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# A study of peripheal nervous system alterations in hypothyroid patients

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***Abstract*---Introduction**: Hypothyroidism is an endocrine disorder of deficient thyroid hormone levels in the circulation. Thyroid hormones are essential for the normal functioning of the brain and nervous system. One of the manifestations of the hypothyroidism is the peripheral neuropathy. **Methods**: This cross sectional study includes 30 hypothyroid patients and 30 normal subjects between the age group of 20 to 60 years. The nerve conduction study was done by using Recorders Medicare System (RMS) EMG EPM2K version-1. Three parameters (latency, amplitude and nerve conduction velocity) of motor and sensory component of three nerves (Median nerve, Ulnar nerve and Peroneal nerve) were compared between cases (Hypothyroidism) and controls (non hypothyroid). Statistical analysis was done by unpaired 't' test and ANOVA with SPSS software for various analysis. **Results**: The nerve conduction velocity is reduced in right median, right and left ulnar and left common peroneal nerves. The latency is prolonged in the right and left ulnar nerve as well as in the peroneal (both right and left) nerve. The amplitude of the nerve conduction action potential of the all the nerves is not significantly reduced. The sensory nerve conduction velocity of the sural nerve is reduced in our present study. There is no correlation between the nerve conduction abnormalities and the age and duration of the disease in hypothyroid patients. **Conclusion**: The prevalence of neuropathy in hypothyroid patients attending the Shri Ramakrishna Institute of Medical Science and Sanaka hospital, Durgapur, West Bengal is 56.66 %. In this study 36.66% hypothyroid patients (11)


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were found to be with carpal tunnel syndrome. The physiological parameters (age and duration of the disease) were not correlated with nerve conduction values. The median nerve was the most affected nerve in the upper limb and the sural nerve was the commonly affected nerve in the lower limb.

***Keywords*---**Hypothyroidism, Nerve conduction study

## Introduction

The thyroid gland is the one of the largest endocrine glands. So it yields its name as it is shield shape in nature. It consists of two lobes connected by an isthmus and located anterior to the trachea. It is 12 to 20 g in size, soft and highly vascular. It secretes thyroxine ($T_4$) and triiodothyronine ($T_3$). These hormones act through the thyroid hormone receptors α and ß by which it plays important physiological role on most of the organs and tissues of the body. An excess production result in hyperthyroidism or deficient hormone secretion leads to hypothyroidism.

### Regulation of $T_3$ and $T_4$:

The anterior pituitary gland secretes the hormone (TSH) Thyroid stimulating hormones along with other hormones. TSH controls the secretion of thyroid hormones ($T_3$ and $T_4$).The normal plasma concentration of TSH is 0.3 to 5 μ U/ml. Its secretion is mainly controlled by two factors: The major stimulant for the secretion of TSH is TRH from hypothalamus. Somatostatin another substance secreted from the hypothalamus inhibits the TSH secretion. The negative feedback mechanism by the thyroid hormones $T_3$ and $T_4$ inhibit the secretion of TRH. The TSH secretion is inhibited by dopamine, another hormone secreted from the hypothalamus. Cortisol and growth hormone also inhibit the TSH secretion.[2]

## Hypothyroidism

Thyroid gland is unable to synthesize and secrete sufficient amounts of thyroid hormone to meet the requirement of the brain and peripheral issues

1. Primary hypothyroidism refers to thyroid failure. This accounts for over 99% of all the cases of hypothyroidism. [3]
2. Central hypothyroidism/ Secondary hypothyroidism is the thyroid failure caused by pituitary or hypothalamic disorders that result in deficient TSH.[3]
3. Overt hypothyroidism describes moderate to severe thyroid failure resulting in high serum TSH levels (TSH >10 μIU/L) associated with low serum concentrations of total thyroxine ($T_4$) or free $T_4$.
4. Subclinical hypothyroidism[4] defined biochemically as association of raised serum TSH (above normal range of 0. 5 to 5 mIU /L) with normal circulating concentrations of free $T_3$and $T_4$.

Increased sensitivity to cold, Hypotonia, Ataxia, remor, dysmetria, Poly neuropathy, Entrapment neuropathy, Slowing voluntary movement, Hypothyroidism is approximately 1% to 2% in women and 0.1% in men[3]. It could

be auto immune disorder, thyroid surgery, radiation therapy pituitary disorder or iodine deficiency. Among all the most common cause is iodine deficiency[3]. it's signs and symptoms [5], [6] are – Dry skin, Muscle pain, tenderness, stiffness, Muscle weakness, Pain and stiffness of joints, Slowed heart rate, Depression, Impaired memory.

**Peripheral Neuropathy:**

One of the manifestations of the hypothyroidism is the peripheral neuropathy. Peripheral neuropathy is divided into three types[7].

