

## RESEARCH ARTICLE

### Peripheral nerve conduction tests in patients with hypothyroidism and healthy volunteers: A comparative study

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#### ABSTRACT

**Background:** The nervous system is the one of the most common sites get affected in patients with hypothyroidism and various tools have been developed for assessing it. Nerve conduction studies are one among them. **Aims and Objectives:** The aim and objective of this study were to compare the nerve conduction study in patients with hypothyroidism and healthy volunteers. **Materials and Methods:** This study was conducted at the PSG Institute of Medical Sciences and Research, Coimbatore, Tamil Nadu, India, on 30 patients with hypothyroidism (cases) and 30 healthy volunteers (controls). The average age of the patients with hypothyroidism was  $38.53 \pm 5.92$  years (mean  $\pm$  standard deviation [SD]) and that of the volunteers was  $37.10 \pm 3.19$  years (mean  $\pm$  SD). After obtaining informed, written consent, the nerve conduction study of the median nerve and ulnar nerve of both the limbs were done for them. **Results:** A statistical analysis was carried out using independent Student's *t*-test, which showed a statistically significant in median nerve conduction velocities ( $P < 0.001$ ) and amplitude ( $P < 0.001$ ). **Conclusion:** Results of this study showed that significant impairment was present in patients with hypothyroidism than in healthy volunteers, and it was more pronounced for median nerve than for ulnar.


**KEY WORDS:** Nerve Conduction Study; Hypothyroidism; Healthy Volunteers; Comparative Study

#### INTRODUCTION

The thyroid gland is the one of the largest endocrine glands in our body. It secretes two important hormones, namely, thyroxine ( $T_4$ ) and triiodothyronine ( $T_3$ ). These hormones act through the thyroid hormone receptors  $\alpha$  and  $\beta$ , by which it plays an important physiological role on most of the organs and tissues of the body.<sup>[1]</sup>

Hypothyroidism is a disorder in which the thyroid gland is unable to synthesize and secrete sufficient amounts of thyroid hormone to meet the requirement of the brain and peripheral tissues. The incidence of hypothyroidism is estimated to be 4–5/1000 population per year for women and 0.6–0.9/1000 population per year for men. The prevalence of overt hypothyroidism is approximately 1–2% in women and 0.1% in men.<sup>[1]</sup> The cause for the hypothyroidism could be autoimmune disorder, thyroid surgery, radiation therapy pituitary disorder, or iodine deficiency. Among all, the most common cause is iodine deficiency.<sup>[1]</sup>

The neurological complications of hypothyroidism include the neuropathy, carpal tunnel syndrome, myopathy, dementia, psychosis, cerebellar syndrome, and coma.<sup>[2]</sup> One of the manifestations of the hypothyroidism is the peripheral neuropathy. The development of this neuropathy is insidious

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in onset, which will take a long period of time for clinical manifestations.

In hypothyroidism, mononeuropathy and polyneuropathy are reported in previous studies.<sup>[3]</sup> Mononeuropathy is the mucinous deposits which compress the nerve and cause nerve damage which can be easily demonstrated by a nerve conduction velocity (NCV) studies. The involvement of primarily the myelin sheath has been revealed by some studies.<sup>[4,5]</sup> Hypothyroidism affects all peripheral nerves, but more commonly affected nerve is the median nerve which results in carpal tunnel syndrome.<sup>[2]</sup> The sensory nerve conduction deficit is more during the early stage of neuropathy, and the clinical symptoms includes pain, cramps, paraesthesia of fingers, and limbs. It has been proved since earlier that the thyroid hormone increases the speed and amplitude of peripheral nerve reflexes.

## MATERIALS AND METHODS

The study was conducted after obtaining clearance from the Institute Ethics Committee for human studies and carries less than minimal risks. This study was conducted on 30 patients with hypothyroidism and 30 healthy volunteers who were motivated and recruited from the operationalized psychodynamic diagnosis of the PSG Institute of Medical Sciences and Research, Coimbatore, Tamil Nadu, India.

