ORIGINAL RESEARCH PAPER

Volume-7 | Issue-3 | March-2018 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

# AUDIOLOGICAL EVALUATION IN HYPOTHYROID PATIENTS AND EFFECT OF THYROXINE REPLACEMENT THERAPY

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## ABSTRACT

**Aims:** To do the audiological evaluation of patients with hypothyroidism and to assess status of hearing after thyroxin replacement therapy (TRT).
**Materials and Methods:** Two groups were included: a hypothyroidism group (HG, n=50), and a control group (CG, n=50). Parameters studied: anominesic data, duration of hypothyroidism, comorbidities, cochleovestibular symptoms, biochemical and hormonal exams (TSH, FT4 and FT3), pure tone audiometry(PTA), impendence audiometry and BERA as where required.
**Results:** Mean age of the patients in HG was 26.5±10.4 yrs. Male/Female ratio was 2.39. All HG patients had altered TSH values and 8% had diminished T4 values. Cochleovestibular symptoms were more common in hypothyroid patients (48%) than control (20%) P value . Pure Tone Audiometric threshold was found higher in 34% of cases. Sensorineural hearing loss was most common (76.46%) compared to conductive and mixed hearing loss. BERA showed significant prolonged absolute peak latency of wave III, inter peak latency(IPL) of wave I-III and reduced amplitude of wave Ia and Va. After thyroxine replacement therapy there was statistically significant improvement in hearing threshold in 46.42% ears ($p<0.05$), (if≥5dB hearing improvement cosider as significant). The significant improvement was also found in BERA, in amplitude of wave Va. Site of involvement was at several levels, middle ear, cochlear or retro-cochlear.
**Conclusion:** HG patients had more cochleovestibular symptoms, higher audiometric thresholds, increase in latency of wave III, IPLof I-III and reduced Ia and Va ampliude in the BERA. After TRT improvement in hearing threshold and BERA was found.

## KEYWORDS

HG-Hypothyroid groups, CG-Control groups, BERA-Brain evoked response audiometry.

## INTRODUCTION

Thyroid hormone is necessary for normal development of the auditory system[1, 2]. The association between thyroid hormone and hearing development has long been recognized in patients with congenital hypothyroidism (CH), endemic cretinism and thyroid hormone resistance[3,4,5]. Hilger (1956)[6] was the first to audiometrically document the extent of hearing loss in acquired hypothyroidism. The hearing impairment may be conductive, sensorineural or mixed and about half of the cases benefited from thyroid therapy [7,8]. Recent reports held after CH screening programs, indicate that mild hearing loss occurs in up to 20% of CH patients [9,10]. The purpose of the present study was to evaluate hearing impairment in hypothyroid patients of Allahabad and its surrounding areas.

### Patients and Methods

This was a controlled observational study conducted in the Department of Otorhinolaryngology and Head & Neck Surgery in 50 hypothyroid patients from April 2012 to April 2013 after due clearance from the Institutional Ethics Committee.

### Method

All hypothyroid patients were confirmed by estimating reduced FT3 (normal value; 1.4-4.2 pg/dl), FT4 (normal value; 0.71-1.85 ng/dl) below normal range and TSH level (normal value; 0.4-5.4 µIU/ml) above normal range. 50 Subjects were chosen in each group i.e. in Hypothyroid (Group H) and Control group (Group C). Group C were examined to exclude any evidence of physical illness, mental illness, hypertension, diabetes, exposure to loud sound, genetic syndrome, ear disease, type B and C tympanometry curve. All hypothyroid and control group patients coming to the O.P.D were assessed by history, physical/local examination, audiological (free field audiometry/pure tone audiometry, tympanometry, BERA) and bio chemical assessment (FT3, FT4, TSH; blood sugar; lipid profile). General physical and loco-regional examination was done.

