Study Protocol

Nerve Conduction Study in Healthy Elderly Subjects in Central India

Abstract:

Background: Electrodiagnostic study is performed in a neurophysiology lab diagnosed peripheral neuropathy. Effect of ageing on nerve and muscle inform of muscle contractility decreased, change in the metabolism of muscle and neuromuscular junction transmission and reduced nerve conduction velocity. As the ageing population increases, information regarding the course of normal ageing, its impact on the nervous system, ways to maintain wellness, and disease that impact the elderly and their management is necessary. Therefore, this proposed study aims to elucidate the effect of physiological factors (height, Body Mass Index and gender) on nerve conduction study and find out the normative data for healthy elderly subjects in central India.

Objectives:

1) To establish normative data of nerve conduction study in Ulnar, median Tibial, and Peroneal nerves in normal healthy elderly subjects.

2) To find out the effect of height, body mass index and gender on nerve conduction in healthy elderly subjects.

Methodology: This will be a Cross-sectional study with participants aged > 60 years of both healthy subjects will be included in the study. The procedure will be performed after written consent from all the subjects. A normative data consist of parameters as distal motor Latency, peak to peak Amplitude and conduction velocity in motor nerve; peak to peak amplitude and nerve conduction velocity for sensory nerves. F wave minimum latency of motor nerve

Nerve conduction study will be performed on Neuron Spectrum 5 (Neurosoft) machine.

Results: Normative data will compare with globally published literature.

Conclusion: The study is expected to draw observation in relation to variables cited with the objectives, which will be compared to draw inference over normative data of nerve conduction studies in healthy elderly subjects from the Wardha district.

Keywords: Nerve Conduction Study, Amplitude, latency

Introduction:

Peripheral nerves are stimulated by adequate stimulation to nerve and record action potential (1). The electrodiagnostic study is Electromyography and nerve conduction study, which are essential investigations to diagnose lesions of peripheral nerves. Patient with limb trauma, it can differentiate nerve injury (2, 3).

Nerve conduction velocity is the speed of impulses passing through nerves (4). Nerve conduction study use in the diagnosis of nerve inform of demyelination and axonal degeneration (5,6). The components of nerve conduction study (NCS) are Motor nerve Conduction Study, sensory nerve Conduction Study and F-minimum latency (7).

NCV is affected by different physiological and non-physiological factors. Physiological factors include age, height, Body Mass Index (BMI) (8), Sex, Temperature, anomalous innervations etc. Non-physiological factors include different primary and secondary neuromuscular disorders and several technical factors.

Muscle contractility decreased, change in the metabolism of muscle and neuromuscular junction transmission and decreased nerve conduction velocity as an increase in age. (9, 10,11). According to a Study by Flack et al., conduction velocity in newborns is slow compared to adults and reaches the adult value after three years of age. In advanced age, nerve conduction velocity decreases (12).

Gender differences are primarily caused by the difference in height (13). La fratta and Smith state the effect of gender on nerve conduction study. Faster nerve conduction velocity in females than males. (14).

Heightened individuals have shorter conduction velocity than shorter persons suggesting the inverse relationship between the length of the nerve and conduction velocity and direct relation with the latencies (1). NCV in the legs relates inversely to body height, explaining one-third of the variance among normal subjects. Soudmand et al. hypothesized that it is unlikely that the same would hold true for the arms. (15).

Physiologic factors such as temperature affect nerve conduction study inform nerve conduction velocity, distal latency, and Amplitude. Physiologically, delayed inactivation of sodium channels in low temperature and depolarization also prolonged. Every 1^0C drop in temperature change found motor and sensory nerve conduction velocity changes by 1.5 and 2.5 m/s and prolonged distal motor latency by 0.2 ms per degree (1).
Low temperature results in slow conduction velocity and longer latency, but nerve and muscle amplitude are higher with lower temperature. Room temperatures above 20 degrees Centigrade minimize the changes (7,16).

With increased BMI, sensory and mixed nerve amplitudes are reduced by 20-40% to that of an individual with normal BMI (17,18).

The cause of disability and dependence is neurological illnesses in the older adult. Research is necessary for older adults for the course of normal ageing, its impact on the nervous system, ways to maintain wellness, and their management. Older patients have a complex array of neurological and medical problems, so that the usual treatment for one illness is prohibited due to complications from a second disease (19).

