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Motor Nerve Conduction Studies in Newly Diagnosed Subclinical Hypothyroidism Patients

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Abstract: ***Aim & Objective: Present study was aimed to assess involvement of peripheral nervous system in newly diagnosed & untreated subclinical hypothyroidism patients. Method: The present study included subjects aged 18-65 yrs (60 cases of biochemically diagnosed subclinical hypothyroidism & 60 healthy age matched controls). Motor nerve conduction parameters i.e. distal latencies (DL), compound muscle action potential (CMAP) & motor nerve conduction velocities (MNCV) were recorded bilaterally in median & ulnar nerves using standard protocols & settings. Results: The study showed significantly prolonged distal latencies (DL), reduced compound muscle action potential (CMAP) & decreased motor nerve conduction velocity (MNCV) in median & ulnar nerves.***

Keywords: subclinical hypothyroid; nerve conduction velocity tests

1. 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 (>5µIU/ml) and normal serum free thyroxin (T4) and triiodothyronine (T3) concentrations.[1] It is defined as an oligo-symptomatic or asymptomatic condition with high serum levels of thyroid stimulating hormone (5.5–10 mIU/liter), and normal free T3 andT4 levels. 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.[2, 3, 4,5,6,7] 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. Most of them had shown that deficiency of thyroid hormones cause motor neuropathy by affecting different peripheral nerves but more commonly the median nerve & the frequency and severity of neuromuscular system involvement depend upon the severity and duration of hypothyroidism. Electrodiagnostic 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. This latent subclinical neuropathy can be investigated using Electroneuromyogram which is a non- invasive electro diagnostic study of muscle and nervous system.

2. Material and Methods

The present 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. A prior approval of institutional Ethical Committee was duly taken. In this study, 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:-Subjects unwilling to participate in the study, Subjects having history of systemic diseases causing neuropathies like Diabetes mellitus, Rheumatoid arthritis; Osteoarthritis; Hyperpitutarism. 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. Anthropometric data including height (m), weights (Kg) were taken and body mass index (BMI) was also calculated. 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

The recording procedure 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.

Equipment: Equipment used in electrophysiological assessment of nerve and has essentially a computer with microprocessor for signal acquisition and controlling a stimulator.

Motor Nerve Conduction

Motor nerve conduction velocity (MNCV); motor distal latency(MDL); Area (MA); Duration and compound muscle action potential amplitude (CMAP) were determined from median and ulnar nerves bilaterally; in both upper limb.

Equipment set-up

a) Filter setting: low cut (2Hz); high cut (3 KHz).
b) Sweep speed: 3msec/division
c) Sensitivity: 5mV
d) Stimulus: The surface stimulation of a nerve was a square wave pulse of 100µsec. with rate of 1 Hz intensity of 20mA- 100mA

Electrodes

a) Stimulating electrode- For surface stimulation.

b) Recording electrode-Three types of disc electrodes- active, reference and ground.

Electrode position

a) Stimulating electrode: The stimulating electrodes are placed on the skin overlying the nerve at two different sites along the course of the nerve.
b) Recording electrode: To perform MNCV of Median nerve- Cleaning of thenar area and skin overlying the median nerve at wrist and elbow was done.

Then placement of active electrode was over the belly of abductor pollicis brevis and reference electrode 30 mm distal to the active electrode at middle of the thumb at 1st metacarpophalangeal joint. To perform MNCV of ulnar nerve- Cleaning of hypothenar area and skin overlying the ulnar nerve at wrist and elbow was done. Then placement of active electrode was over the belly of abductor digiti minimi and reference electrode 30 mm distal to the active electrode at base of little finger placed slightly distal to the 5th metacarpo-phalangeal joint. The ground electrode was placed between stimulation and recording electrodes. Then connection of electrodes through the pre-amplifier to the cathode ray oscilloscope (C.R.O.) was done. After placing all electrodes in place, the instrument is set to deliver repetitive stimuli; the stimulus current initially set to 20mA then gradually increased with successive stimuli. A compound muscle action potential (CMAP) appears that grows larger with the increasing stimulus current. Eventually, further increases in current do not cause any change in CMAP amplitude. A stable response is assured if the current is 25% greater than the voltage needed to produce the highest amplitude CMAP. Supramaximal stimulus to median nerve was given first at wrist position (3 cm. Proximal to the distal wrist crease) and then moved to the elbow position (near the volar crease of the brachial pulse).Similarly a supramaximal stimulus to ulnar nerve was given first at wrist position 3 cm. Proximal to distal wrist crease just adjacent to ulnar head) and then moved to elbow position (near the olecranon fossa).As the nerve stimulated, first trace came on screen followed by three more traces of same stimulation site displayed on screen and after getting appropriate recording highest amplitude wave was selected. Wrist position was stored then same procedure repeated in case of wrist position. The compound muscle action potentials were recorded from abductor pollicis brevis and abductor digiti minimi respectively. Measurements of distance (in mm.) between wrist and elbow points of stimulation done to calculate the velocity of nerve impulse conduction in that nerve (in m/sec.)