Patients older than 60 years, history of prior ear surgery, working in noisy environment, conductive or type B or C type tympanometric curve, history of hereditary hearing loss or genetic syndrome, history of ototoxic medication were excluded from our study. All selected cases were subjected to free field or pure tone audiometry and brain stem evoked response audiometry at first visit. Patients selected for study were given thyroxin hormone for 6 months and were on regular follow-up. During these follow-up visits patients were under audiological assessment pre and post treatment. All the data obtained were analyzed statistically using SPSS (statistical package for social sciences). Student t-test (unpaired and paired) and chi-square test were used where appropriate to test the significance of data. Statistical significance was accepted as $p<0.05$.

## RESULTS

The observations made at the end of the study were, 30 % (15) of patients are males while 70 % (35) are females in hypothyroid group and 36% (18) of patients are males and 64% (32) are females in control group. Mean age of patients in hypothyroid group is 26.5±10.41 yrs (mean +/- SD) and in control group it is 25.54±7.82. Maximum no. of patients were in 12-25 yrs age in both the group.There was no significant difference between mean age of control and hypothyroid group (p value >.05).

Cochleovestibular symptoms reported by control and hypothyroid patients. Maximum no. of cases in control (80%) and hypothyroid (52%) were asymptomatic. In hypothyroid patients 20% had complain of decreased hearing whereas in control group only 8% had complain of decreased hearing. In hypothyroidism 13 (26%) patients complained of tinnitus where as in control group only 6 (12%) patients had complain of tinnitus. Overall cochleovestibular symptoms were more common in hypothyroid patients than control (table no 1).

**Table 1. List of the cochleovestibular symptoms reported by the participants from control groups and hypothyroid patients before and after TRT treatment (6 month).**

| Symptoms | Control (No.) | Hypothyroidism (No.) | |
|---|---|---|---|
| | | Pre-treamtment | post-treatment |
| No Symptoms | 40 | 26 | 40 |
| Tinnitus | 6 | 13 | 05 |
| Hearing impairment | 3 | 8 | 04 |
| Vertigo | 0 | 1 | 00 |
| Hearing impairment + Tinnitus | 1 | 2 | 01 |
| **Total** | 50 | 50 | 50 |

Table 1 shows 26% patients of hypothyroid group had complain of tinnitus before treatment and after treatment only 10% patients had complain of tinnitus (improvement occurred in 61.54% patients). Hearing impairment also improved after treatment in 50% patient, there was 100% improvement in vertigo after the thyroxine replacement therapy. Hearing impairment with vertigo was complained by 4% of patients and after treatment 50% patients became asymptomatic.

In table 2 patients were categorized on the basis of maximum hearing threshold intensity level found either in left or right ear, i.e. if the patient is having different hearing threshold intensity in both ear, patient is grouped in higher threshold intensity group.

In hypothyroidism and control groups hearing impairment was found in 34% and 12% respectively. In which mild hearing loss in 32% of hypothyroid patients in comparison to 10% in control and Moderate

Hearing loss was found in 2% of both hypothyroid and control group

**Table 2. Audiometric threshold of control and hypothyroid patients before treatment (n=50):**

| Threshold intensity (dB) | No. of control | No. of hypothyroid patient |
|---|---|---|
| | | Before treatment |
| <25 | 44 | 33 |
| 26-40 | 5 | 16 |
| 41-60 | 1 | 1 |
| >60 | 0 | 0 |
| **Total** | 50 | 50 |

As shown in table no 3, 50 hypothyroid patients, mean audiometric threshold value in right ear was 24.016±4.979 (dB), compared to mean audiometric threshold of control group in right ear (20.794±4.095). While in left ear mean audiometric threshold value in hypothyroid patients was 23.42±4.036 compared to mean audiometric threshold of control group patients 20.1±2.651. There is statistical significant difference in mean audiometric threshold of hypothyroid patient before treatment and after treatment (p<0.05).

