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Original Research Article

Assessment of peripheral neuronal activity with Nerve Conduction Studies in subclinical hypothyroid females from rural area of Bankura district of West Bengal

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Abstract

Objective: Like overt cases, whether subclinical hypothyroidism also causes suppressed neuronal transmission is still debated. In this study, we tried to explore whether neuronal transmission is impaired in peripheral nerves in subclinical hypothyroidism with the help of Nerve Conduction Studies.

Methods: 30 subclinical hypothyroid cases and 30 age sex matched euthyroid control were examined. All the subjects were assessed for Nerve Conduction velocity (NCV). Latency, amplitude of CMAP (Compound Motor Action Potential) and conduction velocity of peripheral nerves like median and ulnar of both hands were considered. Findings were compared between groups by unpaired Students t- test and association among thyroid function parameters and NCV findings were tested by Pearsons' co-efficient of correlation (r value). Every where $P< 0.05$ was considered as significant.

Results: Subclinical hypothyroids showed significantly higher distal latencies but lower conduction velocities of both median and ulnar nerves than the euthyroid controls ($P<0.05$ in each case). Amplitude of CMAP of both the nerves was not significantly different between the groups. Level of T3 was found to have a significant negative correlation with distal latencies of Median and ulnar nerves (r value = -0.51 and -0.38 respectively, $P<0.05$ in each case) whereas a positive correlation with their conduction velocities (r- value = 0.27 and 0.55 respectively, $P< 0.05$ in each case).

TSH however did not show any significant correlation with NCV parameters.

Conclusion: Subclinical hypothyroidism may cause impairment in peripheral nerve conduction but the severity of such neurodeficit is not correlated with the level of TSH but with the level of T3.

Keywords: Subclinical Hypothyroidism, Peripheral Nerve Conduction, Distal Latencies.

1. Introduction

It has been found that hypothyroidism affects overall neuronal activities of the body leading to increased reaction time. Thyroid hormones have marked effects on brain development in early stages of life. The parts of the central nervous system (CNS) most affected by thyroid dysfunction are the cerebral cortex and the basal ganglia. In addition, the cochlea is also affected. Consequently, thyroid hormone deficiency during development causes mental retardation, motor rigidity, and deaf–mutism[1]. Uncontrolled hypothyroidism in adults also leads to subnormal mental activity (as evidenced by poor judgement, sleepiness, and faulty memory). In adult, peripheral neuropathy, entrapment neuropathymay often be the presenting features [2]. However, Most of these features are pertaining to overt hypothyroidism and are dependent on severity and duration of the disease. But whether, neuronal activity, specifically which of peripheral ones, gets suppressed in subclinical hypothyroidism (only biochemically proved by elevated TSH level but normal T3 and T4)is not adequately explored specially in our

geographic area. So in the present study we attempted to assess the peripheral neuronal activity in subclinical hypothyroid subjects with the help of nerve conduction studies and compared the findings with that of an age- sex matched euthyroid control group. Thus our study explored the possibility of arresting neuronal damage even at an incipient stage by correcting the state of hypothyroidism in adult females.

2. Material and Methods

It was a hospital based cross sectional study. Total 60 female subjects were examined of whom 30 were subclinical hypothyroid cases and 30 age sex matched euthyroid control. All the subjects were selected from the candidates attending Department of Biochemistry of Bankura Sammilani Medical College for Thyroid function test. Hypothyroid cases and Euthyroid controls were diagnosed on the basis of result of thyroid function test. Written Informed Consent was obtained from each subject before inclusion into the study. Entire process was done with due permission from the Institutional Ethics Committee (Letter No. BSMC/Aca/1753 Dated 01/06/2016) and in accordance with the Helsinki declaration, 1975.

2.1 Inclusion criteria

Female subjectswithsubclinical hypothyroidism in 20 to 50 years of age and age sex matched euthyroid controls without any other systemic illness were included in the study. Serum TSH >4.5 ml U/L with normal T3 and T4 levels were considered to be the yard stick for diagnosing subclinical hypothyroidism [2]. Absolutely normal T3, T4 and TSH level without any major systemic illness was the criteria for recruiting controls.

