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Original Research Article

EVALUATION OF VISUAL EVOKED POTENTIAL IN HYPOTHYROID PATIENTS IN A TERTIARY CARE CENTRE

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ABSTRACT

Background: Hypothyroidism has variable clinical manifestations with central nervous system involvement being more vulnerable than peripheral nervous system. Early detection of central nervous system involvement in hypothyroidism can be assessed by Visual Evoked Potential, an electrophysiological test. VEP changes in hypothyroidism are reversible on timely treatment and can prevent complications of the disease.

Aim: To assess the central nervous system involvement in hypothyroid patients using Visual Evoked Potential.

Materials and Methods: This descriptive study was conducted on 51 hypothyroid patients and 51 euthyroid subjects between 20-50 years of age. By simple random sampling patients were selected from General medicine and Endocrinology departments with TSH more than 5µU/mL or free T4 less than 0.7ng/dL. Euthyroid people with TSH [0.4 – 5µU/mL, freeT4 [0.7 – 2.5 ng/dL], freeT3 [0.2- 0.5 ng/dL] were taken. VEP was done in hypothyroid patients and these results were compared with euthyroid people.

Results: Mean values of P100 latencies of right and left eye in hypothyroid patients (115.956 ± 6.019 ,116.472 ± 6.234) were significantly prolonged than euthyroid people (97.544 ± 2.897, 98.169 ± 2.988). Mean values of N75 latencies of right and left eye in hypothyroid patients (82.8824 ± 5.870, 83.3706 ± 5.5748) were significantly prolonged than euthyroid people (65.1373 ± 3.240, 65.6373 ± 3.2557). Mean values of N145 latencies of right and left eye in hypothyroid patients (174.380 ± 8.191,174.741 ± 9.074) were not significantly prolonged than euthyroid people (169.982 ±13.965, 170.535 ± 13.086). Mean values of P100 amplitudes of right and left eye in hypothyroid patients (5.2318±1.0292, 5.2212±1.1205) were significantly prolonged than euthyroid people (5.2212 ± 1.1205,8.5990 ± 1.2073).

Conclusion: Hypothyroid patients exhibit delayed visual evoked potentials, suggesting early or subclinical optic pathway dysfunction.

Keywords: Hypothyroidism, Visual Evoked Potential (VEP), P100 latency, Neurophysiology, Thyroid dysfunction.

INTRODUCTION

Hypothyroidism is a common endocrine disorder which results in metabolic dysfunction due to reduction of thyroid hormones. It is a chronic disease which require lifelong follow up and treatment. Hypothyroidism is characterized by a broad clinical spectrum ranging from an overt state of myxedema, end-organ effects and multisystem failure to an asymptomatic or subclinical hypothyroidism.[1]The prevalence of hypothyroidism in the developed world is about 4-5%.[2] The prevalence of subclinical hypothyroidism in the developed world is about 4-15%.[3] The prevalence of hypothyroidism is high in a developing and densely populated countries. In India it is about

10.9%, affecting one in ten adults.[4] In India, hypothyroidism was categorized under the cluster of iodine deficient disorders (IDDs), which was represented in terms of total goiter rates. Ever since India adopted the universal salt iodization program in 1983,[5] there has been a decline in goiter prevalence in several parts of the country. But the prevalence of hypothyroidism still remains high when compared to developed counties.[6]Hypothyroidism has variable manifestations, that may present with a wide variety of symptoms. The prevalence of neuromuscular disorders related to thyroid dysfunction is 20-80%.[7] Hypothyroidism has central and peripheral nervous system involvement. Literature shows many studies about peripheral nervous system involvement in hypothyroidism. Studies of quantitative changes in central nervous system (CNS) in hypothyroidism are scarce. Hypothyroidism is associated with CNS disturbances such as mental retardation, slurring of speech, convulsions, coma.[8] The thyroid hormone deficiency affects the central and peripheral nervous systems because it has effects on gene expression, production of myelin, neurotransmitter system and axonal transportation.[9] Early detection of central nervous system involvement in hypothyroidism can be assessed by Visual Evoked Potential (VEP), an electrophysiological test. VEPs are potential differences recorded from the scalp by electrodes in response to visual stimuli. Measurement of VEP has provided great sensitivity and precision in the assessment of many disorders of the central nervous system.[10] The study of pattern reversal visual evoked potentials measures the amplitude and latency of the transmission of the electric response along a complex central nervous system pathway after stimulation of the retina.[11] Several studies have suggested that VEP can be performed in hypothyroid subjects early in the course of thyroid deficiency to detect central nervous system involvement. A routine and timely assessment of the VEP in hypothyroidism can effectively contribute to the prevention of complications and achievement of treatment goals of hypothyroidism.