**Table no. 3 Comparison and analysis of mean audiometric threshold before and after treatment of 14 hypothyroid patients.**

| Audiometric Threshold (dB) | | Before treatment | After treatment | P value (paired t test) |
|---|---|---|---|---|
| | Right ear | 30.27±3.932 | 26.471±3.273 | 0.0001 |
| | Left ear | 27.54±4.001 | 25.143±2.144 | 0.008 |

Table no. 4 shows decrease in Absolute peak latencies of wave I, II, III, IV, V and Inter peak latencies of wave I-III, III-V and I-V. However increased amplitude of wave Ia and Va was found in hypothyroid patients after thyroxin replacement therapy. The change in latencies was found not statistically significant (p<0.05) but statistically significant difference was found in amplitude of wave Va.

**Table 4. Auditory Brain Evoked Response Audiometry (ABR) in control group and hypothyroid patient:**

| | | Group C (n=14) | Group H (n=14) |
|---|---|---|---|
| **Absolute peak latencies (msec)** | I | 1.48±0.01 | 1.49±0.01 |
| | II | 2.49±0.01 | 2.49±0.01 |
| | III | 3.65±0.12 | 3.70±0.128* |
| | IV | 4.42±0.10 | 4.44±0.14 |
| | V | 5.25±0.14 | 5.28±0.16 |
| **Inter peak latencies (msec)** | I-III | 1.96±0.06 | 1.99±0.06* |
| | III-V | 1.77±0.19 | 1.77±0.22 |
| | I-V | 3.82±0.20 | 3.83±0.21 |
| **Amplitude (μV)** | Ia | 0.59±0.17 | 0.54±0.18* |
| | Va | 1.06±0.15 | 1.02±0.16* |

P<0.05

## Discussion

A decrease in speed of auditory brain stem responses may because by hypomyelination of the auditory nerve. There are several reports that underline the possibility that parts of the myelination process, including myelin gene expression, may be under the control of TH2 [2].

In our study 55 hypothyroid patients were selected, out of which 50 hypothyroid patients were found to be free from other systemic diseases with mean age 26.5±10.41 yrs. Out of 50 hypothyroid patients 70% were female and 30% male. Maximum no of patients (48%) were in 12-25 year age group. However in control group 64 % were female and 36 % male with mean age 25.54±7.82 and maximum control group were in 12-25 year age group. And There is no statistical significant difference in mean age of control and hypothyroid group (p>0.05 According to Unnikrishan *et al* (2013) [11] significantly higher ($P < 0.05$) proportion of females vs. males (15.86% *vs* 5.02%) and older vs. younger (13.11% *vs* 7.53%), adults were diagnosed with hypothyroidism.

In our study out of 50 patients 8 (16%) patients had subjective hearing loss of insidious onset. The hearing loss was progressive onset. Tinnitus also complain by 13 (26%), vertigo by 1 (2%) and hearing impairment with tinnitus 2 (4%) patients. On otoscopic examination tympanic membrane was found to be retracted in 8 (16%) patients and valsalva was negative in 4 (8%) patients. On tuning fork test (done by 512 Hz) rinnes test was negative in 2 patients. Weber test lateralized in 2 patients, ABC test decreased in 22 ears.

On Pure Tone Audiometry 17 patients were diagnose as hearing loss in which 14 patients were follow up cases of hypothyroidism and were on thyroxine

In our study (Table 1) Cochleovestibular symptoms were reported by participants from both groups 48 % in hypothyroidism and 20% in control group, however, more frequent in those patients with hypothyroidism (p<0.05), 48% patients complain of cochleovestibular symptoms in which tinnitus (26%), decrease hearing (16%), decrease hearing with tinnitus (4%) and 2% patients also complain of vertigo. Most of the patients from the control groups did not report cochleovestibular symptoms (80 %). Our finding similar to Santos et al (2010)[12] Cochleovestibular symptoms were reported by participants from both groups, they were, however, more frequent in those patients with hypothyroidism (p<0.05), highlighting hearing loss (13.33%), tinnitus (16.67%) and vertigo (3.33%). We highlight that 26.67% of these patients had the three associated symptoms (hearing loss, tinnitus, and vertigo). Most of the patients from the control groups did not report cochleovestibular symptoms (73.33%).

