INTERNATIONAL JOURNAL OF CURRENT MEDICAL AND PHARMACEUTICAL RESEARCH

IJCMPR

Available Online at http://www.journalcmpr.com

RESEARCH ARTICLE

NEURO-OTOLOGICAL PROFILE IN THYROID DYSFUNCTION

Srivastava Pankaj[1]*., Gupta Deepak[2]., Mishra S.C[3]., Shukla G.K[4] and Varma K.D[5]

[1]Pankaj E.N.T. Hospital, 56-C Singar Nagar, Alambagh, Lucknow-226005
[2,3,4]Department of Surgery, King George's Medical College, Lucknow

ARTICLE INFO

Article History:
Received 17th March, 2016
Received in revised form 21st April, 2016 Accepted 06th May, 2016
Published online 28th June, 2016

ABSTRACT

Fifty patients of thyroid dysfunction were studied with the help of battery of audiological and vestibular function tests aimed at evaluating the degree and site of neurootopathy whereas the audiological derangements were found in hypothyroidism. The vestibular functions were within normal limits in both cases of hypothyroiddism and hyperthyroidism. A positive and objective neuro-otological dysfunctions in significant number of patients, following treatment, were also seen.

INTRODUCTION

Bircher, in 1883 was the first to describe the impairment of hearing in the patients suffering from goitre[1]. Later, it was confirmed in 1888, when Myxoedema Committee of Clinical Society of London found 'Auditory dysfunction' in 38 out of 69 myxoedematous patients

Hypothyroidism is a clinical syndrome resulting from the deficiency of thyroid hormones which in turn results in generalised slowing down of metabolic processes. The hyperthyroidism on other hand is a clinical syndrome that results when the tissues are exposed to high level of circulating thyroid hormones.

As both hypofunctioning and hyperfunctioning of thyroid affects every tissue of the body, hearing and vestibular system could also be deranged. There are clinical and laboratory evidences linking hearing loss with hypothyroidism, yet the reversibility of these pr-ocesses, the incidence and pathophysiology are not universally agreed upon. The study of hearing disorders in hyperthoidism and a vestibular disturbances in both types of thyroid dysfunction are needed to be established.

This study describes the otoneurological profile of patients of hypothyroidism and hyperthyroidism and its reversibility following treatment.

MATERIAL AND METHODS

Twenty seven patients of hypothroidism with age ranging from 11-55 years (mean 35.16 years) and twenty three patients of hyperthyroidism with age ranging from 13-45 years (mean 29.08 years) were considered for this study. Female to male ratio were 8:1 in hypothyroidism and 1.3: 1 in cases of hyperthyroidism. This study was carried out on twenty age and sex matched individuals as control. The diagnosis was confirmed by serum TSH, T_3 and T_4 levels. Thyroid I^{131} scan and radioiodine uptake test were done in all patients. They were then worked up in the neuro-otology laboratory.

A detailed clinical assessment was done in each case and patients having any known cause of deafness and vertigo were excluded. The audiological tests included pure tone audiometry (PTA), speech audiometry, short increment sensitivity index (SISI), tone decay test (TDT), loudness discomfort level (LDL), tympanometry and auditory Igainstem evoked response (ABR). Auditory Brainstem conduction time (ABSCT) was defined as interpeak inter-val I-V and its normal value, as determined in control group, was 3.98 ms (SD 0.02 ms).

The vestibular tests included bithermal binaural caloric test, electronystagmography, Romberg's test, Unterberger's test and craniocorpography. The patients of hypothyroidism were given substitution therapy in from of Levothyroxine and the patients of hyperthyroidism were given cambamizole. Sixteen hypothyroids and ten hyperthyroids who turned up for follow up after 1-4 months were worked up again on similar parameters.

Observations

Hypothyroidism

Six patients (22.3%) complained of impaired hearing which was bilateral and insidious in onset.

