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Original Research Article

Electrophysiological assessment of auditory transmission by Brainstem Evoked Response Audiometry in subclinical hypothyroidism without any clinical hearing loss

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Abstract
Although overt hypothyroidism is often found be associated with delayed neuronal transmission, subclinical hypothyroidism is not adequately explored in this regard specially in our geographic area. In the present study attempt was made to check whether auditory transmission gets impaired in subclinical hypothyroidism even in absence of clinical deafness. We assessed adequacy of hearing transmission in 30 subclinical hypothyroid candidates without any clinical hearing loss and 30 age, gender matched healthy euthyroid control by Brainstem Evoked Response Audiometry. We found significant prolongation of absolute latencies of wave I and V and inter peak latencies of I-V, III-V and significant reduction of wave V amplitude in subclinical hypothyroidism. We also found significant negative correlation offree T4 (fT4) with absolute latencies of wave I and V and positive correlation with Wave V amplitude. Study also revealed significant negative correlation of serum TSH with absolute latency of wave I and interpeak latency of III-V. Therefore, present study concludes that, auditory transmission may get impaired in subclinical hypothyroidism even in absence of clinical deafness that can be authentically assessed by Brainstem Evoked Response Audiometry. Severity of hypothyroid state may have positive correlation with impairment of auditory transmission.
Keywords: *subclinical hypothyroidism, deafness, Brainstem Evoked Response Audiometry*.

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 hypothyroidism parts of the nervous system most affected are cerebral cortex, basal ganglia and cochlea. Consequently, thyroid hormone deficiency during development causes mental retardation, motor rigidity, and deaf–mutism[1]. Deafness of sensory neural type is the most common otolaryngological manifestations associated with thyroid dysfunction [2]. But in most of the cases, studies were done with overt hypothyroid cases. Whether auditory transmission gets suppressed even in subclinical hypothyroidism (only biochemically proven by elevated TSH level but normal free T3 and T4) in

adults, is not adequately explored specially in our geographic area. In recent times Brainstem Evoked Response Audiometry (BERA) has emerged as a non-invasive objective tool for assessing auditory function especially in uncooperative, unconscious, malingering patients or in children. However, ability of BERA to detect clinically silent cochlear nerve lesions in diseases like sub-clinical hypothyroidism is yet to be explored convincingly. With this background, in our study, we tried to assess auditory transmission by BERA in subclinical hypothyroid patients without any clinical hearing loss and compared the findings with that of an age- gender matched euthyroid control group. Thus our study explored the possibility of neuronal damage in auditory pathway at a very incipient stage of hypothyroidism so that timely remedial measures can be thought of to prevent any future handicap.

Materials and Methods

It was a hospital based cross sectional study. Total 60 participants were examined of whom 30 were subclinical hypothyroid cases and 30 age and gender matched euthyroid controls. All the participants were selected from the candidates attending for 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 and in accordance with the Helsinki declaration, 1975.

Inclusion criteria

Subjects with subclinical hypothyroidism in 20 to 50 years of age and having normal Audiometric findings were recruited as cases and age -gender matched otherwise healthy euthyroid candidates were included as controls. Serum TSH >4.5 mlU/L with normal free T4 (fT4) levels was considered to be the yard stick for diagnosing subclinical hypothyroidism[3]. Absolutely normal free T4 and TSH level without any major systemic illness was the criteria for recruiting controls.

Exclusion criteria

Subjects having any systemic illness or endocrinopathy other than hypothyroidism, any clinical evidence of hearing loss, central or peripheral neuropathy, myopathy, alcoholism, pregnancy or treatment history with any neurotoxic drug e.g. INH, ethambutol, aminoglycosides, quinodochlor etc. 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.

Study Design

All the selected candidates on the basis of history, clinical examination and thyroid function test, were undergone subjective hearing assesment by pure tone audiometry. Candidates with normal Audiometric findings were included in the study. All of them were subjected to BERA testing for objective assessment of auditory transmission.

Study parameters

Thyroid function parameters like freeT4, T3 and TSH; electrophysiologic parameter like absolute latencies of wave I, III and V with inter-peak latencies of I-III and III-V, I-V and amplitude of wave V were explored in the study.