1. Mono neuropathy,
2. Mono neuropathy multiplex/mono neuropathy of multiple single nerves&
3. Poly neuropathy

Features commonly observed in sensory and motor poly neuropathy:

**Effects on Nervous System**

If there is a deficiency of thyroid hormone, it will greatly influence the growth of the cerebral and cerebellar cortex, proliferation of axons and branching of dendrites, myelinization and cell migration. So thyroid hormone deficiency should be recognized as early as possible in the post natal life and prompt treatment is inevitable to avoid the irreversible brain damage. Cognitive neurological symptoms are common in myxoedema, in particular a general slowing of cognitive functions with memory impairment and apathy[8].

**Effects on Peripheral Nervous System**

In hypothyroidism mononeuropathy and polyneuropathy are reported in previous studies. The involvement of primarily the myelin sheath has been revealed by some studies, [9,10]but some other studies show the primary axonal damage by the morphological evaluation of the nerve fibers[11,12].

Hypothyroidism affects all peripheral nerves, but more commonly affected nerve is the median nerve which results in carpal tunnel syndrome. The sensory nerve conduction deficit is more during the early stage of neuropathy, the clinical symptoms includes pain, cramps, parasthesia of fingers and limbs. It has been proved since earlier that the thyroid hormone increases the speed and amplitude of peripheral nerve reflexes.

A light and electron microscopic study of peripheral nerve and muscle done on myxoedematous polyneuropathy patients, shows segmental demyelination of the sural nerve with mucinous deposits [10]. 79%of the hypothyroid patient's complaints neuromuscular problems; 38% presented with clinical weakness. Among them 42% had sensorimotor axonal neuropathy and carpal tunnel syndrome were reported in 29% of the patients included in a study done at netherland[13].

**Effects on musculo skeletal system:**

Since 60th century the relationship between hypothyroidism and muscle disease is well known[14,15]. Muscle pain, stiffness, arthralgia, synovial thickening and effusion, myopathy, cramps and stiffness are common features reported by the hypothyroid patients[16]other symptoms includes pseudo myotonia with delayed relaxation of the muscle and prolonged tendon reflex relaxation time.

**Electro diagnostic studies:**

1. NCS- Nerve conduction study
2. EMG –are the two types of electro diagnostic studies. These studies determine whether the neuropathy is due to damage to the axon (Axonal Neuropathy) or myelin (Demyelinating neuropathy) or both.

**Nerve conduction study:**

It is the study that measures the speed of electrical impulse conducted through the nerve. This test is valuable to determine if there is any damage to the nerve or its abnormal conduction velocity. It assesses the amplitude, latency and conduction velocity of an electrical impulse conducted over the nerve to be tested. Where as in case of demyelination slow conduction velocities will be the finding.[17]

**Electromyography (Emg)**

It is another study used to differentiate the muscle and nerve injury. Electromyography refers to recording of action potentials of muscle fibers. three types of activities are studied:
1. Insertional activity
2. Spontaneous activity
3. Voluntary activity.

A fine needle is inserted into the muscle, to compare the amount of the electrical activity during the rest and contraction of the muscle. Both procedures help to detect the presence, location, and extent of diseases that damage the nerves and muscles.[16]

Eslamian F et al[18]evaluated the signs and symptoms of neuromuscular dysfunction in primary hypothyroid patients with the clinical features of mono neuropathy, proximal muscle weakness and sensorimotor poly neuropathy. MarciaW et al[19]studied 16 patients with primary hypothyroidism. The ENMG and NCS findings are:
1. Motor nerve latency prolonged in median nerve and peroneal nerve
2. Ulnar and sural nerve conduction velocity reduced

The neurological complications in hypothyroidism are well proved findings. Another study done during 1980 shows the prevalence of neuropathy in hypothyroid patients ranges from 10% to 70 %. [20]

**Aim and Objectives**

**Primary Aim:** The aim of the study is to analyze the sensory nerve action potentials of two upper limb nerves (median and ulnar nerve) and two lower limb nerves (sural and common peroneal nerve) in hypothyroid patients and non hypothyroid persons. Three parameters of nerve conduction study – latency, amplitude and nerve conduction velocity are analyzed for four nerves in patients and controls.

**Secondary Aim:** To correlate the nerve conduction values with the physiological variables like age and sex of hypothyroid patients.

**Objectives:**
1. To compare the nerve conduction study of the hypothyroid patients with controls
2. To correlate the conduction deficits with duration and severity of the disease.

**Materials and Methods**

After obtaining clearance from Institutional Human Ethical Committee (IHEC) at Shri Ramakrishna Institute of Medical Science and Sanaka hospital, Durgapur, West Bengal the study was started in patients attending Medicine, Endocrinology and Neurology outpatient department of our hospital.