2.2 Exclusion criteria

Subjects having any systemic illness or endocrinopathy other than hypothyroidism, any known cases of central or peripheral neuropathy, any sort of myopathy, alcoholism, pregnancy or with treatment history with any neurotoxic drug e.g. INH, ethambutol, aminoglycosides, quinodochloretc were excluded. Subjects with treatment history with thyroid hormone supplement or having overt hypothyroidism (both T3, T4 less than normal with elevated TSH) were also excluded.

2.3 Study Design

Willing candidates were interrogated for detailed history of past and present illness as well as treatment. Thyroid function test was performed at the Department of Biochemistry. Subjects were selected on the basis of history and test reports. All the sub clinical hypothyroid cases and their age sex matched controls were assessed for Nerve Conduction Velocity (NCV) testing in RMS EMG EP MARK II machine at the Department of Physiology.

Latency and amplitude of CMAP (Compound Motor Action Potential) and conduction velocity of peripheral nerves like median and ulnar of both hands were taken into consideration. Findings were compared between cases and controls.

2.4 Statistical method used

Value of Individual parameter was expressed as mean and one standard deviationand was compared in groups by unpaired Student's t-test. Association among thyroid function parameters and NCV findings were tested by Pearsons' co efficient of correlation (r value). P< 0.05 was considered as significant.

3. Results

Total 60 participants were assessed, among them 30 were subclinical hypothyroids and 30, age sex matched euthyroid controls. Values of different study parameters (both biochemical as well as NCV parameters) and P- value obtained in unpaired Student's t-test are summarised in table 1.

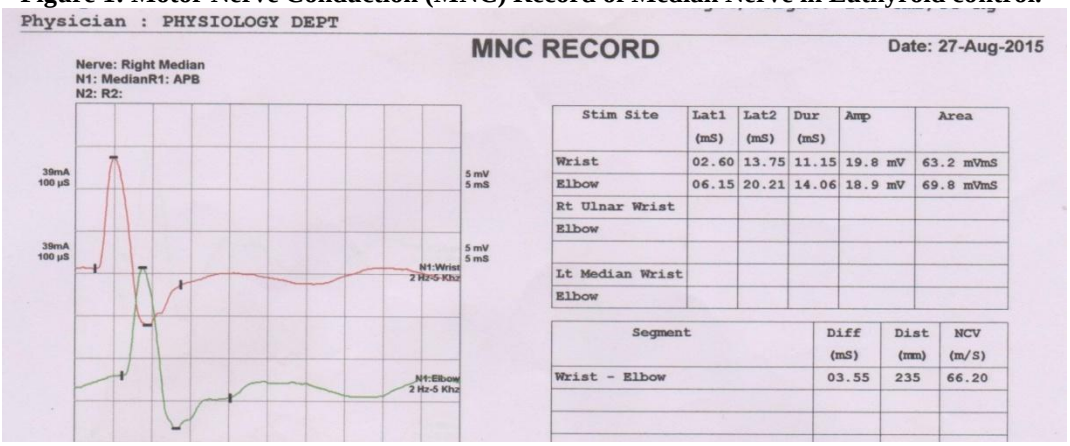
Table 1: Values of different study parameters

Parameters under study	Hypothyroid cases	Euthyroid controls	P -value
Ulnar distal latency	2.02±0.8	1.47±0.41	P= 0.022*
Median distal latency	2.41±0.93	1.87±0.88	P= 0.031*
Ulnal conduction velocity	59.25±4.81	68.09±1.79	P= 0.0001*
Median conduction velocity	55.85±5.82	62.11±2.6	P= 0.0001*
Amplitude of CMAP of Ulnar	10.66±4.33	11.26±2.08	P= 0.24
Amplitude of CMAP of Median	15.08±5.02	16.15±5.6	P= 0.16
Serum TSH	8.94±4.2	1.67±0.47	P= 0.0001*
Serum T3	0.51±0.07	0.77±0.13	P= 0.44
Serum T4	7.3±1.93	9.75±1.81	P= 0.36

*- P<0.05, statistically significant

Among all the NCV parameters, distal latencies as well as conduction velocities of Median and Ulnar nerves were found to be significantly different when compared between cases and controls (P<0.05 in each case). Subclinical hypothyroids showed significantly higher distal latencies but lower conduction velocities of both median and ulnar nerves than the euthyroid controls. But, amplitude of CMAP of both the nerves did not show any significant difference between the groups.

