MINAR International Journal of Applied Sciences and Technology
ISSN: 2717-8234
Article type: Research Article

Received: 07/01/2024 **Accepted:** 11/02/2024 **Published:** 01/03/2024

INVESTIGATION OF ANTI-THYROPEROXIDASE ANTIBODY (anti-TPO Ab) AND THYROID HORMONES IN HYPERTHYROIDISM

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Abstract

This study conducted at the Al Kindi Educational Hospital in Baghdad involved 100 participants, consisting of 50 healthy individuals and 50 patients diagnosed with hyperthyroidism. Both groups were evenly divided, with 25 men and 25 women in each. The baseline control data for the healthy individuals were collected between January 2022 and April 2023 within the same facility. All participants underwent testing for thyroid function markers, specifically TSH (Thyroid Stimulating Hormone), FT4 (Free Thyroxine), and Anti-TPO Ab (Antithyroid Peroxidase Antibodies).

The study's findings revealed a significant gender-related disparity in hyperthyroidism. Females, whether in the patient or control group, exhibited the most pronounced increase in thyroid-related markers, with a highly significant increment ($P \leq 0.01$) compared to their male counterparts. In contrast, no significant differences were observed between male patients and male controls, nor between female patients and female controls in the context of hyperthyroidism.

Furthermore, the research highlighted specific biomarkers, Anti-TPO Ab and Free T4, which exhibited a highly significant increment ($P \leq 0.01$) in hyperthyroid patients compared to the control group. However, TSH levels remained relatively consistent between the two groups, showing no significant differences.

The aim of the study is to investigate the relationship between anti-thyroperoxidase antibody (anti-TPO Ab) levels and thyroid hormone concentrations in individuals with hyperthyroidism**.**

Keywords: *anti-TPO Ab, Hyroid Hormones, TSH.*

http://dx.doi.org/10.47832/2717-8234.18.25

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Introduction

Hyperthyroidism is a medical condition characterized by an overactive thyroid gland, leading to an excessive production of thyroid hormones in the body. The thyroid gland, a butterfly-shaped organ located in the neck, plays a crucial role in regulating various metabolic processes throughout the body. When this gland becomes hyperactive, it produces an excessive amount of thyroid hormones, primarily thyroxine (T4) and triiodothyronine (T3), which control the body's metabolism. Hyperthyroidism is often referred to as "thyrotoxicosis" because of the toxic effects of the excessive thyroid hormones on various bodily functions. This condition can have a profound impact on an individual's health and well-being, as it accelerates many physiological processes, leading to a wide range of symptoms and potential complications (LiVolsi, et al, 2018).

Common causes of hyperthyroidism include autoimmune disorders like Graves' disease, where the immune system mistakenly stimulates the thyroid gland, and toxic multinodular goiter or toxic adenomas, which involve the development of nodules on the thyroid that produce excess hormones independently. Other less common causes may include thyroiditis, certain medications, or tumors of the pituitary gland. The symptoms of hyperthyroidism can be diverse and may include weight loss despite increased appetite, rapid heartbeat (tachycardia), tremors, heat intolerance, excessive sweating, anxiety, irritability, and fatigue. Additionally, hyperthyroidism can affect other systems in the body, leading to issues like osteoporosis, heart problems, and eye changes (particularly in Graves' disease).

Timely diagnosis and management of hyperthyroidism are crucial to alleviate symptoms, prevent complications, and restore normal thyroid function. Treatment options may include medications that reduce thyroid hormone production or radioactive iodine therapy to slow down the thyroid's activity. In some cases, surgical removal of part or all of the thyroid gland (thyroidectomy) may be necessary. Hyperthyroidism is a manageable condition with appropriate medical care, and most individuals can lead healthy, fulfilling lives once their thyroid function is properly regulated. Regular monitoring and follow-up with healthcare providers are essential to ensure that the thyroid hormone levels remain within a healthy range and that the individual's overall health is maintained (Léger, et al, 2018).