It included 30 cases of hypothyroid patients, of both sexes between the age group of 20 to 60 years. The controls were selected from patients who do not have the thyroid hormone deficiency and attending the medicine and neurology OPD of both sexes of the same age group as cases 20 – 60 years.

**Inclusion criteria:**
1. Age 20-60yrs
2. Hypothyroid patient (TSH>10mIU/L)
3. Both male and female

**Exclusion criteria:**
1. Other possible causes of neuropathy or neuromuscular disease like, DM, Alcoholism, Liver and kidney disease.
2. Familyhistoryof neuropathy
3. Usersof drugsthatcausesneuropathy.
4. Pre-existingneuropathy.

**Results**

Three parameters (latency, amplitude and nerve conduction velocity) of motor component of three nerves (Median nerve, Ulnar nerve and Peroneal nerve) and sensory component of three nerves (Median nerve, Ulnar nerve and Sural nerve) were compared between cases (Hypothyroidism) and controls (non hypothyroid).The physiological data(age, gender, and duration of disease) were correlated with nerve conduction values, considering sum of amplitudes and sum

of Nerve conduction velocities. Statistical analysis was done using SPSS software by unpaired' test and ANOVA for various analysis.

**Comparison of motor component of each nerve:**
Comparison of motor nerve conduction values between hypothyroid patients and non hypothyroid controls. Analysis was done by unpaired students" test. The p value <0.05 was considered to be statistically significant.

**Left Median Nerve (Table 2 and chart 2)**
The proximal latency of median nerve inthecontrolswas3.31±0.33andthat of cases was 3.51±1.13.The increase in the proximal latency in cases was not statistically significant with p value of 0.37. The distal latency of median nerve in the controls was 7.62±0.46 and that of the cases was 7.32±1.41. The decrease of the distal latency in the cases was not statistically significance with p value of 0.27.

The compound motor action potential amplitude of median nerve in the controls was 11.66±3.32 and that of the cases was 12.09±3.94. The increase in the action potential in cases was not statistically significant with p value of 0.64. The nerve conduction velocity (NCV) of median nerve in the controls was 58.66±5.02 and that of the cases was 60.52±4.77. The increase in the nerve conduction velocity of the median nerve in the cases was not statistically significant with p value of 0.14.

**Comparison of Ulnar Nerve of Hypothyroid and Euthyroid Subjects**
**Right Ulnar Nerve (Table 3 and chart 3)**

The proximal latency of ulnarnerveinthecontrolswas2.17 ±0.38 and that of ases was 2.28 ±0.27. The increase in the latency in cases was not statistically significant with p value of 0.35. The distal latency of ulnar nerve in the controls was 6.56 ±0.79 and that of the cases was6.69 ±0.58. The increase in the latency in cases was not significant with p value of 0.37.

The amplitude of ulnar nerve in the controls was 11.77±2.43andthat of the cases was12.66±3.55.The increase in the amplitude in the cases was not statistically significant with p value of 0.26.

The nerve conduction velocity (NCV) of ulnar nerve in controls was 59.65±7.15 and that of the cases was 53.65±4.02. The decrease in NCV in cases was highly significant with p value <0.001.

**Left Ulnar Nerve (Table 4 and Chart 4 )**

The proximal latency of ulnar nerve in the controls was 2.32±0.43 and that of the cases was 2.22±0.29. The decrease in the proximal latency in the cases was not statistically significant with p value of 0.30. The distal latency of ulnar nerve in the controls was 7.03±0.63and that of the cases was 6.51±0.46. The decrease in the distal latency of the ulnar nerve in the cases was not statistically significant with p value of 0.30

The amplitude of the ulnar nerve in the controls was 12.03±2.37 and that of the cases was 11.51±2.92. The decrease in the amplitude in cases was not statistically

significant with p value of 0.45. The nerve conduction velocity (NCV) of ulnar nerve in controls was 60.12±6.96 and that the cases was 55.15±5.24. The decrease in NCV in cases was significant with p value < 0.01

**Comparison of Peroneal Nerve of Hypothyroid and Euthyroid Subjects**
**Right Peroneal Nerve (Table 5 and chart 5)**

The proximal latency of peroneal nerve in the controls was 3.44±0.50 and that of the cases was3.11±0.80. The decrease in cases was not statistically significant with p value of 0.06. The distal latency of peroneal nerve in the controls was 10.35±0.88 and that of cases was 9.77±0.80.The decrease in the latency in cases was statistically significant with p value of <0.05.

The amplitude of peroneal nerve in the controls was 6.6±1.92 and that of the cases was 6.08±2.32.The decrease in the amplitude incases was not significant with p value of 0.34. The nerve conduction velocity (NCV) of peroneal nerve in the controls was 47.95±95 and that of the cases was 48.59±5.59. The increase in the conduction velocity of the right peroneal nerve in the cases was not statistically significant with p value of 0.26.

