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Study the Effect of Thyroid Disorders on Uric Acid Levels in a Sample of Iraqi Patients

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Abstract

Background: Thyroid hormones play important roles in body metabolism, and thyroid diseases are commonly metabolic disorders found among general populations. Deficient thyroid hormones causes hypothyroidism, while excessive thyroid hormones causes hyperthyroidism. Thyroid diseases often affect renal functions and purine nucleotide metabolisms, and affect the metabolism of purine nucleotides which can elevate the uric acid levels, the end product resulting from purine metabolisms and the major risk factor for gout development.

Aims of study: The aim of the current study was to determination of hyperuricaemia in patients suffering from thyroid disorders (hypothyroidism or hyperthyroidism).

Methods: In the current case and control study, blood specimens were taken from (90) individuals from both sexes, (60) patients with thyroid disorders (30 hypothyroidism and 30 hyperthyroidism), and (30) apparently healthy persons as control groups. The ages of the study groups ranged between (30-60) years. The study was carried out at the department of teaching laboratories / Medical city in Baghdad-Iraq during the period from September to December 2023.

Serum uric acid was measured using the enzymatic method technique and according to special kit from spine, while the thyroid hormones (T3, T4 and TSH) were measured using the i-Chroma II reader ELISA kits.

Results: It was shown that the highest number and percentage of hypothyroidism, hyperthyroidism and the control group was within the age group >39 years 17 (36.2%), 16 (34%) and 14 (29.8%) respectively. The gender results showed that the number and percentage of males was 16 (34.8%) in hypothyroidism group, 15 (32.6%) in hyperthyroidism group and 15 (32.6%) in controls, while the number and percentage of females was 14 (31.8%) in the hypothyroidism patients, 15 (34.1%) in hyperthyroidism group and 15 (34.1%) in controls. Results of thyroid hormones revealed that the mean+SD of T3 in the hypothyroidism, hyperthyroidism and controls was (7.21±13.98, 4.57±0.919, 1.27±0.31) respectively, while mean+SD of T4 in hypothyroidism, hyperthyroidism and control groups was (3.33±0.52, 17.74±1.85, 9.14±1.36) respectively, whereas mean+SD of TSH in hypothyroidism, hyperthyroidism and controls was (13.25±4.15, 0.06±0.05, 2.41±1.14) respectively. The results of uric acid estimation demonstrated that mean+SD of uric acid in hypothyroidism, hyperthyroidism and controls was (7.86±0.43, 7.89±0.57, 4.53±0.90) respectively.

Conclusions: It can be concluded from the present study that the uric acid concentrations were elevated in both thyroid disorders (hypothyroidisms & hyperthyroidisms).

Key words: Thyroid disorders, Thyroid hormones, Uric acid.

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Introduction

The two related hormones, thyroxine (T4) and triiodothyronine (T3) are produced by the thyroid glands acting via receptors in the thyroid hormones. The thyroid hormones play essential roles in cellular differentiations during developments and aid in maintaining adult people's metabolic and thermogenic homeostasis. Overproductions of thyroid hormones can be stimulated by autoimmune diseases of the thyroid glands (thyrotoxicosis), or glandular destruction and hormone deficiency can be caused in the autoimmune diseases (hypothyroidism) [1].

Autoimmune thyroiditis is a commonly occurring disorder. Women are more affected by this disease compared to men. In elderly women, the incidence may reach up to 20% [2]. Autoimmune thyroiditis includes two major conditions: Hashimoto thyroiditis and Graves disease. Lymphocyte infiltration to thyroid gland causes both conditions. Graves disease is often presented with thyrotoxicosis, while Hashimoto thyroiditis is often presented with hypothyroidism [3].

Hypothyroidism can be defined as a reduced production of thyroid hormones due to defects in any part of hypothalamic, pituitary, and thyroid axis. Laboratory results show elevated TSH, decreased T3 and T4 [4]. The most common endocrine disease is hypothyroidism from clinical aspect. It is a result of insufficient thyroid hormones, leading to generalized impairment of various metabolic processes [5].

Uric acid, the heterocyclic compound, consists of carbon, oxygen, hydrogen as well as nitrogen [6]. The levels of uric acid were found to be related to benign positional vertigo, although they were not independent risk factors [7]. Another study also proposed that levels of serum uric acid are correlated with platelet reactivity in the old aged people [8]. Increased levels of uric acid is thought to be an intermediate factor in fatty tissues which regulate endocrine abnormalities that cause inflammation promotion and can be an essential factor causing atherosclerosis and dyslipidemia [9]. Nowadays, several studies are observed to be conducted on uric acid, moreover, uric acid is found to be associated with renal diseases and cardiovascular diseases, etc., however, few studies are found on the relationship between thyroid functions and uric acid, but there are some controversies as well [10]. Different biochemical disorders are caused by abnormal thyroid hormone production resulting in high metabolic syndrome risks and musculoskeletal and cardiovascular diseases [11]. Some conditions like metabolic syndromes, hypertension, chronic renal diseases and type-2 *Diabetes mellitus* are other comorbid cases correlated to hyperuricemia similar to thyroid disorders [12]. The risk of all deaths may not be elevated by deranged levels of serum uric acid occurrence in individuals affected by primary thyroid disease, but the prognosis and management of the disease may be also affected [13].

