A Study of Nerve Conduction Velocity in Newly Diagnosed Hypothyroid Females

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Abstract: Hypothyroidism is a common endocrinological disorder affecting females produce variety of manifestations of peripheral neuropathy which affects peripheral nervous system namely motor, sensory and mixed nerves producing chronic disability. This peripheral nerve involvement begins at the early phase of disease by the time of diagnosis. We have hypothesized that there is peripheral nerve involvement in the early phase of hypothyroidism and compared nerve conduction of Medial (mixed nerve) and Sural Nerve (sensory nerve) of newly diagnosed Hypothyroid females with that of the healthy females. It is clearly that there is no greater nerve conduction and disturbances in Motor Nerve (Conduction Velocity, F Response in Median Nerve) but significant reduction in sensory Nerve conduction (Latency, Amplitude, Duration, Area, Conduction Velocity in Median and Sural Nerve). Statistical analysis done by t test using SPSS software version 15. p < 0.05 considered significant. 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.

Key words: Hypothyroidism, Nerve conduction study

INTRODUCTION

Hypothyroidism is a clinical disorder due to the deficiency of Thyroid hormone. This Hormone is a key regulator of Cellular metabolism in our body. This deficient state is estimated to affect 3.8 – 4.6 % of general population, with four times common in women. Data shows that subclinical state ranges from 3 – 8% [1]. This Hypothyroid state is usually asymptomatic / mild symptoms in the early phase while associated with number of symptoms later affecting skin, heart, endocrine, brain and nerves.

Thyroid hormones exert multiple effects on the neuromuscular system and the brain, with the most important being their role in stimulating the development and differentiation of the neuromuscular system and brain in foetal and neonatal life [2]. Usually hypothyroidism has both central and peripheral nerve involvement [3]. This peripheral polyneuropathy, a progressive nerve disorder, to become chronic disability may be due to the defect in axons, nerve cell body or myelin sheath [4]. It usually manifests as numbness, paraesthesia, weakness, fatigue, loss of reflexes, loss of vibration. Most of the neuropathy remain latent in the early phase of disorder. This latent subclinical neuropathy can be investigated using Electroneuromyogram. Electroneuromyogram is a noninvasive electrodiagnostic study of muscle and nervous system [5]. It assesses the functional integrity of sensorimotor electrical conduction. This requires a lot of cooperation from participants in the study.

Motor Nerve Conduction Study: Motor NCS performed by electrical stimulation of a peripheral nerve and recording from a muscle supplied by this nerve, characterized by its Latency, amplitude, duration, area and conduction velocity.
Latency in milliseconds (ms) is the time from the onset of stimulus to the point of takeoff from baseline, is an index of speed of impulse travel [6]. Size of the response called amplitude (in mV), measured from the baseline to the top of the motor response. Conduction velocity (in M/s) reflects the fastest motor axons [5].

$$CV (\text{M/s}) = \text{Distance (mm)} / \text{Latency prox} - \text{Latency distal (ms)}$$

Duration in ms signifies the onset of peak to the peak, while the area denotes the product of amplitude and duration and expressed in mVms. Both parameters reflects the density of nerve fibres conducting the impulse.

**Sensory Nerve Conduction Study:** SNAP is obtained by directly stimulating a sensory nerve and recording directly from it or its branches. Here too, Latency, Amplitude, Duration, Area, conduction Velocity were calculated.

The interpretation of Nerve conduction studies is complex. there may be generalized or focal peripheral neuropathy evident from the nerve affected and changes in latencies, amplitude and conduction velocity [5].

**F-Wave Response:** It evaluates the conduction velocity of nerves between the limb and spinal cord. It is a late response long latency muscle action potential after motor response (M wave) following a mixed nerve supramaximal stimulation. 10-20 F waves were obtained, of which shortest latency F wave are used[6]. We have hypothesized that there is subclinical peripheral neuropathy in newly diagnosed Hypothyroid female.

**Aim and Objective:** To study the motor and sensory nerve conduction in Median, Peroneal and Sural Nerve in Hypothyroid females and compare with euthyroid females.

