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Original Article

Effect of Hypertension on Sensory Nerve Conduction Variables

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Abstract

Background: Hypertension is most prevalent cardiovascular disorder that affects many organs of our body and it markedly increases both mortality and morbidity. Nerve conduction studies (NCSs) are most commonly used electro-diagnostic tests to determine the conduction in motor and sensory nerves. NCS estimates conduction velocity, latency, duration, and amplitude. The present study is done to evaluate velocity, latency, and amplitude of sensory nerve conduction variables in peroneal and sural nerve.

Aims and Objectives: The aim was to assess the effect of hypertension on sensory nerve conduction.

Materials and Methods: The study was conducted in tertiary care hospital. A written informed consent was acquired from every member. The study was done in 50 hypertensives and 50 normotensives between the age gatherings of 40–60 years. The data analysis will be done using the "MedCalc." NCV measures were expressed as mean ± SD. Student paired "*t*-test" and Chi-square test were used for comparison of the values between hypertensive and normotensive group.

Results: Peroneal nerve in hypertensive shows latency (1.31 ± 0.35), amplitude (12.60 ± 2.56), and velocity (50.16 ± 2.94) when compared with normotensive shows latency (1.38 ± 0.26), amplitude (12.01 ± 2.51), and velocity (50.05 ± 4.04). Hence, hypertensive group is statistically not significant than normotensive group. Sural nerve in hypertensive shows latency (2.20 ± 0.62), amplitude (18.8 ± 2.18), and velocity (70.4 ± 3.5) when compared with normotensive shows latency (2.16 ± 0.61), amplitude (18.6 ± 2.15), and velocity (69.6 ± 3.56). The final results of sensory nerve conduction variables were not statistically significant when compared in both study groups ($P > 0.05$).

Conclusion: Hypertension may create axonal degeneration, yet may not be influencing the myelination in this way safeguarding nerve conduction speed. Consequently, hypertension itself may not influence the nerve conduction factors. Broad investigations are needed to examine the impact of hypertension in nerve conduction variables.

Key words: Hypertension, Nerve conduction study, Peripheral neuropathy, Peroneal nerve, Sensory nerve, Sural nerve

INTRODUCTION

Hypertension is the most common disease and it markedly increases both mortality and morbidity. The adverse effects of hypertension principally involve the blood vessels, retina, heart, and kidneys including central nervous system.[1] Nerve conduction studies (NCSs) are the most commonly used electro-diagnostic tests to determine the conduction in motor and sensory nerves.[2] NCS involves activation of nerves with small, safe electrical impulses over multiple points on the skin of limbs, and thereafter measuring the obtained responses.[3] NCS is diagnostically helpful in patients suspected of having almost any kind of peripheral nervous system disorder including disorders of nerve roots, peripheral nerves, muscle, and neuromuscular junction.[4] Nerve conduction study measures duration, latency, amplitude, and conduction velocity. Amplitude denotes the number of functioning fibers and it is altered in diseases causing axonal degeneration. Conduction velocity and latency represent the speed of nerve impulse propagation. They are affected in diseases, which causes demyelination of nerves.[5]

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The aim of the study was to identify the effect of essential hypertension alone (without associated diabetes mellitus) on sensory nerve conduction velocity of peroneal and sural nerve.

MATERIALS AND METHODS

The study was conducted in a teaching college and hospital with prior permission of the Institutional Ethics Committee. A written informed consent was acquired from every member. The study was done in 50 hypertensives and 50 normotensives between the age gatherings of 40–60 years which included both males and females. The hypertensives were selected from the outpatient department (OPD) of the hospital and the controls were normotensive volunteers.

Inclusion Criteria

Selection of hypertensive patient

The following criteria were included in the study

- Clinically stable hypertensive patients with duration of illness more than 5 years
- The criteria of considering patient hypertensive were a blood pressure >140/90 mm Hg based on the average of 2 or more readings taken during each of his/her visits to the OPD
- These subjects were not on any antihypertensive medication and they were not acutely ill.

Selection of controls

- The controls were healthy volunteers with systolic blood pressure <120 mm of Hg and diastolic blood pressure <80 mm of Hg.

Exclusion Criteria for Both

The following criteria were excluded from the study

- Age <40 and more than 60
- Subjects having any – Diabetes mellitus, ischemic heart disease, strokes, cardiac pacemaker, gout, rheumatoid arthritis, thyroid, major psychiatric diseases, renal failure, leprosy, tuberculosis, and acquired immunodeficiency syndrome
- Subjects with history of addiction to alcohol, drug abuse, and smokers
- Athletes.

