Sural Nerve Conduction in Healthy Nigerians: Reference Values and Impact of Age

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ABSTRACT

Objective: *To obtain reference values for sural nerve conduction from healthy Nigerians and to evaluate the relationship between their age and sural nerve conduction parameters.*

Method: *A total of 200 healthy volunteers were selected, after clinical evaluation to exclude systemic or neuromuscular disorders. Nerve conduction study (NCS) of the sural nerve was conducted on all the healthy volunteers according to a standardized protocol. The data included in the final analysis were Amplitude, Latency, and Nerve conduction velocity (NCV). Ethical approval was obtained for the study.*

Result: *The reference range for sural nerve velocity, distal latency and base to peak amplitude were 45.67, 64.62, 1.96- 4.52 and 4.8-14.1 respectively. There was a weak correlation between age and Sural nerve conduction velocity.*

Conclusion: *Reference values for sural nerve conduction parameters in the study population are similar to those obtained in the literature. Sural nerve conduction velocity had a weak negative correlation with age.*

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INTRODUCTION

Nerve conduction study (NCS) can be highly useful for localizing lesions and determining the pathological processes. Thus, NCS is often considered an extension of the clinical history and examination. Information obtained from the study of peripheral nervous system function may be of use in diagnosis, description of disease state, monitoring of peripheral nerve disease, advice on prognosis and management based on the test results and the disease detected.[1-4]

Majority of the nerve dysfunctions starts from the sensory nerves of the lower extremities.[5,6] Thus, measurement of sensory nerve function in the lower limb nerves by electrical stimulation is mandatory and diagnostically rewarding.[5,6] To this end, the sensory nerve conduction velocity as well as the sensory latency of the sural nerve provides the highest diagnostic sensitivity.[6]

It is widely accepted that nerve conduction study (NCS) parameters change with age. Several studies have shown an association between age and decreased sensory conduction velocity in healthy individuals. Similarly, an association between aging and motor conduction velocity has also been reported.[7,8]

Many studies have been published from the Western and Middle East countries regarding normative data for the nerves of the sural nerve. [6,8] To the best of our knowledge, there has not been such study from Nigerian population. Consequently, the very few electrodiagnostic laboratories available in the country have been adopting reference values of sural nerve generated in the USA and Europe to diagnose different sural nerve abnormalities.

The study, therefore, aimed to obtain reference values for sural nerve conduction from healthy Nigerians with the view to comparing the Nigerian values with published data elsewhere and to evaluate the relationship between their age and sural nerve conduction parameters.

SUBJECTS AND METHOD

The data was collected over a six-month period at the neuro-diagnostic laboratory of the Aminu Kano Teaching Hospital, Bayero University, Kano, Nigeria. All participants, randomly selected from a population of apparently healthy volunteers, were screened for inclusion criteria that comprised normal neurological examination, absence of symptoms of neuropathy from any cause and absence of alcohol use.

Individuals that were excluded included those with a history of alcohol abuse or medications that might affect the results, and those with a history of diabetes, hypothyroidism and systemic diseases. None of the individuals was taking any medication at the time of conducting the EMG study. A basic neurological examination was performed to assess muscle power, stretch reflexes and sensations.

The NCS study was performed with the subject lying comfortably in the supine position. A standardized technique was used to obtain and record action potentials for motor and sensory functions.[9] The protocol adopted in the current study was like that elsewhere, with minor alteration.[10] The setting for A 4-channel electromyography machine (Digital Nihon Kohden machine [NM- 420S, H636, Japan]) used in the study was as follows: Low cut was set at 5–10 Hz, high cut was set at 2–3 KHz; the amplification between 20,000 and 100,000 times; electrode impedance was kept below 5 kΩ and the sweep speed for sensory nerve conduction was maintained at1–2 ms/ division and a stimulus duration of 50 μs to 1000 μs and current 0–50 mA were required for effective nerve stimulation.

Data was collected for latency measured from the onset of action potential, conduction velocity, and amplitude and sensory nerve action potential (SNAP) were measured from the positive to the negative peaks. All the studies were performed with surface recordings and stimulations.

The nerve was stimulated with bipolar surface electrode cathode located in the midcalf, 10-18 cm proximal to the active recording electrode. The active recording electrode was placed just below the lateral malleolus. A ground electrode was placed between the stimulating and recording electrodes. Sensory nerve conduction was measured antidromically. The sensory nerve conduction velocity (SNCV) was measured by stimulation at a single site (mid-calf). The sensory conduction velocity was calculated by dividing the distance between the stimulating and the recording sites by latency. Skin surface temperatures were measured over the dorsum of the hand. Informed consent was obtained from every participant and ethical approval was obtained from the ethical review committee of the Aminu Kano Teaching Hospital Kano.

ANALYSIS OF DATA

All the data generated were collated, checked and analyzed using Graph Pad Prism (version 6, Graph Pad Software, Inc. CA 92037 USA). Quantitative variables were described using mean with standard deviation and median with range in case of parametric and non-parametric data respectively. The normal reference range of nerve conduction values was set by the 2½ and 97 ½ percentiles, so that reference ranges contain the central 95% of the distribution. The relationship between age and sural nerve conduction parameters was explored using Pearson\s correlation. Linear regression was used to determine the regression equation for the relationship between age and nerve conduction parameters. A confidence interval of 95% was used and a P value of <0.05 was considered significant.