**Materials and Methodology**

**Control Group:** 20 euthyroid adult female >20 years attending female medicine Out Patient Department.

**Study Group:** 22 newly diagnosed Hypothyroid females >20 years attending Endocrinology Out Patient Department.

**Exclusion Criteria:** Diabetes Mellitus, Alcoholism, Neuromuscular Disorder, Leprosy, Drug Induced Neuropathy, Family H/o Neuropathy, Malignancy, HIV, Liver diseases, Kidney Disease, Myopathy.

The study was approved from the Institutional Ethical Committee, Stanley Medical College. After getting informed and written consent, history taking and examination were performed. The procedure was clearly explained to the subjects recruited for study, conducted at Neurophysiology lab at Stanley Medical College, Chennai.

Nerve Conduction Study was performed by using the Standard RMS ENMG EP MARK II machine. The Latency, Amplitude, duration, area and velocity of motor and sensory nerves were studied. Motor Nerve Conduction of Median and Peroneal Nerve and Sensory Nerve Conduction study of Median and Sural Nerve were recorded. All the studies were done on left side.

Three surface disc electrodes, Recording electrode, Ground electrode were placed after applying jelly to reduce resistance in air between electrode and skin surface. MNCV evaluated by Belly Tendon montage. SNCV were measured by anti-dromic stimulation [5]. The parameters were analysed by statistical tests – “t” test and Pearson Correlation using SPSS software version 17.

**RESULTS**

In Table I, there is a significant increase in weight and BMI in hypothyroid females (n=22) (p<0.05) compared to euthyroid females (n=20). Table II showed non-significant increase in conduction velocity and decrease in F wave response of median nerve (motor) in Hypothyroid. Also shows an increase in conduction velocity and F wave response in peroneal Nerve (motor) in hypothyroid females.

In Table III, sensory nerve conduction in Median Nerve showed significant decrease in area but non significant decrease in conduction velocity in hypothyroid compared to healthy females. In sural nerve, conduction velocity and area has decreased in a significant manner in hypothyroid.

Table IV showed negative correlation between BMI of Hypothyroid and sural nerve amplitude but not significant, while observed positive correlation between BMI and sural nerve amplitude in Control group using Pearson Correlation.

**Table 1: Comparison Of Baseline Characteristics**

<table>
<thead>
<tr>
<th></th>
<th>CONTROL</th>
<th>HYPOTHYROID</th>
<th>P VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE in years</td>
<td>37.8±10.83</td>
<td>30.05±10.77</td>
<td>p =0.07</td>
</tr>
<tr>
<td>HEIGHT in cm</td>
<td>151.9 5.84</td>
<td>154.36 5.28</td>
<td>p=0.07</td>
</tr>
<tr>
<td>WEIGHT in Kg</td>
<td>57.45 11.3</td>
<td>60.59 12.49</td>
<td>P=0.01**</td>
</tr>
<tr>
<td>BMI in Kg/m2</td>
<td>24.7 4.94</td>
<td>25.4 5.3</td>
<td>P &lt; 0.01**</td>
</tr>
</tbody>
</table>

*p< 0.05 - significant **p<0.01 – Highly significant
Table 2: Comparison Of Motor Nerve Conduction Between Hypothyroid And Control Females

<table>
<thead>
<tr>
<th></th>
<th>Control (n=20)</th>
<th>Hypothyroid (n=22)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Velocity (M/s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median Nerve</td>
<td>57.81±5.6</td>
<td>59.89±4.5</td>
<td>0.06</td>
</tr>
<tr>
<td>Peroneal Nerve</td>
<td>49.25±2.85</td>
<td>49.6±3.99</td>
<td>0.1</td>
</tr>
<tr>
<td>F Response</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median Nerve</td>
<td>24.9±2.04</td>
<td>24.22±1.75</td>
<td>0.08</td>
</tr>
<tr>
<td>Peroneal Nerve</td>
<td>42.5±3.36</td>
<td>42.9±3.23</td>
<td>0.20</td>
</tr>
</tbody>
</table>

*P < 0.05 significant, **p< 0.01 highly significant

Table 3: Comparison Of Sensory Nerve Conduction Between Hypothyroid And Control Females

