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Original Research

Assessment of Sensory and Neural Hearing Loss in Children Suffering from Hypothyroidism at a Tertiary Care Center

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ABSTRACT:
Aim: Assessment of Sensory and Neural Hearing Loss in Children Suffering from Hypothyroidism at a Tertiary Care Center
Materials & Methods: This prospective observational study was done in the department of ENT. In all, fifty hypothyroid children ranging in age from one to eighteen years were included in the research, along with fifty children of a comparable age who served as controls. This research was carried out on patients, each of whom had a comprehensive history, ENT examination, and audiological assessment. **Results:** In our research, a total of fifty patients ranging in age from one to eighteen years were included. In the hypothyroid group, the mean age was 9.51 years, whereas the control group's mean age was 11.02 years. 25 of the instances included females, while the remaining 25 involved men. Otoscopy was normal in all of the youngsters when they were evaluated clinically. The hypothyroid group had mean values of freeT3, freeT4, and TSH hormones of 2.69 pg/ml, 1.59 ng/dl, and 31.5 uIU/L respectively, whereas the control group had mean values of 2.61 ng/dl, 1.31 micrgram/dl, and 3.59 uIU/l respectively. **Conclusion:** If a hypothyroid youngster delays therapy for an extended period of time or if their hypothyroidism has been present for a longer period of time, the severity and incidence of hearing loss will be increased. In its early stage, SNHL manifests itself bilaterally and is often only moderate.
Keywords: Hypothyroidism; Pure Tone Audiometry; Sensory Neural Hearing Loss(SNHL)

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INTRODUCTION

Hearing loss and deaf-mutism were reported in residents of endemic goitre areas in the last century, which was confirmed by many recent studies by demonstrating a relationship between iodine intake and auditory functions in children who are living in areas that are deficient in iodine. The relationship between thyroid hormone and hearing sensitivity has been known for a very long time. The butterfly-shaped thyroid gland that sits in front of the trachea is responsible for the synthesis and secretion of tetraiodothyronine, also known as T4, and triiodothyronine, also known as T3. [1] Hypothyroidism is one of the most significant dysfunctions of the thyroid gland. Hypothyroidism may be acquired or present from birth, and it causes a broad slowdown in the metabolism of all systemic organs. Not only is the regulation of metabolism dependent on thyroid hormone, but the coordinated development of the neurological system is also dependent on this hormone. Hearing loss if it is not detected and treated in a timely manner. In more advanced instances, it may lead to a delay in language development as well as problems with understanding, auditory processing, and reading. The pathophysiology of hearing loss in hypothyroidism may be attributed to a decrease in the synthesis of cellular energy, which in turn leads to a reduction in microcirculation, which ultimately results in a poor oxygenation and metabolism of the evolved organ. Children diagnosed with congenital hypothyroidism have a higher risk of experiencing neurological issues. [2,3] Around one in every 4000 newborns is diagnosed with hypothyroidism. Synthesis of protein, lipid, myelin, and enzymes are all involved in the production of thyroid hormone. In addition, as T4

functions as a neurotransmitter, research has shown that thyroid hormone receptors have a role in the development of the cochlea and the retrocochlear area, as well as in hearing function. It has been known for a long time that hearing loss is linked to endemic cretinism, congenital hypothyroidism, thyroid hormone resistance, and Pendred's syndrome, which is an autosomal recessive illness that presents with sensory neuronal hearing loss and goitre. [4-8] Hearing loss is still a serious issue, especially for people who were born with severe congenital hypothyroidism. Auditory symptoms might be the only ones present or they could be accompanied by vertigo and tinnitus. Early diagnosis and treatment, in the form of thyroxin replacement therapy and hearing rehabilitation, were the primary focuses of our research project. Because an early diagnosis and treatment might boost these patients' chances of a favourable outcome in the long run. [9]

MATERIALS & METHODS

This prospective observational study was done in the department of ENT.

INCLUSION CRITERIA

In all, fifty hypothyroid children ranging in age from one to eighteen years were included in the research, along with fifty children of a comparable age who served as controls. This research was carried out on patients, each of whom had a comprehensive history, ENT examination, and audiological assessment.

EXCLUSION CRITERIA

Those who had a history of hearing problems in their families, prenatal hypoxia, intrauterine infections, patients with middle and external ear pathology, long-term treatment with amino glycosides, a history of acoustic trauma, or a history of prior ear surgery were excluded from the study.

