



Evaluation of olfactory bulbus volume and olfactory sulcus depth in patients with Hashimoto's thyroiditis with 3T MRI

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Abstract

Aim: The aim of this study is to assess the olfactory bulb volume (OBV) and olfactory sulcus depth (OSD) in Hashimoto's Thyroiditis (HT) patients and control group patients and comparing the measurements between two groups with 3T MR.

Materials and Methods: Cranial MRI examinations of a total of 210 patients, 105 patients in the HT group and 105 patients in the control group, were evaluated retrospectively. Right, left, OBV and OSD were calculated from coronal T2W images.

Results: Patients mean age was 43.74 ± 12.4 years. The mean OBV was measured as $88.57 \pm 8.4 \text{ mm}^3$ in HT patients and $93.43 \pm 8.3 \text{ mm}^3$ in control patients. The mean OSD was $8.35 \pm 0.69 \text{ mm}$ in HT patients and 8.65 ± 0.66 in control patients. Left, right, mean OBV and OSD were significantly lower in HT patients than in the control group.

Conclusion: HT patients are under risk of decreased OBV and OSD, which can affect olfactory functions. This can affect the quality of life.



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Introduction

Hashimoto's thyroiditis, also known as chronic lymphocytic thyroiditis and Hashimoto's disease, is an autoimmune disease in which the thyroid gland is gradually destroyed. It is the commonest cause of hypothyroidism. HT is more common in women than in men. The disease is seen in approximately 2% of the population [1]. Persons with HT have serum antibodies against TG (anti thyroglobulin), TPO (anti thyroid peroxidase), and colloid. Cell-mediated immunity to thyroid antigens has also been demonstrated in many patients [2]. HT can be often associated with type 1 diabetes, coeliac disease, type 2 and type 3 polyglandular autoimmune disorders [2].

Thyroid gland disorders can cause psychiatric problems, such as cognitive impairment and depression, as well as neurological problems such as cerebrovascular disease [3]. Moreover, Hashimoto's encephalopathy (HE) has been described, caused by an autoimmune mechanism associated with HT. All HE patients had anti-thyroid (TG) antibodies and anti-thyroid peroxidase (TPO) antibodies and in

some patients anti-TSH receptor (TSH-R) antibodies as well [4].

We could not find a study in the literature that evaluates olfactory bulb volume (OBV) and olfactory sulcus depth (OSD) values in patients with HT by measuring with MRI. The aim of this study is to measure OBV, OSD values with 3T MRI in HT patients and control group patients and to evaluate whether there was a change in these values in HT patients via control group.

Materials and Methods

This study was performed in Muğla Sıtkı Kocman University Training and Research Hospital between January 2018 and January 2020. This retrospective study was approved by the ethics committee of Muğla Sıtkı Kocman University (24.03.2021-Protocol No: 210034- No: 47). Because of retrospective nature of study, written informed consent was not obtained.

Patients under the age of 65 who underwent cranial MRI for non-specific reasons such as vertigo and headache without Hashimoto's thyroiditis were determined as the control group. The information of the patients was accessed through the information system of our hospital. HT patients who underwent cranial MRI examination were noted

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as the study group. Patients who have neurological, psychiatric, endocrinologic autoimmune diseases, chronic sinusitis/rhinitis, chronic drug, smoke and alcohol use/abuse and patients older than 65 years (because of age related olfactor bulbus degeneration) were excluded from study groups because of these pathologies affect our measurements. In the current study, 105 patients with HT, 105 patients for control group who had cranial MRIs were included and retrospectively evaluated.

All HT patients have antibodies to TG and/or to TPO in their blood tests. All patients were euthyroid at the time of MRI examination. Abnormal ultrasound patterns like bilateral heterogeneity- hypoechogenicity, pseudonodules were present in patients with HT.

Olfactor bulbus volume and OSD measured from cranial MRI performed with a 3 T scanner (Siemens Skyra, Berlin, Germany). OBV and OSD measurements were performed on coronal T2-weighted brain MR images. Images were obtained with a protocol of 256×256 matrix and a 22-cm field of view, repetition time = 3500 ms (TR 3500 ms), echo time = 75 ms (TE 75 ms), number of excitations = 2 (NEX2) and a 4-mm slice thickness. The volume and depth measurements were calculated by a radiologist who had 5-year experience and was blinded to the subjects. An electronic cursor was used for manually delineating the contours of OB and olfactor sulcus. The mean, right and left olfactory bulb volume (mm^3) and sulcus depths (mm) were measured and calculated for evaluation. The technique used described before [5, 6,7] as shown in Figure 1. Three measurements were made and their mean were recorded.