Recording of Nerve Conduction Velocity

The study was done using NEURO – MEP – NET Machine equipped for EMG/NCV/EP manufactured by NEUROSOFT TM. The apparatus works on a computer with Windows 98 operating system having MS Office 97 package.

For sensory nerve conduction study, the low frequency filter was set at 5 Hertz (Hz) and high frequency filter at 3 kHz. Thus, the signals between the above mentioned frequencies were recorded.

Sweep speed: The sweep speed was set at 2 ms/division.

Peroneal (superficial) sensory nerve conduction study [Table 1 and Figure 1]

leg is relaxed over couch and lateral aspect of leg, ankle and foot exposed.

Sural sensory nerve conduction study [Table 2 and Figure 2]

Leg is relaxed and placed in lateral position.

RESULTS

Superficial Peroneal Nerve [Table 3 and Graph 1]

The results of Sensory nerve conduction variables were not statistically significant between normotensive and hypertensive group ($P > 0.05$).

Sural Nerve [Table 4 and Graph 2]

The results of sensory nerve conduction variables were not statistically significant between normotensive group and hypertensive group ($P > 0.05$).

Table 1: Peroneal (superficial) sensory nerve conduction study

Electrodes	Position
Recording electrode	Placing active electrode just above the junction of lateral third of a line connecting the malleoli
Reference electrode	3 cm distal to the active electrode
Ground electrode	Placing between the stimulating and recording electrodes
Stimulating Electrode	Anti-dromic surface stimulation is carried out 10–15 cm proximal to the upper edge of lateral malleolus anterior to peroneus longus

Table 2: Sural sensory nerve conduction study

Electrodes	Position
Recording electrode	Placed on motor point between lateral malleolus and Achilles tendon
Reference electrode	Placed 3cm distal to recording electrode
Ground electrode	Placed below the lateral malleolus of ankle
Stimulating electrode	• Cathode: 10–16 cm proximal to recording electrode, distal to the lower border of gastrocnemius at the junction of middle and lower third of the leg • Anode: Placed 3 cm distal to the cathode

Table 3: Superficial peroneal sensory nerve conduction variables in normotensive and hypertensives

Parameters	Hypertensive (*n*=50) Mean±SD	Normotensive (*n*=50) Mean±SD	*P*-value
Latency	1.31±0.35	1.38±0.26	0.2590
Amplitude	12.60±2.56	12.01±2.51	0.2474
Velocity	50.16±2.94	50.05±4.04	0.8766

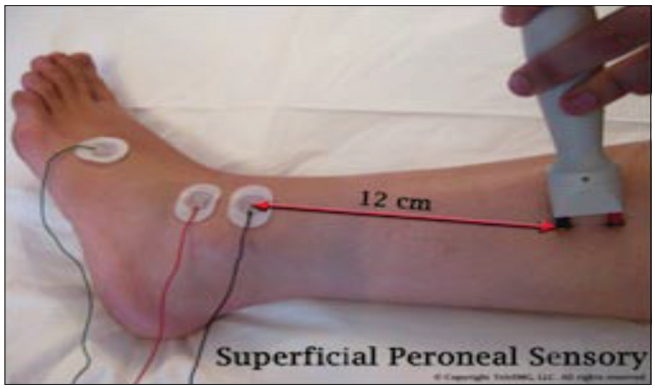
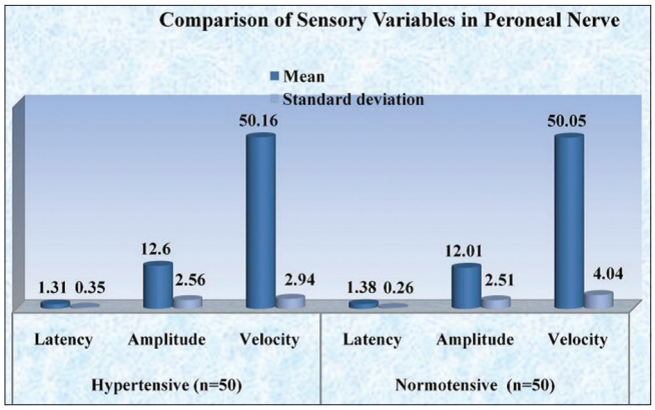


