BIOCHEMICAL CHANGES IN PATIENTS WITH HYPERTHYROIDISM

Nihad Abdul Jabar Jalal[1], Abdulmonaim H Majied Al-Samarrai[2], Khedair A. Al-Tikriti[3],

[1]*Kirkuk general hospital , kirkuk , Iraq*

[2]*Department of Chemistry , College of Education-Samarra , Tikrit University , Tikrit , Iraq*

[3]*Department of Biochemistry , College of medicine , Tikrit University , Tikrit , Iraq.*

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Abstract:

This study is an attempt to investigate the biochemical changes caused by hyperthyroidism. It has been carried out on the sera of (106)

Patients diagnosed with hyperthyroidism collected during their attendance to the endocrinology department, Tikrit teaching hospital – Tikrit and Kirkuk general hospital – Kirkuk / Iraq, compared with (50) samples of normal individuals used as control.

The results indicated that the rate of hyperthyroidism is the highest among the age group (40-50) years old. Calcium, Phosphorus, and Potassium serum levels increase, while the level of Sodium remains within the normal range. Total Cholesterol, Triglycerides, LDL, VLDL and HDL levels decrease. Deficiency in the level of total protein and Albumin has been detected in patients with hyperthyroidism.

Key Words: thyrotoxicosis, hyperthyroidism, biochemical changes

Introduction:

Thyroid follicle cells synthesize three major iodothyronine hormones: thyroxin (T4), tri-iodothyronine (T3) and reverse tri-iodothyronine (rT3). Thyroxin and T3 have effect on proteins, carbohydrates, and lipids metabolism and increase oxygen consumption, While rT3 is biological inactive(1,2,3).

There are two major categories, of thyroid disorders; hyperthyroidism and hypothyroidism ,depending on the level of thyroid hormone when is increased or decreased respectively(4,5,6).

Thyrotoxicosis or hyperthyroidism is the clinical syndrome caused by an excess of circulating free thyroxine and free triiodothyronine, or both. It is common, affecting about 2% of women and 0.2% of men.

The most common causes of Thyrotoxicosis are Graves' disease,and formation of multinodular goiter, and autonomously functioning solitary thyroid nodule. The most common manifestations of thyrotoxicosis are weight loss in spite of good appetite, goiter (rarely), heat intolerance, osteoporosis , tachycardia (with or without palpitation or atrial fibrillation), anxiety, tremor with hyper-reflexia, sweating, amenorrhea /oligomenorrhea, myopathy , lid lag and lid retraction.(7)

The risk factors for thyrotoxicosis include: Family history, high iodine intake, smoking (particularly for thyroid-associated ophthalmopathy), toxic multi-nodular goiter is especially associated with an increased iodine intake either from a change in diet or an acute dose from iodine-containing agents e.g. Amiodarone.

While the most common non-specific biochemical abnormalities in hyperthyroidism are, raised enzymes such as Alanine aminotransferase, Gamma glutamyl transferase, and Alkaline phosphatase of liver and bone , Mild hypercalcemia, Normocytic normochromic anemia, Leucopenia, Lymphocytosis, hypoalbumineamia, Low total cholesterol and low HDL (7 & 8).

The study was conducted to determine some biochemical changes that may be associated with thyrotoxicosis.

Materials And Methods:

Patients and sample collection:

Patients were recruited attendants to the Endocrinology Departments of, Tikrit Teaching Hospital, Tikrit, & Kirkuk General Hospital –Kirkuk / Iraq. Those patients were previously diagnosed with hyperthyroidism. The study was carried out on (106) patients with hyperthyroidism and (50) normal individuals as control. Eight milliliters fasting blood samples were drawn from the cubital vein using disposable needles and syringes, without using tourniquet. All laboratory reagents and kits used through this study, were of analar grade sources, purchased from international companies obtained from the clinical chemistry laboratory of the department of biochemistry, College of Medicine University of Tikrit.

Determination of serum biochemical parameters:

All biochemical parameters were determined using commercial kits. The procedures of the chemical test were performed according to manufacturer instructions (9,10,11,12). These include (Ca, P, Na, K. Cholesterol, Triglycerides, VLDL, LDL, HDL, TSH, T3, and T4).

Statistical analysis:

The results of serum levels were presented as mean [±SD]. The student t- test was used to determine the significance. P value of <0.05 was considered as significant.

