

## SENSORY NERVE CONDUCTION STUDIES IN SUBCLINICAL HYPOTHYROIDISM

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**Abstract**

**Background:** Subclinical hypothyroidism is the most common form of thyroid dysfunction and its effect on the peripheral nerves and muscles has been a matter of debate. Diagnosis of SHT has been recently growing due to a popularized screening test for thyroid function. As a result, concerns about the natural course and prognosis of subclinical hypothyroidism and long-term consequences of a persistent subclinical hypothyroid state are on the rise. However, the clinical significance of subclinical hypothyroidism has not been fully characterized. A comprehensive understanding of the clinical significance of SHT will aid in the establishment of a management plan and treatment guidelines for SHT patients. As neuromuscular dysfunction may be associated with hypothyroidism, the nerve conduction parameters are expected to be altered in these patients. The present study was intended to assess various sensory nerve conduction parameters in subclinical hypothyroid patients and compare them with that of normal healthy control. **Materials and Methods:** The present study included subjects aged 18-65 yrs (60 cases of biochemically diagnosed subclinical hypothyroidism & 60 healthy age matched controls. Sensory nerve conduction parameters i.e. distal latencies (DL), compound muscle action potential (CMAP) & sensory nerve conduction velocities (SNCV) were recorded bilaterally in median & ulnar nerves using standard protocols & settings. **Result:** The study showed that in case of subclinical hypothyroidism there is increase in latency and decreased in amplitude, duration, area and sensory nerve conduction velocity in patients as compare to controls but the significant changes seen only in latency and SNCV of median nerve (bilaterally) and right ulnar nerve while amplitude of right median nerve only. **Conclusion:** According to our results, overt hypothyroidism shows an obvious involvement of the motor and sensory bundles and this is also somewhat visible in subclinical hypothyroidism using electrophysiological measures.

## INTRODUCTION

"Subclinical hypothyroidism" is the most prevalent thyroid disorder followed by overt hypothyroidism and hyperthyroidism. (Framingham, Rotterdam and Colorado studies). Subclinical hypothyroidism is defined biochemically as a high serum TSH concentration ( $>5\mu\text{IU/ml}$ ) and normal serum free thyroxin (T<sub>4</sub>) and triiodothyronine (T<sub>3</sub>) concentrations.<sup>[1]</sup> There is a rise in the prevalence of subclinical hypothyroidism in India affecting 3–15% of the adult population but there are only scarce reports published in Indian population. In a study Unnikrishnan AG et al,<sup>[2]</sup> (2011) found 9.4% prevalence rate in iodine sufficient adult south Indian population while in another recent Indian study by Thomas cyriac et al,<sup>[3]</sup> (2015) says that prevalence of hypothyroidism and subclinical

hypothyroidism of 11.7% and 15% respectively in Kerala region. The thyroid hormones are essential for growth and development, myelination of neurons, metabolism and normal organ functions. It influences the functioning of nearly all organ systems throughout lifetime specially many functions of the central and peripheral nervous system; as a result hypothyroidism may cause various neurological signs and symptoms.<sup>[4-7]</sup> There is an increased risk of progression from subclinical hypothyroidism to overt hypothyroidism so this condition needs to be identified and monitored to prevent associated complications. Present-day neuroscientists studied nerve conduction parameters in hypothyroid patients to observe the incidence of neuropathy and functional status of peripheral nerves in thyroid deficiency.<sup>[8,9]</sup> Most of them had shown that deficiency of thyroid hormones cause neuropathy by affecting different peripheral nerves

but more commonly the median nerve.<sup>[10]</sup> Development of this neuropathy is insidious in onset, which will take a long period of time for a clinical manifestation.<sup>[11]</sup> Electro-diagnostic studies have shown low conduction amplitude in peripheral nerves with subclinical hypothyroidism, but only a few studies have evaluated the functional alteration in central and peripheral nervous systems and results obtained have been controversial.<sup>[12]</sup> This latent subclinical neuropathy can be investigated using Electroneuromyogram which is a non-invasive electro diagnostic study of muscle and nervous system, so the present study is planned to observe changes in nerve conduction velocity of median and ulnar nerves and its different parameters in newly diagnosed subclinical hypothyroid patients & to assess and compare the extent of involvement of peripheral nerves in subclinical hypothyroid patients with control.<sup>[13]</sup>

