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Evaluation of the effect of using different doses of levothyroxine on TSH, T₃ and T₄ in hypothyroid patients

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Abstract--The current study included the collection of ninety serum samples to evaluate the effect of using different doses of levothyroxine drug on some biochemical parameters in patients with hypothyroidism. Samples were collected from external laboratories in Baghdad, for the period between 15/9/2021 to 1/10/2022. Sixty samples were taken for patients with hypothyroidism, as the group of patients (G1) which subdivided into two subgroups, 26 of them were taking levothyroxine dose of 200 µg/day (G2), and 34 of them were taking levothyroxine dose of 100 µg/day (G3), and 30 samples represented the control group, the ages of patients and control ranged between (40-60) years old. The level of TSH hormone, T₃ and T₄ hormones were estimated in the serum of patients with hypothyroidism and healthy people as a control group. The results showed a significant ($P \leq 0.05$) increase in the level of TSH in serum of people with hypothyroidism compared to the control group. The results showed a significant ($P \leq 0.05$) decrease in the level of T₄ hormone in patients with hypothyroidism compared with the control group, the results showed a significant ($P \leq 0.05$) decrease in T₃ level in patients with hypothyroidism compared to the control group, except for the group (G2) (after treatment), where the level was significantly higher than the rest of the others groups and close to the healthy group.

Keywords--hypothyroidism, tetra iodothyronine, tri iodothyronin, thyroid stimulating hormone.

Introduction

Hypothyroidism is one of the most important diseases worldwide. It is a chronic disease and is associated with a deficiency of thyroid hormones. Levothyroxine is a treatment primarily used to treat hypothyroidism. Hypothyroidism occurs when the thyroid gland in the neck does not produce enough of thyroid hormone to meet the body's demands ^(1,2). This can lead to heart disease, infertility, and poor brain development in children. People with hypothyroidism may experience changes in body weight, and feel tired, weak, or unhappy, all of which can reduce their quality of life. Hypothyroidism is diagnosed through biochemistry. Primary and explicit hypothyroidism is identified through elevated levels of TSH ^(4,3). Iodine deficiency leads to a defect in the function of the thyroid gland and causes a deficiency in the formation of its hormones, and to compensate for this deficiency, the secretion of thyroid-stimulating hormone (TSH) increases, which in turn leads to the enlargement of the gland and increase its tissue, this condition is called goiter, and the term goiter is used to refer to the enlargement of the thyroid gland and its secretion of its hormones in the natural proportions, it is necessary to have iodine in the water or in the foodstuffs that a person eats daily and in small quantities ^(6,5).

Levothyroxine is the standard treatment for patients with hypothyroidism. Oral levothyroxine is approved by the US Food and Drug Administration for the treatment of primary and secondary hypothyroidism. Initial doses of levothyroxine can vary widely and may depend on the amount of remaining thyroid function the patient maintains., body weight or lean body mass of the patient, and thyroid-stimulating hormone levels, since levothyroxine is usually given over the course of a patient's life ^(7,8). Levothyroxine is a synthetic version of the body's natural T₄ thyroxine, thyrotropin - TRH stimulates the anterior pituitary gland to secrete TSH, which in turn stimulates the thyroid gland to secrete 80% of T₄ and 20% of T₃ Then 50% of T₄ is converted to its active T₃ receptor, then thyroid hormones act by binding to thyroid receptor proteins located in the cell nucleus ⁽⁹⁾.

Methodology

The study samples

The study was conducted on 90 blood samples, 60 samples from people with hypothyroidism with 30 blood samples from healthy people as a control group, their ages ranged between (40-60) years for patients and healthy people, the samples were collected from external laboratories in the city of Baghdad, for the period between 2021 9/15 to 1/10/2022.

Estimation blood serum TSH concentration

The concentration of TSH was measured by following the steps included with its ready-made kit, according to the manufacturer's instructions for ELISA technology (Human Company) and the normal range for TSH ml\1 (0.3 - 4.0).

Estimation blood serum T₃ and T₄ concentration

The concentration of T₃ and T₄ hormones was measured by following the steps included with the ready-made analysis kit, and according to the manufacturer's instructions for ELISA technology (Human Company), the normal range for T₃ hormone is (0.69 - 2.02 ng/ml) and the normal range for T₄ hormone for women is (4.8-4.8 11.6 ng/ml) and for males (4.4 - 10 ng/ml).

Statistical analysis

The statistical program (SPSS) was used, using the Duncan test to compare between a group of patients suffering from hypothyroidism and a group of healthy people as a control group. The significance was calculated when performing the statistical analysis of all data at the probability level ($p \leq 0.05$).

Result and discussion

Thyroid hormone levels

The levels of the hormones (TSH, T₄, T₃) were estimated in serum of patients with hypothyroidism and the healthy ones, and the mean standard deviation of the hormones was shown in Table (1).