Results:

The study population included hyperthyroidism patients with three age groups (30-35, 35-40, and 40-45 years old). Of the total 106 patients 36 were males (34.0 %) and 70 patients (66.0 %) were females. (Table1).

The results indicated that the serum levels of TSH were significantly ($P<0.01$) lower (0.08± 0.02 mmol/l) compared to control. However, T3 was significantly higher (3.35± 0.58 nmol/l, $P<0.01$) as compared to control. Furthermore, T4 was higher than normal (189.84± 25.34 nmol/l). (Table2).

The mean of serum calcium level was (2.66± 0.16 mmol/l) which was significantly higher than control (2.28±0.23 mmol/l, $P< 0.01$) while,the mean of serum phosphorus level was (1.49± 0.25 mmol/l).

The difference in serum phosphorous levels between patients and control was statistically significant ($P<0.01$). (Table3).

The level of serum Potassium was significantly higher (5.14± 0.63 mmol/l, $P< 0.01$) than in normal control (4.36±0.81 mmol/l) while, the mean of Sodium level in hyperthyroid patients was (147.71± 6.82 mmol/l), which

was slightly higher than normal (146.84± 7.39 mmol/l , P<0.05). (Table3).

The levels of total cholesterol and triglycerides were lower than in control (3.70± 0.35 mmol/l and 0.82± 0.20 mmol/l respectively).While, the mean of serum HDL level was slightly lower (1.02± 0.25 mmol/l) than in control (1.16± 0.166 mmol/l). In addition, in hyperthyroid patients both LDL and VLDL are significantly lower compared to control (2.23± 0.43 mmol/l; (0.40± 0.09 mmol /l ; respectively). (Table 4).

(Table 5). Shows the mean values of serum total Protein (58.8± 3.21g/l) which were significantly lower than normal (71.86± 5.92, P< 0.01) While, serum Albumin level was (32.33± 3.86 g/l) which was significantly lower than control (39.6 ±4.4 , P< 0.01).

Table (1) : Age and sex distribution of patients with hyperthyroidism

Total No.106		Age (Yrs.)			Total
		30-35	35-40	40-45	
Male	No.	7	9	20	36
	%	(6.6)	(8.4)	(19.0)	(34.0)
Female	No.	13	27	30	70
	%	(12.3)	(25.4)	(28.3)	(66.0)
Total	No.	20	36	50	106
	%	(18.9)	(34.0)	(47.1)	(100)

Table (2) : Serum TSH, T3 and T4 levels in hyperthyroidism patients compared to control.

Groups	TSH mmol/L	T3 (nmol/L)	T4 (nmol/L)
	Mean ± SD	Mean ± SD	Mean ± SD
Patient	0.08 ± 0.02	3.35 ± 0.58	189.84 ± 25.31
Control	1.08 ± 0.40	1.92 ± 0.44	115.34 ± 24.79
Probability	P< 0.01	P< 0.01	P< 0.01

Table (3): Serum calcium, phosphorus, potassium and sodium concentrations in hyperthyroidism patients compared to control.

Groups	S.Ca mmo/L	S.P mmol/L	S.K mmo/L	S.Na mmol/L
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Patients	2.66 ± 0.16	1.49 ± 0.25	5.14 ± 0.63	147.71 ± 6.82
Control	2.28 ± 0.23	1.16 ± 0.24	4.36 ± 0.81	146.84 ± 7.39
probability	P<0.01	P<0.01	P<0.01	P>.0.05

Table (4): Serum cholesterol , triglyceride, HDL, LDL and VLDL concentrations in hyperthyroidism patients compared to control

Groups	S.cholesterol mmol/	S.triglyceride mmol/L	S.HDL mmol/L	S.LDL mmol/L	S.VLDL mmol/L
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Patients	3.70 ± 0.35	0.82 ± 0.20	1.02± 0.25	2.23±0.43	0.40±0.09
Control	5.13±0.85	1.69±0.37	1.16±0.166	3.23±0.8	0.77±0.16
Probability	P<0.01	P<0.01	P<0.01	P<0.01	P<0.01

Table (5): Serum total protein and albumin levels in hyperthyroidism patients compared to control.