Procedure of BERA

We followed standard technique for recording of BERA .[4]

Statistical calculation: Significance of difference in the mean values of different parameters in two groups was assessed by unpaired Student's "t" test and correlation was checked by Pearson's co-efficient of correlation (r-value). p-value < 0.05 was considered to be significant. All the values were expressed as mean and 1 standard deviation. Calculations were done using SPSS (version 18) and Microsoft Excel soft ware.

Results

Total 60 candidates were investigated among whom 30 were subclinical hypothyroids and 30 were age and gender matched euthyroid controls. Values of different parameters as obtained in cases and controls are given in table 1.

Table 1: values of different parameters as found in two groups with their comparasion

Parameters under study	Hypothyroids	Euthyroid Control	P- value
Free T4 (ng/ml)	0.71 ± 0.21	0.8 ± 0.26	P>0.05
TSH (µIU/ml)	52.83± 44.5	4.8 ± 0.32	P<0.05*
Wave V latency	5.96± 0.2	5.14±0.42	P<0.05*
Wave V amplitude	0.36 ± 0.16	0.62±0.08	P<0.05*
Wave I latency	1.9± 0.23	1.58±0.3	P<0.05*
Wave III latency	3.35±0.32	3.49±0.26	P>0.05
I-III latency	1.35 ± 0.64	1.75± 0.54	P>0.05
III-V latency	2.21± 0.39	1.95±0.34	P<0.05*
I-V latency	4.09± 0.56	3.96±0.51	P<0.05*

* P<0.05= significant

Table 2: Important Correlations among different parameters

Parameters	Co-efficient of correlation (r)	P - value
fT4 and wave I latency	-0.30	<0.05*
fT4 and wave V latency	-0.31	<0.05*
fT4 and wave V amplitude	0.33	<0.05*
TSH and wave I latency	-0.45	<0.05*
TSH and wave V latency	-0.16	>0.05
TSH and wave V amplitude	-.0.05	>0.05
TSH and wave III-V linter peak latency	-0.42	<0.05*

* P<0.05= significant

Figure 1: BERA tracing from a Euthyroid control

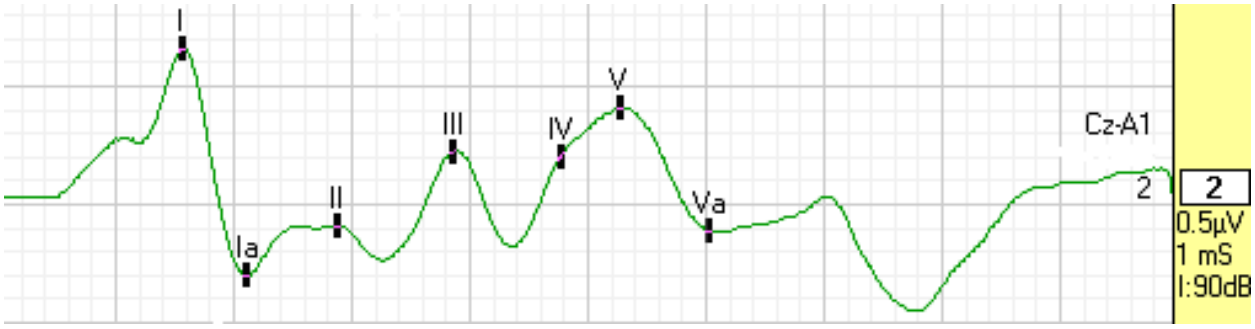
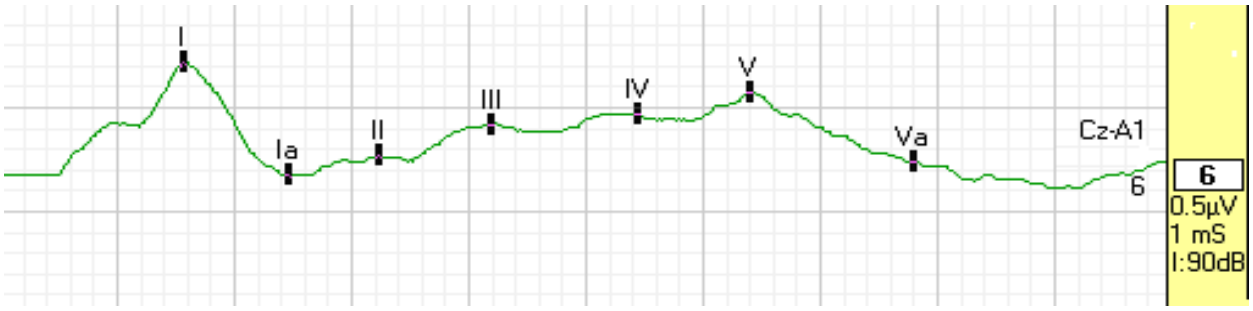


