RESEARCH ARTICLE

A study of pure tone audiometry in adults with hypothyroidism

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ABSTRACT

Background: Thyroid hormones are important for overall growth and maturation. Hypothyroidism is associated with many symptom complexes, one of them being hearing loss. Aim and Objectives: Evaluating the hearing loss in hypothyroid patients of the age group of 18–45 years and comparing them with those in healthy people. Materials and Methods: A case-control study was conducted in subjects aged between 18 and 45 years, in which 80 hypothyroid cases were selected after proper exclusion and informed consent and 80 age-and sex-matched healthy controls were studied. Hearing loss was assessed by pure tone audiometry. Statistical Package for the Social Sciences version 18 was used for statistical analysis. Results: SNHL was the common type of hearing loss seen. The prevalence of hearing loss was found to be 66.3% in cases. Hearing loss was mild, bilateral, and commonly affected the high frequency. Conclusions: Hypothyroid patients were more prone to sensorineural hearing loss. In patients with thyroid disorders, hearing evaluation helps in the detection of hearing loss earlier and thus treatment could be started.

KEYWORDS: Pure Tone Audiometry; Hearing Loss; Adult Hypothyroidism

INTRODUCTION

Thyroid diseases are prevalent all over the world and are one of the most commonly found endocrinological disorders. In India, there are around 42 million people suffering from thyroid diseases. The manifestations of thyroid disorders can range from small goiters which are harmless to grave life-threatening cancers. The most commonly found thyroid diseases involve deviation from the production of normal amount of thyroid hormones i.e changing from the euthyroid state to either hyperthyroid or hypothyroid state.

Thyroid hormones play a very important role in the overall growth and maturation. Hence, the features associated with hypothyroidism or hyperthyroidism could involve all systems.

The clinical manifestations and the symptom complexes associated with hypothyroidism have been greatly studied ever from 15th century BC. One of the neglected manifestations is hearing loss. Thyroid hormone is necessary for the normal development of the auditory system. We are already aware of the association between hypothyroidism and hearing impairment in patients with congenital hypothyroidism (CH), endemic cretinism, and thyroid hormone resistance. But their association in adult hypothyroidism has been contradictory and hence this study was done to determine whether there is a hearing impairment in acquired hypothyroidism.

The first case of hearing loss in hypothyroidism was reported in 1907.[1] Hearing loss is the diminished acuity to sounds that would be heard normally otherwise i.e hearing loss is said to be present when hearing thresholds of 20 dB or better is in both ears. The terms hearing impaired or hard of hearing refer to the people with a relative inability to hear sound in the speech frequencies. The severity of hearing loss can be classified into mild, moderate, moderately severe, severe as per the increase in the intensity of sound above the usual level required for the listener to detect it. The factors causing hearing loss are exposure to noise, genetics, aging, infections,
birth complications, ear trauma, medications, toxins, etc. As per studies done by Vanasse et al. and Ben-Tovim et al., hearing loss was found in nearly 1/4th of the patients with acquired hypothyroidism when compared to patients with CH which was found to be 35–50%.[2,3]

Thyroid hormones are crucial for the development of cochlea.[4] As a consequence, hypothyroidism affects the integrity of the auditory system. Compiling a few studies done by Post et al., Vant Hoff et al., De Vos et al., Rubenstein et al., hearing loss was found to differ from 11.5 to 95% of the hypothyroid cases as per pure tone audiometry.[5-8] There are conflicting reports on the association of hypothyroidism and deafness. Means et al.[9] in their study found hearing loss in 66.7% of hypothyroid cases. On the other hand, none of the hypothyroid patients complained of hearing impairment as found in studies done by Post et al.[5] Hence, the correlation between hypothyroidism and deterioration in hearing is controversial.

The significance of screening for hearing impairment in hypothyroid patients can be assessed if the prevalence of hearing loss in the same are well established. This leads to increased quality of life in patients with thyroid disorders.

In my study, an attempt was made to ascertain the association between hypothyroid state and hearing impairment.

MATERIALS AND METHODS

After receiving permission from the ethics committee, eighty patients with hypothyroidism and eighty age and sex-matched normal subjects were taken from the Medicine Outpatient Department, hospital staff, and patient bystanders at Government Medical College, Kozhikode after getting their informed consent between July 2017 and June 2018. The age of patients ranged between 18 and 45 years. Hypothyroidism was substantiated by determining serum TSH (above 4.5 µU/ml) and free T4 (below 0.8 ng/dl).

These hypothyroid cases were worked upon in the Audiology laboratory within the Otorhinolaryngology Department, in Government Medical College, Kozhikode. A detailed clinical evaluation (thorough history along with systemic and audiological evaluation) followed by Pure tone audiometry were done to establish the effect of hypothyroidism on hearing. Hearing loss is analyzed by pure-tone audiometry (PTA). PTA ascertains the threshold of hearing of the patient which can be described as the lowest hearing level when the patient acknowledges to at least 50% of auditory stimuli applied.[10] The instrument used in the measurement of auditory threshold is the audiometer. The generated pure-tone audiogram is in common use as a fundamental interpretation of the degree of hearing loss. Audiogram is a plot that represents hearing threshold as a function of frequency.

Data obtained from the hypothyroid patients were compared with those of the euthyroid controls.

Statistical Analysis

The present study is a case-control study. The data obtained were analyzed using SPSS (Statistical Package for Social Sciences) version 18 software of Windows. In this study, $P \leq 0.05$ was taken as the level of significance for all the statistical tests.