Statistical analysis

Statistical evaluation was done using the IBM SPSS version 20.0 software (IBM Corp, Armonk, NY, USA). Normal distribution was controlled with the Kolmogorov Smirnov. Measurements were shown as mean \pm standard deviation. Independent samples t-test was used for evaluating the statistical differences between HT and control groups for OBV and OSD values. P value of 0.05 was accepted as statistically significant.

Results

Patients in the study group with HT, 85 (81%) were female and 20 (19%) were male. The HT group included 105 patients with the mean age 43.74 ± 12.4 years and the control group included 105 individuals with the mean age 43.96 ± 9.9 (Table 1). There was no statistical difference between ages of HT and control groups. The mean OBV was $88.57 \pm 8.4 \text{ mm}^3$ in the HT group and $93.43 \pm 8.3 \text{ mm}^3$ in the control group. The mean OSD was $8.35 \pm 0.69 \text{ mm}$ in the HT group and $8.65 \pm 0.66 \text{ mm}$ in the control group. Left, right, and mean OB volumes and OSD were significantly lower in patients with HT than the control individuals (all $p < 0.05$) (Table 1).

Discussion

The most important finding of our study is that OBV and OSD values were found to be significantly lower in the HT patient group compared to the control group.

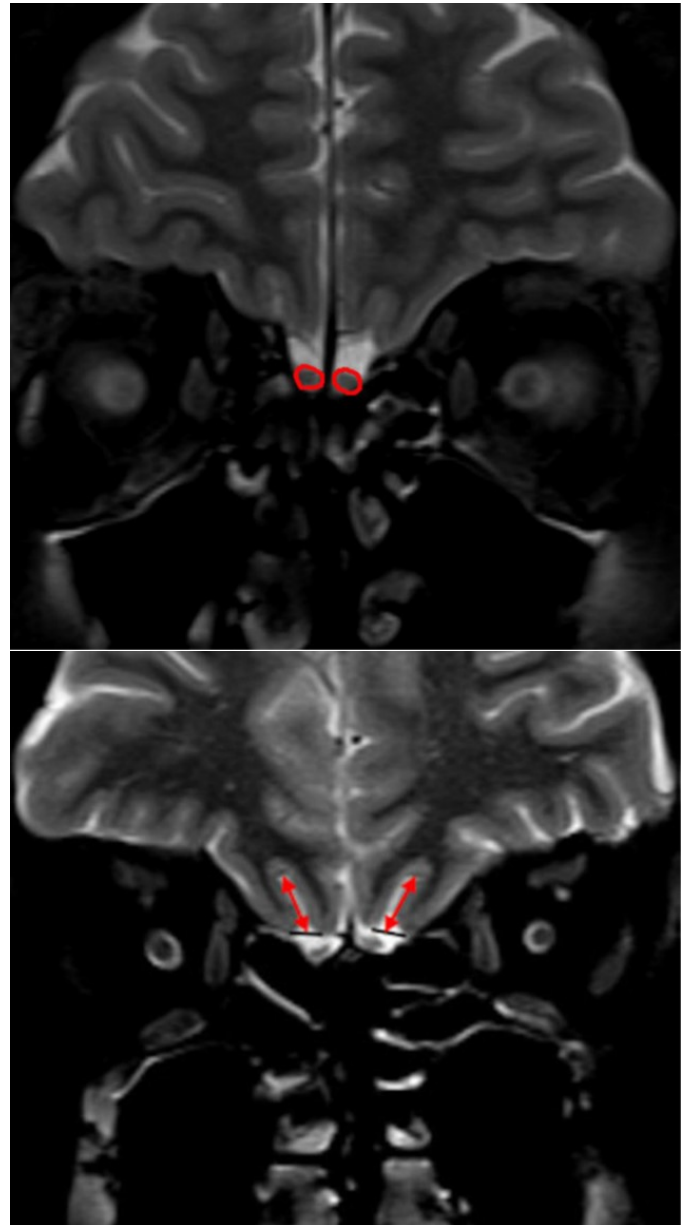


Figure 1. Olfactory bulb volume (a) and Olfactory sulcus depth (b) measurement from coronal T2W images.