Fig. 2: BERA tracing from a subclinical hypothyroid case



Discussion

Subclinical hypothyroidism is 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 disorder like abnormal myocardial contractility, skeletal muscle dysfunction and sensory and motor neurological impairment[3]. Not many studies are available in this regard pertaining to auditory transmission among the said population. In BERA, which is an objective electrophysiological recording, an evoked potential is created by stimulating different structures of the auditory pathway and recorded using electrodes placed on the scalp. The resultant output is a series of waves that occur within 10 milliseconds of the stimulus presentation. The most consistent and clinically relevant wave forms of BERA include wave I, III and V which are generated from cochlea and distal portion of the auditory nerve, cochlear nucleus and lateral lamniscus and inferior colliculus respectively[5]. Absolute as well as interpeak latencies of the above wave forms are

prolonged in a variety of disorders, including focal damage (demyelination, ischemia, tumors), or diffuse problems (degenerative disorders, posthypoxic damage, etc.)[6]. Our study revealed a significant prolongation of absolute latencies of wave I and V and interpeak latencies of I-V, III-V and significant reduction of wave V amplitude in subclinical hypothyroidism. Our finding is almost similar to that of Kowsalya V et al[2] but the novelty of our study is that we targeted the hypothyroid candidates in its subclinical stage which is more incipient and having potential to get normalized without any lingering effect on neuronal function. Normal levels of thyroid hormones are required for proper excitability of the peripheral auditory pathway, thalamocortical projections and auditory processing at the cortical level. Consistent with this fact, we found significant negative correlation of fT4 with absolute latencies of wave I and wave V, and positive correlation with Wave V amplitude. Interestingly we also found significant negative correlation of serum TSH with absolute latency of wave I and interpeak latency of III-V. As TSH is the yardstick for the severity of thyroid failure, higher level of it may denote a more serious deficient state that may provoke a more serious neuronal damage. This may explain our above finding. The changes in BERA could be due to multiple factors like low body temperature, alteration in cerebral metabolism, myxoedematous infiltration, defective myelination and regulator proteins like "otoferlin" and "prestin" which entirely depend upon the metabolic action of thyroxine. Our finding is also supported by that of Goulis DG et al[7] who found an abnormal Stapedial reflex in subclinical hypothyroidism. Similarly, in some other studies by Misiunas A et al[8] and Das P et al[9] peripheral neuropathy was found to be present in subclinical hypothyroidism which is also supportive of impaired neuronal transmission in such cases. In all such studies subclinical hypothyroidism represents mild thyroid failure which may lead to deposition of glycosaminoglycans in nerves and soft tissues surrounding them with resultant axonal degeneration and secondary segmental demyelination forming the pathogenetic basis of alterations in neuronal function in thyroid hormone deficiency. These changes are more probable with high basal level of TSH, which is reversible with thyroxine [8].On the contrary, author like Jalilzadeh SH et al[2] could not find any significant alterations in peripheral nerve function in patients with subclinical hypothyroidism though they could not delineate any obvious reason for that. Therefore, our study concludes that auditory transmission may get impaired in subclinical hypothyroidism even in absence of clinical deafness which can be objectively assessed by Brainstem Evoked Response Audiometry. Severity of hypothyroid state may have positive correlation with impairment of auditory transmission.

Conclusion

Present study concludes that, auditory transmission may get impaired in subclinical hypothyroidism even in absence of clinical deafness that can be authentically assessed by Brainstem Evoked Response Audiometry. Severity of hypothyroid state may have positive correlation with impairment of auditory transmission.

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