METHODOLOGY

Individuals who had been given a diagnosis of hypothyroidism were given either pure tone audiometry or free field audiometry, and in certain circumstances, an ABR Study was performed to evaluate the patient's hearing health. Pure tone audiometry was used to screen 30 individuals older than the age group of 10 years, and ABR was scheduled to be performed on the remaining 20 patients less than 10 years. All of these studies were regular and noninvasive, and the relevant institutional ethics committee gave their blessing as far as ethical considerations are concerned. In our research, a comprehensive audiological evaluation was performed on individuals who had a clinical diagnosis of hypothyroidism in order to determine the degree and type of hearing loss. Impedance audiometry was performed on each and every participant before the selection process began for the research. The individuals with congenital hypothyroidism were all given thyroxin replacement treatment both throughout and after the course of the trial. Once three and six months have passed since the patient with hearing loss has reached euthyroid level, a follow-up audiometry test is administered to the patient. Patients with hypothyroidism who exhibited signs of hearing damage even after six months of reaching euthyroid levels were given hearing aids, audio-verbal therapy, and speech therapy as forms of treatment. After getting normal readings, pure tone audiometry was performed on fifty healthy youngsters ranging in age from ten to eighteen. The threshold level of normal hearing was determined to be below 25 dBHL over the whole frequency range of 500 to 8000 Hz. ABRs were recorded by employing an Intra Acoustic Sensor System with click stimuli that had a hearing level of 90 dB and were provided at a rate of 20 clicks/s with alternating polarity while the subjects wore Standard TDH39 headphones. Latencies of waves one and five were analysed, and the average of 1024 sweeps was taken as the measure.

STATISTICAL ANALYSIS

The statistical analysis was conducted for both of these groups (control and hypothyroid group). The data were generated with the aid of Microsoft Excel 2007, and the analysis was carried out with the assistance of the Epi-Info 7 programme. The frequency and percentage were computed, and the Chi Square test was used for statistical analysis whenever it was appropriate; a value of p less than 0.05 was considered to be statistically significant.

RESULTS

In our research, a total of fifty patients ranging in age from one to eighteen years were included. In the hypothyroid group, the mean age was 9.51 years, whereas the control group's mean age was 11.02 years. 25 of the instances included females, while the remaining 25 involved men. Otoscopy was normal in all of the youngsters when they were evaluated clinically. The hypothyroid group had mean values of freeT3, freeT4, and TSH hormones of 2.69 pg/ml, 1.59 ng/dl, and 31.5 uIU/L respectively, whereas the control group had mean values of 2.61 ng/dl, 1.31 micrgram/dl, and 3.59 uIU/l respectively.

IMPEDANCE AUDIOMETRY

The average volume of the ear canal in the control group was 1.19 millilitres in the left ear and 1.16 millilitres in the right ear. On the other hand, the volume of the ear canal in hypothyroid children was 0.91 millilitres in the left ear and 0.87 millilitres in the right ear. The control group had a mean static compliance of 0.66 and the hypothyroid group had a mean static compliance of 0.67 in the left ear. The control group had a mean static compliance of 0.50 ml. The control group had a mean middle ear pressure of 7.85 daPa, whereas the hypothyroid group had a mean pressure of 1.54 daPa.

IPSILATERAL ACOUSTIC REFLEX

Acoustic reflex was present in the right ear of 47 subjects in the control group and 5 subjects in the hypothyroid group. It was elevated in 3 and 45 respectively in both groups. On the other hand, acoustic reflex was present in the left ear of 45 subjects in both groups respectively and was elevated in 5 and 45 subject.

CONTRALATERAL ACOUSTIC REFLEX

There was an acoustic reaction in the right ear in 48 of the control subjects and 7 of the hypothyroid patients, however only 2 and 43 of the patients had an increased reflex.

The acoustic reflex was found to be present in 45 of the subjects, and it was found to be enhanced in 5 of the subjects and 43 overall. There was a material disparity between the two.

OTOACOUSTIC EMISSION

In the right ear, TEOAEs were discovered to be present in 42 of the subjects in the control group and 30 of the subjects in the hypothyroid group, whereas they were not present in 8 and 20 of the subjects, respectively. In the left ear, TEOAEs were found in 47 of the subjects in the control group, 20 of the subjects in the hypothyroid group, and 3 and 30 subjects, respectively, did not have them. There was a difference that was statistically quite significant. DPAOEs were found in the right ear of 44 of the subjects in the control group, 35 of the subjects in the hypothyroid group, and 6 and 15 of the subjects, respectively, did not have any. In the hypothyroid group, DPOAEs were found in 46 and 37 subjects in the left ear, while they were missing in 4 and 13 subjects, respectively. No major differences.