**Left Peroneal Nerve (Table 6 and chart 6)**

The proximal latency of peroneal nerve in the controls was 3.40±0.53 and that of the cases was3.41±0.42. The increase in the proximal latency of the left peroneal nerve in the case was not statistically significant with p value of 0.92. The distal latency of peroneal nerve in the controls was10.28 ±0.81andthatof the caseswas10.72±0.96.The increase in the cases was not statistically significant with p value 0.61. The nerve conduction velocity (NCV) of peroneal nerve in the controls was 48.90±4.74 and that of the cases was 52.96 ±7.20. The increase in the conduction velocity in case was statistical significant with pvalue < 0.05.

**Comparison Of Sensory Nerve Conduction Values Between Hypothyroid Patietns And Non Hypothyroid Controls**
Analysis done by unpaired students 't' test. The p value <0.05 was considered to be statistically significant.

**Comparison of (sensory) median nerveof hypothyroid patients with eu thyroid controls**
**Right median nerve (Table 7 and chart7)**

The latency of median nerve in the controls was 2.38±0.35 and that of the cases was 2.71±1.06. The increase in the case was not statistically significant with p value of 0.10. The amplitude of median nerve in the controls was 61.74±30.63 and that of the cases was 46.80±25.83. The decrease in the amplitude in cases was significant with p <0.05. The nerve conduction velocity (NCV) of median nerve in the controls was 61.03±10.89 and that of the cases was 55.23±14.88. The decrease in the cases was not statistically significant with p value of 0.90.

**Left Median Nerve (Table 8 and chart 8)**

The latency of median nerve in the controls was 2.29 ±0.47 and that of the cases was2.65±1.32. The increase in the cases was not statistically significant with p value of 0.17. The amplitude of median nerve in the controls was 58.23±29.25 and that of the cases was 62.23±25.13. The increase in the cases was not statistically significant with p value of 0.052. The nerve conduction velocity (NCV) of median nerve in the controls was 62.76±10.94 and that of the cases was 58.26±16.17. The decrease in the conduction velocity in the cases was not statistically significant with p value of 0.21.

**Comparison of ulnar nerve of hypothyroid and euthyroid subjects**
**Right ulnar nerve (Table 9 and chart9)**

The latency of ulnar nerve in the controls was 1.87±0.26 and that of the cases was 1.71±0.29. The decrease in the latency in cases was not statistically significant with p value 0.08. The amplitude of ulnar nerve in the controls was53.53±28.12 and that of the cases was 65.53±36.33. The increase in the amplitude in cases was not statistical significant with p value of 0.15. The nerve conduction velocity (NCV) of ulnar nerve in the controls was64.10±29.49 and that of the cases was 63.36±9.49. The decrease in the conduction velocity in the cases was not statistically significant with p value of 0.15.

**Comparison of ulnar nerve of hypothyroid and euthyroid subjects**
**Left ulnar nerve (Table 10 and chart 10)**

The latency of ulnar nerve in the controls was 1.91 ±0.42 and that of the cases was 1.71±0.54. The decreased latency of ulnar nerve in the cases was not statistically significant with p value of 0.11. The amplitude of ulnar nerve in the controls was 48.53±2.12 and that of thecaseswas55.00±3.33.The increase in the amplitude of the ulnar nerve in the cases was not statistically significant with p value of 0.08. The nerve conduction velocity (NCV) of ulnar nerve in the controls was 57.63±10.15 and that of the cases was65.76±14.5. The increase conduction velocity incase was not statistically significant with p value of 0.05.

**Comparison of sural nerve of hypothyroid and euthyroid subjects**
**Right sural nerve (Table11 and chart11)**

The latency of sural nerve in the controls was 2.44±0.67 and that of the cases was 2.53±0.73.The increase in the latency in cases was not statistically significant with p value of 0.60. The amplitude of sural nerve in the controls was 12.28±7.48 and that of the cases was 13.30±10.79. The increase in the amplitude in cases was not statistically significant with p value of 0.67. The nerve conduction velocity (NCV) of sural nerve in the controls was 56.70±22.11 and that of the cases was 50.64±14.93. The decrease in cases was not statistically significant with p value of 0.22.

**Left Sural Nerve (Table12 and chart 12)**

The latency of sural nerve in the controls was 2.44±0.57 and that of the cases was 2.44 ±0.52.There was no statistical significance as the p value was 0.99. The amplitude of sural nerve in the controls was 18.28±18.52 and that of the cases was 13.34±8.19. The decrease in cases was not statistically significant with p value of 0.18. The nerve conduction velocity (NCV) of sural nerve in controls was 56.10±13.47 and that of the cases was 45.23±3.97. The decrease in the sural nerve conduction velocity in cases was statistically significant with pvalue < 0.001.