We found that (Table 1) after thyroxin replacement therapy 61.54% of hypothyroid patients of tinnitus were improved similar to finding of Malik et al (2002) [13] who reported improvement in 57.14% patients after treatment. Tinnitus could be attributed to Eustachian tube edema as all of them had retracted tympanic membrane and one fourth of them revealed abnormally reduced compliance.

In our study (Table 2) Mild hearing loss was found in 32% of hypothyroid and 10% of control cases where as moderate Hearing loss was found in 2% of both hypothyroid and control group. In study 50 hypothyroid group mean audiometric threshold value in right ear 24.016±4.979 (dB) and left ear 23.4±4.635(dB),compaire to right and left ear in control group (20.794±4.095) and20.1±4.01 respectively. Mean audiometric threshold significantly higher in comparison to control group (P<0.05).

Significant hearing improvement was found in 46.42% of ears after thyroxin replacement therapy in hearing impaired hypothyroid patients. Our results are in agreement with the findings of Malik *et al* (2002) [13] who also found statistically significant improvement in hearing threshold in 30% of ear in which conductive impairment was more common to be improved. But he was not clearly mentioned criteria of hearing improvement.

There was no statistically significant difference (p<0.05) in Absolute peak latencies of wave I, II, IV, V and Inter peak latencies of wave III-V & I-V of control and hypothyroid group but statistically significant difference was found in absolute peak latencies of wave III, Inter peak latencies of wave I-III & amplitude of wave Ia & Va.

Mordechai et al (1981)[14] found that the pattern of ABR was generally characterized by prolonged BSCT (Brain stem conduction time), diminished amplitudes, flattened peaks and poor synchronization. Anand et al in1989 [15], demonstrated reduction of amplitudes of wave I, II and V, and these parameters did not show significant reversibility to normalcy following treatment. Thus their findings clearly indicate that presence of optimal thyroid hormones is required to improve

excitability of neuronal pools (generators) in brainstem particularly for waves III and V. Altered BAEP values were seen in 10 ears from patients with hypothyroidism, with higher absolute latencies of waves I, III and V when compared to the control group; however, only the L-V values were statistically significant ($p<0.05$). Important BAEP changes were also seen by Figueiredo et al. (2003) [16] in patients with subclinical hypothyroidism, stressing the increase in the absolute latency of waves I and V, as well as that of interpeaks LI-III, LIII-V and LI-V.

According to our study (Table 4) there was no statistically significant difference ($p<0.05$) in Absolute peak latencies of wave I, II, III, IV, V and Inter peak latencies of wave I-III, III-V, I-V and amplitude of wave Ia of hypothyroid patients before and after thyroxin replacement but statistically significant difference was found in amplitude of wave Va. Similar to our study Anjana *et al* (2006) [17] reported that, in hypothyroid patients there is decrease in amplitude of wave I while there is significant decrease in amplitude of wave V and there is significant improvement after treatment *i.e* amplitude increases after treatment. This indicates that there is better recruitment of neuronal pool of the generators of these waves of ABR in the brainstem which may further go in favor of subjective hearing improvement.

## Conclusion

In most of hypothyroid patients FT4 , FT3 was within normal range TSH level was increased. Tinnitus (26%), hearing loss (20%) were common symptoms in hypothyroid patients. Cochleovestibular symptoms were more common in hypothyroid patients (48%) than control (20%). In hypothyroid patients sensorineural hearing loss was more common (76.46%) compared to conductive and mixed hearing loss. Sensorineural hearing loss patients showed predominantly cochlear pathology (84.61%) than retro cochlear. After thyroxine replacement therapy most of cochleovestibular symptoms were improved. Tinnitus and hearing impairment was improved in 61.54% and 50% patients respectively. Following thyroxine replacement statistically significant improvement (46.42% of ear) of hearing threshold was observed by PTA. Following thyroxine replacement, significant improvement occurred only in amplitude of wave Va in BERA.

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