PURE TONE AUDIOMETRY

Average Air conduction threshold at frequencies 500Hz, 1000Hz and 2000Hz was calculated. The mean air conduction threshold in right ear of control group was 12.14 dB and hypothyroid group was 18.49 dB in left ear it was 11.79 dB and 19.30 dB respectively Significance differences between two.

BONE CONDUCTION THRESHOLD

The mean bone conduction in the right ear was 12.14 dB and 15.43 dB in the control group, whereas the mean bone conduction in the left ear was 8.19 dB and 15.90 dB in the hypothyroid group. difference between the two that is statistically very substantial.

AUDITORY BRAINSTEM EVOKED RESPONSES

Hearing loss in both ears was found to be modest and sensorineural in three of the individuals. We examined the inter-peak latency as well as the latencies for waves I, III, and V between the two groups. The results indicated that there was a statistically significant difference in latency for wave I, III, and wave V for the right ear. Inter-peak latency showed no significant changes from run to run.

HEARING LOSS

In the comparison group, all of the subjects had hearing that was within the normal limit. In the hypothyroidism group, however, eight of the subjects showed minor hearing loss in pure tone audiometry, and five of the subjects had it in BERA. 10 of the subjects in the hypothyroid group reported hearing loss in both ears. The result demonstrates a considerable and high level of variance.

Table 1: Comparison Of Pta (Air Conduction And Bone Conduction) Among Control Group And Hypothyroid Group

Test	Ear	Control Group (n=30)		Hypothyroid Group (n=30)		P value
		Mean	SD	Mean	SD	
PTA (Air conduction in dB)	Right	12.14	1.75	18.49	4.63	0.001
	Left	11.79	1.55	19.30	5.25	0.003
Bone Conduction (dB)	Right	12.14	1.29	15.43	1.36	0.001
	Left	8.19	1.82	15.90	3.64	0.001

Table 2: Comparison Of Abr Among Control Group And Hypothyroid Group

Wave	Ear	Control Group(n=20)		Hypothyroid Group (n=20)		P value
		Mean	SD	Mean	SD	
I	Right	1.22	0.01	1.42	0.05	<0.01
	Left	1.33	0.01	1.45	0.01	<0.01
III	Right	3.37	0.01	3.50	0.03	<0.01
	Left	3.42	0.02	3.55	0.04	<0.01
V	Right	5.20	0.03	5.40	0.05	<0.01
	Left	5.17	0.03	5.33	0.01	<0.01
I-V	Right	3.98	0.04	3.99	0.07	0.32
	Left	3.69	0.54	3.88	0.01	0.52
I-III	Right	2.16	0.01	2.09	0.06	0.47
	Left	2.09	0.01	2.11	0.03	0.007
III-V	Right	1.84	0.02	1.91	0.08	0.22

	Left	1.76	0.02	1.79	0.03	0.02

DISCUSSION

In this research, a patient with hypothyroidism had a complete audiological evaluation to determine the degree of hearing loss as well as the cause of the condition. A patient is considered to have hypothyroidism if their blood level of free T4 is normal, but their serum TSH level is high. When choosing volunteers for the research, it was ensured that there were no diseases affecting the external ear or the middle ear; thus, all of the patients' middle ear pressure and compliance readings were within the normal range. On the other hand, a research conducted by Knipper M et al revealed that out of 23 hypothyroid patients, 4 demonstrated lowered middle ear pressure (less than- 100daPa) and compliance, both of which improved on therapy [10].