**Comparison of age of the hypothyroid patients with sum of nerve conduction velocites**

Cases were divided into two age groups 20–40 and 41 - 60 groups. Analysis done by unpaired students't' test. Age group 20-40: 18 patients and Age group 41-60years:12patients. The nerve conduction velocity in the patients under age group 20-40 years was 56.71±6.25 and that of the patients under the age group 41-60 years was 62.56±15.71.There was no statistically significant (p value of 0.41) difference between two groups, considering sum of amplitudes.

**Comparison of duration of disease in hypothyroid patients with sum of nerve conduction velocites**

Cases were divided into three age groups as follows:
Group 1: Newly diagnosed patients. There were 5 patients in group 1.
Group 2: duration of disease up to 5 years (19 patients) Group 3: duration of disease >5years to 10years (6 patients). The nerve conduction velocity in the patients under age group1was54.63±4.56.The nerve conduction velocity of the patients under the group 2 was56.98±6.58 and that of group 3 was57.23±6.75.There was no statistically significant difference between the group1and group 2with p value 0.36 , considering sum of conduction velocities. The group 1 and group 3 were compared and it did not show any significant with p value 0.89. The group 2and group 3were compared, there was no statistical significance with p value 0.17.

**The Percent Age Of Median, Ulnar, Sural And Common Peroneal Nerve Involvement In Hypothyroidism**

In 30 hypothyroid patients and 30 controls all the 3 parameters were considered for each nerve (median, ulnar, sural and CPN), and if one parameter was abnormal, the nerve was considered to be involved.

**Results Of Nerve Conduction Studies In Patients: Median Nerve-Motor**
11 patients had abnormal nerve conduction values. 36.6% of median nerve was affected in hypothyroidism.

**Median Nerve-Sensory Component**
5 patients had abnormal nerve conduction values. 16.6% of median nerve was affected in hypothyroidism.

**Ulnar Nerve – Motor Component**
3 patients had abnormal nerve conduction values.10% of ulnar nerve was affected in hypothyroidism

**Sural Nerve**
5 patients had abnormal nerve conduction values. 16.6%ofsural nerve was affected in hypothyroidism
**Peroneal Nerve**

2 patients had abnormal nerve conduction values. 6%of median nerve was affected in hypothyroidism. This study showed that median was the most affected nerve in upper limb and sural nerve was most affected in the lower limb.

**The Most Affected Parameters**

In those with hypothyroidism, (150 nerves studied i.e, 5 nerves of30patients)27 patients had prolonged latencies (18%), 5 patients had Reduced amplitudes(3%)and 53 had decreased NCV(35.33%). In controls 4 had abnormal latencies, 1 had abnormal amplitude and 5 had abnormal nerve conduction velocities. This analysis showed that the nerve conduction velocity is the most affected parameter in hypothyroid induced neuropathy.

Table: 1 Comparison of latency, amplitude and NCV of right median nerve-motor Component between hypothyroid patients and controls

| PARAMETER | GROUP | NUMBER | MEAN±SD | P Value |
|---|---|---|---|---|
| Proximal latency (ms) | Controls | 30 | 3.45±0.38 | 0.39(NS) |
| | Cases | 30 | 3.63±1.03 | |
| Distal latency(ms) | Controls | 30 | 7.80±0.58 | 0.16(NS) |
| | Cases | 30 | 7.44±1.28 | |
| Amplitude (mV) | Controls | 30 | 9.92±1.97 | 0.46(NS) |
| | Cases | 30 | 10.42±3.14 | |
| NCV (m/s) | Controls | 30 | 58.50±4.59 | <0.001* |
| | Cases | 30 | 46.09±8.61 | |

* Statistically Significant NS-Non Significant

Table: 2020 Comparison of latency, amplitude and NCV of motor component of left median nerve between hypothyroid patients and controls

| PARAMETER | GROUP | NUMBER | MEAN±SD | P Value |
|---|---|---|---|---|
| Proximal latency (ms) | Controls | 30 | 3.31±0.33 | 0.37(NS) |
| | Cases | 30 | 3.51±1.13 | |
| Distal latency(ms) | Controls | 30 | 7.62±0.46 | 0.27(NS) |
| | Cases | 30 | 7.32±1.41 | |
| Amplitude (mV) | Controls | 30 | 11.66±3.32 | 0.64(NS) |
| | Cases | 30 | 12.09±3.94 | |
| NCV (m/s) | Controls | 30 | 58.66±5.02 | 0.14(NS) |
| | Cases | 30 | 60.52±4.77 | |