TABLE I : TYPE OF HEARING LOSS

Type of Hearing Loss	CONTROL No.	%	HYPOTHYROIDISM No.	%	HYPERTHYROIDISM No.	%
(a) Conductive						
- High Frequency	0	0	0	0	1	4.3
- Low Frequency	0	0	0	0	0	0
- Flat Curve	0	0	7	25.9	4	17.4
(b) Sensorineural						
- High Frequency	1	5	0	0	0	0
- Low Frequency	0	0	3	11.2	0	0
- Flat Curve	0	0	1	3.7	1	4.3
(c) Mixed						
- High Frequency	0	0	0	0	0	0
- Low Frequency	0	0	0	0	0	0
- Flat Curve	0	0	6	22.2	0	0
Total	1	5	17*	63	6*	26

* $p < 0.001$; + $p > 0.05$ (NS)

TABLE II : SEVERITY OF HEARING LOSS

Severity	Control	Hypothyroidism	Hyperthyroism
Normal	19	10	17
Mild	1	10	1
Moderate	0	7	2
Severe	2	0	0
Total	20	27	23

Three patients (11.2%) had tinnitus in two which was of low frequency and mask able in all of them. Tympanic membrane was dull and retracted in sixteen ears (29.6%) and the Valsalva test was found to be negative in eighteen ears (33.3%). The Tunning fork test as well as PTA revealed hearing loss in seventeen patients (63%) being bilaterally symmetrical twelve in (70.9%) of them. The type of hearing loss is shown in Table I and quantitative measurement of hearing loss is shown in table II. In patients with neurosensory hearing loss, poor speech discrimination score (SDS) was found in four patients, two of which revealed abnormal adaption in TDT and the other two had a high SISI. In fourteen ears (25.9%), tympanometry revealed reduced middle ear compliance (Table III). Acoustic reflex was not recordable upto 110 dB in 26 ears (48.2%). BSEP revealed increase in BSCT (> 4 ms) in 15 patients (71.5%) out of 21 patients. In rest of the six patients no definite wave form could be elicited. In general, the waves were not well formed and were of low amplitude.

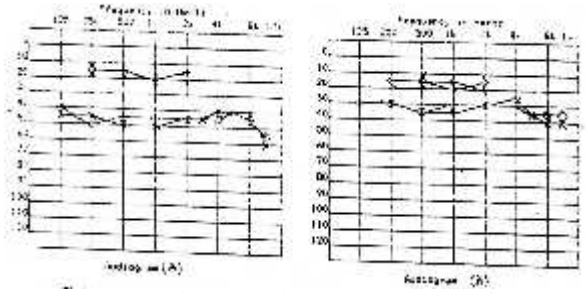


Fig.1 Audiograms of a patient of hypothyroidism (A) before and (B) after treatment

The complaint of vertigo was present in three patients (11.2%). The vestibular tests- electronystagmography and bithermal caloric test revealed labyrinthine hypoactivity in two patiens (7.4%). Unterberger's test and craniocorpography revealed abnormal angular deviation in three patients (11.2%).

Sixteen patients turned up for follow up after taking substitution therapy and all of them had subjective improvement in their hearing.

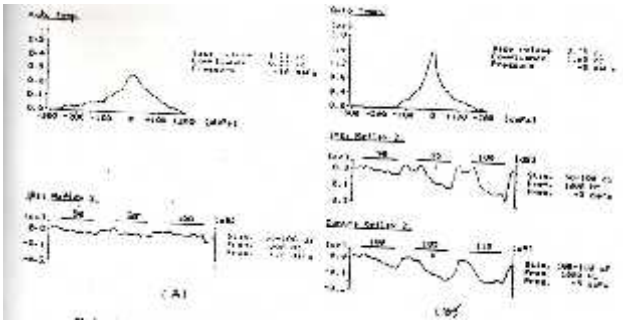


Fig. 2 Impedance audiometry in a patient of hypothyroidism (A) before and (B) after treatment.

