

Respiratory muscle strength in Hashimoto's disease

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Abstract

Objective: The present study aimed to investigate the respiratory function and respiratory muscle strength in Hashimoto's disease.

Material and methods: Thirty-two patients newly diagnosed with Hashimoto's disease between January 2017 and July 2017 were included in this study. Pulmonary function tests were also performed. FEV1 / FVC, FEV1%, FEV1 (l/sec), FVC (%), FVC (l), DLCO, DLCO/VA, maximum inspiratory pressure (MIP) and maximum expiratory pressure (MEP) values were examined.

Results: The mean age of the hypothyroid group was 43 (36-45), and the euthyroid group was 40 (35-46) years. The DLCO/VA level [86.00 (79.00-99.00)] in the hypothyroid group was significantly lower than the euthyroid group [99.00 (95.00-115.00)] (p: 0.007). MIP level in the hypothyroid group [75.00 (69.00-79.00)] was significantly lower than the euthyroid group [99.00 (83.00-112.00)] (p: 0.008). A negative correlation was found between TSH and DLCO, DLCO/VA and MIP (r: -0.376, p: 0.034; r: -0.499, p: 0.004 and r: -0.378, p: 0.033). A positive correlation was found between T4 and DLCO and DLCO/VA (r: 0.390, p: 0.027 and r: 0.351, p: 0.049, respectively).

Conclusion: In light of the data obtained in this study, the findings suggest that hypothyroidism affects respiratory muscle strength, and this weakness is associated with thyroid hormone levels

Key words: hypothyroid, respiratory muscle strength, maximum insufflation

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Introduction

Hashimoto's disease is the most common autoimmune thyroiditis that was described by Hakaru Hashimoto in 1912 as autoimmune thyroiditis [1], which is the result of the interaction between genetic and environmental factors [2]. Hashimoto's disease is the most common cause of hypothyroidism [3]. The hormones secreted by the thyroid gland may affect lung function [4]. Lung volumes are usually normal, but few studies showed that hypothyroidism leads to various respiratory diseases ranging from mild dyspnea to severe respiratory failure [5]. In hypothyroidism, hypoactive respiratory center, respiratory muscle weakness, and respiratory alveolar-capillary membrane changes occur due to respiratory problems [6]. Also, hypoxemia and hypercarbia may develop due to obesity, respiratory muscle weakness, a decrease in lung volumes and ventilation-perfusion imbalance [7]. Previous studies reported that dormant breathing problems, dyspnea of effort, impaired diaphragmatic function and decreased inspiratory muscle strength might occur due to hypothyroidism [8]. In a study examining the relationship between thyroid

function and weakness in respiratory muscles, a positive correlation was found between thyroid function and respiratory muscle strength [9]. Another study found a significant difference between the hypothyroid group and the control group concerning pulmonary function tests [10]. In a systematic review, 22 studies were evaluated, and the findings showed the possible mechanism of respiratory manifestations in patients with hypothyroid [11]. The direct effects of hypothyroidism on pulmonary function have not been clearly identified. The influence of hypothyroidism on the respiratory function has been inadequately addressed. The present study aimed to investigate the respiratory function and respiratory muscle strength of the euthyroid and hypothyroid groups in Hashimoto's disease.

Material and methods

Fifty-two patients who were admitted to the Endocrine Department of our hospital and were diagnosed with Hashimoto's disease between January 2017 and July 2017 were evaluated in this study. Twenty people who had known lung disease and smoked were excluded from

this study. Thirty-two patients were included in this study. Data on age, gender, additional diseases, and thyroid hormone tests were recorded.

The patients were divided into two groups as the hypothyroid and euthyroid groups according to thyroid-stimulating hormone (TSH) and free triiodothyronine (fT3) or free thyroxine (fT4) values. Thyroid function tests, thyroid autoantibody level, clinical findings and thyroid USG findings were used for the diagnosis of Hashimoto's disease in this study (3) Patients were accepted as euthyroid when their hormone levels are in between normal laboratory ranges as TSH:0,34-5,6 mIU/L, T4:7,71-16,09pmol /L, T3: 3,98-6,94 pmol/L.