* Statistically Significant NS-Non Significant

Table 3 Comparison of latency, amplitude and NCV of motor component of Right ulnar nerve between hypothyroid patients and controls

| PARAMETER | GROUP | NUMBER | MEAN±SD | PValue |
|---|---|---|---|---|
| Proximal latency (ms) | Controls | 30 | 2.17±0.38 | <0.05* |
| | Cases | 30 | 2.37±0.27 | |
| Distal latency(ms) | Controls | 30 | 6.56 ±0.58 | <0.001* |
| | Cases | 30 | 7.60 ±0.79 | |
| Amplitude (mV) | Controls | 30 | 11.77±2.43 | 0.26(NS) |
| | Cases | 30 | 12.66±3.55 | |
| NCV (m/s) | Controls | 30 | 59.65±7.15 | <0.001* |
| | Cases | 30 | 53.65±4.02 | |

* Statistically Significant NS-Non Significant

Table: 4 Comparison of latency, amplitude and NCV of motor component of left ulnar nerve between hypothyroid patients and controls

| PARAMETER | GROUP | NUMBER | MEAN±SD | PValue |
|---|---|---|---|---|
| Proximallatency (ms) | Controls | 30 | 2.32±0.43 | 0.30(NS) |
| | Cases | 30 | 2.22±0.29 | |
| Distal latency(ms) | Controls | 30 | 7.03±0.63 | <0.01* |
| | Case | 30 | 6.51±0.46 | |
| Amplitude (mV) | Controls | 30 | 12.03±2.37 | 0.45(NS) |
| | Cases | 30 | 11.51±2.92 | |
| NCV (m/s) | Controls | 30 | 60.12±6.96 | <0.01* |
| | Cases | 30 | 55.15±5.24 | |

* Statistically Significant NS-Non Significant

Table: 5 Comparison of latency, amplitude and NCV of right common peroneal Motor nerve between hypothyroid patients and controls

| PARAMETER | GROUP | NUMBER | MEAN±SD | P Value |
|---|---|---|---|---|
| Proximal latency (ms) | Controls | 30 | 3.44±0.50 | 0.06.(NS) |
| | Cases | 30 | 3.11±0.80 | |
| Distal latency(ms) | Controls | 30 | 10.35±0.88. | 0.06(NS) |
| | Case | 30 | 10.24±0.80 | |
| Amplitude (mV) | Controls | 30 | 6.6±1.92. | 0.34(NS) |
| | Cases | 30 | 6.08±2.32 | |
| NCV (m/s) | Controls | 30 | 47.95±95 | 0.26(NS) |
| | Cases | 30 | 48.59±5.59 | |

* Statistically Significant NS-Non Significant

Table 6 Comparison of latency, amplitude and NCV of left common peroneal motor nerve between hypothyroid patients and controls

| PARAMETER | GROUP | NUMBER | MEAN±SD | PValue |
|---|---|---|---|---|
| Proximallatency (ms) | Controls | 30 | 3.40±0.53 | 0.92(NS) |
| | Cases | 30 | 3.41±0.42 | |
| Distal latency(ms) | Controls | 30 | 10.28±0.81 | 0.61(NS) |
| | Cases | 30 | 10.72±0.96 | |
| Amplitude (mV) | Controls | 30 | 5.68 ±1.90 | 0.60(NS) |
| | Cases | 30 | 5.90±1.96 | |
| NCV (m/s) | Controls | 30 | 48.90±4.74 | <0.05* |
| | Cases | 30 | 52.96±7.20 | |

* Statistically Significant NS-Non Significant

Comparison Of Latency, Amplitude And NCV Sensory Component Of Right Median Nerve Between Hypothyroid Patients And Controls

| PARAMETER | GROUP | NUMBER | MEAN±SD | Pvalue |
|---|---|---|---|---|
| Proximallatency (ms) | Controls | 30 | 2.38±0.35 | 0.10(NS) |
| | Cases | 30 | 2.71±1.06 | |
| Amplitude (mV) | Controls | 30 | 61.74±30.63 | <0.05* |
| | Cases | 30 | 46.80±25.83 | |
| NCV (m/s) | Controls | 30 | 61.03±10.89 | 0.90(NS) |
| | Cases | 30 | 55.23±14.88 | |

* Statistically Significant NS-Non Significant

Table: 8 Comparison of latency, amplitude and ncv of sensory component of left median nerve between hypothyroid patients and controls

| PARAMETER | GROUP | NUMBER | MEAN±SD | P value |
|---|---|---|---|---|
| Proximallatency (ms) | Controls | 30 | 2.29 ±0.47 | |
| | Cases | 30 | 2.65±1.32 | 0.17(NS) |
| Amplitude (mV) | Controls | 30 | 58.23±29.25 | |
| | Cases | 30 | 62.23±2513 | 0.052(NS) |
| NCV (m/s) | Controls | 30 | 62.76±10.94 | |
| | Cases | 30 | 58.26±16.17 | 0.21(NS) |