In our study, there was no significant difference between the ages of the HT and control groups and our average age was approximately 43 years old. We did not include patients over 65 years of age in our study. Because there are publications stating that olfactory bulb volume decreases with aging [7, 8, 9]. Therefore, we think that we have ruled out age-related measurement changes. The mean OBV of our control group was $93.43 \pm 8.3 \text{ mm}^3$. Wang et al found this value as $81.70 \pm 16.8 \text{ mm}^3$ and Cullu et al $91.17 \pm 7.8 \text{ mm}^3$ and Hang et al $87.79 \pm 7.57 \text{ mm}^3$ [8, 9]. Accordingly, our measurement value is above the Wang et al and Hang et al, results but similar to the result Cullu et al reached. This may be due to geographic and racial differences. These researchers found no significant difference between right and left olfactory bulbus. Our findings were similar. Cullu et al., Wang et al. found no difference between genders, but Hang et al found significantly higher OBV in males. We did not compare genders because the

Table 1. The distribution of mean and both sides olfactory bulb volume (OBV) and olfactory sulcus dept in according to Hashimoto thyroiditis and control groups.

	Hashimoto Thyroiditis (n=105)	Control (n=105)	p value
Age (years)	43.74 ± 12.4	43.96 ± 9.9	0.918
OBV (mm³)			
Mean	88.57 ± 8.4	93.43 ± 8.3	0.001
Right	88.49 ± 8.7	93.48 ± 8.7	0.001
Left	88.65 ± 8.7	93.38 ± 8.7	0.001
OSD (mm)			
Mean	8.35 ± 0.69	8.65 ± 0.66	0.001
Right	8.37 ± 0.71	8.66 ± 0.68	0.003
Left	8.33 ± 0.68	8.65 ± 0.66	0.001

number of men in our group was significantly less than women.

Previous studies stated relationship between OBV and olfactory functions [5,10]. Olfactory pathway impairment plays an important role to lead decrease of quality of life, due to taste alterations and loss of pleasure from eating. Also olfactor pathway is a part of central nervous system (CNS) and it can be affected in CNS lesions and disease that affect CNS like autoimmun diseases [6,11,12]. In autoimmun diseases, such as; rheumatoid arthritis [6], Behçet's disease [11], decrease of olfactor bulbus volume has been showed, and olfactory dysfunction is defined in SLE and systemic sclerosis [12]. In addition many neurodegenerative CNS diseases including Alzheimer's, Parkinson's, and CNS related some psychiatric disease (for example depression/ anxiety) are associated with decreased olfactory sulcus depth and reduction of the sense of smell [11,13,14]. Strous et all. find the relations with olfactory impairment with various CNS disorders and possible autoimmune diseases [15]. Significant reductions of OBV and OSD in HT patients in our study may indicate that olfactory function is impaired in HT patients in the light of previous studies.

HT is an autoimmune disease. It causes chronic autoimmune thyroiditis and decreased function over time in the thyroid gland. However, findings indicative of CNS involvement during the course of the disease have been described. For example, it is stated that it may cause encephalopathy, which may occur independently of hormone levels and possibly due to antithyroid antibodies [16,17,18-25]. Attacks of hyperthyroidism and hypothyroidism may cause clinical signs such as dementia, psychosis (myxoedema madness), cerebellar ataxia, progressive stupor, coma (myxoedema coma), seizures, and myoclonus [1,2,18,19,20]. However, most studies indicate that anatomical and functional findings regress and disappear after appropriate treatment [20]. Gültekin et al. showed microstructural changes in areas related to neurocognitive function with diffusion tensor imaging examination in patients with HT, all of whom had no signs of euthyroid and encephalopathy. They stated that their results may be re-

lated to loss of WM fiber integrity, axonal damage and demyelination [14]. In Hashimoto's encephalopathy, changes in the brain due to ischemia and hypoperfusion, which disappear over time and with treatment, have been reported [22, 23]. However, it has been indicated that ischemia may cause permanent gliotic changes [24]. Diffuse demyelination and atrophy are other findings that may be related to hashimoto encephalopathy [25, 26]. All these studies mention that there may be mostly temporary and sometimes permanent changes in the CNS due to antibodies or hormonal changes caused by the disease. However, to our knowledge, we could not find any other study evaluating olfactor function or olfactory bulbus volume in patients with HT. The decrease in the olfactory bulbus volume we obtained in our study may be due to ischemia caused by encephalopathy in the central nervous system, demyelination effect due to hypoperfusion or cellular changes caused by hormonal changes. However, more extensive studies on the etiology are needed.

Our study has some limitations. First, thyroid hormone values and duration of illness of the patients were not used as study criteria. The effect of hormone levels and duration of illness may be the subject of prospective studies involving higher number of patients. Second, our study was designed retrospectively. Another limitation of ours is to investigate whether this finding causes olfactory dysfunction, although OBV and OSD decrease.

Conclusion

In conclusion, patients with HT patients can be under risk of decreased OBV and OSD and this findigs may related olfactory impairment which can affect the quality of life adversely.

Ethical approval

This retrospective study was approved by the ethics committee of Muğla Sitki Kocman University (24.03.2021- Protocol No: 210034- No: 47).

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