Interpretation: LATENCY (MDL): In millisecond (ms) is the time from the onset of stimulus to the point of take off from baseline; is an index of speed of impulse travel.

Amplitude (MA): CMAP Amplitude in milivolt (mV) is size of response; measured from the baseline to the top of the motor response. It is most commonly measured from the baseline to the negative peak but it can also be measured from peak to peak. In our study, baseline to peak amplitude in mill volts (mV) was considered.

Duration: In millisecond (ms) signifies the onset of peak to peak.

Area: In mVms denotes the product of amplitude and duration. Both duration and area reflects the density of nerve fibers conducting the impulse.

Conduction Velocity (MNCV): In (M/s) reflects the fastest motor axons. The motor nerve conduction velocity is the measure of the speed of conduction across the nerve which is calculated by dividing the distance between two stimulation points (i.e. cathode of stimulation point 1 to cathode of stimulation point 2) by the difference in latencies of two CMAPs.
{CV (M/S) = Distance (mm) /Latency proximal–Latency distal (ms)}

3. Result

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 1: Comparison of motor 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	2.49±0.46	2.69±0.42	0.0143*
AMPLITUDE	26.83±5.06	26.32±5.02	0.5805
DURATION	15.91±4.26	15.07±3.78	0.2500
AREA	52.82±4.92	51.14±6.57	0.1155
MNCV	53.66±3.14	51.11±4.13	0.0002*
LEFT MEDIAN:			
LATENCY	2.89±0.37	2.98±0.39	0.1972
AMPLITUDE	24.20±3.45	23.06±3.98	0.0963
DURATION	18.34±3.63	18.06±3.61	0.6726
AREA	54.76±4.42	53.92±3.15	0.2330
MNCV	59.74±5.25	59.42±3.55	0.6964

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

Table 2: Comparison of Motor 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	2.83±0.62	3.11±0.98	0.0639
AMPLITUDE	27.52±4.65	27.23±4.01	0.7151
DURATION	17.10±6.07	17.02±3.68	0.9306
AREA	53.49±6.94	53.19±3.73	0.7686
MNCV	61.19±6.06	60.05±4.35	0.2389
LEFT ULNAR:			
LATENCY	2.95±0.37	3.10±0.58	0.0939
AMPLITUDE	26.74±4.25	26.10 ±3.28	0.3577
DURATION	20.69±3.11	19.69±2.50	0.1410
AREA	53.34±7.18	51.38±7.40	0.1436
MNCV	61.11±4.31	60.05±3.55	0.1441

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

Table-1: Compares different motor parameters of median nerve of both side in case and controls showing significant (p- value <0 .05) increase in latency and decrease in motor nerve conduction velocity of right median nerve of patients in comparison to controls.

Table-2: shows comparison of motor parameter of ulnar of both side in patients and controls. There is increased latency and decrease motor nerve conduction velocity in patients as compare to controls but not up to statistically significant level.

4. Discussion

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 ScHt and long-term consequences of a persistent subclinical hypothyroid state are on the rise. Misiunas et al.found (1995) 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 hypothyroidism & there was significantly increased ($p < 0.05$) motor distal latencies (MDL) in patients when compared to the control group. In addition they also found decreased amplitude of compound muscle action potential of motor component of median nerve in their studies. Gulbun Yuksel et al. (2007) performed a study in Turkey and concluded that in subclinical hypothyroid patients median nerve was the most commonly affected nerves with carpal tunnel syndrome being positive in 54.5 % of these patients. A decrease in median and ulnar nerve action potential amplitudes and motor nerve conduction velocities were the other findings in this group. These results are in contrary to the study of Jalilzadeh SH et al. (2006) which showed that there is no significant alterations in peripheral nerve function in patients with subclinical hypothyroidism. Emel Oguz Akarsu et al. (2013) found decreased median and ulnar motor nerve conduction velocity and compound muscle action potential amplitude and increased latency of motor latency in both median and ulnar nerve but the value reached to significance level is of ulnar MNCV. Adhikesavan Balaraman et al.(2013) stated that there is peripheral nerve involvement in the early phase of hypothyroidism and compared nerve conduction of median nerve of newly diagnosed subclinical hypothyroid females with that of the healthy females & found that that there is no greater nerve conduction disturbances in Motor Nerve Conduction Velocity in Median Nerve but significant reduction in sensory Nerve conduction parameters.

5. Conclusion

Nerve conduction study (NCS) is an electro-diagnostic technique to study functional status of the peripheral nerves and establish the type and degree of abnormalities of the nerves. It is now widely used, not only for the precise localization of neural lesions, but also for the accurate characterization of the peripheral nerve functions. In the middle aged subjects with subclinical hypothyroidism all electrophysiological parameters were reduced and latency was increased in median and ulnar nerve as compare to control, in which there was statistically significant (p- value <0 .05) increase in latency and decrease in motor nerve conduction velocity of right median nerve of patients 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.

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