* Statistically Significant NS-Non Significant

Table: 9 Comparison of latency, amplitude and NCV of right ulnar Nerve-sensory component between hypothyroid patients and controls

| PARAMETER | GROUP | NUMBER | MEAN±SD | P value |
|---|---|---|---|---|
| Proximallatency (ms) | Controls | 30 | 1.87±0.26 | |
| | Cases | 30 | 1.71±0.29 | 0.08(NS) |
| Amplitude (mV) | Controls | 30 | 53.53±28.12 | |
| | Cases | 30 | 65.53±36.33 | 0.15(NS) |
| NCV (m/s) | Controls | 30 | 64.10±29.49 | |
| | Cases | 30 | 63.36±9.49 | 0.15(NS) |

* Statistically Significant NS-Non Significant

Table: 10 Comparison of latency, amplitude and NCV of left ulnar nerve-sensory component between hypothyroid patients and controls

| PARAMETER | GROUP | NUMBER | MEAN±SD | Pvalue |
|---|---|---|---|---|
| Proximallatency (ms) | Controls | 30 | 1.91±0.42 | |
| | Cases | 30 | 1.71±0.54 | 0.11(NS) |
| Amplitude (mV) | Controls | 30 | 48.53±2.12 | |
| | Cases | 30 | 55.00±3.33 | 0.08(NS) |
| NCV (m/s) | Controls | 30 | 57.63±10.15 | |
| | Cases | 30 | 65.76±14.54 | 0.05(NS) |

* Statistically Significant NS-Non Significant

Table: 11 Comparison of latency, amplitude and NCV of right sural nerve (sensory) Between hypothyroid patients and controls

| PARAMETER | GROUP | NUMBER | MEAN±SD | Pvalue |
|---|---|---|---|---|
| Proximallatency (ms) | Controls | 30 | 2.44±0.67 | |
| | Cases | 30 | 2.53±0.73 | 0.60(NS) |
| Amplitude (mV) | Controls | 30 | 12.28±7.48. | |
| | Cases | 30 | 13.30±10.79 | 0.67(NS) |
| NCV (m/s) | Controls | 30 | 56.70±22.11 | |
| | Cases | 30 | 50.64±14.93 | 0.22(NS) |

* Statistically Significant NS-Non Significant

Table:12 Comparison of latency, amplitude and NCV of left sural nerve (sensory) component between hypothyroid patients and controls

| PARAMETER | GROUP | NUMBER | MEAN±SD | Pvalue |
|---|---|---|---|---|
| Proximallatency (ms) | Controls | 30 | 2.44±0.57 | 0.99(NS) |
| | Cases | 30 | 2.44 ±0.52 | |
| Amplitude (mV) | Controls | 30 | 13.34±8.19 | 0.18(NS) |
| | Cases | 30 | 18.28±18.52 | |
| NCV (m/s) | Controls | 30 | 56.10±13.47 | <0.001* |
| | Cases | 30 | 45.23±3.97 | |

* Statistically Significant NS-Non Significant

**Discussion**

Hypothyroidism is deficient thyroid hormone levels in the circulation. It can affect multiple system in our body. including nervous system, musculoskeletal system, cardiovascular system, respiratory system, gastrointestinal system, reproductive system and genitourinary system. Thyroid hormones are essential for the normal functioning of the brain and nervous system[8].

Endocrine manifestations depend on the cause of the disease, duration and severity of hypothyroidism. Nerve conduction study (NCS) provides the greatest help in assessing the peripheral nerve disorder. Prolonged nerve conduction time, decreased amplitude and longer latencies are the well documented features of neurological findings in hypothyroidism and that can be reversed with treatment[31]. More common presenting feature is the carpal tunnel syndrome with 29% incidence[13].The connective tissues of the tendon get thickened and entrap the median nerve, which is the reason for the carpal tunnel syndrome.

In our present study we find that the nerve conduction velocity is reduced in right median, right and left ulnar and left common peroneal nerves. Somey G et al [26]reported slowed nerve conduction velocity in median, ulnar and sural nerves. The latency is prolonged in the right and left ulnar nerve as well as in the peroneal (both right and left) nerve in our present study. In the right ulnar nerve both the proximal and the distal latencies are prolonged, where as in left ulnar the distal latency is prolonged. The distal latency of the both side of the peroneal nerve is abnormally increased. A study done by Etorre Beghi et al[33] showed the most commonly affected parameter was the increased distal latency of the peroneal nerve with incidence of 36%.