Aims and objectives

1. To assess the central nervous system involvement in hypothyroid patients compared using Visual Evoked Potential.

MATERIALS AND METHODS

Present study was a descriptive study conducted in Department of physiology in association with Endocrinology and General Medicine OPD and Department of Neurology in Government Medical College, Kottayam. Thestudy was conducted over a period of twelve months. A total of 51 hypothyroid patients were included for the study along with 51 age and sex matched euthyroid people were also be included as comparison group.

Inclusion Criteria

- Cases included hypothyroid patients, both males and females aged between 20 to 50 years attending Endocrinology and General Medicine OPD and who are willing to participate in the study with serum TSH more than 5μU/mL or Serum free T4 less than 0.7ng/dL.
- Control group included euthyroid people with Serum TSH [0.4 – 5μU/mL], Serum free T4 [0.7 – 2.5 ng/dL], serum free T3 [0.2- 0.5 ng/dL]. Aged between 20 to 50years. [12]

Exclusion Criteria

- Diagnosed cases of Diabetes mellitus, Hypertension, optic neuritis, optic atrophy.
- Patients with clinical symptoms or signs of CNS dysfunction
- Pregnant females.
- Patients with history of eye diseases like glaucoma, Cataract, malignancies
- Drug history - Oculotoxic drugs like anti tubercular drugs (Ethambutol, Isoniazid) amiodarone, tamoxifen and drugs affecting thyroid status like lithium.
- History of Smoking or alcoholism.

Procedure

Scalp electrodes recorded VEPs using the 10–20 International System. he active electrode (Oz) was positioned 2 cm above the inion, the reference electrode (Fz) was on the forehead, and the ground electrode (Cz) was at the vertex. While the other eye was patched, the subjects focused one eye on a central location. With no change in brightness, chequerboard designs reversed at a set rate. Each response was amplified and averaged per eye. Separate monocular recordings were made. The N75, P100, and N145 peaks were present in the waveform. P100, which is produced in the occipital cortex, reflected CNS activity with a constant latency (84–105 ms, mean 96 ± 4 ms).

Statistical analysis

Data were entered in MS EXCEL Spreadsheet. The analysis was done using SPSS Software version 16. Latency of P100, N75 & N145 and amplitude P (100) of VEP waveform were described as' mean and standard deviation' for both hypothyroid patients and control. Differences in means of quantitative variables (VEP latencies, amplitude) between two groups were tested using unpaired t test.

RESULTS

Mean age of hypothyroid patients in this study in years was 32.92± 6.352 and control group was 31.29 ± 5.147. Majority of hypothyroid females belongs to age group of 31 to 40 years and hypothyroid males belongs to 20-30 years of age. Out of 51 hypothyroid patients, 35 were female and 16 were male. Females made up 32 of 51 euthyroid persons. The condition was more common in women. Among the hypothyroid patients, 36 were newly diagnosed

and had not received any treatment. The remaining 15 were previously diagnosed and undergoing treatment for hypothyroidism, with 10 on regular treatment and 5 on irregular treatment. The mean duration of treatment was 48.33 ± 30.65 months. About 62.7% of the hypothyroid patients belongs to obese category, 21.6% belongs to overweight whereas majority of euthyroid people belongs to normal BMI. There was statistically significant difference between BMI of hypothyroid and euthyroid people (p<0.001). BMI of hypothyroid patients was greater than euthyroid group. There was prolongation of P100, N75 and N145 latencies for both eyes in hypothyroid patients. It was found that there is statistically significant difference between P100, N75 and N145 values of hypothyroid patients and euthyroid people (p value < 0.001). (Table 1,2,3). Mean values of P100 amplitude of right eye in hypothyroid patients and euthyroid people were 5.2318 ± 1.0292 and 8.5480 ± 1.2077 respectively. Mean values of P100 amplitude of left eye in hypothyroid patients and euthyroid people were 5.2212 ± 1.1205 and 8.5990 ± 1.2073 respectively. Mean amplitude of P100 is reduced in hypothyroid patients. there was reduction of P100 amplitude in hypothyroid patients. There was statistically significant difference between amplitude of P100 values hypothyroid patients and euthyroid people (p value <0.001).

