

Original Research Article

Role of thyroid metabolism in vestibular vertigo

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ABSTRACT

Background: Thyroid hormones play a role in the development and functioning of the inner ear. Therefore, it was hypothesized that a derangement in the thyroid hormone levels can affect the cochleo-vestibular system.

Methods: The present study included 64 cases and 64 controls. All patients diagnosed with peripheral vertigo were enrolled into the study. All the subjects underwent thyroid function tests- serum T3, T4 and thyroid stimulating hormone (TSH). Free hormone levels were obtained in patients with subclinical hypo or hyperthyroidism. The data was analyzed using Independent sample t test.

Results: Out of 64 cases only 10 patients showed altered thyroid values. Fifty-nine cases were diagnosed with benign paroxysmal positional vertigo (BPPV) out of which 9 (15%) had altered thyroid hormone levels. Among the control group, 12 were found to have deranged thyroid hormone levels.

Conclusions: There is no association between functional thyroid hormone levels and BPPV. Therefore, altered thyroid metabolism has no role in the causation of vestibular dysfunction due to BPPV. However, in case of Meniere's disease and Vestibular neuronitis further studies with large sample size are required to ascertain the role of functional thyroid hormones in producing vestibular symptoms.

Keywords: Thyroid hormones, Vertigo, Inner ear

INTRODUCTION

Altered thyroid metabolism can adversely affect the normal functioning of inner ear. It can hamper the blood flow or affect the oxygen supply to the inner ear.¹ It can produce symptoms pertaining to vestibule like vertigo or cochlear disturbances like tinnitus and hearing loss.² Studies have shown a greater prevalence of metabolic disorders like diabetes mellitus, hyperlipidemia and hypothyroidism with vestibular dysfunction. Previous studies have formulated that the functional status of the thyroid can influence labyrinthine function. There are also studies which highlight that vestibular vertigo is the impact of thyroid autoimmunity rather than its dysfunction. The present study was conducted to find out the association between altered thyroid hormone levels and vestibular vertigo so as to determine the importance

of thyroid profile in the evaluation of patients with vestibular vertigo.

METHODS

The present study was conducted in Yenepoya Medical College Hospital in the Department of ENT, Derlakatte, Mangalore, India from August 2018 to April 2019. All patients diagnosed with peripheral vertigo attending the ENT outpatient department (OPD) were selected as cases for the study. Age and sex matched controls were taken from the patients attending the ENT OPD with symptoms other than that of ear diseases. Consecutive sampling was done and the sample size was calculated based on 5% level of significance, 80% power and effect size 0.5. Minimum sample required was 64 per group.

Detailed history including demographic details was taken and thorough ENT examination was performed. Diagnosis of vestibular causes of vertigo such as benign paroxysmal positional vertigo (BPPV), Meniere's disease (MD) and vestibular neuronitis was made based on following diagnostic criteria.

Benign paroxysmal positional vertigo

Recurrent attacks of vertigo with duration of attack <1 minute along with symptoms provoked by changes of head position like lying down or turning over in the supine position or at least 2 of the following manoeuvres: reclining the head, rising up from supine position, bending forward, not attributable to any other disorder.³

Meniere's disease

Two or more spontaneous episodes of vertigo each lasting 20 minutes to 12 hours, audiometrically documented low to medium frequency sensorineural hearing loss in one ear, defining the affected ear on at least one occasion before, during or after one of the episodes of vertigo, fluctuating aural symptoms (hearing, tinnitus or fullness) in the affected ear and not attributable to another vestibular diagnosis.⁴

Vestibular neuronitis

Acute onset of vertigo with absent cochlear symptoms like tinnitus and hearing loss and neurological symptoms like diplopia, dysarthria.⁵

Patients with middle ear/external ear diseases, age >60 years or <20 years, head injury or trauma to ear, on ototoxic drugs, cervical radiculopathy, central vertigo, ophthalmic causes for vertigo, on treatment for previously diagnosed thyroid disease and pregnant women were excluded from the study.

All cases and controls were subjected to thyroid function tests like serum T3, T4 and TSH which were measured using chemiluminescence immunoassay. Normal value for serum T3 was 0.97-1.69 ng/ml, T4 was 5.5-11 mcg/dl and thyroid stimulating hormone (TSH) was 0.4-4.6 mIU/l. Patients with normal T3 and T4 but elevated or

reduced serum TSH underwent free T3 and T4 to rule out subclinical hypo or hyperthyroidism. All the patients were subjected to pure tone audiometry (PTA) and videonystagmography (VNG). Special tests of hearing-short increment sensitivity index test (SISI) and tone decay were done in selective cases to differentiate between cochlear and retrocochlear causes of sensorineural hearing loss. Magnetic resonance imaging was done when in doubt to rule out central cause of vertigo.

Statistical analysis

Statistical analysis was done using IBM SPSS 22 programme running on windows operating system. Independent sample t test was used for comparison of parameters between the groups. A p value <0.05 was considered as statistically significant.