The patients who had tinnitus also had a subjective improvement. The PTA revealed improvement in hearing threshold up to 10 dB in ten patients (62.5%)

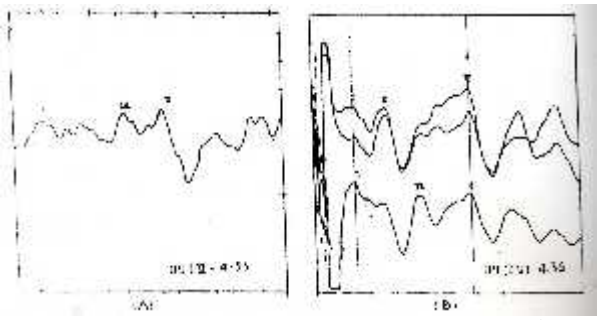


Fig.3 Auditory brainstem evoked responses in a patient of hypothyroidism (A) before and (B) after treatment.

and in eight of them, the improvement was seen only in air conduction curves (Fig. 1). Tympanometry revealed improvement in compliance (Fig. 2) in nine ears (28.2%). BSCT showed a decrease of 0.2-0.3 ms (Fig.3) in eight patients (66.7%). The waves were now well formed and of higher amplitude than before.

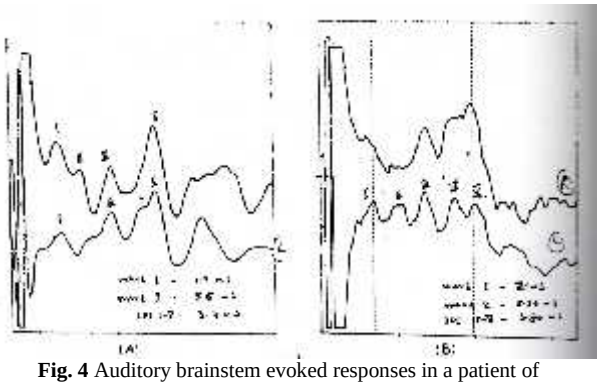
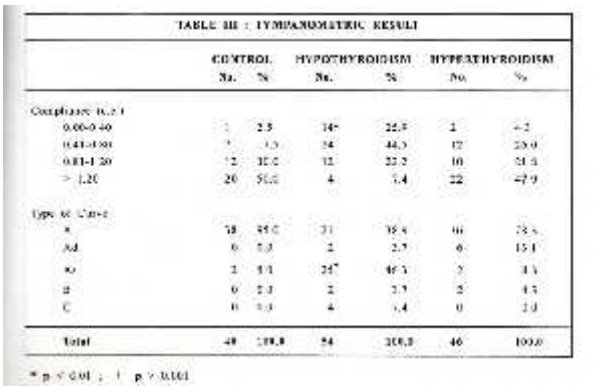


Fig. 4 Auditory brainstem evoked responses in a patient of hypothyroidism (A) before and (B) after treatment.

Hyperthyroidism

None of the patients had subjective hearing impartment. Two patients (8.6%) complained of tinnitus which was of high frequency and unmaskable. Three patients (6.6%) had dull and retracted tympanic membrane and negative valsalva test was found in five ears (10.9%). PTA revealed mild hearing loss (Table II) in six patients (26.9%) and five of them had conductive hearing loss (Table I)

In two ears (4.5%), tympanometry revealed abnormally reduced compliance (Table III). Acoustic reflex was not elicitable in 5 ears (11.2%). BSEP revealed well formed waves of high amplitude and a decrease in ABSCT (Table IV) in twelve patients (52.2%).

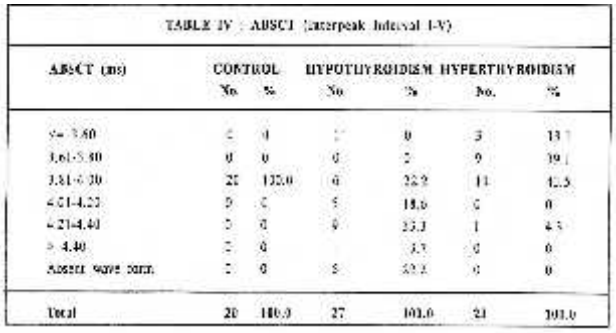


Vertigo was complained by three patients (13.1%). The caloric test and electronystagmography revealed labyrinthine hypoactivity in one patient (4.4%). Unterberger's test and Craniocorpography revealed abnormal angular deviation in two patients (8.7%).

