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The effects of thyroid hormones on uroflowmetry parameters in asymptomatic women

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Aim: To investigate whether there is any association between uroflowmetry parameters and blood levels of thyroid hormones in asymptomatic women.

Materials and methods: Included in the study were 110 consecutive female patients with no urinary complaints who had thyroid function tests performed in an endocrinology clinic. Uroflowmetric measurements were performed for each patient in a sitting position. The patients were divided into 3 groups, hypo-, hyper-, and euthyroidism, and were investigated for statistical difference among them regarding maximum flow rate (Qmax), average flow rate (Qave), voided volume (VV), and voiding time (VT).

Results: The mean Qmax and Qave values of hypo-, eu-, and hyperthyroid groups were 25.3 ± 9.1 and 14.9 ± 5.8, 28.6 ± 9.6 and 16.2 ± 6.4, and 21.5 ± 8.7, and 13.2 ± 5.6, respectively. In the evaluation of all groups, a statistically significant difference was found regarding Qmax ($P = 0.004$) and Qave ($P = 0.024$). When the groups were evaluated between each other, Qmax ($p = 0.003$) and Qave ($P = 0.027$) were significantly different between hyper- and euthyroid groups, with no statistically significant differences in other groups regarding the uroflowmetry parameters ($P > 0.05$).

Conclusion: It has been found that Qmax and Qave were significantly lower in the hyperthyroid group as compared with the euthyroid group. According to these findings, it may be thought that hyperthyroidism negatively affects uroflowmetry parameters. To reach a definitive judgment, more investigations supported by urodynamic studies are necessary.

Key words: uroflowmetry, thyroid hormone, urination

1. Introduction

Thyroid hormones play an important role in the metabolic action of almost all organs, such as the cardiovascular, respiratory, and gastrointestinal systems (1–3). Thyroid hormone levels must be in a steady state for homeostasis. Thyroid disorders are very common and one of the most frequent problems in endocrinology practice, following diabetes mellitus. In the United States, hyperthyroidism and hypothyroidism are present in 1.3% and 4.6% of the population, respectively (4). All types of thyroid disorders in women are much more common than those in men (5,6).

Normal functioning of the urinary bladder is dependent upon regular function of the detrusor muscle during the storage and voiding phases. The relaxation and contraction functions of the detrusor muscle are mediated by several neural circuits, including sympathetic, parasympathetic, and somatic nerves (7). Thyroid hormone levels in blood circulation are highly effective on the autonomic nervous system (8). In hyperthyroid patients, sympathetic activity increases and parasympathetic activity decreases, while the opposite situation might be detected in hypothyroidism. These alterations in the autonomic nervous system, depending on the thyroid hormone levels, may interact with lower urinary tract (LUT) function.

The aims of this study were to evaluate the voiding function using noninvasive uroflowmetric measurements and to investigate whether there was any relationship between LUT functions and thyroid hormone levels in female patients without any urinary complaints.

2. Materials and methods

This study included 110 female patients attending endocrine clinics and having their thyroid hormone panel detected at our institution between September 2009 and August 2010. Male subjects were not included in the study in order to avoid the conflicting effect of the prostate on micturition dynamics that can be seen in middle-aged men. None of the patients had any urinary complaints during their attendance. The participants were divided

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into 3 groups, including hypo-, eu-, and hyperthyroidism, according to their thyroid status. The thyroid status of the patients was determined by an endocrine specialist based on both clinical presentations and serum levels of thyroid hormones. The serum levels of thyroid-stimulating hormone (TSH), free triiodothyronine (fT3), and free thyroxine (fT4) were measured using the chemiluminescence immunoassay method. The normal range of TSH, fT3, and fT4 were 0.1–4.5 µIU/mL, 1.5–4.4 pg/mL, and 10.2–24.4 pmol/L, respectively.

All participants were screened by means of physical examinations, urinalysis, and abdominopelvic ultrasound in order to determine the presence of any urinary disorder. Subjects were excluded from the study if they had previous pelvic surgery, concurrent neurological disease, or use of any medication known to interfere with the autonomic nervous system and/or lower urinary tract function such as anticholinergics, diuretics, sympathomimetics, sympatholytics, antidepressants, and antipsychotics.

Uroflowmetric measurements were performed in a private room that was locked from the inside and out of the hearing range of other staff members. All subjects performed uroflowmetric measurements when they felt the need to urinate during their daily activities. Subjects did not change their daily drinking habits and none of them received either a diuretic or a large fluid bolus. Measurements were done in a sitting position. All subjects were instructed to void without increasing their abdominal pressure. Urinary flow rates were measured using a weight transducer uroflowmetry device (Dyno Urodynamic System, Aymed Medical Technologies, Turkey). Voided volumes of <150 mL and >500 mL were disregarded for further analysis and the measurements were repeated. Mean maximum flow rate (Qmax), average flow rate (Qave), voided volume (VV), and voiding time (VT) were recorded for each group.

Statistical analysis was performed using SPSS 16.0 (SPSS Inc., Chicago, IL, USA). All results are presented as mean ± standard deviation (SD). One-way ANOVA was used to evaluate the intergroup differences regarding the uroflowmetry parameters. Differences were considered to be statistically significant at $P < 0.05$.

The local ethics committee approved the study protocol. Informed consents of all participants were obtained before the study began. Subjects did not receive any financial compensation for the time spent performing the study.

3. Results

The mean age, body mass index (BMI), and serum levels of thyroid hormones are shown in Table 1. There were no statistically significant differences regarding the mean age and mean BMI among all groups. In contrast, statistically significant differences were found in thyroid hormone levels among the groups, as expected.