RESULTS

Two hundred healthy volunteers comprising one hundred and sixteen (58%) males and eighty four (42%) females were evaluated. Their age ranged between 11years and 91years with a mean age of 44.95yrs ± 20.7 years. One hundred and thirteen (56.5%) of them were within the age bracket of 30 and 59 years. Table 1 showed age by sex distribution of the participants in the study.

The mean sural nerve velocity in the healthy volunteers was 54.23 ± 4.36 with 2.5 and 97.5 percentile of 45.67 and 64.62 respectively. The mean latency of sural nerve in the healthy volunteers was 3.07 ± 0.68 with 2.5 and 97.5 percentile of 1.96 and 4.52 respectively. The mean amplitude of sural nerve in the healthy volunteers was 9.6±2.6 with 2.5 and 97.5 percentile of 4.8 and 14.1 respectively (Table 2). Table 3 showed comparison between the result of the nerve conduction parameters in the study and elsewhere. There was a weak correlation between age and sural nerve conduction velocity and latency (r = -0.27, 0.2 respectively) whereas no significant relationship was found between age and sural nerve amplitude. Figure 1 showed the graphical representation between age and sural nerve conductions and their respective regression equation.

Table 1: Age distribution of the healthy volunteers

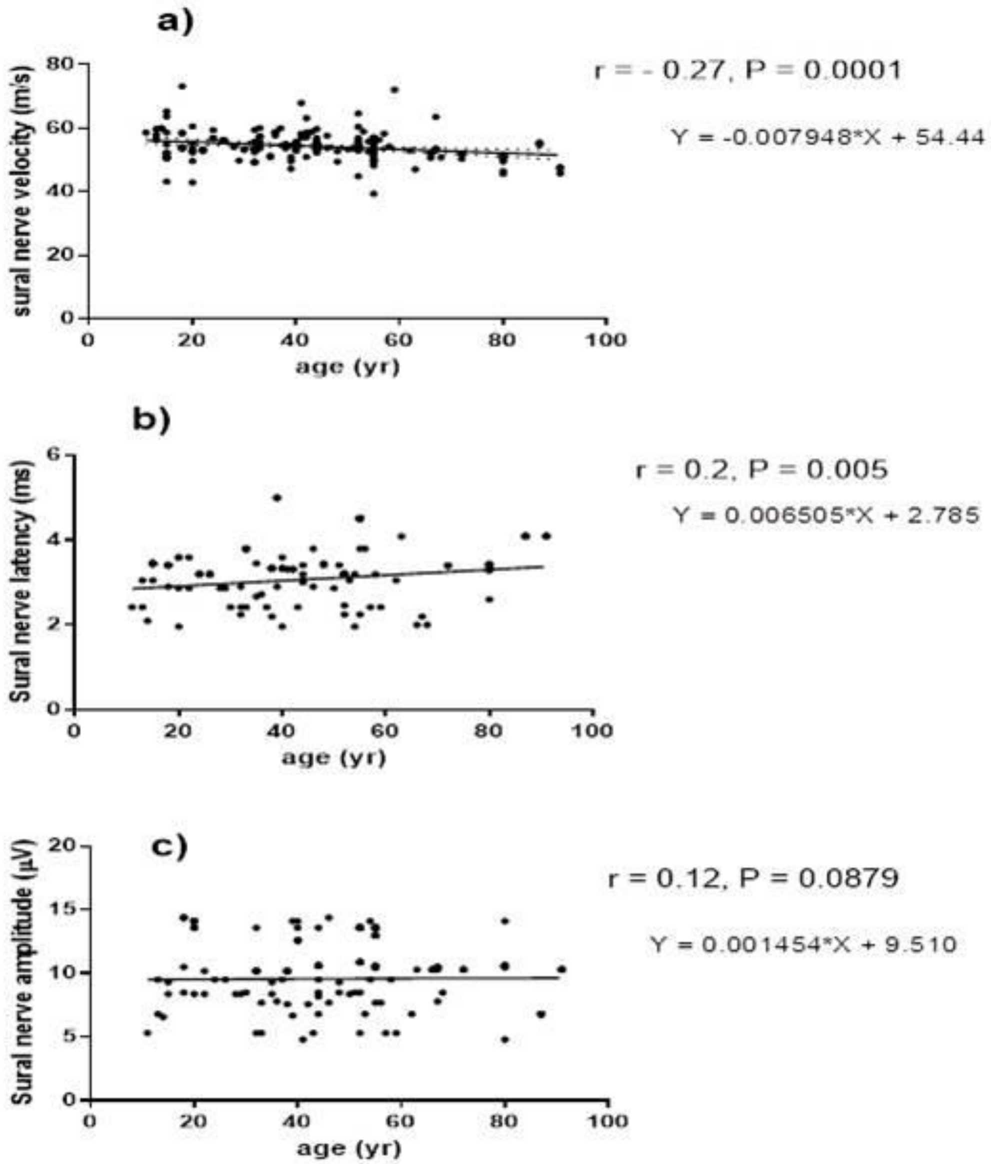
Age group	Male	Female	Total
10-19	18	8	26
20-29	12	9	21
30-39	27	8	35
40-49	7	26	33
50-59	25	20	45
60-69	10	4	14
70-79	0	3	3
80-89	13	6	19
90-99	4	0	4
Total	**116**	**84**	**200**