DISCUSSION

Hypothyroidism

Audiological derangement is known to be associated with hypothyroidism but the site and mechanism of its involvement are still being debated. In this series, a significantly higher number of patients had hearing loss (62.9%, $p<0.001$) including conductive hearing losses in seven out of



seventeen cases. McMohan has attributed conductive deafness in hypothyroids to reduced compliance of middle ear due to hypertrophy and oedema of Eustachian tube[2]. It leads to catarrhal Eustachian tube malfunctioning. The thickened tympanic membrane caused by myxomatous infilteration of middle ear also contributes to this pathology. Such middle ear changes were responsible for clinical findings like retracted tympanic membrane (29.6%) and negative Valsalva test (33.3%), and tympanometric findings such as reduced compliance in significantly higher number of patients (25.9%, $p<0.01$) and flat curve, Type B (3.7%). Meyerhoff (1979) studied morphological changes in middle ear in experimental hypothyroid animals which included partial and complete obliteration of oval and round windows in all animals[3], fusion and distortion of the incus and stapes, and non-union of normally fused malleus and incus.

Among the patients with neurosensory or mixed hearing loss, poor SDS was present in four patients and two of these patients had abnormal fatigue in TDT, both signifying a retrocochlear involvement. A significant increase in ABSCT (mean 4.18 ms, SD 0.19, $p< 0.001$) also suggests impairment in physiology of nerve conduction. Bass *et al*. (1977) has attributed such changes to biochemical, metabolic and morphological changes in the nervous system induced by deficiency of thyroid hormones[4]. Two of the patients had positive SISI with no abnormal auditory adaptation in TDT, both of which point to cochlea being the possible site of involvement. The Mixed or neurosensory hearing loss was represented with a flat audiometric curve, categorised as Type III by Shuknecht and which is perhaps indicative of atrophy of stria vascularis[5]. The ascending type of audiometric curve in three cases is perhaps suggestive of cochlear hydrops. Ritter and Lawrence suggested that the deafness associated with hypothyroidism may be caused by edematous cochlear changes[6]. Anniko and Rosenkoist demonstrated changes in tectorial membrane and thickening of basement membrane in cochlea in experimental hypothyroidism[7]. Jahnke *et al*. has shown damaged hair cells in hypothyroids[8].

In the present study, the vestibular function tests were not deranged enough so as to establish a causal relation ship with hypothyroidism. Bhatia *et al*. has found absence of spontaneous as well as postural nystagmus or vertigo in their cases[9]. Howarth and Lloyd also found caloric test to be normal in patients of hypothyroidism[10]. But Moehling collected 24 cases of hypothyroidism having attacks of dizziness associated with vomiting and loss of hearing[11] and Barlow also found objective evidence of vestibular dysfunction in 7 out of 15 cases of myxoedema[12]. Vestibular part of inner ear is known to be affected much less than the cochlear part by disease processes probable as the former is phylogenitically older than the latter. In can be inferred from our investigations that the vestibular system is least affected in hypothyroidism.

A considerable contradiction can be seen in the literature for the reversal of subjective as well as objectively deranged audiological functions after treatment with thyroid extract. Bhatia *et al*. reported subjective improvement[9]. McMohan also noted similar changes and attributed this to slowed mentation during hypothyroid state may be interpreted by the patient as a subjective hearing loss[2] Post was able to demonstrate only a questionable reversible sensorineural deafness in four cases[13]. The subjective hearing improvement in hearing threshold in PTA was only confirmed to air conduction, which sould be attributed to the reversal of middle ear changes. The improvement in compliance during tympanometry further supports this view. The decrease in ABSCT[14] by 0.2-0.3 ms further shows the dyanamic alterations in the nervous system caused by substitution therapy.