Thyroperoxidase (TPO) is a critical enzyme involved in the production of thyroid hormones within the thyroid gland. Its role is fundamental to the thyroid's ability to synthesize thyroxine (T4) and triiodothyronine (T3), the two main thyroid hormones that play a crucial role in regulating various metabolic processes in the body. TPO-mediated reactions are a vital component of the thyroid hormone synthesis pathway. In the thyroid gland, TPO is primarily found on the surface of thyroid follicular cells, which are responsible for producing and secreting thyroid hormones. The enzyme catalyzes two key reactions in thyroid hormone synthesis:

1. Organification of Iodine: TPO facilitates the incorporation of iodine atoms into the amino acid tyrosine, an essential step in the creation of thyroid hormones. This process

involves iodination of tyrosine residues on thyroglobulin, a protein stored within the thyroid follicles (Maganha, et al, 2022).

2. Coupling of Iodotyrosines: TPO catalyzes the coupling of iodinated tyrosine molecules on thyroglobulin to form the thyroid hormones T4 and T3. These hormones are released into the bloodstream as needed to regulate metabolic processes throughout the body.

The proper functioning of TPO is crucial for maintaining normal thyroid hormone levels in the body. Any disruption or dysfunction of TPO activity can lead to thyroid-related disorders, including hypothyroidism (underactive thyroid) or hyperthyroidism (overactive thyroid). Anti-Thyroperoxidase (TPO) antibodies, often referred to as TPO antibodies or anti-TPO antibodies, are autoantibodies produced by the immune system that target and attack the enzyme thyroperoxidase (TPO) found in the thyroid gland. These antibodies are associated with various thyroid-related autoimmune disorders, primarily Hashimoto's thyroiditis but also sometimes Graves' disease (Maganha, et al, 2022).

Clinical Significance

The presence of anti-TPO antibodies may signal an increased risk of developing thyroid dysfunction, particularly hypothyroidism, in individuals with Hashimoto's thyroiditis. Regular monitoring of thyroid hormone levels and thyroid function is often recommended for those with anti-TPO antibodies (Ragusa, et al, 2019).

Material and methods

Subjects and study design

A total of 100 individuals from the Al Kindi Educational Hospital in Baghdad, including 50 healthy individuals and 50 patients with hyperthyroidism. There are 25 men and 25 women in each of the groups for the controls and patients. Between January 2022 and April 2023, the controls were collected from the baseline controls in the same facility. Each member of the two groups had their TSH, FT4, and Ant-TPO Ab levels checked.

Preparation of samples

All blood samples were gathered at Baghdad's Al Kindi Educational Hospital. Five milliliters of blood were drawn from 50 patients (25 women and 25 men), while 50 people (25 women and 25 men) acted as the control group. The blood samples were stored in the gel tube at room temperature for 20 minutes. The serum was separated using centrifugation for 15 minutes at 2000 rpm. To measure the levels of the TSH, T4, and Ant-TPO antibody the serum was separated into small aliquots.

Determination of Hormonal level

Using the Cobas C411 fully automated instrument and a close-system laboratory kit, the levels of TSH, T4, and Ant-TPO antibody were measured for the control and infertile female groups. The method of measurement was based on the chemical reaction that results in the visible radiation emission that is produced when an electron transitions from an excited state to ground state.

Statistical analyses

The influence of different groups (patients and controls) on study parameters was examined using the Statistical Analysis System- SAS (2018) application. To significantly compare between means, the T-test was utilized. Estimated correlation coefficient between the study's variables.

Result

The results showed a greater significant difference between the male and female of control and patients groups in hyperthyroidism disorder and non significant difference between control and patients groups as shown in table (1). The highest significantly increment (P≤0.01) was detected in female compared with male of patients and control group in hyperthyroidism disorder. In contrast, the result showed non significant increment between male of patient group and male of control group, in the same time, non significant increment was detected between female of patient gruop and female of control group in hyperthyroidism disorder as shown in table (1).

Table 1: Distribution of sample study according to Gender in patients and control

Factor		Patients (No=50)	Control (No= 50)	P-value
Gender: No (%)	Male	15 (30.00%)	17 (34.00%)	0.702 NS
	Female	35 (70.00%)	33 (66.00%)	0.688 NS
	P-value	0.0073 **	0.0091 **	---
** (P≤0.01).				

On the other hand, the results showed a greater significant difference between the control and patients groups in Anti-TG Ab and Free T4 of hyperthyroidism disorder and non significant difference between control and patients groups in TSH as shown in table (2). The highest significantly increment (P≤0.01) was detected in patients compared control group in hyperthyroidism disorder groups of Anti-TG Ab and Free T4. While, the TSH levels between

the control and patients groups did not differ significantly as shown in table (2) and figuer (1,2, and 3).