Table 2: Velocity, latency and amplitude of sural nerve (sensory) in healthy volunteers showing mean and reference values for the nerve conduction parameters

Sural nerve	Velocity	Latency	Amplitude
Mean	54.23	3.07	9.6
Standard deviation	4.36	0.68	2.6
2.5Percentile (Lower limit)	45.67	1.96	4.8
97.5 Percentile (Upper limit)	64.62	4.52	14.1

Table 3: Comparison of the sural nerve conduction parameters in the current study and studies elsewhere

	Velocity	Latency	Amplitude
Mean in the current study	54.23±4.36	3.07±1.96	9.6±4.8
Mistra et al[19]	50.9±5.4	-	18±10.5
Lambert et al [18]	53.2±6.4	3.9±0.7	8±5



Y= Velocity, latency, amplitude respectively.
X= Age

Fig. 1: Relationship between age and sural nerve conduction parameters (a: velocity, b: latency, c: amplitude).

DISCUSSION

Nerve conduction reference values are used to define the limits of normal function with test values outside the range suggesting the presence of some form of neuropathy. Like for other NCS, reference values of the sural nerve should be established from the local population because previous studies have shown differences in NCS function related to ethnicity and demographic factors.[11,12]

In other words, it is obviously preferable in a clinical setting to have normative data derived from a sample population that approximates, as closely as possible, the demographic characteristics of the patient being tested.[13,14] To the best of our knowledge, before the current study, no similar study had been conducted in Nigeria. Consequently, comparison could only be drawn using findings of studies from outside Nigeria.

The reference values of sural nerve parameters observed in the current study were similar to the normative values of sural nerve conduction parameters reported by Tohgi et al.[15], and Fujimaki et al.[16] The sural nerve parameters as recorded in this study generally agree with the results of other researchers.[15,17] The reference value of latency of sural nerve in the present study was in close proximity to that reported by Lambert *et al*.[18]

The Sural nerve conduction velocity values were also similar to the values reported by other workers,[17,18] while the Sural nerve latency and Sural nerve amplitude values were slightly less than values reported by Mistra and Kalita.[19]

It is widely accepted that nerve conduction study (NCS) parameters change with age. Consequently, many electrodiagnostic laboratories have tables of normative values that are divided by age groups. Simply, the concept suggests that normal nerve functioning in a normal individual changes with aging.

The current study demonstrated a significant, though weak, negative correlation between age and conduction velocity of the sural nerve. A significant but weak positive correlation between age and distal latency was also observed. The decrease in nerve conduction velocity and sensory latency associated with increasing age has been well reported and attributed to a decreased number of nerve fiber, a reduction in fiber diameter,[20] and changes in the fiber membrane.[21]

The influence of age on CV has been the subject of many reports. A linear relationship between age and sensory nerve conduction velocity had been described such that there was a decrease in in velocity of sensory nerve as age increases, in the order of 0.5 to 1.8 m/s per 10 years.[15,16] It should be noted, however, that their studies represent change per year of age or change per year of follow-up. Nonetheless, some other studies reported no relationship within age range of 6 to 84 years in nerves of upper and lower limbs.[22,23]

Previous studies indicated that nerve conduction velocity (NCV), sural NCV inclusive, decreases with age. [24, 25] Saeed et al, in their study on sural nerve conduction in healthy subjects, reported that conduction velocity decreases and latency increases with advancing age.[26]

In the current study, regression equation defining the relationship between sural nerve velocity and age was also obtained. In the literature, there is little agreement on equations to correct for age, and data from older studies are contradictory. In some studies, mean NCV calculated from a sample of elderly subjects was found to be slower than that from a similar sample taken from younger subjects.[24,25] In line with the observed relationship between age sural nerve velocity is the anatomical evidence demonstrating a reduced number of nerve fibers with aging.[27] In some other studies, it was noted that NCV was only slightly slower in the elderly.[28,29] Some other studies have found the relationship between age and NCV to be nonlinear, with only a minimal decline in NCV in the very young and becoming significant only with advanced age.[28,29]

In any case, it is logical to predict that age would have an effect because aging is associated with decreased physiological functioning including muscle and nerve functioning and regeneration. Needless to state that the cross-sectional design nature of the current study is somewhat a limitation to flawless evaluation of the relationship between age and sural nerve conduction parameters, a study with prospective or longitudinal design might throw more light on this relationship.

CONCLUSION

The reference values of sural nerve conduction parameters obtained in a Nigerian population compared favorably with the existing literature data. Sural nerve conduction velocity had a weak negative correlation with age.

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