The absolute value of the conduction velocity is significant for detecting ulnar nerve lesion; this shows decreased conduction velocity due to the lesion at the elbow site. The diagnostic values of conduction block for ADM were not established Edvard Ehler et al. reported in their study (20).

For normative data, many other studies were published in the upper or lower limb nerve conduction, but no such studies were published Maharashtra state, specifically in Wardha. Therefore, we were interested in obtaining a bunch of information in healthy individuals to create the new reference values for our electrophysiology research laboratory. Physiologically the median and the ulnar nerves were the commonly observed in the upper

limb. Hence, this study suggested the normative data in standard settings for the median or the ulnar nerves in healthy individuals (21).

Nerve Conduction Study (NCV) has regularly performed an investigation to find out peripheral nerve injury. Some studies evaluate the effect of Physiological factors height, age, BMI and effect of temperature nerve conduction velocity. Many research studies are based on white colour subjects. The standardizing data were collected from western countries with cold climatic conditions. As evident, temperature affects nerve conduction velocity & India is a tropical region with a hot climate, there is a need to determine a range of normative values in this part of India (22).

Therefore, this proposed study aims to elucidate the effect of physiological parameters like Gender, Height and BMI on nerve conduction velocity (Ulnar, Median, Peroneal, Tibial and Sural nerves) and find out normative data for healthy elderly subjects in central India.

Rationale:

Neuroelecltrophysiology laboratory needs to establish the standard data for the diagnosed patient. To evaluate peripheral nerve injury, a Nerve conduction study is an important method. Studies evaluate the effect of Physiological factors like Age, Height, BMI, and body temperature on nerve conduction velocity. The other study reflects the normative data collected so for belongs to western countries with cold climatic conditions. As evident, temperature affects nerve conduction velocity & due to Central India is a tropical region with a hot climate, there is a need to determine a range of normative values in this part of India. Therefore, this proposed study aims to elucidate the effect of physiological factors Gender, Height and BMI on nerve conduction velocity and find out normative data for healthy elderly subjects in central India.

Objectives: To establish the normative data of nerve conduction velocity in peripheral nerves in normal healthy elderly subjects.

To study the physiological factor influence on gender, body mass index (BMI) and height on nerve conduction study in healthy elderly subjects.

Hypothesis - Null: - It is hypothesized that no variation exists for in healthy elderly subjects for nerve conduction study with gender, body mass index and height in central India population for latency, Amplitude, conduction velocity, F-minimum latency for motor nerve and Amplitude, conduction velocity for sensory nerve.

Alternative: Latency, Amplitude, conduction velocity, F-minimum latency for motor nerve and Amplitude, conduction velocity for sensory nerves is expected to vary with gender, body mass index and height at locoregionally population with healthy elderly subjects.

Methods:

The study will be conducted on the adult age group of>60 yrs healthy subjects of central India.

Study Design: Cross-sectional study

Study site: AVBRH Sawangi (M) Wardha.

Study duration: 2 years

Inclusion criteria: age > 60 years of both healthy genders

Exclusion criteria:

1. Age less than 60 years.

2. Metabolic disorders: Diabetic Mellitus, leprosy, chronic renal failure, Thyroid disease, malignancy.

3. History of limb injuries to upper or lower limbs

4. Neuromuscular transmission disorders, myopathy,

5. Alcohol addiction

Sample Size:

The elderly population in India (60 years and above) is approximately 7.7% of the total population of 1.20 billion (22).

Total population of Wardha district 1300774

Total population of elderly in Wardha district 7.7% of 1300774 = 100159.6

N= X2 x N x P (1 - P) / C2 (N - 1) + X2 x P (1 - P)

N = Total Population = 100159.6

X2 = Chisquare value for 1 degree of freedom at some desired probability level = 3.84

P = 50% proportion

C = confidence interval of one choice = 0.05

N = 3.84 * 100159 * 0.5 * 0.5/ 0.052 * 100158 + 3.84 * 0.5 * 0.5

= 96152.64/ 250.395 + 0.96

= 96152.64/ 251.355

= 382

Study setting:

The study will be conducted on healthy elderly subjects attending the Adhar OPD at AVBRH Wardha. Total Three hundred and eighty-two (382) volunteer healthy subjects will be taken in this study. The age group of subjects will be 60 yrs and above 60 yrs with no history of trauma in the past, neurological deficiency or any systemic illness that may lead to neuropathy. Written consent will be taken from the subjects.