Forced expiratory volume in 1 s (FEV1 l/sec), FEV1 (%), Forced vital capacity (FVC%), FVC (l), FEV1/FVC, maximum mid-expiratory flow (MMEF), diffusing capacity of the lungs for carbon monoxide (DLCO), diffusing capacity of the lungs for carbon monoxide divided by alveolar volume (DLCO/VA) were examined. We measured maximum inspiratory pressure (MIP) generated at the mouth during a forceful inspiration and the maximum expiratory pressure (MEP), which is the maximum pressure measured at the mouth that can be generated during expiration. Testing adhered to the American Thoracic Society (ATS)/European Respiratory Society (ERS) guidelines [12,13]. A consent form was obtained from patients. Also, ethical approval was obtained from the ethics committee of our hospital to conduct this study.

Statistical analysis

Data were analyzed using SPSS 17.0. Descriptive data were presented as count (n) and percentage (%) for categorical

variables and presented as mean ± standard deviation and median (25-75) percentile values for continuous variables. The normality of data was analyzed using Kolmogorov-Smirnov and Shapiro-Wilk tests.

An independent t-test was used to compare normally distributed data, while the Mann-Whitney U test was used to compare data that did not show normal distribution. Spearman correlation analysis was used to examine the correlation of data. Fisher's test was used to compare categorical data. P <0.05 was accepted for statistical significance.

Results

In this study, 32 patients (26 females and six males) were included: 13 (40.6%) of the patients were hypothyroid and 19 (59.4%) were euthyroid. The mean age of the hypothyroid group was 43 (36-45), and the euthyroid group was 40 (35-46) years. The incidence of cough, shortness of breath, wheezing, and chest pain was higher in the hypothyroid group than in the euthyroid group (p: 0.001) (Figure 1). Demographic data are presented in Table 1. A comparison of pulmonary function tests of patients revealed that the median DLCO/Va level in the hypothyroid group [86.00 (79.00-99.00)] was significantly lower than the euthyroid group [99.00 (95.00-115.00)] (p: 0.007). There was no difference between the two groups regarding FEV1/FVC, FEV1 (%), FEV1 (l/sn), FVC (%) and FVC (l) (p>0,05) j (Table 2). Examination of maximum inspiratory pressure (MIP) and maximum expiratory pressure (MEP) values revealed that the median MIP level in the hypothyroid group [75.00 (69.00-79.00)] was significantly lower than the euthyroid group [99.00 (83.00-112.00)] (p: 0.008) (Figure 2).

Figure 1 - Comparison of pulmonary symptoms of hypothyroid and euthyroid group

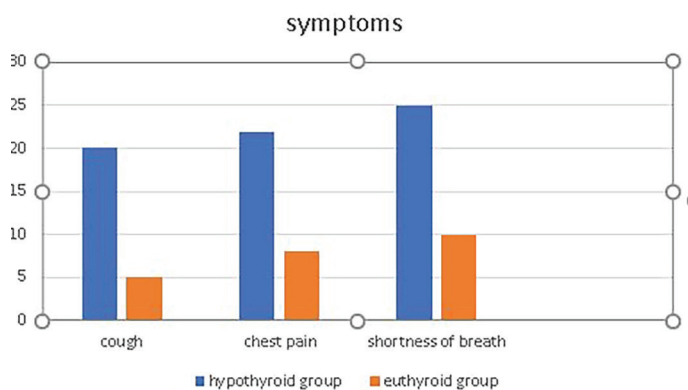


Figure 2 -Comparison of the MIP value of hypothyroid and euthyroid

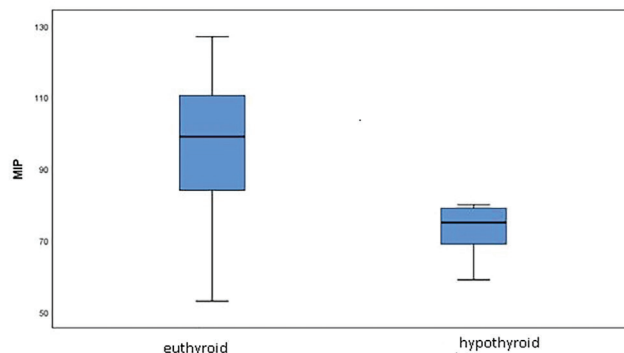


Table 1

Demographic information of the patients in this study

		euthyroid (n=19)		hypothyroid (n=13)		p
		n	(%)	n	(%)	
Sex	female	14	(73,7)	12	(92,3)	0,361
	male	5	(26,3)	1	(7,7)	
Age (years)		40	(35,00-46,00)	43	(36,00-45,00)	0,570
Height (m)		1,62	(1,59-1,65)	1,63	(1,59-1,66)	0,850
Weight (kg)		78,37	±12,54	73,00	±13,10	0,252
BMI (kg/m2)		29,59	±5,44	27,48	±4,40	0,254

