and sensory latencies were comparable in males and females. Motor nerve conduction velocity was higher in females but sensory nerve conduction velocity was higher in males. Previous studies have reported findings similar to the present study. Higher CMAP amplitude in males has been reported by Dilip Thakur [16] et al. Dilip Thakur [16] et al and Chi Ren Huang et al [17] have reported that males have longer F-wave latency. Fuji [18] et al, Chi Ren Huang [17] et al found that there is no influence of gender on nerve conduction velocity and distal latency but the effect of gender is only significant and affects the SNAP amplitude. This difference has been explained by Bolton and Carter [15] to be because of varying finger circumferences between men and women rather than as a direct gender influence. The subcutaneous tissues in fingers close to the recording of sensory response in females can explain the higher SNAP amplitude than males. Dilip Thakur [16] et al and Shehab DK [19] found that the latencies of all motor nerves were longer in males than in females. Probably the reason behind this finding may be the greater height & limb length of the male volunteers. The present study did not find any difference in the distal motor latency between males and females.

Effect of age

With increasing age, latencies became longer, amplitudes became smaller and conduction became slower. A moderate negative correlation was found between age and three electrophysiological parameters, namely Motor NCV, SNAP amplitude and SNCV. A strong positive correlation was found between age and F-wave latency. The decrease in NCV and SNAP amplitude with increasing age has been well documented and attributed to a decreased number of nerve fibres, [20] a reduction in fibre diameter [20,21] and changes in the fibre membrane. [22,23] Stetson [7] et al reported a 1.3m/s decrease in SNCV and 0.8m/s decrease in MNCV per decade of aging. Further, Stetson [7] et al showed an average loss of 5 µ v per decade for SNAP amplitude (median nerve, wrist-digit II). Although the magnitude of change is relatively small within a narrow age range it does affect predicted normal values. A prolonged latency in a young age-group will be missed if normal values based on an older age –groups are used. [24] Henry C Tong [10] et al found that sensory NCS parameters do change with time. The study by Dorfman and Bosley [3] of 30 normal subjects (15young&15 older adults) estimated a decrease of 0.16m/s per year of age; that of Stetson [7] et al of 105 normal workers (excluding workers on jobs thought to involve repetitive or forceful hand exercises) estimated a decrease of 0.13 m/s per year & that by Letz and Gerr [25] of over 4000 veterans estimated a decrease of 0.13m/s per year. Tong [10] et al noted a slightly larger decrease in SNCV OF 0.21m/s per year of follow up.

F wave

"The F wave is a late response resulting from antidromic activation of motor nerves involving conduction and occurs at the interface between the peripheral & central nervous system. The name F-wave is attributed to their recognition for the first time in the small muscles of the foot by Magladency and McDongal in 1950. Minimal latency is the most frequently used F-wave parameter. The minimal F latencies in the elderly after 65 years is reported to be slightly longer which is more marked in men." [26] According to Chi Ren Huang [17] et al, gender is a significant factor in F wave studies. The female gender has a negative correlation with the latency of F wave after adjustment of other factors. Huang [17] et al reported a significant effect of age on F-wave latency in the median F-wave, increasing 0.02ms/yr. Dilip Thakur [16] et al reported that F-wave latencies of motor nerves were longer in males compared to females .Probably the reason behind this finding may be the greater height and limb length of the male volunteers Huang [(17)] et al reported that compared to males, females had shorter latencies in the upper limbs and longer latencies in the lower limbs by F-wave studies.

CONCLUSION

To conclude, the present study shows that age and gender both affect the values of the various parameters of median nerve conduction study, including F-wave .The median nerve CMAP amplitude was higher in males whereas females had higher SNAP amplitudes Aging is associated with prolongation of latencies, decreased amplitudes and slowing of conduction velocities. F-wave latency has a strong negative correlation with age and is longer in males compared to females. It is therefore important to take a person's age and gender into consideration while reporting and evaluating nerve conduction studies.

ACKNOWLEDGEMENT

The author is thankful to Dr. (Mrs.) Dula Deka, In-charge, Electrophysiology laboratory as well as all the technical staff of the laboratory for their help and kind co-operation during the study period.

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How to cite this article: Mahanta A. A hospital-based retrospective study of the effect of age and gender on median nerve conduction study. Int J Res Rev. 2016; 3(6):20-25.

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