Motor nerve parameter Distal motor latency, Amplitude and Nerve CV; sensory nerve parameter amplitude and CV and F minimum latency of motor nerve will be recorded and analyzed in the form of normative date.

Neuron Spectrum 5 machine will be used for recording nerve conduction velocity.

Motor nerve conduction velocity: It is recorded from the motor nerve with the help of three surface electrodes (Ground, reference and active). Placement of active electrode on the belly of recording muscle, reference electrode 3 cm distal to active electrode and ground electrode between active and stimulation point. Conduction velocity is calculated by measure the distance between a cathode of distal and proximal stimulation.

Setting for motor nerve conduction study – upper limb Duration 100 µs, sweep speed 5 ms/D, filter between 2Hz to 5 KHz, and for lower limb duration 200 µs, filter between 2Hz to 10 KHz, sweep speed same as upper limb.

Sensory nerve conduction study was recorded by surface and ring electrodes.

•Setting for sensory nerve conduction study - Duration 100 µs, sweep speed 2 ms/ distance and filter between 20Hz to 3 KHz.

F wave study:

• F- Wave study recorded by stimulation to motor nerve supramaximally.

• F wave recording electrode setting same as MNCs.

•Setting for F wave study was, duration 100 µs, filter between2 Hz to 10 kHz, and sweep speed 10ms/D.

Funding: Not required

Feasibility: Feasible

Statistical Analysis:

Descriptive and inferential statistics methods use for analysis. Software SPSS 17.0 version and Graphpad Prism 5.0 version will be used for analysis. Amplitude, distal motor latency and conduction velocities of the peripheral motor and sensory nerves will be assessed for gender, BMI & height.

(Risk factor: As it is a non-invasive study, there will be no harm to the study subjects)

Expected Results:

Participants: The study will be conducted on 382 adult age groups of>60 yrs healthy subjects of central India. Descriptive and inferential statistics methods used for analysis. Software SPSS 17.0 version and GRAPHPAD PRISM 5.0 version will be used for analysis.

Descriptive data: Frequency and percentages.

Outcome data: Normative Data of nerve conduction velocity.

Main results: This Will be presented after statistical analysis.

Other analyses: Not any

Discussion and Conclusion

Normative data of nerve conduction velocity will be collected in a healthy elderly population in central India for asses the peripheral nerve function and management of peripheral

neuropathy and use this normative data for the Neurophysiology lab at Acharya Vinoba Bhave Rural Hospital Sawangi (M) Wardha. References value will be compared with other published studies.

The study is expected to draw observation in relation to variables cited with the objectives, which will be compared to draw inference over normative data on nerve conduction studies in healthy elderly Wardha district population.

We will observe in our study, motor and sensory nerve response may alter age group and height. The decreased in the nerve conduction velocity and Amplitude were associated with age as advances. It is also documented that the change in the diameter of nerve fiber can alter the nerve fiber membrane. A similar finding was observed by Stetson DS et al. in 1992 (23).

The nerve conduction slow and sensory latency increase as age increases due to loss of myelin sheath in peripheral nerves. Duration of motor and sensory nerves also changes as age increase. F Minimum latency and H Wave latency shows positive correlation with age.(24)

As age increased with increased F minimum latency, slowed Somatosensory Evoked potential, motor and sensory nerve conduction velocity. Height affects somatosensory evoked potential and F minimum latency (25-27).

Generalisability: Data will be used for assessing the physiological status of peripheral nerve and diagnose neuropathy

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

References:

1. Preston DC, Shapiro BE. Electromyography and neuromuscular disorders, clinical-Electrophysiologic correlations 2nd edition Elsevier.2005:25-45.
2. Lee DH, Claussen GC, Oh S. Clinical nerve conduction and needle electromyography studies. J Am AcadOrthopSurg 2004; 12(4):276-87.
3. Robinson LR. Role of neurophysiologic evaluation in diagnosis. J Am AcadOrthopSurg 2000; 8(3):190-199.
4. Campellone JV. Nerve conduction velocity. Med healthcare Network 2007.
5. Kimura J. Electrodiagnosis in diseases of nerve and muscle: Principles and practice. 2nded. Philadelphia: F.A.Davis Company; 1983.