## MATERIALS AND METHODS

The study was conducted after obtaining clearance from the Institute Ethics Committee for human studies and carries less than minimal risks. The study was conducted in the Autonomic Function Lab of the Department of Physiology, LLRM medical college, Meerut (UP) in collaboration with Department of Endocrinology of associated SBVP Hospital. In which, 60 newly diagnosed untreated middle-aged patients of either sex having subclinical hypothyroidism were randomly selected from the endocrine OPD of SVBP Hospital; Meerut in the age group range of 18-65 years along with 60 age and sex matched euthyroid volunteers taken from healthy attendants of the patients as well as students and staff of institution for the comparison. The following subjects were excluded: -Pt. with Diabetes mellitus, Rheumatoid arthritis; Osteoarthritis & other condition causing neuropathy (vitamin B12; FA Deficiency), subjects with history of alcoholism, smokers and tobacco users as well as subjects on drugs like steroids, chemotherapy etc. The test was performed in thermo-neutral conditions between 9 AM to 12PM. 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. Thyroid function test including serum TSH; free T3; T4 was carried out by radioimmunoassay methods for all patients in endocrine lab of HORMONE AND METABOLIC DEPARTMENT of our college.

**Nerve Conduction Velocity Tests:** Electro diagnostic studies were performed in all patients and controls using Medicaid Neurostim EMG/NCV/EP System Model NS-4: 4 channel Equipment according to international guidelines. Sensory nerve conduction velocities (SNCV); Sensory distal latency (SDL); Area (SA); Duration; Sensory nerve action potential amplitude (SNAP) was measured antidromically of both median and ulnar nerve bilaterally in upper limb. A sensory nerve action potential (SNAP) appears in the form of sine wave that grows larger with increase of current. Measurements of distance (in mm) between stimulating and active electrode done to calculate the Sensory nerve conduction velocity of median and ulnar nerve. For 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

[Table 2] reveals comparison of sensory parameters of median nerve in patients and controls. There is significant increase in latency and decrease in sensory nerve conduction velocity of median nerve bilaterally & while significant decrease in amplitude only on right side median nerve in patients as compare to controls.

[Table 3] depicting comparison of sensory parameters of ulnar nerve in patients and controls. There is statistically significant increase in latency and decrease in sensory nerve conduction velocity of right ulnar nerve in patients as compare to controls.

**Table 1: Age distribution of subjects**

| Age Group (Years) | Patients(n=60) | Controls(n=60) |
|-------------------|----------------|----------------|
| 18-28             | 20             | 22             |
| 29-38             | 13             | 14             |
| 39-48             | 14             | 12             |
| 49-58             | 11             | 11             |
| 59-65             | 02             | 1              |

**Table 2: Comparison of Sensory Parameters of Median Nerve of Controls and Subclinical Hypothyroid Patients**

| Electro-diagnostic Parameters | Control(n= 60)Mean ± SD | Patients(n=60)Mean ± SD | p-value |
|-------------------------------|-------------------------|-------------------------|---------|
| RIGHT MEDIAN:                 |                         |                         |         |
| LATENCY                       | 2.45±0.35               | 3.46±0.70               | 0.0001* |
| AMPLITUDE                     | 23.67±3.20              | 22.51±2.09              | 0.0204* |
| DURATION                      | 3.37±1.10               | 3.13±0.41               | 0.1160  |
| AREA                          | 37.70±6.99              | 34.71±4.66              | 0.1692  |
| SNCV                          | 61.08±6.46              | 48.39±3.40              | 0.0320* |

|              |            |            |         |
|--------------|------------|------------|---------|
| LEFT MEDIAN: |            |            |         |
| LATENCY      | 2.32±0.45  | 2.67±0.32  | 0.0001* |
| AMPLITUDE    | 30.23±5.85 | 28.91±4.06 | 0.1537  |
| DURATION     | 3.26±0.62  | 3.10±0.61  | 0.1568  |
| AREA         | 35.98±8.14 | 34.31±3.07 | 0.1397  |
| SNCV         | 56.29±3.36 | 47.66±5.54 | 0.0001* |