Patients and methods

In the current case and control study, venous blood specimens were taken from (90) individuals from both sexes, (60) patients with thyroid disorders (30 hypothyroidism and 30 hyperthyroidism), and (30) apparently healthy persons as controls. The ages of the study groups ranged between (30-45) years. The study was carried out at the teaching laboratories / Medical city in Baghdad-Iraq during the period from September to December 2023.

The blood samples were collected by means of disposable syringes, left for 15 minutes to clot and centrifuged at 3000 rpm for 10 minutes for serum obtaining, which was placed in small tubes and kept at -20^{o}C until use. Serum uric acid was measured using the enzymatic method technique and according to special kit from spine, while the thyroid hormones (T3, T4 and TSH) were measured using the i-Chroma II reader ELISA kits (Republic of Korea).

Statistical analysis

For data analysis of the study, the statistical package for social sciences (SPSS) program (SPSS -22. Inc., Chicago, IL, USA, 2013) was used, and significance level was established at ($p \leq 0.05$).

Results

Table (1) revealed that mean+SD age of hypothyroidism group was (39.80±3.48), and mean+SD age of hyperthyroidism group was (39.20±4.39), whereas mean+SD age of controls was (38.73±3.68), with non-significant differences between the three groups (p=0.56).

Table (1): Distributions of study groups according to ages(years)

Study Groups	N	Mean	Max-Min	Rnage	P-value
Hypothyroidism	30	39.80±3.48	45.00-32.00	13.00	0.56 N.S
Hyperthyroidism	30	39.20±4.39	45.00-30.00	15.00	
Control	30	38.73±3.68	45.00-31.00	14.00	
Total	90	39.24±3.85	45.00-30.00	15.00	

It was shown in the current study that the highest number and percentage of hypothyroidism, hyperthyroidism and the control group was within the age group >39 years 17 (36.2%), 16 (34%) and 14 (29.8%) respectively, with non-significant differences between groups (p=0.71), as illustrated in table (2).

Table (2): Distributions of study groups according to the age range

			Age range (Years)			Total	P-value
			(30-34)	(35-39)	>39		
Study Groups	Hypo	N	2	11	17	30	0.71 (N.S)
		%	18.2%	34.4%	36.2%	33.3%	
	Hyper	N	5	9	16	30	
		%	45.5%	28.1%	34.0%	33.3%	
	Control	N	4	12	14	30	
		%	36.4%	37.5%	29.8%	33.3%	
Total		N	11	32	47	90	
		%	100.0%	100.0%	100.0%	100.0%	

The gender results showed that the number and percentage of males was 16 (34.8%) in hypothyroidism group, 15 (32.6%) in hyperthyroidism group and 15 (32.6%) in controls, while the number and percentage of females was 14 (31.8%) in the hypothyroidism patients, 15 (34.1%) in hyperthyroidism group and 15 (34.1%) in controls, with non-significant differences between groups (p=0.95) as shown in table (3).

Table (3): Distributions of the study group according to genders

			Gender		Total	P-value
			Male	Female		
Study Groups	Hypothyroidism	N	16	14	30	0.95 (N.S)
		%	34.8%	31.8%	33.3%	
	Hyperthyroidism	N	15	15	30	
		%	32.6%	34.1%	33.3%	
	Control	N	15	15	30	
		%	32.6%	34.1%	33.3%	
Total		N	46	44	90	
		%	100.0%	100.0%	100.0%	

The results of thyroid hormones revealed that mean+SD T3 in hypothyroidism, hyperthyroidism and controls was (7.21±13.98, 4.57±0.919, 1.27±0.31) respectively, while mean+SD T4 in hypothyroidism, hyperthyroidism and controls was (3.33±0.52, 17.74±1.85, 9.14±1.36) respectively, whereas mean+SD TSH in hypothyroidism, hyperthyroidism and controls was (13.25±4.15, 0.06±0.05, 2.41±1.14) respectively, with a highly significant difference between the groups ($p \leq 0.0001$) as demonstrated in table (4).

Table (4): Distribution of the study groups according to mean T3,T4,TSH levels

Groups	N	T3(ng/ml)	T4(µg/ml)	TSH(µU/ml)
		Mean±Std	Mean±Std	Mean±Std
Hypo	30	7.21±13.98	3.33±0.52	13.25±4.15
Hyper	30	4.57±0.919	17.74±1.85	0.06±0.05
Control	30	1.27±0.31	9.14±1.36	2.41±1.14
Total	90	4.35±8.36	10.07±6.10	5.24±6.27
P-value		0.02	≤0.0001	≤0.0001

Data in table (5) regarding the results of uric acid estimation demonstrated that mean+SD of uric acid in hypothyroidism, hyperthyroidism and controls was (7.86±0.43, 7.89±0.57, 4.53±0.90) respectively, with a highly significant difference (p≤0.0001).