RESULTS

Sixty-four cases and equal number of controls were enrolled in the study. Out of 64 cases diagnosed of vestibular vertigo, 32 were males and 32 were females. Mean age of patients was 45 years. Fifty-nine patients (92%) were diagnosed with BPPV. Out of the remaining five, 3 were Meniere's and 2 were vestibular neuronitis.

Table 1 illustrates the frequency variables of T3, T4 and TSH. Table 2 lists the number of cases with normal and deranged thyroid values. Table 3 shows the statistical analysis using Independent sample t test. Alteration in the thyroid hormone levels were seen in 10 patients diagnosed with vestibular vertigo. Among them, one patient had only low T3 value, 8 patients had only high T4 value and one patient had high TSH but normal T3 and T4. The latter patient with subclinical hypothyroidism underwent free T3 and free T4 and found to be within normal limits. All these variations in thyroid hormone levels were shown by BPPV patients except one patient with Meniere's disease who had a high T4 value. PTA and VNG were normal in all patients with BPPV. Patients with Meniere's disease showed low to medium frequency sensorineural hearing loss in the affected ear in PTA. Their VNG showed hypofunction of affected labyrinth.

Table 1: Frequency and percent of T3, T4 and TSH values.

Thyroid hormone values	N	%
T3		
<0.97 ng/ml- altered	1	1.6
0.97-1.69 ng/ml- normal	127	98.4
T4		
5.5-11 mcg/dl- normal	108	83.7
>11 mcg/dl- altered	20	16.3
TSH		
<0.4 mIU/l- altered	1	1.6
0.4-4.6 mIU/l- normal	125	96.7
>4.6 mIU/l- altered	2	1.7

Table 2: Cases with normal and altered thyroid values.

Cases	Normal thyroid values	Altered thyroid values
BPPV	49	10
MD	2	1
VN	2	0
Total	53	11

Table 3: Independent sample t test.

Thyroid hormone values	Group	Number of subjects	Mean	Standard deviation	t-statistic/ p value	Mean	95% confidence interval of the difference	
							Lower limit	Upper limit
T3	Case	64	1.2073	0.18707	-0.529/ 0.598	-0.02094	-0.09930	0.05743
	Control	64	1.2283	0.25567				
T4	Case	64	9.4128	1.64471	0.055/ 0.956	0.01875	-0.65803	0.69503
	Control	64	9.3941	2.18378				
TSH	Case	64	2.4356	1.97548	1.624/0.107	0.47797	-0.10451	1.06044
	Control	64	1.9577	1.28137				

Controls included 34 males and 30 females with mean age 42 years. Twelve of them showed altered thyroid values- 10 had elevated T4 value, one had elevated T4 and reduced TSH, one showed only elevated TSH but free T3 and free T4 were normal. Independent sample t test was used to compare the parameters between the two groups which are given in Table 3. The p value of T3, T4 and TSH are 0.598, 0.956 and 0.107 respectively, which implies that there is no association between altered thyroid hormone levels in cases and controls.

DISCUSSION

BPPV is the most frequent cause of peripheral vertigo. It accounts for 20% of vestibular dysfunction.⁶ Patients experience sudden brief attacks of vertigo provoked by certain head positions. Patient giving history of vertigo while rolling over in bed is highly suggestive of BPPV.⁷ They may also have vomiting associated with severe attack, postural instability and light-headedness.⁶ Otoconia in the semicircular canal which get displaced from the utricle by certain head movements are responsible for the vertigo. It also produces canal-specific nystagmus.⁷ Posterior canal is the commonly affected one. Superior canal is least commonly affected due to its vertical placement which does not allow the otoconia to settle in the canal. The two theories of BPPV are canalolithiasis and cupulolithiasis introduced by Schucknecht (1969) and Hall (1979) respectively.⁶ Canalolithiasis implies that otoconia are present in the endolymph of semicircular canal whereas in cupulolithiasis, they are seen adherent to cupula of the canal.⁸ Even though Dix-Hallpike is the diagnostic manoeuvre for posterior canal BPPV it is associated with false negative findings which were confirmed after repeating the manoeuvres.⁹

It was postulated that thyroid hormones are required for the functioning of the inner ear. Alpha and beta specific receptors related to thyroid hormones seen in the vestibule and cochlea were found to have a role in the labyrinthine development.¹⁰ Deficiency of thyroid hormones also affects the conduction of nerve impulses along the central vestibular pathway.¹¹ It is shown that a protein called as prestin which helps in the contractility of outer hair cells is dependent on thyroid hormones.¹²

Our study aimed to find an association between alterations in thyroid hormone levels and vestibular vertigo. Majority of the cases (92%) in our study were BPPV. Therefore, we can only draw our inference on the association between the functional status of thyroid and vestibular dysfunction associated with BPPV. We found no association between altered thyroid hormone levels and BPPV. There have been previous studies in literature showing similar results. However, literature review has shown that some studies could elucidate a relationship between thyroid autoimmunity and peripheral vertigo.