Table 2: Comparison between patients and control groups in parameters study µmol min^{-1}

Group	Mean ± SE		
	TSH (µIU/mL)	Anti- TPO Ab (IU/mL)	Free T4 (ng/dL)
Patients	0.00779 ±0.00056	36.40 ±0.34	3.63 ±0.02
Control	0.00774 ±0.00004	21.70 ±0.23	2.92 ±0.02
T-test	0.00012 NS	0.831 **	0.0647 **
P-value	0.466	0.0001	0.0001
** (P≤0.01).			

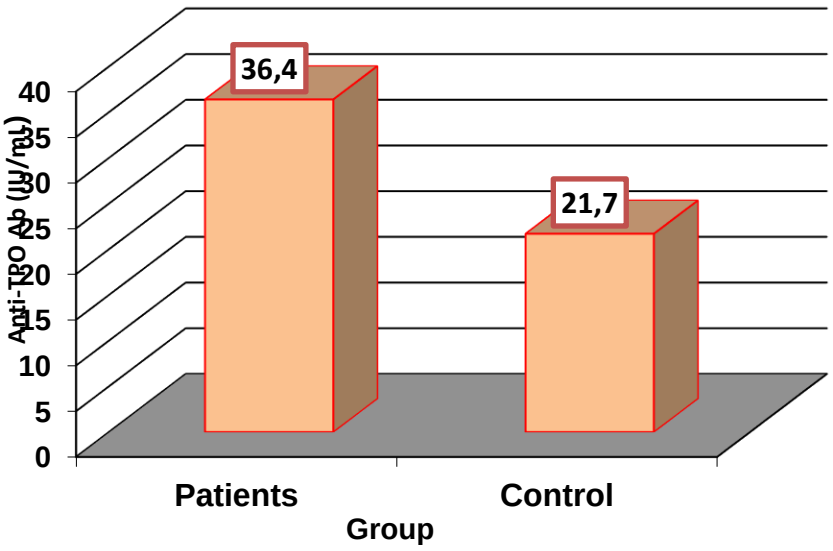

Figure 1: Comparison between patients and control groups in Anti- TPO Ab

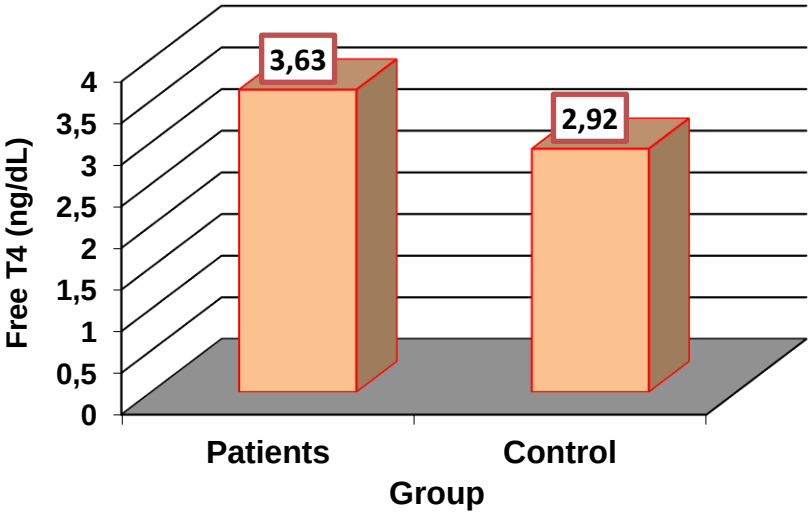

Figure 2: Comparison between patients and control groups in Free T4

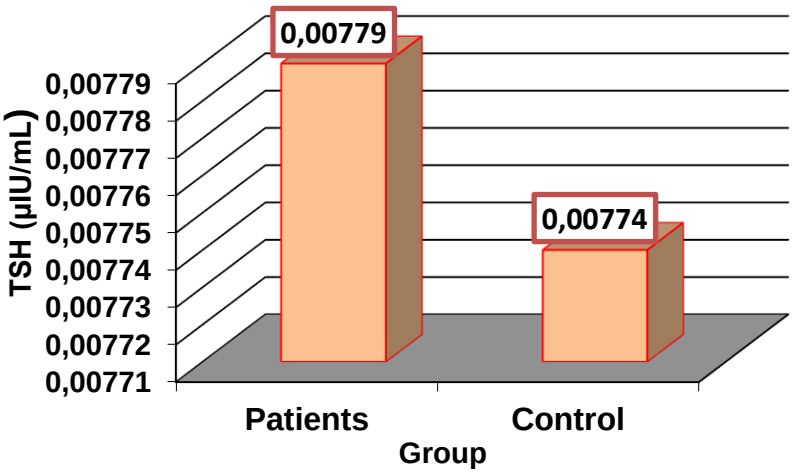

Figure 3: Comparison between patients and control groups in TSH

Discussion

The causes of the differences in females with hyperthyroidism compared to both males with hyperthyroidism may include hormonal fluctuations related to the menstrual cycle, differences in thyroid hormone metabolism, variations in thyroid autoantibody production, and potential differences in the prevalence of underlying autoimmune diseases. Differences between females and males with hyperthyroidism stem from various factors, notably hormonal fluctuations unique to the female reproductive system. Pregnancy-related changes, including elevated levels of human chorionic gonadotropin (hCG), can stimulate thyroid activity, leading to hyperthyroidism. Postpartum thyroiditis, an autoimmune condition following childbirth, also affects females disproportionately. Menopausal hormonal shifts can likewise influence thyroid function, potentially inducing hyperthyroidism in females. Additionally, the higher prevalence of thyroid nodules in females can contribute to

hyperthyroidism through excessive hormone production. Autoimmune disorders like Graves' disease, more prevalent in females, are significant contributors to hyperthyroidism cases. Furthermore, medication interactions, such as those involving estrogen-containing contraceptives or hormone replacement therapy, are more common among females and can impact thyroid function. These multifaceted factors underscore the complexities in diagnosing, managing, and understanding hyperthyroidism across genders. In addition to hormonal variations, socio-cultural factors may also influence the manifestation of hyperthyroidism between females and males. Females are statistically more likely to seek medical attention for symptoms, leading to earlier detection of hyperthyroidism. Moreover, societal expectations may affect how females perceive and report symptoms, potentially leading to differences in diagnosis rates. Biological disparities, including differences