Figure 1: Recording of Superficial Peroneal nerve conduction

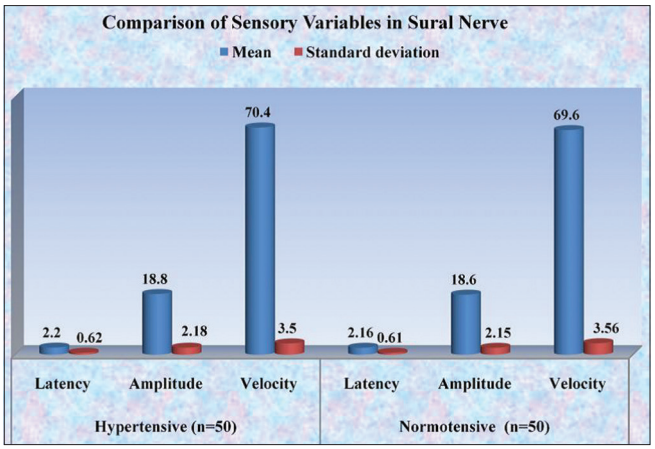
Figure 2: Recording of sural sensory nerve conduction



Graph 1: Superficial peroneal sensory nerve conduction variables in normotensive and hypertensives

DISCUSSION

This study aimed to investigate the effect of sensory nerve conduction variables in patients with hypertension. No statistical significant differences were found in sensory nerve conduction velocity of hypertensives as compared to normotensives.



Graph 2: Sural nerve conduction variables in normotensive and hypertensives

Table 4: Sural nerve conduction variables in normotensive and hypertensives

Parameters	Hypertensive (*n*=50) Mean±SD	Normotensive (*n*=50) Mean±SD	*P*-value
Latency	2.20±0.62	2.16±0.61	0.7457
Amplitude	18.8±2.18	18.6±2.15	0.6452
Velocity	70.4±3.5	69.6±3.56	0.2599

A study was done by Yassin *et al.*[6] to assess the relationship between hypertension and peripheral neuropathy. The study assessed nerve conduction variables of sensory nerve function, motor nerve function, and also F wave measurement. They observed statistical significance of ($P < 0.05$) for the association between hypertension patients and sensory nerve conduction that presented deterioration. However, the motor NCSs (Median, Ulnar, and Tibial) did not show many changes; whereas, in their F-wave parameter assessment, the latency of the slowest F wave was observed in the common peroneal nerve, which was prolonged. From their results, they interpret that smallest fibers were affected in hypertension.

Legrady *et al.*[7] presented that non-diabetic hypertensive patients also present the complications presented in diabetes. Patients who presented hypertension were undergoing antihypertensive therapy. In the study done by Viskoper *et al.*,[8] there is a reduction in nerve conduction velocity in hypertensives. This is because hypertension causes vasospasm of blood vessels supplying the nerves. Popvtzer *et al.*[9] showed that motor nerve conduction velocity is reduced in hypertensives when compared with controls. The result of our study is in accordance with the study done by Shubhangi *et al.*[10] and Lloyds *et al.*[11] who failed to demonstrate the effect of hypertension on nerve conduction velocity. Another study done by Negler *et al.*[12] also showed similar results of our study,

which showed that there is no effect of hypertension on nerve conduction. They proposed that hypertension maybe producing axonal degeneration, but not affecting myelination there by preserving nerve conduction velocity. Crowley[13] and Yasunari *et al*.[14] have proved clinically that oxidative stress is an outcome of chronic inflammation in hypertensive subjects. The onset of oxidative stress in hypertensive subjects depletes the levels of nitric oxide through the formation of peroxynitrite. This mechanism has been clinically proved by Moriel *et al*.[15]

However, our study is in relation with the study done by Negler *et al*.,[12] Shubhangi *et al*.,[10] and Lloyds *et al*.[11] which showed a negative correlation between nerve conduction and hypertension.

CONCLUSION

This study demonstrates that:

- Hypertension may create axonal degeneration, yet may not be influencing the myelination in this way safeguarding nerve conduction speed
- Hypertension itself may not affect the nerve conduction variables. Associated factors such as age, body mass index, and other diseases may cause variations in nerve conduction defects. Broad investigations are needed to examine the impact of hypertension in nerve conduction variables
- Finding of reduced nerve conduction velocity in hypertensive patients should alert the physician to the possibility of associated diseases such as diabetes mellitus, alcoholism, or concomitant peripheral vascular diseases
- Extensive studies are required to study the effect of hypertension alone on nerve conduction velocity, taking into consideration the severity, duration, and treatment of hypertension.

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DATA AVAILABILITY

The data used to support the findings of this study are included within this article.

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