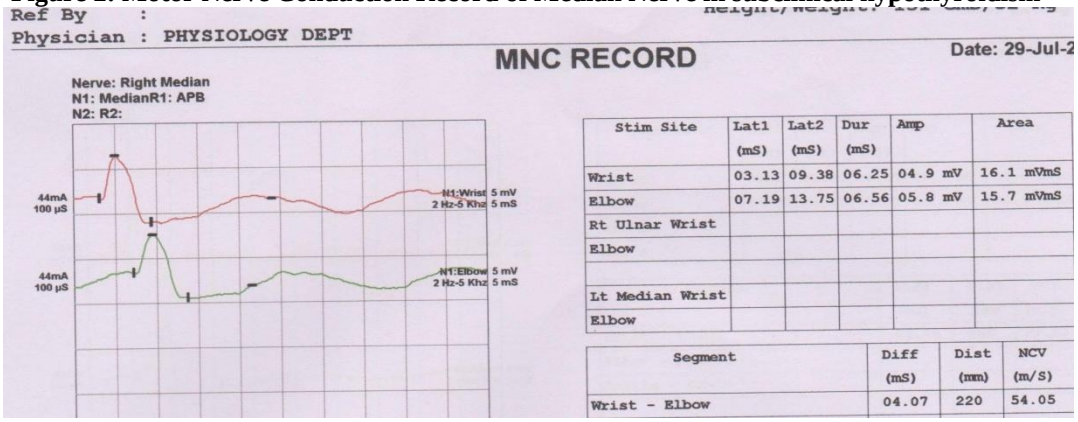
Figure 1: Motor Nerve Conduction (MNC) Record of Median Nerve in Euthyroid control.



Stim Site	Lat1 (mS)	Lat2 (mS)	Dur (mS)	Amp	Area
Wrist	02.60	13.75	11.15	19.8 mV	63.2 mVmS
Elbow	06.15	20.21	14.06	18.9 mV	69.8 mVmS
Rt Ulnar Wrist					
Elbow					
Lt Median Wrist					
Elbow					

Segment	Diff (mS)	Dist (mm)	NCV (m/S)
Wrist - Elbow	03.55	235	66.20

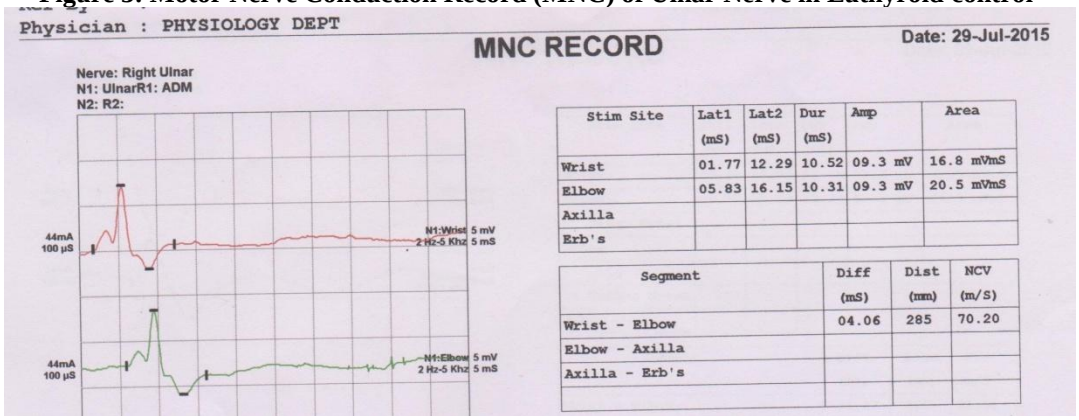
Figure 2: Motor Nerve Conduction Record of Median Nerve in subclinical hypothyroidism