Hyperthyroidism

Himelfarb *et al* studied six patients of hyperthyroidism and found normal hearing acuity in all but there was decrease in ABSCT. In this study, none of the patients had subjective hearing impairment but PTA revealed mild hearing loss in few patients. But the only significant audiological dysfunction was decrease in ABSCT **(**mean 3.75 ms, SD 0.23, $p< 0.001$). In most of these patient& the BSEP was characterized by high amplitude of waves and sharp peaks. Though, vertigo was complained by only three patients but the vestibular functions tests were not deranged in significant number of patients.

Kahonen *et al*. found no pathological changes in the cochleas of 14 hyperthyroid guinea pigs[15].

Allowing treatment the ABSCT was seen to increase by 0.1-0.3 ms in six (50%) of the patients. This again indicates to the relationship between the serum thyroxine level and the BSCT. In general, a good correlation was observed between the value of ABSCT and the level of serum T_4 (Fig. I). Himelfarb has

stated that ABSCT appears to be sensitive index of thyroxine dependent cellular status in the neural pathways of brainstem'[4], and it may thus serve as an important tool in the overall assessment of the thyroid status.

References

1. Bircher, H. (1883): Der Endemische Kropf. Basal (Quoted by Bhatia).
2. Mc Mohan, B.J.: Influence of constitutional factors in otological condition. Annals. Otolaryngology.1956; 65: 395-413.
3. Meyerhoff, W.L.: Hypothyroidism and the Ear: Electrophysiological Morphological and Chemical considera tions. Laryngoscope. 1979; 89 (10 Pt. Z. Suppl. 9): 1-25.
4. Bass, N.H., Petion, E.W. and young E.: Defective maturation of cerebral cortex an inevitable consequence of dysthyroid states during early postnatal life. In Gilman G.D. (Ed.): Thyroid hormones and brain devel opment, New York, Raven Press, 1977; pp. 203-209 (Quoted by Himelfarb *et al*.).
5. Schuknecht, H.F.: Further observations on pathology of Presbiacusis. *Arch. Otolaryngol* 1982; 80: 369-382.
6. Ritter, F.N. and Lawrence M.: Reversible hearing loss in human hypothyroidism and correlated changes in the chick inner ear. Laryngoscope 1960; 60: 393-407.
7. Anniko, M. and Rosenkoist, U.: Tectorial and Basal mambranes in experimental hypothyroidism. *Arch. Otolaryngol.* 1982; 108(4): 218-20.
8. Jahnke, K., Mass, B., Modder, G.: Hypacusis in acquired hypothyroidesm (author's transl.).H.N.O. 1979; 27 (1): 1-6.
9. Bhatia, P.L., Gupta, O.P., Agarwal, M.K. and Mishra, S,K. : Audiological and Vestibular Function Tests in Hypothyroidism. *The Laryngoscope.* 1977; 87: 2082-2089. .
10. Howarth, A.E., Lloyd, H.E.D.: Perceptive deafness in hypothyroidism. *British Medical Journal.* 1956; 25: 431-433.
11. Moehliz, R.C.: Vertigo and deafness associated with hypothyroidism. *Endocrinology.* 1927; 11: 229-232.
12. Barlow, R.A.: A study of vestibular nerve functions in Myxoedema. *American Journal of Medical Science.* 1922; 16: 401-415.
13. Post, J.T.: Hypothyroid deafness. *The laryngoscope.* 1964; 74: 221-232.
14. Himelfarb, M.Z., Lakretz, T., Gold, S. and Shanon, E.: Auditory brain stem responses in thyroid dysfunction. *The Journal of Laryngology and Otology, 1981;* 95: 679-686.
15. Kohonen, A., Jahuiainen, T., Liewendahl, K., Tarkkanen, J. and Kaimio M.: Deafness in experimental hypo and hyperthyroidism. *The Laryngoscope.* 1971; 81: 947-956.