Table (5): Distribution of the study groups according to mean uric acid levels(mg/dl)

Groups	N	Mean±Std	Max-Min	Range	Anova P-value
Hypo	30	7.86±0.43	8.80-7.20	1.60	≤0.0001 H.S
Hyper	30	7.89±0.57	9.10-7.20	1.90	
Control	30	4.53±0.90	6.20-3.00	3.20	
Total	90	6.76±1.71	9.10-3.00	6.10	

Discussion

In the current case-control study, (90) individuals from both sexes, (60) patients with thyroid disorders (30 hypothyroidism and 30 hyperthyroidism), and (30) apparently healthy persons as a control group.

It was shown in our study that the highest number and percentage of hypothyroidism, hyperthyroidism and the control group was within the age group >39 years. The gender results showed that no significant differences were found between males and females suffering from thyroid diseases. The results of uric acid estimation demonstrated a highly significant variation between uric acid levels in thyroid disorder patients compared to the control group.

During development, adult individual's thyroid hormones play major roles in cell differentiation and help to maintain metabolic and thermogenic homeostasis. Metabolism, breathing, brain development, cardiac and nervous system function, body temperatures, muscle strengths, skin dryness, menstrual cycle, weight as well as cholesterol levels are affected by thyroid hormones [14].

It has been suggested by a recent study that the thyroid stimulating hormone (TSH) and thyroid hormones are related to each organ's function and also influence the growth and development of the body, and it has been found that the thyroid hormone levels is related to different sex and age [15].

It was shown by Bensenor et al [16] that the natural reduced pituitary TSH secretions and deiodinations of T4 are promoted by aging, but aging raises anti-thyroglobulin and anti-thyroperoxidase antibody occurrence. The reproductive and non-reproductive sex steroid hormone actions are significantly decreased during aging [17].

It was found in one study that hyperuricemia prevalence has been increased with age, with the lower rates in young people and the higher rates of in the old people [18].

The prevalence of hyperthyroidism was found to be the least in the age group (30–40) years, and the highest in the age group (50–60) years. Likewise, the prevalence rate of hypothyroidism was lowest in the age group (30–40) years, but highest in the age group (>=60) years. Although, no significant relationship was found between age and hyperuricemia in either of the two groups, the trend shed light on the age-related alterations in the uric acid homeostasis [18].

In one study, it was revealed that the overall hyperthyroidism and hypothyroidism was f significantly higher in females compared to males [19].

Variable trends to thyroid disorders were found in males and females, which are not similar to metabolic abnormalities. Different thyroid disorder types and Hashimoto thyroiditis are more commonly found in women, and their incidence is increased with ages in both sexes. Distribution of TSH shifts with age, particularly in females [20].

Studies conducted by [20,21], they demonstrated that a significantly higher hypothyroidism and hyperthroidism incidence was detected in females compared to males.

In the study done by [19], they reported that hyperuricemia prevalence rate was higher in females compared to males in both thyroid dysfunction groups. Nevertheless, no significant correlation was detected between hyperuricemia and sex in any of the groups. In a study performed by Zhang et al [22], they stated that there was a highly significant increase in prevalence of hyperuricemia rate in males with subclinical hypothyroidism than in females.

However, decreased levels of uric acid in both hyperthyroid and hypothyroid patients was also recorded by Abebe et al [23]. The variation in the studied populations as well as differences in sample size may be attributed to the divergence between such results and our findings [24].

Purine metabolism is affected by thyroid diseases, possibly leading to increased levels of serum uric acid. Former studies revealed an increased hyperuricemia incidence in thyroid disorder cases, but with reduced thyroid stimulating hormone -to-serum uric acid [25].

Some conditions like metabolic syndromes, hypertension, chronic renal diseases and type-2 *Diabetes mellitus* are other comorbid cases correlated to hyperuricemia similar to thyroid disorders [12].

In both hyperthyroidism and hypothyroidism, the levels of uric acid increased, the increase in hypothyroidism was more than the increase of other parameters specific to chronic renal diseases including blood urea, creatinine, glomerular filtration rate suggesting that the low uric acid excretion is the main pathogenesis to this increase in patients with hypothyroidism [24].

This can be explained by the high metabolism of purines in the primary hyperthyroidisms and low renal perfusions and glomerular filtrations (GFRs) in primary hypothyroidism. The increased levels of uric acid is believed to be an intermediate factor in adipose tissues. Nevertheless, the findings in these studies were contradictory and the relationship between thyroid disorders and uric acid levels is still obscure [25].

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