Stim Site	Lat1 (mS)	Lat2 (mS)	Dur (mS)	Amp	Area
Wrist	03.13	09.38	06.25	04.9 mV	16.1 mVmS
Elbow	07.19	13.75	06.56	05.8 mV	15.7 mVmS
Rt Ulnar Wrist					
Elbow					
Lt Median Wrist					
Elbow					

Segment	Diff (mS)	Dist (mm)	NCV (m/S)
Wrist - Elbow	04.07	220	54.05

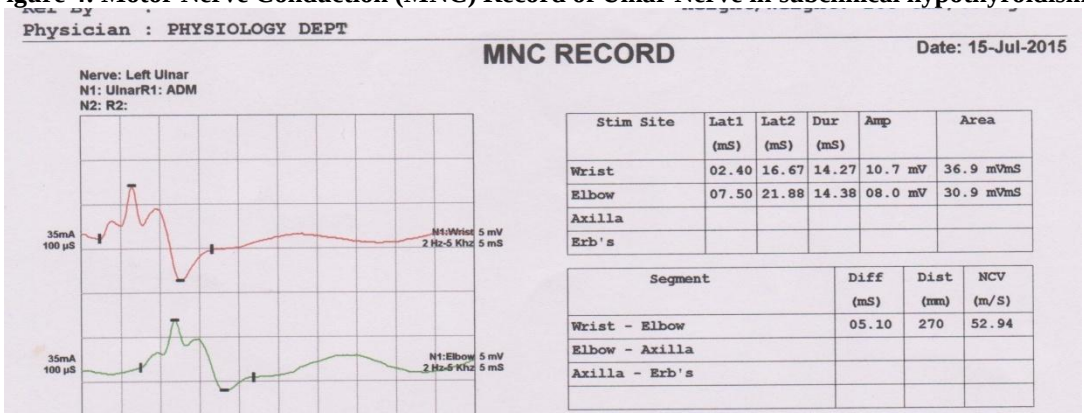
Figure 3: Motor Nerve Conduction Record (MNC) of Ulnar Nerve in Euthyroid control



Stim Site	Lat1 (mS)	Lat2 (mS)	Dur (mS)	Amp	Area
Wrist	01.77	12.29	10.52	09.3 mV	16.8 mVmS
Elbow	05.83	16.15	10.31	09.3 mV	20.5 mVmS
Axilla					
Erb's					

Segment	Diff (mS)	Dist (mm)	NCV (m/S)
Wrist - Elbow	04.06	285	70.20
Elbow - Axilla			
Axilla - Erb's			

Figure 4: Motor Nerve Conduction (MNC) Record of Ulnar Nerve in subclinical hypothyroidism



Stim Site	Lat1 (mS)	Lat2 (mS)	Dur (mS)	Amp	Area
Wrist	02.40	16.67	14.27	10.7 mV	36.9 mVmS
Elbow	07.50	21.88	14.38	08.0 mV	30.9 mVmS
Axilla					
Erb's					

Segment	Diff (mS)	Dist (mm)	NCV (m/S)
Wrist - Elbow	05.10	270	52.94
Elbow - Axilla			
Axilla - Erb's			

Regarding the correlation among thyroid function and NCV parameters, we found significant negative correlation between level of T3 and distal latencies of Median and Ulnar MNC. Coefficient of correlation (r value) were -0.51 and -0.38 respectively, P<0.05 in each case.

Both Median and Ulnar conduction velocities also showed significant positive correlation with level of T3 (r-value were 0.27 and 0.55 respectively, P< 0.05 in each case.).

TSH however did not show any significant correlation with NCV parameters.