There has been some discussion in the medical literature on a possible connection between hypothyroidism and hearing loss. One of the many physiological processes that are affected by thyroid hormone in our bodies is the auditory system. Thyroid hormone is essential to the function of this system. 78% of patients had normal results on the pure tone audiometry, whereas 22% of patients had SNHL in both ears. PTA showed SNHL in 38 percent of instances of thyroid disease, according to research done by Karamizadeh Z et al. Anand et al found a decrease in hearing thresholds and brainstem auditory evoked potential changes in 16 out of 20 patients with hypothyroidism who did not receive thyroid hormone treatment or hormone replacement therapy for a period of 3.7 months. These patients reported an improvement in their auditory functions. Additionally, there was a decrease in the absolute latency amplitude on waves I, III, and V and an increase in the absolute latency in wave V as well as inter peaks L I-III [11-13] Testing of the acoustic reflex was carried out on individuals with hypothyroidism as well as controls, and the findings revealed a very significant difference (p 0.01) between the two groups in both ears, both ipsilaterally and contralaterally. The findings revealed that the mean acoustic reflex test for both the ipsilateral and contralateral of the hypothyroid group were significantly higher than those of the control group across the board for every frequency that was examined. In the hypothyroid group of our research, TEOEs were found in the ears of 43.75% of individuals in the left ear and 53.13% of patients in the right ear. However, in the same group, TEOEs were not found in 56.25 and 46.88% of subjects in the respective ears. Due to the reduced activity of cells in the organ of corti, similar results were discovered in the research that was conducted by Khechinschvili and his colleagues. The findings indicated that 25% of the subjects had a minor hearing loss in both ears, but the findings of the research by Khechinschvili and colleagues indicated that 74% of the subjects had hearing loss. [14]. In the study conducted by Thornton and Jarvis, a comparison was made between hyperthyroidism and hypothyroidism. The researchers found that the average threshold was higher by more than 25 dB in hypothyroidism. They hypothesised that this may be due to a change in metabolism as well as a pathophysiological change in the auditory system. They also make the assumption that involvement of the retrocochlear region in hypothyroidism may be associated with the patient's body temperature, which may affect the absolute latency as well as the inter peak latencies of ABR waves. [15] In a study conducted by Francois M. and colleagues on the role of congenital hypothyroidism in hearing loss in children, the researchers found that there was no significant difference in the auditory thresholds at conversational and high frequencies between 42 children with congenital hypothyroidism treated with l- thyroxine and an age-matched control group. This result held true regardless of the cause of the thyroid failure or hormone level and the age at the start of treatment. The control group was comprised of children [16]

Hung W. and colleagues wanted to find out if an early and adequate replacement treatment might be able to prevent sensorineural hearing loss in 32 children who were screened for CH and had no associated risk factors for neuro-otologic alterations. This was the purpose of the study that Hung W. and colleagues conducted. These patients were recruited using very restrictive criteria with the intention of excluding, at least provisionally, the potentially detrimental interference of treatment variables and other underlying risk factors. The authors came to the following conclusions: a) the risk of hearing loss is higher in CH young patients than in age-matched control subjects without CH; b) the risk of hearing loss is closely associated with the severity of CH; c) this risk is particularly relevant in the children who had pre-natal onset of hypothyro. d) 25% of CH patients detected by CH screening may show, at a median age of 15.4 years, a mild and subclinical hearing impairment, despite early and adequate [17] Lichtenberger-Geslin L. and colleagues conducted a study on a national population sample to determine the factors associated with hearing impairment in patients diagnosed with congenital hypothyroidism who had received treatment since the neonatal period. Under the context of a population-based registry of young adult patients with CH, the objective of this research was to evaluate hearing and the factors that influence it. It was found that the type of CH was associated with the severity of hearing loss (patients with athyreosis and gland in situ were more frequently affected than those with an ectopic gland). There was also a suggestion of an association with serum free T4 concentration at the time of diagnosis (relative risk = 1.47; 95% confidence interval [CI], 0.96–2.23). Hearing loss was mostly bilateral (90%) and mild to

severe (96%), being of the sensorineural type (76%), and affecting high or very high frequencies. The researchers came to the conclusion that despite substantial advancements in prognosis, hearing loss continues to be a serious issue, especially for patients who have severe CH. The early diagnosis and treatment of these patients could improve their long-term prognosis, so it is important for parents and primary care providers to be aware of this risk. [18] Russ SA et al., in their otorhinolaryngology reports on diagnosis and treatment of congenital sensorineural hearing loss, reviewed current literature regarding the work-up and management of congenital sensorineural hearing loss. They discovered that the diagnostic evaluation of a newborn with sensorineural hearing loss begins with a complete audiologic evaluation as well as a comprehensive history and physical exam. This article gives a diagnostic algorithm for the work-up of congenital hearing loss, with an emphasis on the three modalities of CMV testing, genetic assessment, and imaging. The methodology is presented in this review. [19] Hashemipour M et al., who conducted a study on hearing impairment in congenitally hypothyroid patients very similar to the one we did, came to the conclusion that the rate of hearing loss was quite low among our CH patients who were studied. It's possible that the effective care of CH patients is to blame. In light of the fact that all CH neonates were dyshormonogentic and of the connection between certain gene mutations and hearing impairment in CH patients, it is important to conduct additional research with a larger sample size, focusing on the various causes of CH, in order to identify the possible gene mutations that are associated with hearing loss in CH. These studies should investigate the various aetiologies of CH. [20]

CONCLUSION

If a hypothyroid youngster delays therapy for an extended period of time or if their hypothyroidism has been present for a longer period of time, the severity and incidence of hearing loss will be increased. In its early stage, SNHL manifests itself bilaterally and is often only moderate.