The amplitude of the nerve conduction action potential of the all the nerves included in our study is not significantly reduced. Jane Martin[36] reported in their study that they found the sensorimotor axonal neuropathy in their patients with nerve conduction abnormalities. The following three types of pathological changes can affect the impulse conduction in a nerve[21],

1. Axonaldegeneration
2. Axonalregenerationand
3. Demyelinationor remyelination.

If the entire neuron is damaged that leads to the death of the neuronal cell body. Hence the axonal degeneration occurs, which can also occur as a 'dying back' phenomenon in the most distal part of the nerve[21]. The conduction velocity is a measure of the faster conducting fibres. The loss will be random, that is even 75%of the axonal Population is reduced, many of the quite fast conducting fibres will be functionally active and the conduction velocity be mildly altered[39].

The sensory nerve conduction velocity of the sural nerve is reduced in our present study. Ploalapenza et al[20] also showed the decreased sensory conduction velocity of the sural nerve. Dyck and Lambert[9] studied the sural nerve biopsy by an electron microscope and demonstrated both axonal degeneration and segmental demyelination with remyelination.

Demyelination is due to the loss of the myelin sheath of the axon, where the axon tubule is intact. The functional recovery is better in this demyelination when compared to axonal degeneration. It may be paranodal or segmental demyelination. The former will block the conduction where as the later can only reduce the conduction velocity[21]. In a study done by Gulbun Yuksel[5], 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. In this present study 16 patients found to have carpal tunnel syndrome (53.33%) among them ten patients (33.33%) had bilateral carpal tunnel syndrome. Six patients (20%) had median nerve sensory nerve abnormality. Cruz et al[32] studied the electro neuro myography and neuromuscular findings in 16 primary hypothyroid patients among them 43.7% had CTS. In our present study sural nerve was affected in five patients out of the thirty hypothyroid patients (16%).

In this present study we could not find any correlation between the nerve conduction abnormalities and the age and duration of the disease in hypothyroid patients. Eslamian F et al[18] studied the electro physiological changes in patients with untreated hypothyroidism and stated that they could not find either any significant relationship between age, duration of disease, serum TSH level or the presence of neuropathy or myopathy. Based on the duration of the hypothyroidism, we categorized our patients in to three groups as follows:
Group I: Newly diagnosed hypothyroid patients (4), that is on that visit in our hospital, when they are found to be hypothyroid.
GroupII: the patients with duration of diseaselessthan5 years(16) and
GroupIII: patients with duration of disease more than 5years(10).

In our study there is no statistically significant difference in nerve conduction values between the three groups of duration. But we found that two out of four newly diagnosed hypothyroid patients have carpal tunnel syndrome either bilaterally or unilaterally. Age and duration of the disease do not correlate with the changes in the nerve conduction parameters. By this nerve conduction study it is found that 36.66% of hypothyroid patients have neuropathy. On analysis of the nerve conduction study values of the three (median, ulnar and sural nerve) nerves on patients and controls the findings are follows:

a) 36.66% of hypothyroid patients show electrophysiological changes suggestive of neuropathy

b) 20% of the patients (6) show sensory abnormality in the median nerve conduction, 16.66% patients (5) show abnormal in the sural nerve .so the upper limb is more affected than the lower limb considering the sensory component, according to our study.
c) Considering the parameters most affected, the latency is the most affected parameter (18%), next is the amplitude (3%). The nerve conduction velocity is reduced in patients (35.33%). Amplitude measures are important in sensory nerve conduction evaluations.[21.] The nerve conduction velocity in turn is depend mainly on the faster conducting nerve fibre, even if maximum number of nerve fibres get affected, the presence of few faster conducting fibre carry the conduction and the result will be disproportionate to the affected fibres[21].

Both latency and conduction velocity depend on the intact, myelinated nerve fibre as the myelin and node are essential for the fast action potential propagation. In contrast, the amplitude of the wave form depends primarily on the number of the axons functioning within the nerve. Slowing conduction velocity or prolongation of latency usually implies demyelinating injury, while loss of amplitude usually correlates with axonal loss or dysfunction[39]. 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.

**Conclusion**

The prevalence of neuropathyis 56.66 % among the hypothyroid patients attending the Shri Ramakrishna Institute of Medical Science and Sanaka hospital, Durgapur, West Bengal 36.66% of the hypothyroid patients (11) were found to be with carpal tunnel syndrome. The physiological parameters (age and duration of the disease) are not correlated with nerve conduction values. The median nerve is the most affected nerve in the upper limb and the sural nerve is the commonly affected nerve in the lower limb.

Estimation of the nerves conduction values can be considered as a useful parameter in the diagnosis and evaluation of the neuropathy in hypothyroid patients. The presence of carpal tunnel syndrome without clinical neuropathy, suggests that nerve conduction study can be carried out as a routine investigation to find out the electrophysiological alterations without clinical presentation in hypothyroid patients.

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