Groups	Total protein g/L	Albumin g/L
	Mean ± SD	Mean ± SD
Patients	58.8 ± 3.21	32.33 ± 3.86
Control	71.86 ± 5.92	39.6 ± 4.4
probability	P<.0.01	P<.0.01

Discussion:

Hyperthyroidism incidence tend to be higher among older adults, this was explained due to the well known changes in thyroid gland anatomy and function with aging, and there may be an age-related resistance to thyroid hormone action(13).

In this study a significantly high serum Calcium and phosphorus levels were observed, while other study indicated that there is a significant elevation in serum Calcium and Alkaline Phosphatase with Osteoporosis, without any change in serum Phosphorus level(14).On the other hand, there was a significant hypercalcemia and hyperphosphatemia observed in patients with Graves disease (15).

Potassium level in hyperthyroid patients were significantly higher compared to control ($P<0.01$),while Sodium level is slightly (not significant) higher than the normal ($P>0.05$).

This is in agreement with the study done by Foye et al (16).

Routine Lipid profile test in hyperthyroidism patients have shown low level, with a mean of cholesterol and triglyceride concentrations as (3.70 ± 0.35 mmol/l), and (0.82 ± 0.20 mmol/l) respectively.

This was explained by increased thyroid hormone levels, stimulate fat mobilyzation , leading to increase concentration of fatty acids in blood. They also enhance oxidation of fatty acid in many tissues.

There is an unexpected improvement in lipid profile among patients with hyperthyroidism and previous hyperlipidemia (17). The level of serum LDL and VLDL were stayed lower compared to control.Which was attributed to hypotriglyceridemia (17& 18) .

The reduction in lipid profile parameters and improvement in dyslipidemia has been observed in patients with hyperthyroidism and subclinical hyperthyroidism which was a significant finding during many studies (19,20&21).

Both T3 and T4 were significantly higher in patients of hyperthyroidism .

Both total serum protein and albumin were lower than control in patients with hyperthyroidism. It was noticed that, in patients with familial dysalbuminemic hyperthyroxinemia (FDH) "an inherited abnormality" there is a variant of serum albumin with preferential affinity for T4 and there is excessive thyroxine binding to serum albumin. (22).

It may be concluded that the frequency of hyperthyroidism is higher in females than males, in patients who have thyrotoxicosis which seems more likely to develop hyperthyroidism .

The levels of serum calcium , phosphorus and potassium are higher in patients with hyperthyroidism , while there was a normal value of sodium. As for this study cholesterol and Triglycerides levels in hyperthyroidism are lower compared to control, as well as there was a low level of protein and albumin.

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التغييرات الكيموحيوية لدى المرضى المصابين بفرط افراز الغدة الدرقية

نهاد عبد الجبار جلال[١] ٢٣٤ يد السامرائي[٢] ،و خضير عباس التكريتي [٣]

[١] *مستشفى كركوك العام ، كركوك ، العراق*

[٢] *قسم الكيمياء ، كلية التربية سامراء ، جامعة تكريت ، تكريت ، العراق*

[٣] *فرع الكيمياء الحياتية ، كلية الطب ، جامعة تكريت ، تكريت ، العراق .*

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الملخص :

استهدفت هذه الدراسه التحري عن التغييرات الكيموحيويه التي تحصل نتيجة الاصابه بفرط افراز الغده الدرقيه. تمت هذه الدراسه باستخدام مصل الدم ل (١٠٦) من المرضى المشخصين باصابتهم بفرط افراز الغدة الدرقية الذين راجعوا قسم الغدد الصماء في مستشفى تكريت التعليمي– مدينة تكريت ومستشفى كركوك العام–كركوك / العراق ، كما تم اختيار ٥٠ شخصاً طبيعياً كمجموعة سيطرة .

بينت النتائج بأن معدل الاصابة بمرض فرط افراز الغدة الدرقية كان الاعلى في المجموعة العمرية (٤٠ – ٥٠ سنة) كما اظهرت النتائج زيادة مستوى الكالسيوم و الفوسفور ، والبوتاسيوم وكان مستوى الصوديوم ضمن الحدود الطبيعية .

اظهرت نتائج هذه الدراسه ايضا انخفاض مستوى الكوليسترول والكليسرايد الثلاثي ومستويات الدهون البروتينية LDL,VLDL & HDL ، كذلك وجد نقص في مستويات البروتين الكلي والزلال عند الاشخاص المصابين بفرط افراز الغده الدرقيه .