RESULTS

Hearing loss, tinnitus, and dizziness were the common cochleovestibular symptoms among the hypothyroid group [Figure 1]. Pure tone audiometry results revealed mild hearing loss in 66.3% of cases, moderate hearing loss in 20% of cases and moderately severe hearing loss in 2.5% of cases [Figure 2]. 53 cases (66.3%) hypothyroid adults had sensorineural deafness, 4 cases (5%) had conductive hearing loss and 5 cases (6.3%) had mixed hearing loss [Figure 3]. Hearing loss was bilateral, mild, and predominantly sensorineural mostly affecting the higher frequencies.

![Figure 1: Otoneurological symptoms in hypothyroid patients in comparison with healthy subjects](image)

![Figure 2: Hearing impairment in hypothyroid cases and healthy controls through Pure tone audiometry](image)
On compiling the data, it is observed that the hypothyroid adults have a higher proportion of bilateral, mild, sensorineural hearing loss affecting the higher frequencies as observed through pure tone audiometry when compared to the healthy subjects.

In my study, 53.8% of patients had subjective bilateral hearing loss. This was similar to the observations of Anand et al. in his studies where he found that 45% of hypothyroid patients had complained of hearing loss. McMohan proposed that this could be due to an actual conductive or sensorineural type of hearing loss or could be due to slowed mentation in the hypothyroid state misinterpreted by the hypothyroid patients as subjective hearing loss. Tinnitus was present in around 20% of patients. This could be due to edema in the Eustachian tube as most of them had retracted tympanic membranes and a few had revealed reduced compliance. This finding is similar to the studies done by Anand et al. who reported tinnitus in 15% of hypothyroid patients. On performing pure tone audiometry, 66.3% had mild hearing loss which was bilaterally symmetrical. Moderate hearing loss was found in 20% while profound or severe hearing impairment was not detected in any hypothyroid patients. Studies done by Devos, Stephen and Bhatia et al. have reported similar findings. 66.3% had sensorineural deafness, 5% had conductive hearing loss and 6.3% had mixed hearing loss similar to the observations of Aggarwal et al. where he found 15% patients with sensorineural, 8% with conductive, and 13% with mixed type of hearing loss, besides, most of them had mild to moderate hearing loss. Adults with hypothyroidism were detected to have sensorineural, conductive or mixed form of hearing loss. In cases having sensorineural or mixed hearing loss, the explanation behind the neural involvement could be the metabolic, biochemical, or morphological changes within the nervous system, which would alter the nerve conduction. The low amounts of thyroid hormones affect the various components of the cochlea, thereby producing sensory deafness. The conductive hearing loss could be because of decreased compliance because of hypertrophy and edema in the eustachian tube and middle ear mucosa leading to eustachian tube catarrh. Meyerhoff mentioned changes within the ossicles and round or oval windows, such as crystallized type of consistency in bone, fusion or distortion of bones like incus and stapes, partial to complete obliteration of oval or round windows as the other possible explanations for conductive hearing loss. The thyroid hormone is vital for the normal growth of the auditory system. Low thyroid hormones lead to a reduction in cell energy production thereby reducing the microcirculation which consequently involves the metabolism and oxygenation of the organ. It also affects structures within the ear. Bhatia et al. confirmed that cochlea was the site of lesion in 34.72% of patients having sensorineural hearing impairment in his study. Schaitzak and Haubrich in their experiments in hypothyroid guinea pigs revealed acid mucopolysaccharides within the scalae of cochleas. Anniko in his studies reported that the tectorial membrane was the first structure to show changes in hypothyroidism. Changes such as alterations in their normal structure, thickening of the basilar membrane, debris in the cochlear duct, enlarged intercellular spaces in stria vascularis along with degeneration of marginal and intermediate cells, degeneration of inner and outer hair cell, irregularities in the tectorial membrane, etc. have been reported in a few studies. The effect of hypothyroidism on cochlear function has been studied in detail in many studies which suggested that hypothyroidism leads to defects in the morphological and neurological development of the organ of Corti proposing that thyroid hormones have a direct influence on the cochlea. These observations help us in concluding that hypothyroidism affects multiple sites in the ear which presents as conductive, sensorineural, or mixed type of hearing impairment. Studies by Vent Hoff and Stuard, Anand et al. and Rubeinstein et al. have reported in their studies that hearing would improve in hypothyroidism following thyroxine therapy. Hearing loss in acquired hypothyroidism was found to be treatable and reversible if a proper replacement therapy was available.

The strength of my study is that pure tone audiometry is a simple and commonly done audiological investigations essential to diagnose the type of hearing loss. It can easily be done among hypothyroid adults and normal subjects. However, tympanometry, otocoustic emission tests, Brainstem evoked response audiometry, etc. would be needed for confirmation of retrocochlear pathology which is not done in this study hence being a limitation.

To conclude, the hypothyroid subjects had significant mild, bilateral sensorineural hearing impairment compared to the normal healthy control group. The hearing impairment was noted maximally with higher frequencies. Even though the relationship between adult hypothyroidism and hearing loss has been controversial, it is now clear that adult hypothyroidism is linked to hearing loss. Because of the
high-frequency nature of hearing loss in hypothyroidism, it commonly goes undetected and unreported. A clinical approach to monitor hearing in hypothyroid patients is therefore important. Early diagnosis and interventions to prevent the worsening of hypothyroidism will thereby reduce the deterioration of hearing.

CONCLUSIONS

The present study was conducted on eighty hypothyroid patients. Clinical examination, laboratory and audiological evaluation were done. It was found that low thyroid hormones affect the ears at various sites thereby producing conductive, sensorineural and mixed types of hearing impairment. The results of the audiological assessment suggested a causal relationship between hypothyroidism and loss of hearing. The sites of lesion within the auditory system are mostly at many levels like within the middle ear, at the cochlear, and the retrocochlear sites.

REFERENCES


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