Examination of the correlation between thyroid function tests and pulmonary function tests revealed a moderate negative correlation between TSH and DLCO, DLCO/VA and MIP (r: -0.376, p: 0.034; r: -0.499, p: 0.004 and r: -0.378, p: 0.033). There was no statistically significant correlation between

TSH and other pulmonary function tests (p>0.05). There was a moderate positive correlation between T4 and DLCO and DLCO/VA (r: 0.390, p: 0.027 and r: 0.351, p: 0.049, respectively). There was no statistically significant correlation between T4 levels and other pulmonary function tests (p>0.05) (Table 3).

Table 2

Comparison of the MIP, MEP and pulmonary function tests of the patients according to the groups

	hypothyroid (n=13)		euthyroid (n=19)		p value
FEV1/FVC	80,89	±4,54	82,38	±4,81	0,381
FEV1 (%)	104,37	±14,02	99,46	±16,55	0,373
FEV1	3,04	(2,50-4,49)	2,64	(2,40-3,05)	0,170
FVC (%)	106,00	(102,00-108,00)	92,00	(88,00-110,00)	0,126
FVC	3,50	±0,76	3,28	±0,50	0,370
MMEF (%)	79,00	(59,00-99,00)	85,00	(80,00-90,00)	0,623
MMEF	3,38	±0,84	2,98	±0,54	0,135
DLCO	97,11	±14,50	86,77	±14,65	0,058
DLCO/VA	99,00	(95,00-115,00)	86,00	(79,00-99,00)	0,007
MIP (%)	101,00	(80,00-128,00)	89,00	(80,00-101,00)	0,136
MIP	99,00	(83,00-112,00)	75,00	(69,00-79,00)	0,008
MEP (%)	60,63	±23,82	46,62	±15,42	0,072
MEP	64,00	(60,00-85,00)	62,00	(55,00-68,00)	0,254

FVC: Forced vital capacity; FEV1: Forced expiratory volume in 1 s; MMEF: maximum mid-expiratory flow; DLCO : diffusing capacity of the lungs for carbon monoxide ; DLCO/VA: diffusing capacity of the lungs for carbon monoxide divided by the alveolar volume
MIP: maximal inspiratory pressure ;MEP: maximal expiratory pressure

Table 3

Correlation between thyroid function tests and pulmonary function tests

	TSH		T4	
	r	p	r	p
FEV1/FVC	0,197	0,280	-0,148	0,420
FEV1(%)	-0,122	0,507	0,190	0,297
FEV1	-0,076	0,679	-0,064	0,728
FVC(%)	-0,137	0,453	0,114	0,533
FVC	-0,060	0,742	-0,039	0,831
MMEF(%)	0,080	0,663	-0,023	0,902
MMEF	-0,227	0,212	-0,023	0,900
DLCO	-0,376	0,034	0,390	0,027
DLCO/VA	-0,499	0,004	0,351	0,049
MIP(%)	-0,178	0,331	0,079	0,666
MIP	-0,378	0,033	0,059	0,747
MEP (%)	-0,220	0,227	-0,121	0,508
MEP	-0,064	0,729	-0,127	0,490

Discussion

In our study, the incidence of cough, shortness of breath, wheezing, and chest pain was found higher in the hypothyroid group. DLCO/VA value was observed lower in the hypothyroidism group than the euthyroid group. We also found that respiratory muscle strength measuring with MIP was affected and this weakness was correlated with thyroid hormone levels. In hypothyroidism, the central response to hypoxia and hypercapnia reduced. Hypoxemia, hypercarbia, and respiratory muscle weakness occur with a decreased central response [14]. Pulmonary manifestations may range from mild dyspnoea to life-threatening respiratory failure [15]. Mild-to-severe diaphragmatic muscle dysfunction has also been shown in these patients [16].

