Original article

A study of effect of temperature on conduction velocity of median sensory and motor nerve in normal subjects

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Abstract

The present study was conducted in the Department of Physiology, Netaji Subhash Chandra Bose Medical College and Hospital, Jabalpur (M.P.) . Median motor and sensory nerves were examined in 60 medical students aged between 17-25 years ,having no signs or symptoms of neurological impairment. Using surface and ring electrodes. Different temperature i.e. hot& cold were maintained with the help of water bath and skin temperature measured by using Digital Mercury Thermometer. The result of our study showed that as on increasing the temperature from 29^0 C to 39^0C there was significant increase in nerve conduction velocity by 1.0 to 1.4 m/second per degree rise in temperature

KeyWords: Nerve conduction study, median nerve, Effect of temperature, median motor and sensory nerve

Introduction

Nerve conduction study is a part of electrodiagnostic procedures that help in establishing the type and extent of the abnormality of the nerves. There are anatomical and physiological aspects to nerve conduction velocity. The conduction velocity of the nerve depends on the fiber diameter, degree of myelination and the inter-nodal distance. Other factors such as age, temperature, height, gender, and limb are the physiological variables affecting nerve conduction study. The use of conduction velocity measurement as a diagnostic procedure in neurology requires a knowledge of a range of values encountered in healthy individuals. Normal values for maximum conduction velocity in human peripheral nerve had been described way back in 1850 by Helmholtz who measured median conduction velocity of humans using crude mechanical instruments and had found the normal range to be 61.0 ± 5.1 m/s.[1]

Nerve conduction studies are being increasingly used in diagnosis and prognosis of various neurological diseases. Nerve conduction studies assess the peripheral motor and sensory functions by recording the evoked response to stimulation of peripheral nerves. They have an important role in evaluation of peripheral and entrapment neuropathies by confirming the clinical suspicion of neuropathy. Identifying the predominant pathophysiology such as conduction block, axonal demyelination, and temporal course of the disease i.e. Acute, subacute or chronic, the nerve conduction studies provide an objective and qualitative measure of nerve function and also help in predicting the prognosis of neuropathy. With steady improvement in recording apparatuses; nerve conduction studies have

become a simple and reliable test of peripheral nerve function (Aminoff 1999). [2]

Temperature variation in the tissue surrounding a nerve is an important factor influencing the velocity of the nerve impulse. The distal extremities are constantly exposed to environmental temperature changes and are subjected to significant tissue temperature variation even in healthy subjects (Halar et al, 1981).[3,4,5]

Material and Methods

Present study was conducted in the Department of Physiology, Netaji Subhash Chandra Bose Medical College and Hospital, Jabalpur (M.P.)

Sixty (60) Medical student both male and female healthy volunteers aged between 17-25 year were recruited from the First M.B.B.S batch of N.S.C.B. Medical College, Jabalpur (M.P.), having no signs or symptoms of neurological impairment.

Nerve conduction study of Median nerve both motor and sensory bilaterally were performed with help of Computerized machine RMS Aleron 201 EMG & NCV, using surface and ring electrodes. Different temperature i.e. hot& cold were maintained with the help of water bath and skin temperature measured by using Digital Mercury Thermometer.

Surface stimulation was performed as per steps following steps-

S_1 –First stimulus placed at the wrist between the Palmaris Longus& Flexor Carpi Radialis tendon at the second crease.

(Approximately 1cm proximal to the most distal crease.)

S_2 - Second stimulus placed at the elbow crease, medial to the Biceps tendon and Brachial artery.

The criteria of selection of cases was random. The nerve were stimulated supramaximally with the wave pulses of 0.2ms duration for every recording of sensory median nerve conduction velocity and motor median nerve conduction velocity.

After obtaining the first motor and sensory record at a room temperature the forearm including the elbow was cooled in a thermostated waterbath at 32^0 C for 10 minutes. The upper extremity was then lifted from the bath and dried, the electrode were reapplied over the marked points and recording was performed again. Then the arm was immersed in the water again and cooled the forearm including the elbow at 29^0 C for 10 minutes. Similarly recording was done at 39^0 C. Hence, the temperature was changed stepwise to 32^0 C, 29^0 C & 39^0 C [6].

Observations & Result:

Table – 1 Mean & standard deviation of conduction velocity of median motor & sensory nerve recorded at various skin temperature.

Temperature	Motor velocity	Sensory velocity
29	53.66 (±6.53)	54.56 (±5.69)
32	55.89 (±6.55)	57.63 (±5.75)
37	58.77 (±6.84)	60.38 (±5.44)
39	63.17 (±6.81)	63.64 (±5.35)

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Table-2 One way ANOVA of median motor & sensory nerve recorded at various skin temperatures

	Motor velocity	**Sensory velocity**
F-value	14.482	18.625
Significance	.0001	.0001

($p < 0.05$, statistically significant)

Discussion

The result of present study showed that as the temperature was increased gradually from normal body temperature 37^0 C to 39^0C(temperature range 29^0 C -39^0C) conduction velocity of median motor and sensory nerve increased by 1.0 to 1.4 m /second/^{0}C (table 1) . On performing ANOVA this change was found statistically significant ($p<0.05$) for median motor and sensory nerve (table 2) in all subjects . On increasing the temperature, rise in velocity has been reported by KTodem et. al,1988 [7]. The result of their study showed that motor and sensory velocity increased non-linearly with increase in skin temperature ($F = 5.16$, $p=0.009$). We obtained similar findings in our study. There is significant increase in velocity with rise in temperature ($p< 0.05$). The findings of our study are different than that of K Todem et al in linear relationship between conduction velocity with variation in skin temperature. Gasser and Trojaborg (1964)[9], DeJong et al.(1966)[10], Halar et al. (1981)[5] reported that there is a linear relationship between skin temperature and nerve conduction velocity finding are similar to present study. The degree of slowing is of the order of 1-2 m /second/^{0}C taking 33^0C as standard skin temperature.

Another similar study was performed on impact of temperature on nerve conduction study at Department of Neurology, Faculty of Medicine, Ege University, Turkey. They found conduction velocity slows down by 1.5 to 2.5 m/s for the environmental temperature decrease per degree centigrade[8]. Similar findings are obtained in our study. We found little variation in conduction velocity 1.0 to 1.4 m /second/^{0}C. It may be due to difference in environmental temperatures of two areas. Johnson and Olsen, 1960[11]; De Jesus *et al.*, 1973[12]; Lowitzsch *et al.,* 1977[13] found that conduction velocity increases by ~5% per degree C as the temperature of the nerve increases from 29 to 38°C.

Summary & Conclusion

The result of our study showed that on increasing the temperature from 29^0 C to 39^0C there was significant increase in nerve conduction velocity by1.0 to 1.4 m/second per degree rise in temperature of median motor and sensory nerve.

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