Papi et al had demonstrated an association between BPPV and thyroid disease in their study. They had taken 134 patients with BPPV and compared with control. The values of thyroid autoantibodies and TSH were found to be elevated significantly in cases. But the independent role of autoimmunity and high TSH value could not be understood from the study.¹³

Subsequently, one more study was done to look for symptoms of BPPV in Hashimoto's patients with euthyroid status. It was found that there is a clear-cut association between autoimmune thyroiditis and BPPV. Mechanical stimulation of the vestibular receptors by the free movement of autoantibodies in the inner ear fluid and autoimmune microangitis were thought to be the reason for this.¹⁴

Similar findings were obtained in another study done by Modugno et al wherein 34 out of 70 BPPV patients were found to have autoimmune alterations. The change in the composition of endolymph brought about by the presence of autoantibodies causing stimulation of labyrinthine receptors was implicated as the pathophysiology of vertigo here.¹⁵

As opposed to the findings in these studies, a study conducted by Sari et al could not find any relationship between thyroid autoimmunity and BPPV.⁶

Meniere's disease is characterized by episodic vertigo, fluctuating sensorineural hearing loss and tinnitus. This clinical triad was first explained by Prosper Menier in 1861. Vertigo persists for few minutes to 2 hours and aural fullness may accompany or precede an attack. Hearing affects the low frequencies in the initial stages. Decreased absorption or increased production is the pathophysiology of endolymphatic hydrops. Another theory described by Schuknecht is that minute ruptures of Reissner's membrane cause mixing of endolymph and perilymph producing symptoms. This damage will heal subsequently resolving the symptoms.¹⁶ Glycerol dehydration test and electrocochleography are the basis for diagnosis.

Influence of thyroid hormone levels in the progression of Meniere's disease was first proposed by Tamura in 1964.⁸ A study done by Santhosh et al revealed that 12 out of 35 Meniere's disease patients were hypothyroid. A significant improvement in symptoms like hearing loss, vertigo, tinnitus and aural fullness noticed after the intake of oral thyroxine emphasizes the association between hypothyroidism and MD.¹⁷ Powers et al found that 17% of patients with Meniere's disease in the study had hypothyroidism. But thyroid hormone supplement alone could correct the vertigo in only 3 patients of these 17 patients.¹⁸

Evans postulated the relationship between Meniere's disease and thyroid autoimmunity in 1988.¹⁹ Blood labyrinth barrier is permeable to the immune complexes. Autoimmune antibodies can cause abnormalities in the endolymphatic sac structure affecting its function.⁶

Animal model study has shown that autoantibodies against type II collagen in the membranous labyrinth, sub-epithelial layer of the endolymphatic duct, spiral ligament, and enchondral layer of the capsule may induce autoimmune hydrops.²⁰ The mechanisms attributed to the causation of sensorineural hearing loss in autoimmune disorders are cytotoxicity mediated T lymphocyte, vasculitis, and immune complex accumulation.²¹

Fattori et al evaluated serum TSH, free T3, free T4 and thyroid autoantibodies like anti-TSH receptor antibody, anti-thyroperoxidase antibody and antithyroglobulin antibody. They observed that thyroid autoantibodies are found significantly high in MD patients as compared to

non-Meniere's acute unilateral peripheral vestibulopathy and healthy controls. But the effect of functional status of thyroid in the development of MD was sceptical.²² Similar study was done by Nacci et al where antibodies against non-organ specific antigens were evaluated in addition and obtained comparable results.²³

Vestibular neuronitis is caused by the involvement of vestibular nerve. Patient presents with sudden onset vertigo, nausea and vomiting without any cochlear symptoms. There may be a preceding upper respiratory tract infection.

Two important factors determining the involvement of vestibular and cerebellar system in congenital hypothyroidism are prior thyroid hormone level and time at which treatment was started. Mild hypothyroidism produces peripheral vertigo whereas chronic and profound ones will cause vestibular and cerebellar dysfunction.²

Hearing can get affected in hypothyroidism because of inadequate oxygenation in the organ of Corti and stria vascularis. Defective protein and myelin synthesis, enzymatic dysfunction is also suggested as probable causes. There can be structural abnormalities in the organelle. Auto antibodies can cause degeneration of neurons and Corti organelle, edema of endolymphatic system, excess production of fibrous tissue.²¹

Studies in English literature have also established an association of peripheral vertigo with carbohydrate and lipid metabolism. The inner ear does not store energy for its activities. Hence any disturbance in the blood glucose level can adversely affect its function. Microangiopathy and polyneuropathy causes changes in the blood flow to the internal ear.¹ Insulin receptors are known to be present in the saccule. Insulin has an influencing role in the lipid metabolism. Altered lipid metabolism can cause increased viscosity of blood and decrease the blood flow affecting the labyrinthine function.¹

CONCLUSION

Since majority of the patients (92%) in our study had BPPV we can conclude that there is no direct relationship between BPPV and functional thyroid hormone levels. Hence, thyroid profile need not be part of the basic workup in patients with BPPV. However, with regard to Meniere's disease and vestibular neuronitis, further studies evaluating the functional status of thyroid hormones in a larger sample size are required to establish the association.

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