\*p value ≤0.05 significant \*\*p value ≤0.01 highly significant

**Table 3: Comparison of sensory parameters of ulnar nerve of controls and subclinical hypothyroid patients**

| Electro-diagnostic Parameters | Control(n= 60)Mean ± SD | Patients(n=60)Mean ± SD | p-value |
|-------------------------------|-------------------------|-------------------------|---------|
| RIGHT ULNAR:                  |                         |                         |         |
| LATENCY                       | 2.27±0.36               | 3.21±0.63               | 0.015*  |
| AMPLITUDE                     | 16.37±4.10              | 16.18±4.88              | 0.989   |
| DURATION                      | 3.49±0.84               | 3.24±0.64               | 0.0692  |
| AREA                          | 35.56±8.67              | 34.73±7.44              | 0.5747  |
| SNCV                          | 55.82±3.22              | 50.67±4.03              | 0.0001* |
| LEFT ULNAR:                   |                         |                         |         |
| LATENCY                       | 2.23±0.48               | 2.31±0.58               | 0.4121  |
| AMPLITUDE                     | 31.12±5.87              | 30.22±4.35              | 0.3419  |
| DURATION                      | 3.30±0.70               | 3.14±0.58               | 0.1754  |
| AREA                          | 35.70±4.65              | 34.80±3.86              | 0.2510  |
| SNCV                          | 59.55±4.53              | 59.11±5.77              | 0.6431  |

\*p value ≤0.05 significant \*\*p value ≤0.01 highly significant.

## DISCUSSION

In the present study after comparison of sensory parameters of median and ulnar nerve of subclinical hypothyroidism patients and controls, we found increase in latency and decreased in amplitude, duration, area and sensory nerve conduction velocity in patients as compare to controls but the significant changes seen only in latency and SNCV of median nerve (bilaterally) and right ulnar nerve while amplitude of right median nerve only.

These results are similar to Yuksel G et al (2007) who performed a study in Turkey and concluded that in subclinical hypothyroid patients median motor and sensory nerves were the most commonly affected nerves with carpal tunnel syndrome being positive in 54.5% of these patients. Sensorimotor polyneuropathy were found in 8-9% of subclinical hypothyroid patients.

In another study of Adalet et al(2012) median and ulnar nerves were assessed electrophysiologically in the group of 15 patients with clinical hypothyroidism (group1) and 18 patients with subclinical hypothyroidism (group 2), who were asymptomatic from the neurological point of view along with 27 age- and gender-matched healthy individuals (control group).They found slowing of ulnar motor nerve conduction velocity (uMNCV) and ulnar nerve sensory latency (uSDL) elongation values in group 2 were significant compared to the control group. When group 1 was compared with group 2, in patients with clinical hypothyroidism, no statistically significant differences were found between the groups in terms of median sensory nerve conduction velocity (mSNCV), median distal sensory latency (mSDL), ulnar sensory nerve conduction velocity (uSNCV), and ulnar distal sensory latency (uSDL) values.

EmelOğuzAkarsu et al(2013) done a study on subclinical hypothyroid patients and results were compared with control. Similar changes found in patients median and ulnar nerve sensory parameters as present study but the result was not reached up to significant levels.

In another study Adhikesavan Balaraman et al (2013) stated that there is peripheral nerve involvement in the early phase of hypothyroidism and compared nerve conduction of Median(mixed nerve) Nerve of newly diagnosed subclinical hypothyroid females with that of the healthy females & they seen that there is no greater nerve conduction disturbances in Motor Nerve Conduction Velocity in Median Nerve but significant reduction in sensory Nerve conduction (Amplitude, Duration, Area, Conduction Velocity in Median and Nerve). There is definite subclinical sensorineurological involvement in early hypothyroidism which can be assessed by Electroneuromyogram, need to be intervened as early as and can be reversed by treatment.

These results are in contrary to the study of A. Misiunas et al (1995) who observed no differences in the Sensory nerve conduction velocities of these groups. However, the median nerve showed significant decrease (p < 0.05) in amplitude in subclinical hypothyroid patients as compare to controls. In another study of Jalilzadeh SH et al (2006) done in Iran showed that there are no significant alterations in peripheral nerve function in patients with subclinical hypothyroidism.

Deposition of glycosaminoglycans in nerves and soft tissues surrounding them with resultant axonal degeneration and secondary segmental demyelination forms the pathogenic basis of alterations in peripheral nerve function in thyroid hormone deficiency, which is reversible with thyroxine replacement.

In our study we found some extent of electromyographic alterations, even in the earlier stages of subclinical hypothyroidism. Such electrophysiological changes are qualitatively similar to those observed in patients with overt myxedema. As known, the high specialization of neurons and the long distance between the cellular core and the most distal terminals makes the nerves more vulnerable to lesions producing neuroselective terminal degeneration, which usually begin at the longer axons. Such specialization involves the electrical conduction of the nerve impulse and the slow and rapid active transport of micro and macromolecules, both by ortho- and antidromic pathways. The progression of thyroid insufficiency to subclinical hypothyroidism stage correlated with the diminution of the motor and sensory amplitudes in all the studied nerves. These findings agree with the alterations in the rapid axonal transport observed in experimental polyneuropathies in rats, and in patients who have received chemotherapy treatments. In summary, our findings confirm a true subclinical polyneuropathy of probable axonal origin in patients with subclinical hypothyroidism, and correlate the magnitude of the neurological lesion with the degree of thyroid insufficiency. Limitations of our study were that we didn't include all other peripheral nerves & autonomic function tests. While our study gives solid evidence of impairment of median & ulnar nerve conduction parameters, it may come to a definite conclusion if we involve more number of patients.