Table 1: Comparison of p100 latency in hypothyroid patients and euthyroid patients

Variable	Hypothyroid patients		Euthyroid subjects		t value	Mean difference	Confidence interval	P value
	Mean	SD	Mean	SD				
P100 latency (ms) right eye	115.955	6.0191	97.544	2.897	19.684	18.411	16.5471 to 20.2764	**<0.001**
P 100 latency (ms) Left eye	116.472	6.234	98.169	2.988	18.907	18.303	16.3736 to 20.2334	**<0.001**

Table 2: Comparison of N75 latency in hypothyroid patients and euthyroid patients

Variable	Hypothyroid patients		Euthyroid subjects		t value	Mean difference	Confidence interval	P value
	Mean	SD	Mean	SD				
N75 latency (ms)right eye	82.882	5.870	65.137	3.240	18.900	17.745	15.879 to 19.614	<0.0001
N75 latency (ms)Left eye	83.371	5.575	65.637	3.256	19.616	17.333	15.934 to 19.532	<0.0001

Table 3: Comparison of N145 latency in hypothyroid patients and euthyroid patients

Variable	Hypothyroid patients		Euthyroid subjects		t value	Mean difference	Confidence interval	P value
	Mean	SD	Mean	SD				
N145 latency (ms) right eye	174.38	8.191	169.982	13.965	1.940	4.398	-0.113 to 8.909	**0.056**
N145 latency (ms) Left eye	174.74	9.074	170.535	13.086	1.886	4.208	-0.224 to 8.636	**0.063**

DISCUSSION

Thyroid hormone is crucial for neuroretinal development, particularly in how it and its receptor isoforms affect retinal cell proliferation and fate decisions during foetal development. Additionally, variations in thyroid hormone levels are believed to influence adult hippocampal neurogenesis. Thyroid problems may induce ocular neuropathy or serve as a risk factor for glaucoma. Visual evoked potentials effectively evaluate demyelinating impacts on visual conduction, likely associated with metabolic and structural changes. The initial engagement of the central nervous system in hypothyroidism is typically asymptomatic and can be identified solely through neurophysiological assessments. Assessments of stimulus conduction by visual evoked potentials facilitate the sensitive and reliable identification of central nervous system involvement in hypothyroidism. In the present study, the mean age of hypothyroid patients was 32.92 ± 6.35 years, slightly higher than controls (31.29 ± 5.15 years). Most hypothyroid females were aged 31–40, while males were 20–30. Out of 51 hypothyroid cases, 35 were female, highlighting the higher prevalence in women consistent with known gender related thyroid susceptibility. In their study, Dubey N et al,[13] noted that 90% of the participants were female and 10% were male in both study groups. A maximum of 67.5% of study participants were aged 41-50 years, whereas a minimum of 3 participants (7.5%) were aged 18-30 years throughout both study groups. This was analogous to the current investigation. A study by Unnikrishnan AG et al,[14]also revealed a higher prevalence of hypothyroidism in females compared to males, particularly in the age group of 46-54 years (13.1%). In the present study obesity was common in hypothyroid patients (62.7%), and 21.6% were overweight, compared to mostly normal BMI in controls. The BMI difference was statistically significant (p < 0.001), reflecting the metabolic

impact of hypothyroidism. Several studies have proved that there is association between hypothyroidism and obesity. Overt hypothyroidism leads to increased body weight by increasing mucin deposits in skin and other organs and by salt and water retention. Compared to the present study, research done by Dubey N et al,[13] the mean BMI in hypothyroid group was 28.60 ± 4.61 while it was 25.93± 3.17 in euthyroid group. VEP analysis in the present study revealed significantly prolonged latencies of P100, N75, and N145 waves in hypothyroid patients ($p < 0.001$), indicating delayed neural conduction in the visual pathway. These findings suggest that hypothyroidism may affect central nervous system function, even in early or subclinical stages, reinforcing the importance of early diagnosis and management. The study conducted by Taisescu CI et al,[15] revealed that hypothyroid individuals had increased latencies for the P100 wave by 17.88% ($p=0.0028$) and for the N75 wave by 9.98% ($p=0.016$), while the duration of the N75 wave was reduced by 26.37% ($p=0.026$). Gautam V et al.[16] also noted that the hypothyroid group exhibited greater VEP delay compared to the euthyroid group in the N75 wave (72.12±6.34 vs. 68.54±4.32).

Jaiswal P et al,[17] similarly pointed out that hypothyroidism cases exhibited increased P100 (VEP) latency in both the right (103.2 ± 12.3 vs. 102.7 ± 6.8 ms) and left eye (101.1 ± 9.1 vs. 96.2 ± 10.7 ms) relative to controls; however, the difference was statistically insignificant. Pinar BB et al,[18] reported in their study that euthyroid individuals had a substantially prolonged P100 latency difference and elevated N75/P100 amplitude compared to the control group ($p=0.014$ and 0.007, respectively). Increased thyroid-stimulating hormone levels correlated with prolonged N75 and P100 latencies. The mean P100, relative P100, and N145 VEP latencies were significantly prolonged, and P100 amplitude was markedly elevated in HT patients compared to controls in the study conducted by Waliszewska-Prosół M et al.[19]

CONCLUSION

Individuals with hypothyroidism showed notable delays in VEP latencies (P100, N75, and N145), suggesting delayed neural conduction along the visual pathway, which may reflect early involvement of the central nervous system, even in subclinical or newly diagnosed hypothyroid patients. These findings highlight the potential of VEP as a sensitive tool for early neurological assessment in hypothyroid individuals. Constraints encompass a limited sample size and absence of prolonged follow-up. The lack of data correlating hormone levels with VEP changes limits insight into the severity of dysfunction across varying degrees of hypothyroidism. Longitudinal studies may be done to evaluate the effect of thyroid hormone replacement therapy on VEP parameters.