Çakmak et al. found that respiratory symptoms were statistically higher in the hypothyroid group when compared to the euthyroid group, which is consistent with our findings [10]. Also, similar to our study, Birring et al. found that respiratory symptoms were high in hypothyroid patients [14]. In a cross-sectional study in Egypt, the findings showed that respiratory symptoms were high in hypothyroid patients when compared to euthyroid patients [15]. Patients with hypothyroidism have airway dysfunction and inflammation. Thus, it supports the hypothesis that respiratory symptoms develop more frequently

in these patients, which is associated with increased airway inflammation. Birring et al. showed that cough reflex, airway hyperresponsiveness, and an increased number of inflammatory cells in sputum were increased in patients with low thyroid hormone levels [17].

The respiratory center can be stimulated directly by the thyroid hormone or its metabolites. Changes in pulmonary function were associated with increased overweight and obesity in hypothyroid patients. However, in our study, the average BMI was similar in the patients. Therefore, additional effects of obesity on spirometric parameters were excluded. Several abnormalities in respiratory function may be found in hypothyroidism concerning that in controls [18-19]. Valjevac et al. showed that FVC and FEV1 decreased in hypothyroid patients in contrast to our study [20].

Another study, on the other hand, found similar results to those of the present study: a significant decrease in DLCO was found in the hypothyroidism group compared to the euthyroidism group [15]. Çakmak et al. also found a significant decrease in DLCO in subclinical hypothyroidism patients compared to controls. The same study reported that FVC, FEV1, FEV1%, FEF 25–75, and FEF 25–75% significantly decreased in the hypothyroid group compared to the euthyroid group [21].

In another study, the findings showed that DLCO values

were lower in the hypothyroid group than the control group, but this difference was not significant [22].

In our study, the median MIP level was significantly lower in the hypothyroid group than in the euthyroid group. Similar to our study, in another study, the MIP value significantly decreased in the hypothyroid group compared to the euthyroid group. In the same study, the MEP level of the hypothyroid group was also lower than that of the other group [15]. In our study, no difference was found between the two groups concerning MEP. The MIP reflects the strength of the diaphragm and other inspiratory muscles, while the MEP reflects the strength of the abdominal muscles and other expiratory muscle. Reduction in all respiratory parameters in hypothyroid patients may be attributed to low serum T4, which may lead to weakness, especially in the inspiratory muscles and hypoventilation.

In another study, muscle strength was significantly lower in the hypothyroid group than in the control group [22]. Basi et al. found a significant decrease in lung function in their study with the patients who received no treatment and patients who received thyroid hormone replacement therapy, which was attributed to reduced muscle strength and reduced contractile strength due to low serum T4 level [23]. Martinez et al. demonstrated diaphragmatic dysfunction in patients with hypothyroidism ranging from mild forms associated with reduced tolerance to the physical effort to severe forms that could mimic diaphragm paralysis [16]. This was associated with low serum FT4 levels. Both inspiratory and expiratory respiratory muscle weakness seen in hypothyroidism had a direct linear relation to thyroid hormone level [24]. MIP was found to be related to DLCO (%), DLCO/VA (%), TSH and T4 in the present study as well. The

review from Chaitanya evaluated that deficiency of thyroid hormones reduces the strength of the respiratory. Muscles and thought that a reduction in diffusion lung capacity for carbon monoxide points to lung parenchymal involvement as well. These two changes lead to a predominantly restrictive pulmonary physiology on spirometry [25].

One of the major respiratory muscles affected by hypothyroidism is the diaphragm. Diaphragm weakness may be of considerable significance and is associated with hypoventilation. In hypothyroidism, surfactant lipids in alveolar epithelium may reduce phosphatidylserine and phosphatidylinositol, as well as decreased surfactant phospholipid, phosphatidylglycerol, and phosphatidic acid alveolar septation and reduce lung compliance and surfactant adsorption [26].

Given that the study group was small in size and the absence of respiratory function parameters after thyroid replacement are among the limitations of the present study.

Hypothyroidism was found to affect respiratory muscle strength in light of these data. It is clinically important to routinely perform pulmonary function tests to patients who are diagnosed with Hashimoto's disease.

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