## CONCLUSION

Nerve conduction study (NCS) is an electrodiagnostic technique to study functional status of the peripheral nerves and establish the type and degree of abnormalities of the nerves. In the middle aged subjects with subclinical hypothyroidism there is increase in latency and decreased in amplitude, duration, area and sensory nerve conduction velocity in patients as compare to controls but the significant changes seen only in latency and SNCV of median nerve (bilaterally) and right ulnar nerve while amplitude of right median nerve only in comparison to controls. According to our results, overt hypothyroidism shows an obvious involvement of the motor and sensory bundles and this is also somewhat visible in subclinical hypothyroidism using electrophysiological measures. Since the

thyroid replacement therapy can effectively alleviate the motor bundle and neuromuscular junction involvement due to slow basal metabolism in hypothyroidism, we believe further studies are needed to compare the post-treatment electrophysiological findings to pre-treatment assessments and conduct clinical evaluation.

## REFERENCES

1. Guilherme Almeida Rosa da Silva, Thiago Boscher da Costa Subclinical hypothyroidism: a review for the clinic physician *Rev Bras Clin Med. São Paulo*. 2013 jul-set; 11(3):289-95.
2. Unnikrishnan AG, Menon UV. Thyroid disorders in India: An epidemiological perspective. *Indian J Endocrinol Metab* 2011; 15:S78-81
3. Thomas Cyriac, Peter Manoharan C. et al. Prevalence of hypothyroidism and its association with anti-thyroid peroxidase antibody among adult sea food consuming population attending a tertiary health care centre in Kerala International Journal of Biomedical and Advance Research 2015; 6(09): 648-655.
4. Dutta Choudhury S. Hypothyroidism - A common Phenomenon. *The Clarion*, [S.l.], v. 1, n. 1; Mar, 2012. Available from: <http://www.clarion.ind.in/index.php/clarion/article/view/14/15>. [Last accessed on 2014Dec29].
5. Hollowell JG et al. Serum TSH, T4 and Thyroid antibodies in United States population (1988-1994): National Health and Nutrition Examination survey (NHANES III). *J Clin Endocrinol Metab* 2002; 87:489-99.
6. Yeasmin S, Begum N, Begum S, Rahman SM. Sensory neuropathy in hypothyroidism: Electrophysiological and clinical findings. *J Bangladesh Soc Physiol* 2007; 2:1-6.
7. Deshmukh V, Behl A, Iyer V, Joshi H et al. Prevalence, clinical and biochemical profile of subclinical hypothyroidism in normal population in Mumbai. *Indian J Endocrinol Metab* 2013; 17:454-459
8. Yuksel G, Karlikaya G et al. Nerve conduction studies, SEP and blink reflex studies in recently diagnosed, untreated thyroid disease patients. *Journal of Neurological Sciences (Turkish)* 2007; 24:7-15
9. Adalet Arıkanoglu, Yaşar A., Ertuğrul Uzar et al. Electrophysiological Examination of the Median and Ulnar Nerve in Patients with Clinical and Subclinical Hypothyroidism: A Case-Control Study *Archives of Neuropsychiatry* 2012; 49: 304-307
10. Emel Oğuz Akarsu, Hürtan Acar, Feriha Ozer et al. Electromyographic Findings in Overt Hypothyroidism and Subclinical Hypothyroidism *Turkish Journal of Neurology* 2013; 19: 128-133 .
11. Adikesavan Balaraman, Gowdhaman Natarajan, B. et al. Study of Nerve Conduction Velocity in Newly Diagnosed Hypothyroid Females *World Journal of Medical Sciences* 9 (4): 198-201, 2013.
12. Misiunas A, Niepomniszcze H, Ravera B et al. Peripheral neuropathy in subclinical hypothyroidism. *Thyroid*. 1995; 5:283-6.
13. Jalilzadeh SH, Bahrami A et al. Nerve Function in Subclinical Hypothyroidism: A Case-Control Study *Int J Endocrinol Metab* 2006; 4:78-83.