in thyroid hormone metabolism and autoimmune susceptibility, further contribute to the gender-specific presentation of hyperthyroidism. Understanding these nuanced differences is crucial for tailored treatment approaches and improved outcomes for both female and male patients with hyperthyroidism. In contrast, there is no significant increase between males with hyperthyroidism and males in the control group. Additionally, there is no significant increase between females with hyperthyroidism and females in the control group.

These findings suggest that hyperthyroidism may affect females more significantly than males. The lack of significant differences between male groups and between female groups (patients vs. controls) may indicate that gender alone may not be a significant factor in the development or progression of hyperthyroidism, this agree with Sullivan, et al, (2017).

The most significant increase ($P \leq 0.01$) was observed in hyperthyroid patients compared to the control group for Anti-TPO Ab and Free T4 levels. However, there was no significant difference in TSH levels between the control group and the hyperthyroid patient group.

These findings suggest that Anti-TPO Ab and Free T4 are potentially valuable biomarkers for diagnosing and monitoring hyperthyroidism. The lack of a significant difference in TSH levels between the two groups might be surprising, as TSH is typically used as a primary marker for thyroid disorders. It's possible that in hyperthyroidism, TSH levels may not always reflect the severity of the condition, and other markers like Free T4 and Anti-TPO Ab become more important, as shown by Anita, et al, (2019).

Overall, these results indicate that gender differences may play a role in the impact of hyperthyroidism, with females experiencing more significant changes in certain indicators. Additionally, specific biomarkers like Anti-TPO Ab and Free T4 appear to be more useful in diagnosing hyperthyroidism compared to TSH levels. However, a comprehensive clinical interpretation of these findings should consider other factors and medical history to better understand the implications for individual patients, this agree with Shalit, et al, (2023).

Conclusion

These findings underscore the importance of personalized and gender-specific approaches in the diagnosis and management of hyperthyroidism. The identified biomarkers, Anti-TPO Ab and Free T4, hold promise for improving the accuracy of hyperthyroidism diagnosis, ultimately aiding in better patient care and treatment strategies.

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