Pregnant females, all the patients with a past or family history of neuropathy or neuromuscular diseases, history of alcoholism, kidney and liver disease, diabetes mellitus (DM), use of drugs known to cause neuropathy or myopathy, other serious illnesses as cardiac failure, or HIV infection were excluded from the study.

The purpose of the study, procedure, and benefits was explained in detail to the participants, and informed written consent was obtained. The average age of the patients with hypothyroidism was  $38.53 \pm 5.92$  years (mean  $\pm$  standard deviation [SD]) and that of volunteers was  $37.10 \pm 3.19$  years (mean  $\pm$  SD). The nerve conduction study is done using recorders' Medicare System EMG EPM2K version-1. Electrodiagnostic procedure was carried out as per standardized protocols<sup>[5]</sup> to record the motor and sensory nerve conduction studies. The patients were examined while lying comfortably in the supine position. The skin was adequately prepared before application of the stimulating and recording electrodes so that a good contact can be made between the electrodes and skin.

### Nerve Conduction Studies

The motor nerve and sensory nerve conduction studies were performed on median and ulnar nerves bilaterally in upper limbs. The motor nerve conduction studies included determination of distal motor latencies, motor NCV, and

amplitude of the compound muscle action potentials. The sensory nerve conduction studies included determination of sensory NCV and amplitude of sensory nerve action potentials.

### Statistical Analysis

Data for all parameters were collected as per the study protocol and were entered in Microsoft Office Excel database. Statistical analysis was performed using SPSS software by unpaired *t*-test and ANOVA for various analyses.  $P < 0.05$  was considered as statistically significant.

## RESULTS

Average age of the patients with DM was  $38.53 \pm 5.92$  years (mean  $\pm$  SD) and that of volunteers was  $37.10 \pm 3.19$  years (mean  $\pm$  SD).

### Conduction Velocity

NCV of median nerve motor and sensory component in controls was  $58.50 \pm 4.59$  and  $61.03 \pm 10.89$  (mean  $\pm$  SD) and that for cases was  $46.09 \pm 8.61$  and  $50.23 \pm 5.88$  (mean  $\pm$  SD), respectively [Table 1]. The decrease in NCV in cases was highly significant with  $P < 0.001$ .

### The Distal Latency

There is no statistical significant increase in distal latency of any nerve either ulnar or median with a  $P = 0.16$  [Table 1].

### Amplitude

The motor action potential amplitude of median nerve in the controls was  $9.92 \pm 1.97$  and that of the cases was  $7.42 \pm 2.14$ . The decrease in the amplitude in cases was statistically significant with  $P < 0.001$ . There was a significant difference in amplitude between cases and controls as the  $P < 0.05$ .

## DISCUSSION

In the present study, patients with hypothyroidism showed significantly reduced amplitudes and slowed conduction velocities of median nerve. There was no significant increase in the latency of any of the nerves either median or ulnar. The ulnar nerve conduction values showed no statistically significant changes in any parameters such as conduction velocity, amplitude, and latency.

Musculoskeletal disorders are common in patients with hypothyroidism.<sup>[6]</sup> In a study done by Yuksel *et al.*,<sup>[7]</sup> the most affected nerve median (54%) motor and sensory nerves followed by the sural nerve (18%). This study supports our finding that, in our study also, the most affected nerve is median nerve. Both the median nerve sensory and motor

**Table 1:** Comparison of latencies, conduction velocities, and amplitudes of motor nerves of controls and hypothyroid patients

