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Biochemical study of the association between serum level of Zinc, Copper and Selenium with hormone of thyroid in thyroid disorders

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ABSTRACT

The current study has been performed in AL-Hussein General Hospital, Imam Zine ALabiden Hospital, and one clinic in Karbala to determine the value of thyroid hormone including T3 triiodothyronine, T4 tetraiodothyronine, thyroid stimulating hormone and the concentration of Zinc, Copper and Selenium in patients with thyroid disorders of hyperthyroidism 31 and hypothyroidism 26 and their relation. All patients are females in the age of 20 to 55 years old beside the control groups including 50 healthy females selected from the medical staffs or patients' relatives carrying out no signs and symptoms of thyroid disorders. The results of the study have shown that the concentration of serum zinc and copper in females with hyperthyroidism is higher than the control group ($p < 0.001$), also the concentration of serum selenium in patient with hyperthyroidism is lower than control group ($p < 0.001$), subsequently, the concentration of serum zinc, copper and selenium in females with hyperthyroidism is lower than control group ($p < 0.001$) and the concentration of serum zinc in females with hyperthyroidism is lower than control group ($p < 0.001$).

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INTRODUCTION

The thyroid gland is located immediately below the larynx on each side of anterior is one of the largest endocrine glands weighing 15-20 grams in adults increased in pregnancy (Chernick and Friis, 2003), (Baloch *et al.,* 2003). Thyroid gland has played a vital role in a normal body and grows during the infancy and childhood accompanied by the metabolic rate regulation (Spencer, 2010) Thyroid has released thyroxin directly to the blood by absorbing iodine from the diet, regarding the iodine as an essential component of the hormone (Dabak N., 2010). The primary function of the thyroid is the production of thyroxin T4 (3,5,3,5 tetraiodothyronine), T3 (3,5,3 triiodothyronine) and calcitonin a hormone concerned with calcium homeostasis (Szkudlinski *et al.,* 2002).

Thyrotropin of Thyroid Stimulating Hormones (TSH) is a glycoprotein hormone produced by anterior pituitary gland stimulating the thyroid gland to produce thyroxine and T3 (Hauser *et al.,* 1993). Thyrotropin-releasing is started by acting of thyrotropin releasing factor (TRF) produced by the hypothalamus (Rivkees, 2014). Thyroxin inhibits the further release of thyrotropin by acting of TRF to regulate the level of thyroid hormones. In the case of inadequate iodine in the diet, inadequate thyroxin would be made to shut off the thyrotropin-releasing (Szkudlinski *et al.,* 2002). The synthesis of thyroid hormones is controlled through feedback regulation. T3 appears to be more actively involved than T4 in regulation processing. The production of TSH by pituitary and TRH by hypothalamus are inhibited by T3 and to a less ratio by T4. More production of TSH and TRH occur in response to the decreased circulatory levels of T3

Table 1: The correlation Coefficients between T3, T4, TSH, Zn, Cu and Se

	T3	T4	TSH	Zn	Cu	Se
T3	r 1.0000	r 0.9189	r -0.8020	r 0.7418	r 0.8089	r -02430
		p<0.0001	p<0.0001	p<0.0001	p<0.0001	0.0265
T4	r 0.9189	r 1.0000	r-0.7717	r 0.7531	r 1.00	r-0.3473
	p<0.0001		p<0.0001	p<0.0001		0.0013
TSH	r 0.8020	r -0.7717	r 1.0000	r-0.6547	r 0.6547	r-0.0008
	p<0.0001	p<0.0001		p<0.0001	p<0.0001	0.9942
Zn	r 0.7185	r 0.7531	r-0.6547	r 1.0000	r 0.7754	r-03480
	p<0.0001	p<0.0001	p<0.0001		1.0000	0.0012
Cu	r 0.8089	r 0.8624	r-0.7124	R 0.7754	r 0.7754	r-03720
	p<0.0001	p<0.0001	p<0.0001	p<0.0001	p<0.0001	0.0050
Se	r -0.2435	r- 0.3473	r-0.0008	r-0.0008	r-0.3724	r 1.0000
	p<0.0265	0.0013	0.9942	0.0012	0.0005	