4. Discussion

Subclinical hypothyroidism is defined as a biochemical state characterized by an elevated serum TSH concentration with concomitant normal serum free thyroid hormones. Though overt hypothyroidism is often found to be associated with significant alterations in neuromuscular transmission, data pertaining to subclinical hypothyroidism in this regard is not adequate. There are some school of thoughts who consider subclinical hypothyroidism to be a state of mild thyroid failure associated with a number of neuro-muscular disorders like abnormal myocardial contractility, skeletal muscle dysfunction and sensory and motor neurological impairment [3]. In our present study we found prolonged distal latencies of peripheral neuronal transmission in median and ulnar nerves and consequently reduced nerve conduction velocities of them. This finding is corroborative with that of Misiunas *et al* [4] who also found an impaired neuronal transmission in hypothyroidism characterized by prolonged median distal latency. Deposition of glycosaminoglycans in nerves and soft tissues surrounding them may lead to degeneration of axon as well as myelin sheath. Consistent with our finding, Uzun *et al* [5] also found an impaired muscle strength and easy fatigability in hypothyroidism (both subclinical and overt) where loss of muscle strength was correlated positively with severity of hypothyroidism. However we didn't find any impairment in amplitude of CMAP of the peripheral nerves which goes against gross axonal damage in subclinical hypothyroidism.

Level of TSH gets elevated as a compensatory mechanism in hypothyroidism which on the other hand helps to normalise thyroid hormone level. Therefore, elevated TSH level in hypothyroidism is not actually a mark of severity of the disease unless it is associated with grossly reduced level of thyroid hormones as well. Biological effects of thyroid hormones on peripheral tissues are dependent on availability of active form of thyroid hormones over there. So, it is the actual deficiency of the thyroid hormones but not only the level of TSH which reflect the clinical severity of hypothyroidism. [6].

Consistent with this fact, we did not find any correlation of TSH level with NCV parameters of both the peripheral nerves, rather a positive correlation of T3 level with conduction velocity and negative correlation with distal latencies of both the nerves were found. Relevantly, some authors suggested the level of TSH as a marker of brain hypothyroidism as it was found to be associated with depressed working memory and neuro cognition but not with peripheral neuronal activities [7]. This is also in agreement with our finding that elevated TSH is not a reflection of peripheral thyroid activity.

Therefore, our study finding suggest that, impairments of peripheral neuronal activity starts even at the sub clinical stage of hypothyroidism but the severity of such impairment may not be reflected in terms of elevated TSH level. Level of T3 (the active form of thyroid hormone) remains the main yardstick to predict the neuronal activity at the periphery.

5. Conclusion

Subclinical hypothyroidism may lead to impairment in peripheral nerve conduction but the severity of such neurodeficit is not correlated with level of TSH, rather with the level of T3. So, even at the incipient stage of hypothyroidism, impairment in peripheral neuronal activity should be sought for with Nerve Conduction Studies so that it can be reverted back with proper thyroid supplement at the earliest.

References

[1]. Ganong's Review of Medical Physiology. 23rd edition. New Delhi: Tata McGraw-Hill, 2009; p.403-5.

[2]. Jalilzadeh SH, Bahrami A, Eftekharosadat B, Mobasseri M, Pezeshki Z. Peripheral Nerve Function in Subclinical Hypothyroidism: A Case-Control study. *Int J Endocrinol Metab* 2006;4:78-83

[3]. Fatourechi V. Upper Limit of Normal Serum Thyroid Stimulating Hormone: A Moving and Now an aging Target? *J Clin Endocrinol Metab* 2007; 92(12): 4560-4562.

[4]. Misiunas A, Niepomniszcze H, Ravera B, Faraj G, Faure E. Peripheral neuropathy in subclinical hypothyroidism. *Thyroid* 1995; 5: 283-6.

[5]. Uzun MK, Tas N, Meray J, Colbay M, Yetkin I. Evaluation of Muscle Strength and Fatigue Using Isokinetic Testing in Hypothyroid Patients. *Turk J Phys Med Rehab* 2013; 59:286-91.

[6]. Meier C, Trittibach P, Guglieimetti M, Staub JJ, Muller B. Serum thyroid stimulating hormone in assessment of severity of tissue hypothyroidism in patients with overt primary thyroid failure: cross sectional survey. *BMJ* 2003; 326:311-312.

[7]. Schraml FV, Goslar PW, Baxter L, Beason-Held LL. Thyroid stimulating hormone and cognition during severe, Transient Hypothyroidism. *Neuro Endocrinol Lett* 2011; 32(3): 279-285.