The uroflowmetric measurements are also shown in Table 2. Statistically significant differences were found regarding Qmax and Qave when the uroflowmetric parameters of all 3 groups were compared ($P = 0.004$ and 0.024, respectively). When the groups were compared in pairs, there were statistically significant differences regarding the mean Qmax and Qave between the hyper- and euthyroidism groups, while there were no significant differences between the hyper- and hypothyroidism or the hypo- and euthyroidism groups ($P > 0.05$). Similarly, no statistically significant differences were found regarding the VV and VT parameters among all groups ($P > 0.05$).

4. Discussion

Our preliminary study was intended to investigate whether any association between uroflowmetric parameters and thyroid status revealed a significant decrease in urinary flow rates in patients with hyperthyroidism compared to patients with euthyroidism.

The most commonly used technique for the evaluation of LUT functions is uroflowmetry, which can be performed easily and in a simple manner. Uroflowmetric measurements could be done in a sitting or crouching position in women. It has been demonstrated that there is no difference between these positions regarding the uroflowmetric parameters (9). Nevertheless, we instructed

Table 1. Age, BMI, and thyroid hormone levels for each group (mean ± SD).

	Hypothyroidism (n = 32)	Euthyroidism (n = 51)	Hyperthyroidism (n = 27)	P
Age	43.5 ± 11.8	39.9 ± 11.3	44.6 ± 10.6	0.179
BMI	30.8 ± 6.7	27.8 ± 5.9	28.9 ± 6.1	0.060
TSH	11.8 ± 9.1	3.8 ± 4.9	0.31 ± 3.3	0.000
fT3	2.5 ± 0.7	3.0 ± 0.6	4.4 ± 4.6	0.002
fT4	12.1 ± 4.6	15.3 ± 3.4	19.0 ± 5.8	0.000

BMI: body mass index, TSH: thyroid-stimulating hormone, fT3: free triiodothyronine, fT4: free thyroxine.

Table 2. Uroflowmetric parameters for each group (mean ± SD).

	Qmax (mL/s)	Qave (mL/s)	VV (mL)	VT (s)
Hypothyroidism	25.3 ± 9.1	14.9 ± 5.8	280.4 ± 130.4	21.6 ± 12.9
Euthyroidism	28.6 ± 9.6	16.2 ± 6.4	315.1 ± 119.6	24.0 ± 12.7
Hyperthyroidism	21.5 ± 8.7	13.2 ± 5.6	389.3 ± 124.3	27.1 ± 13.9
P				
Hypo- vs, euthyroidism	0.447	0.265	0.934	1.000
Hypo- vs. hyperthyroidism	0.203	1.000	1.000	0.558
Eu- vs. hyperthyroidism	0.003	0.027	0.602	0.912

Qmax: maximum flow rate, Qave: average flow rate, VV: voided volume, VT: voiding time.

the subjects to void in a sitting position to provide standardization.

Alteration in thyroid hormone levels is characterized by a variety of clinical features that closely mimic those of catecholamine levels in the circulation (i.e. tachycardia, sweating, tremor, diarrhea) (10). For example, hyperthyroidism causes an increased sympathetic activity by enhancing cellular response to adrenergic activity. There are 3 types of nervous systems innervating the smooth muscles of bladder and proximal urethra: sympathetic, parasympathetic, and somatic (7). In a normal voiding process, detrusor muscles contract by parasympathetic stimulation, bladder neck and proximal urethral smooth muscles relax by alpha-adrenergic activity, and the striated urethral sphincter relaxes by somatic innervations. Therefore, LUT functions might be affected by the changes in the autonomic nervous system (ANS). For example, hyperthyroidism that is characterized by increased adrenergic activity might cause an inhibition in detrusor muscle action. Indeed, in an animal study, Hess et al. found an increased beta-adrenergic receptor density of the urinary bladder strip in hyperthyroid rats (11).

The effects of thyroid hormone alterations on LUT function have not been studied extensively. In the current literature, there is very scant information regarding the relationship between thyroid hormones and voiding function. In their clinical trial investigating LUT symptoms and urinary flow rates in female patients with hyperthyroidism, Ho et al. concluded that hyperthyroid women had worse LUT symptoms and lower peak flow rates (12). The results of this study regarding the urinary flow rates are in accordance with our results. Similarly, Andersen et al. investigated the voiding patterns in patients with thyroid disease and demonstrated that hyperthyroid patients had significantly increased voiding frequency and nocturia (13), whereas we did not reach any comment about LUT symptoms, since only subjects without any urinary complaints were included in our study.

Studies investigating the effect of hypothyroidism on voiding function are even fewer. There are a few cases of reported urinary retention due to hypothyroidism in the literature (14,15). However, we did not find any differences in the uroflowmetric parameters between hypothyroidism and hyper- or euthyroidism.

Our study is limited by the lack of urodynamic assessment, including detrusor pressure and pressure-flow study. As is known, decreased urinary flow rates might be dependent on both infravesical obstruction and/or impaired bladder contractility. However, urodynamic studies are less often used in clinical practice due to their invasive manner, despite the fact that more precise information to explore the exact mechanism of LUT functions could be provided by these diagnostic methods.

In this study, the effects of thyroid status on the lower urinary tract were evaluated with noninvasive uroflowmetric measurements. Urinary flow rates were significantly lower in patients with hyperthyroidism than those of euthyroidism. The most reasonable explanation of this effect is ANS alterations such as increased adrenergic activity at the level of detrusor muscle or even more central levels of LUT innervations. The exact mechanism of LUT dysfunction in thyroid disorders require further investigations, including urodynamic studies, in larger patient groups.

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