<table>
<thead>
<tr>
<th>Sural Nerve</th>
<th>Control</th>
<th>Hypothyroid</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latency (s)</td>
<td>2.58±0.4</td>
<td>2.41±0.28</td>
<td>0.21</td>
</tr>
<tr>
<td>Amplitude (mv)</td>
<td>23±11.7</td>
<td>16.6±6.4</td>
<td>0.16</td>
</tr>
<tr>
<td>Duration (ms)</td>
<td>2.78±0.54</td>
<td>2.47 ±0.42</td>
<td>0.24</td>
</tr>
<tr>
<td>Area (mv. ms)</td>
<td>22.9±20.1</td>
<td>11.94±5.6</td>
<td>0.02*</td>
</tr>
<tr>
<td>Conduction Velocity (M/s)</td>
<td>54.43±7.16</td>
<td>53.99±5.95</td>
<td>0.02*</td>
</tr>
</tbody>
</table>

*P<0.05 significant **p <0.01 Highly significant

Table 4: Correlation Between BMI And Sural Nerve Amplitude

<table>
<thead>
<tr>
<th>BMI Kg/ M²</th>
<th>Control</th>
<th>Hypothyroid</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>r = 0.266</td>
<td>0.257</td>
</tr>
<tr>
<td>Hypothyroid</td>
<td>r = -0.393</td>
<td>0.05</td>
</tr>
</tbody>
</table>

*P < 0.05 significant

**DISCUSSION**

The present study showed that there is subclinical peripheral nerve involvement in new hypothyroidism. There were no changes in motor nerve conduction velocity in our study unlike Schutt et al. [7] who had shown a decreased motor nerve conduction velocity. Parallel to the study by O Malley et al. [8] found that the sensory threshold were elevated and suggested that it seem to be reliable reflectors of hypothyroid nature. F wave response done in median and peroneal nerve within normal limits contrary to Udayakumar et al. [9]. Sensory nerve Conduction showed an overall decrease in conduction in hypothyroid females compared to control. This decrease is well appreciated and significant in conduction velocity of sural nerve and area of both sural and median nerve. This also correlated with study done by Ruud F Duyff et al. [10, 11] and O Malley et al. [8]. Similarly, conduction velocity and amplitude decreased in Lai et al. [12] also It is well known that conduction velocity which denotes fastness with which nerve signal spreads, determined by myelination, diameter and length of the axon [5]. It is well established that thyroid hormones have profound effects on mitochondrial oxidative activity, synthesis and degradation of proteins, sensitivity to catecholamines, differentiation of muscle fibres, capillary growth and level of antioxidant enzymes and compounds [13]. Demyelination due to oxidative damage to myelin membrane or oligodendroglial cells may result in decrease in nerve conduction velocity [4]. As per Abbott RJ et al. [14] conduction delay in hypothyroid predominantly due to subnormal temperature prevailing in this disorder. Also Fall in thyroxine hormone has decreased membrane excitability by decreasing the sodium entry responsible for shoot up of action potential due to hyponatremia.

Involvement of sensory may be due to axonal degeneration of sensory nerve. It is identified that sensory nerve are affected earlier than motor. But it is not clear why sensory nerve is affected earlier than motor nerve.

We know that obesity, characterized by increase in adipose tissue is a type of subclinical inflammation which causes release of free radicals that injure nervous tissues. This deficiency of thyroid hormone results in increased deposition of adipose tissue. In addition to other causes, this excess adiposity also acts an important factor affecting nerve conduction depicted as in Fig. 1. Hence, the correlation between increased BMI and lower sensory Nerve Amplitude should be taken into account in clinical practice.
CONCLUSION

The study clearly depicts the peripheral neurological involvement in newly diagnosed hypothyroidism with sensory preponderance. Hence electrophysiological studies can be useful in the diagnosis of subclinical polyneuropathy in Hypothyroid. Since this neuropathy is reversible, it can also be used to test the prognosis of hypothyroidism on L-Thyroxine treatment.

Limitations: Our study has been done with female a subject who needs to be generalized. Also the sample size is small.

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