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REFERENCES

1. Unnikrishnan AG, Kalra S, Sahay RK, Bantwal G, John M, Tewari N. Prevalence of hypothyroidism in adults: An epidemiological study in eight cities of India. Indian J Endocrinol Metab. 2013;17(4):647–52.
2. Aghini-Lombardi F, Antonangeli L, Martino E, Vitti P, Maccherini D, Leoli F, et al. Thyroid function and prevalence of anti-thyroperoxidase antibodies in a population with borderline sufficient iodine intake: Influences of age and sex. Clin Chem [Internet]. 2006 [cited 2019 Sep 26];52(1):104–11.
3. Hamm RM, Garamella JJ, Harkins KS. Thyroid disease in the elderly. Part 2: Predictability of subclinical hypothyroidism [Internet]. [cited 2019 Sep 26].
4. Bagcchi S. Hypothyroidism in India: more to be done. Lancet Diabetes Endocrinol. 2014;2(10):778.
5. Toteja GS, Singh P, Dhillon BS, Saxena BN, Ahmed FU, Gaya DRPS, et al. Iodine deficiency disorders in 15 districts of India. Indian J Pediatr. 2004;71(1):25–8.
6. Andersson M, Takkouche B, Egli I, Allen HE, de Benoist B. Current global iodine status and progress over the last decade towards the elimination of iodine deficiency. Bull World Health Organ. 2005; 83:518–25.
7. Khaleeli AA, Lawden M, Elia M, Edwards RH. Neuromuscular findings in thyroid dysfunction: a prospective clinical and electrodiagnostic study. J Neurol Neurosurg Psychiatry [Internet]. 2000 [cited 2019 Aug 18];68(6):750–5.
8. Anjana Y, Tandon OP, Vaney N, Madhu SV. Cognitive status in hypothyroid female patients: Event-related evoked potential study. Neuroendocrinology. 2008;88(1):59–66.
9. Sankareswari A, Affiya SL, Vigil T, Naveen S, Chandrasekhar M. Evaluation of peripheral nerve conduction and visual evoked potential in newly diagnosed hypothyroid females. Int J Med Res Health Sci. 2016;5(1):43.
10. Aminoff MJ. Evoked potentials in clinical medicine. N Engl J Med [Internet]. 1982 [cited 2019 Sep 26];306(19):1140–50.
11. Trick GL, Barris MC. Visual evoked potentials to multiple temporal frequencies: Use in the differential diagnosis of optic neuropathy. JAMA Ophthalmol [Internet]. 1991 [cited 2019 Sep 26];109(5):613–20.
12. Shlomo M, Polonsky KS, Larsen PR. Williams Textbook of Endocrinology. 12th ed. Philadelphia: Saunders; 2012. p. 350-51.
13. Dubey N, Rai P, Arora J, Rai N, Budholia PK. A comparative study on visual evoked potential (VEP) wave P100 latency in hypothyroid and euthyroid individuals. International journal of health sciences. 2022;6(S3):3800-10.
14. Unnikrishnan AG, Kalra S, Sahay RK, Bantwal G, John Tewari N. Prevalence of hypothyroidism in adults: An epidemiological study in eight cities of India. Indian J EndocrMetab 2013; 17:647-52
15. Taisescu CI, Biciusca V, Sas L, Camen G, Sas T, Albu C, Taisescu O. Changes of visual evoked potentials in patients with thyroid dysfunction. Rev. Chim.(Bucharest). 2019 Mar 1; 10:961-8.
16. Gautam V, Paudel BH, Lamsal M, Agrawal K, Jha MK, Maharjan S, Thakur D. Visual evoked potentials' responses in hypothyroidism and hyperthyroidism. Int J Res Med Sci. 2019 May; 7:1589-93.
17. Jaiswal P, Saxena Y, Gupta R, Kaushik RM. Pattern reversal visual evoked potential and cognitive functions in subclinical hypothyroid subjects. Journal of Neurosciences in Rural Practice. 2016 Dec;7(Suppl 1):S46.
18. Pinar BB, Muhammet A, Murat B. Evaluation of visual evoked potentials in patients with Hashimoto thyroiditis. Ideggyogyaszati szemle. 2025 May 30;78(5-6):181-8.
19. Waliszewska-Prosół M, Ejma M. Assessment of visual and brainstem auditory evoked potentials in patients with Hashimoto's Thyroiditis. Journal of Immunology Research. 2021;2021(1):3258942.