Table 2: Comparison between patients with hyperthyroidism and control groups

	Unit	Hyperthyroidism	Control group
Number of patients	(n)	41	40
Mean of age	(year)	41.68±11.1	40.68 ± 11.1
Total T3	(ng/mL)	3.78± 0.9	1.11 ± 0.317
Total T4	(µg/ dL)	23± 3.94	7.94 ± 2.14
TSH	(µIU/mL)	0198± 0.15	4.48 ± 1.79
Zn	(µg/dL)	92.02± 8.2	86.2 ± 9.9
Cu	(µg/dL)	179.3± 9.1	118.1± 25
Se	(µg/dL)	0.34±0.3	0.89.3± 0.4

Table 3: Comparison between patients with hypothyroidism and control groups

	Unit	Hyperthyroidism	Control group
Number of patients	(n)	26	40
Mean of age	(year)	41±11.1	40.68 ± 11.1
Total T3	(ng/mL)	0.35± 0.105	1.11 ± 0.317
Total T4	(µg/ dL)	3.4± 0.48	7.94 ± 2.14
TSH	(µIU/mL)	14.5± 1.84	4.48 ± 1.79
Zn	(µg/dL)	54.4± 12	86.2 ± 9.9
Cu	(µg/dL)	82± 16.5	118.1± 25
Se	(µg/dL)	0.53±0.28	0.89± 0.33

Table 4: Comparison between patients with hypothyroidism and control groups

	Unit	Hyperthyroidism	Control group
Number of patients	(n)	31	26
Mean of age	(year)	41.97±13.8	40.68 ± 11.1
Total T3	(ng/mL)	3.78± 0.9	035 ± 0.105
Total T4	(µg/ dL)	23± 3.94	3.5 ± 0.4 8
TSH	(µIU/mL)	0.198± 0.15	14.5 ± 1.79
Zn	(µg/dL)	92.02±8.2	54.4 ± 12
Cu	(µg/dL)	± 9.1 179	82± 16.5
Se	(µg/dL)	0.34±0.33	0.53± 0.28

and T4, accordingly, the body has adequate hormones lasting for few weeks, and hence, it lasts few months in case of functional thyroid deficiency (Rondeel, 1990), (Pickles, 2013). Hyperthyroidism has been occurred in the overproduction of thyroid hormone by the thyroid gland, increasing the level of this hormone within the blood known as an overactive thyroid (Bonamico *et al.,* 2001), (Aihara *et al.,* 1984).

The purpose of the study

- To measure the level of thyroid hormone (T3, T4, and TSH) in thyroid disorder patients (hypothyroidism, hyperthyroidism)
- To evaluate the concentration of zinc, copper and selenium in correspondent patients (by atomic absorption)
- To correlate the trace element and thyroid hormone in patients with a thyroid disorder
- To evaluate the concentration of copper in correspondent patients. *Chemicals:*

All common laboratory chemicals and reagent are highly valuable Instruments

Patients and control group

Two patient groups (all female) with thyroid dysfunction have been used as a healthy group. All samples are gathered from the laboratory unit in Al-Hussein general hospital and Imam Zain Alabiden hospital in Karbala and outpatient clinic. Samples are classified into three groups as follows:

Group (I) has included 31 females with hyperthyroidism (mean age as 41‰± 9.7 yr), group (II) has included 26 females with hypothyroidism (mean age as 41‰± 11 yr) and the control groups (III) including 40 females with hypothyroidism (mean age as 40.68‰ ± 11.1 yr).

Specimen collections

Samples have been collected from the patients admitted for treatment in AL-Hussein general and Imam Zine ALabiden Hospital in Karbala and outpatients' clinic by taking 5ml venous blood from all groups (patients and control). Slow-aspiration of a venous blood sample by the use of a syringe needle has been performed to avoid the hemolysis with a tourniquet applied in anterior. All gross hemolysis samples are removed, then new samples are selected and dropped into disposable tubes waiting at room temperature for 30 min to be a clot and centrifuged (20 min in 5000 rounds).