Variables	Mean $\pm$ SD		P
	Controls (n = 30)	Hypothyroids (n = 30)	
Conduction velocity (ms)			
Median motor	58.50 $\pm$ 4.59	46.09 $\pm$ 8.61	<0.001*
Median sensory	61.03 $\pm$ 10.89	50.23 $\pm$ 5.88	<0.001*
Ulnar motor	59.65 $\pm$ 7.15	58.65 $\pm$ 4.02	0.27 (NS)
Ulnar sensory	64.10 $\pm$ 9.4	63.36 $\pm$ 9.49	0.15 (NS)
Distal latency (ms)			
Median motor	7.80 $\pm$ 0.58	7.44 $\pm$ 1.28	0.16 (NS)
Ulnar motor	6.56 $\pm$ 0.58	6.60 $\pm$ 0.79	0.18 (NS)
Amplitude (mA)			
Median motor	9.92 $\pm$ 1.97	7.42 $\pm$ 2.14	<0.001*
Median sensory	61.74 $\pm$ 30.63	46.80 $\pm$ 25.83	<0.05*
Ulnar motor	11.77 $\pm$ 2.43	12.66 $\pm$ 3.55	0.26 (NS)
Ulnar sensory	53.53 $\pm$ 28.12	55.53 $\pm$ 36.33	0.15 (NS)

\*Statistically significant, NS: Non significant, SD: Standard deviation

component are affected in the present study. The conduction velocity and amplitude of this median nerve are the affected parameters in this study. In hypothyroidism, accumulation of mucopolysaccharides, chondroitin sulfate, and hyaluronic acid occurs in the interstitial spaces which tend to retain water and hence result in weight gain.<sup>[4]</sup> Their deposition in the tissues surrounding the nerves may lead to compression over the peripheral nerves resulting in swelling and degeneration of the nerves.<sup>[8]</sup> Median nerve entrapment at the wrist caused by the deposition of mucinous material in the tissue surrounding the nerve is one of the most frequent causes of peripheral nerve damage in hypothyroidism.<sup>[5]</sup> Dyck and Lambert<sup>[4]</sup> studied two cases morphologically and neurophysiologically and suggested that metabolic alterations caused by endocrine disorders are responsible for the peripheral neuropathy. The peripheral nerve dysfunction was also linked to the morphological evidence of primary axonal degeneration in the form of shrinkage of axons, disintegration of neurotubules and neurofilaments, and active axonal breakdown.<sup>[9]</sup>

The conduction velocity is a measure of the faster conducting fibers. Hence, unless the pathological disturbance occurs selectively in the largest myelinated fibers, the loss will be random, that is even 75% of the axonal population is reduced, many of the quite fast-conducting fibers will be functionally active, and the conduction velocity be mildly altered. Demyelination is due to the loss of the myelin sheath of the axon, where the axon tubule is intact. It may be paranodal or segmental demyelination. The former will block the conduction, whereas the latter can only reduce the conduction velocity.<sup>[10]</sup>

Amplitude measures are important in sensory nerve conduction evaluations.<sup>[11]</sup> The NCV in turn is depend mainly on the faster conducting nerve fiber, even if maximum number of nerve fibers get affected, the presence of few faster conducting fiber carries the conduction, and the result will be disproportionate to the affected fibers.<sup>[12]</sup> Both latency and conduction velocity depend on the intact, and myelinated nerve fiber as the myelin and node is essential for the fast action potential propagation. In contrast, the amplitude of the waveform depends primarily on the number of the axons functioning within the nerve. Slowing conduction velocity or prolongation of latency usually implies demyelinating injury, while the loss of amplitude usually correlates with axonal loss or dysfunction.<sup>[13]</sup> Abnormal nerve conduction study with sensorimotor neuropathy of axonal type was the finding of another electrophysiological study.<sup>[10]</sup>

In this study, electromyography was not done. Our study did not include the autonomic function test and all other peripheral nerves. These are the limitations in our study.

Our study gives a solid evidence of impairment of median nerve conduction defect of both sensory and motor component. A more detailed study involving more number of patients with hypothyroidism is warranted to come to a definite conclusion.

## CONCLUSION

We conclude that the results of this study confirm the presence of neuropathy in patients with hypothyroidism and nerve conduction studies can be used as a validated tool for assessing it. A more detailed study involving more number of patients with hypothyroidism is warranted to come to a definite conclusion.

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