REFERENCES

1. Stanfield C. Principles of Human physiology. Third ed. San Francisco, CA: Pearson Benjamin Cummings, 2008.
2. Mac Faul R, Dorners, Brett EM, Grant DB. Neurological abnormalities in patient treated for hypothyroidism form early life Arch Dis Child. 1978; 53:611-9
3. Wolter R, Noel P, De cock P et al. Neurophysiological study in treated thyroid dysgenesis. Acta Paedaltr Scand [Suppl]. 1979; 277:41-6.
4. Ng L, Goodyear RJ, Woods CA, Schneider MJ, Diamond E, Richardson GP, Kelly MW, Germain DL, Galton VA, Forrest D. Hearing loss and retarded cochlear development in mice lacking type 2 iodothyronine deiodinase. Proceedings of the National Academy of Sciences of the United States of America. 2004; 100(10):3474-3479
5. Ng L, Hernandez A, He W, Ren T, Srinivas M, Ma M, Galton VA, St Germain DL, Forrest D. A protective role for type 3 deiodinase, a thyroid hormoneinactivating enzyme, in cochlear development and auditory function. Endocrinology. 2009; 150(4):1952-1960
6. Forrest D, Erway LC, Ng L, Altschuler R, Curran T. Thyroid hormone receptor beta is essential for development of auditory function. Nature genetics. 1996; 13(3):354-357.
7. Fraser GR. Association of congenital deafness with goiter (Pendred's syndrome) A study of 207 families. Ann Hum Genet. 1965; 28:201-49.
8. Meyer Holl WL. The thyroid and audition. Laryngoscope. 1975; 85:483-9
9. Lichtenberger-Geslin L, Dos Santos S, Hassani Y, Ecosse E, Van Den Abbeele T, Leger J. J Clin Endocrinol Metab. 2013; 98(9):3644-52
10. Knipper M, Richardson G, Mack A, et al. Thyroid hormone-deficient period prior to the onset of hearing is associated with reduced levels of beta-tectorin protein in the tectorial membrane: implication for hearing loss. *J Biol Chem.* 2001;276(42):39046–52.
11. Savatore D, Davis TF, Schlumberger J, Hay ID, Larsen PR. Thyroid physiology and diagnostic evaluation of patient with thyroid disorders. In: Melmed S, Polonsky KS, Larsen PR, Kronenberg HN(eds) Williams Textbook of endocrinology, 12th edition. Elsevier Saundet, Philadelphia, pp327-361.
12. Karamizadeh Z, Dalili S, Sanei-far H, et al. Does Congenital hypothyroidism have different etiologies in Iran? *Iran J Pediatr.* 2011;21(2):188–92.
13. Anand VT, Mann SBS, Dash RJ, Mehara YN. Auditory investigations in hypothyroidism. Acta Otolaryngol. 1989; 108:83-87
14. Khechinaschvili S, Metreveli D. The hearing system under thyroid hypofunction. Georgian Med News. 2007; 144:30-33.
15. Thornton AR, Jarvis SJ. Auditory brainstem response findings in hypothyroid and hyperthyroid disease. Clin Neurophysiol. 2008; 119(4):786-790.
16. François M, Bonfils P, Leger J, Czernichow P, Narcy P. Role of congenital hypothyroidism inhearing loss in children. The Journal of pediatrics. 1994; 124(3):444-6.
17. Hung W, Sarlis NJ. Current controversies in the management of pediatric patients with well-differentiated nonmedullary thyroid cancer: a review. *Thyroid* 2002;12:683–702.
18. Lichtenberger-Geslin L, Dos Santos S, Hassani Y, Ecosse E, Van Den Abbeele T, Léger J. Factors associated with hearing impairment in patients with congenital hypothyroidism treated since the neonatal period: a national population-based study. The Journal of Clinical Endocrinology & Metabolism. 2013; 98(9):3644-52.
19. Russ SA, White K, Dougherty D, et al. Preface: newborn hearing screening in the United States: historical perspective and future directions. *Pediatrics.* 2010;126(Suppl 1):S3–6.
20. Hashemipour M, Hovsepian S, Hashemi M, Amini M, Kelishadi R, Sadeghi S. Hearing impairment in congenitally hypothyroid patients. Iranian journal of pediatrics. 2012; 22(1):92