6. Nisargandha MA, Parwe SD, Wankhede SG, Deshpande VK. Comparison of nerve conduction studies on affected and non-affected side in the patients of sciatica. Int j basic appl physiol. 2020;9(1):1.
7. Mishra UK, Kalita J. Clinical neurophysiology. Elsiver pub. 2nd edition 2006. 1-10.
8. Nisargandha MA, Parwe SD. Does Obesity Lead to Sciatic Pain: A Comparative Study. Int J Cur Res Rev. 2020 Dec;12(23):120.
9. Akataki K, Mita K, Watakabe M, Ito K. Age related changes in motor unit activation strategy in force production. A Mechanomyographic Investigation. Muscle Nerve 2002; 25:505-12.
10. Campbell MJ, Mc Comas AJ, Petito F. Physiological changes in ageing muscles. JNeurolNeurosurge Psychiatry 1973; 36:174-82.
11. Roos MR, Rice CL, Vandervoort AA. Age related changes in motor unit function. Muscle Nerve 1997; 20:679-90.
12. Flack B, Stålberg E, Bischoff C: Sensory nerve conduction studies with surface electrodes. Methods In Clinical Neurophysiology 1994; 5:1–20.
13. Aminoff MJ. Electrodiagnosis in clinical neurology 5th edition, Elsevier Churchill livingstone 2005.285-320
14. Lafratta CW, Smith OH. A study of the relationship of motor nerve conduction velocity in the adult to age, sex and handedness. Arch Phys Med rehabil1964; 45:407-412.
15. Soudmand R, Ward LC, Swift TR. Effect of height on nerve conduction velocity. Neurology: 1982; 32:407-410.
16. Parwe S, Kuchewar V, Nisargandha M, Patil M. Comparative evaluation of effective route of administration of MASAM oil in Vishwachi (Cervical Radiculopathy): A Study Protocol. Indian Journal of Forensic Medicine & Toxicology. 2020 Oct 1;14(4):6765.
17. Buscbacher RM. Body mass index on common nerve conduction study measurements. Muscle & Nerve 1998; 21(11): 1398-1404.
18. Nisargandha MA, Parwe S, Wankhede SG, Shinde PU, Phatale SR, Deshpande VK. Nerve Conduction Studies on Patients of Sciatica. Int J Biol Med Res. 2017;8(3):6050-2.
19. Sirven JI, Malanut BL. Clinical neurology of the older adult. WoltersKlunner ,Lippincottwillian&wilking pub. 2nd edition 2008.
20. Ehler E, Ridzoň P, Urban P, Mazanec R, Nakládalová M, Procházka B, Matulová H, Latta J, Otruba P. Ulnar nerve at the elbow–normative nerve conduction study. Journal of brachial plexus and peripheral nerve injury. 2013 Dec;8(01):e55-60.
21. Garg R, Bansal N, Kaur H, Arora KS. Nerve conduction studies in the upper limb in the malwa region-normative data. Journal of clinical and diagnostic research: JCDR. 2013 Feb;7(2):201.
22. Mathew AC, Das D, Sampath S, Vijaykumar M, Ramkrishnan N, Ravishankar S.L. Prevalence and correlate of malnutrition among elderly in an Urban area in Coimbatore. Indian journal of Public Health 2016; 60 (2) April – June: 112 – 117.
23. Stetson DS, Albers JW, Silverstein BA, Wolfe RA. Effects of age, sex, and anthropometric factors on nerve conduction measures. Muscle & Nerve: Official Journal of the American Association of Electrodiagnostic Medicine. 1992 Oct;15(10):1095-104.
24. Palve SS, Palve SB. Impact of aging on nerve conduction velocities and late responses in healthy individuals. Journal of neurosciences in rural practice. 2018 Jan;9(01):112-6.

25. Dorfman LJ, Bosley TM. Age-related changes in peripheral and central nerve conduction in man. Neurology. 1979 Jan 1;29(1):38.
26. Rathi, Nikhil, Bharati Taksande, and Sunil Kumar. “Nerve Conduction Studies of Peripheral Motor and Sensory Nerves in the Subjects With Prediabetes.” JOURNAL OF ENDOCRINOLOGY AND METABOLISM 9, no. 5 (October 2019): 147–50. https://doi.org/10.14740/jem602.
27. Gondivkar SM, Indurkar A, Degwekar S, Bhowate R. Evaluation of gustatory function in patients with diabetes mellitus type 2. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2009 Dec 1;108(6):876-80.