METHODS

Each serum sample has been analysed for T3, T4, TSH, Zn, Cu and Se. All assays have been derived by running duplicates for the test, control and standard (Idrose, 2015), (Walter *et al.,* 2007), (Rao *et al.,* 2010).

Determination of Zinc in the serum

Serum sample has been prepared by diluting of a deionised distilled water in a dilution 1/100 (50µL of serum in 5 mL of deionised distilled water) to determine the concentration of Zinc equation of the strain line based on the Zinc standard curve.

Determination of Copper in the serum

Serum sample has been prepared by diluting of a dilution 1/10 (300µL of serum in 3 mL of 0.1 N HNO3) to determine the concentration of copper in an equation of the striate line of the copper standard curve.

Statistical Analysis

The results have been presented as mean, ± standard deviation (M± SD), then, the statistical analysing has been conducted through the use of SAS showing ($p<0.05$) the lowest limit significance.

RESULTS

97 patients (female, age= 22-55) have been analysed. While the mean age of samples with hypothyroidism is 41± 11.1-year-old (table,1), the mean age of samples with hyperthyroidism is 47± 97. Also, the mean age of the control group is 40.68± 11.1(table,1). Serum samples are used in this study.

Table 5: The value copper in a patient with hyperthyroidism

Sample number	T3	T4	TSH	Cu
1	4.1	26	0.09	191
2	5.2	29	0.05	184
3	4.4	26.6	0.08	193

Table 6: The value of copper in a patient with hypothyroidism

Sample number	T3	T4	TSH	Cu
1	0.19	2.1	16.3	102
2	0.22	2.0	18	87
3	0.36	2.7	13.2	81

Table 7: Compression of copper concentration between the atomic absorption and spectrophotometric in patients with hypothyroidism and hyperthyroidism

Hypo thyroidism	Atomic absorption	Spectro photometric
1	98	102
2	81	87
3	75	81
	Hyperthyroidism	
1	187	191
2	175	184
3	183	193

Comparison between hyperthyroidism and control groups: The comparisons of Copper, Zinc and Selenium concentration in patients with hyperthyroidism are classified as table 2. Zn and Cu have been increased in patients with hyperthyroidism. However, selenium concentration has been decreased in patients with hyperthyroidism.

Comparisons between hypothyroidism and control group: The comparison of copper, Zinc and selenium concentration in patients with hypothyroidism are classified as table 3, while Zn, Cu and Selenium are lower in patients with hypothyroidism.

Comparisons between hyperthyroidism and hyperthyroidism: Comparing of the patients with hyperthyroidism and hypothyroidism are summarized (table, 4), when serum Zn, Cu has been increased in hyperthyroidism; Meanwhile, Se is lower in patients with hyperthyroidism and hypothyroidism.

Determination of Copper ion in patients with thyroid disease by using a spectrophotometric method: The concentration of copper ion to three patients with

hyperthyroidism and three patients with hypothyroidism have been measured. Thus the obtained results have been compared to the result of atomic absorption technique. The value of a concentration

of copper ion in patients with hyperthyroidism and hypothyroidism in this technique are summarized (Table, 5 - 6).

Compression of serum copper concentration between the atomic absorption and spectrophotometric method in patients with hyperthyroidism and hypothyroidism: The comparison between atomic absorption and spectrophotometric method is summarized in table (7). The concentration of Cu in atomic absorption is lower than spectrophotometric method.

CONCLUSION

The concentration of serum copper in patients with hyperthyroidism is higher than the control group ($p<0.001$). The concentration of serum Zinc in patients with hyperthyroidism is higher than the control group ($p<0.001$). The concentration of serum selenium in patients with hyperthyroidism is lower than the control group ($p<0.001$). The concentration of serum copper in patients with hypothyroidism is lower than the control group. The concentration of serum Zinc in patients with hypothyroidism is lower than the control group ($p<0.001$). The concentration of serum selenium in patients with hypothyroidism is lower than the control group ($p<0.001$). Determination of this trace element by atomic absorption is more precession and economical than spectrophotometric method.

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