Table (1) The average \pm standard deviation of the levels of the hormones in the study groups

Parameter	Mean \pm SD		
	TSH (ng/ml)	T ₄ (ng/ml)	T ₃ (ng/ml)
C1	0.554 \pm 0.129 b	40.019 \pm 10.379 a	108.885 \pm 27.028 a
G1	0.817 \pm 0.146 a	10.505 \pm 2.375 c	87.338 \pm 22.590 bc
G2	0.781 \pm 0.110 a	10.530 \pm 3.090 c	101.679 \pm 33.590 a
G3	0.783 \pm 0.102 a	10.407 \pm 2.100 c	87.036 \pm 20.788 bc

Different letters mean that there are significant differences at $P \leq 0.05$
Similar letters mean there are no significant differences

The level of TSH hormone in the blood serum.

The results of the current study showed that the level of TSH hormone was (0.817 \pm 0.146) ng/ml in serum of patients with hypothyroidism, while its level was (0.554 \pm 0.129) ng/ml in healthy subjects as a control group as shown in Table

(1). It is clear from the above table that the level of TSH significantly ($p \leq 0.05$) increased in patients with hypothyroidism compared to the healthy control group as shown in Figure (1).

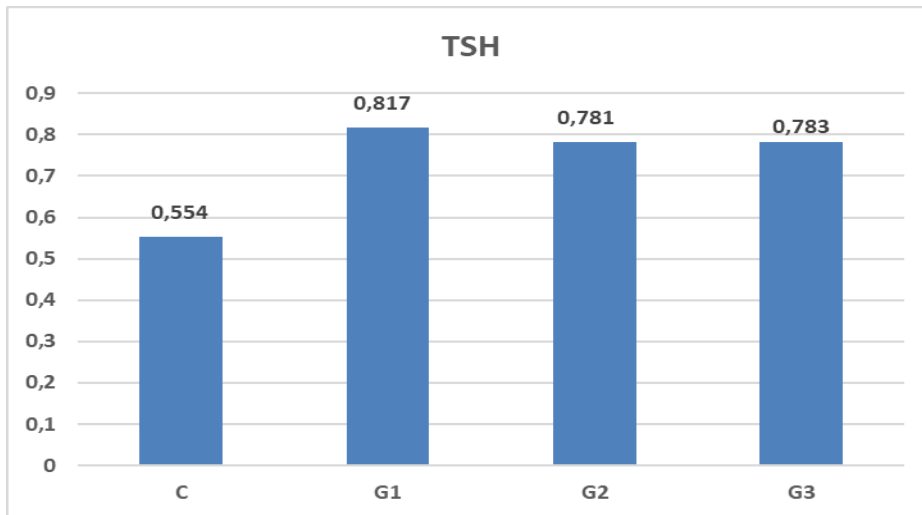


Figure (1) The level of TSH hormone concentration in the blood serum of the study groups

The level of T₄ hormone in the blood serum

The results of the current study showed that the level of T₄ hormone was (10.505 ± 2.375) ng/ml in the serum of patients with hypothyroidism, while its level was (40.019 ± 10.379) ng/ml in healthy subjects as a control group as shown in Table (1). The result of the study in the above table indicated that the level of T₄ was significantly ($p < 0.05$) decreased in patients with hypothyroidism compared to the healthy control group as shown in Figure (2).

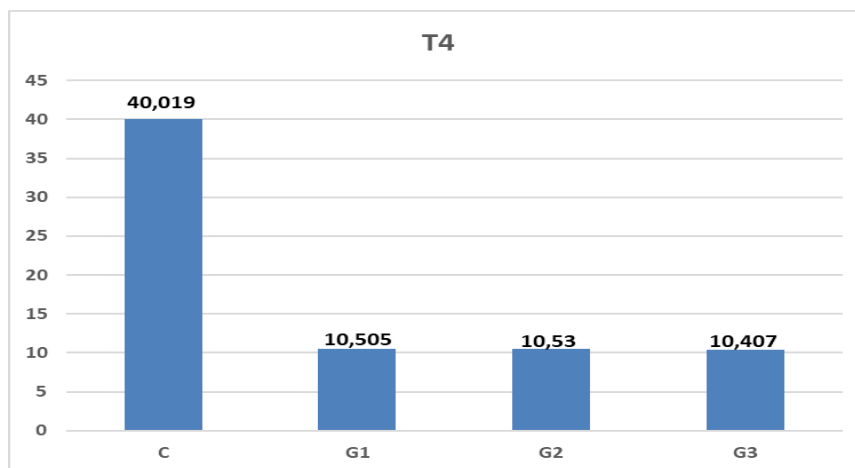


Figure (2) The level of T4 hormone concentration in the blood serum of the study groups

The level of T₃ hormone in the blood serum

The results of the current study showed that the level of T₃ hormone was (87.338 ± 22.590) ng/ml in serum of patients with hypothyroidism, while its level was (108.885 ± 27.028) ng/ml in healthy control group as shown in Table (1). It is clear from the result of Table(1)that the level of T₃wasignificantly($p \leq 0.05$)decreased in patients with hypothyroidism compared to the healthy control group, except for the group (G2), where the level of T₃ was significantly($p \leq 0.05$)higher than the rest of the groups and close to the healthy group, as in Figure (3).

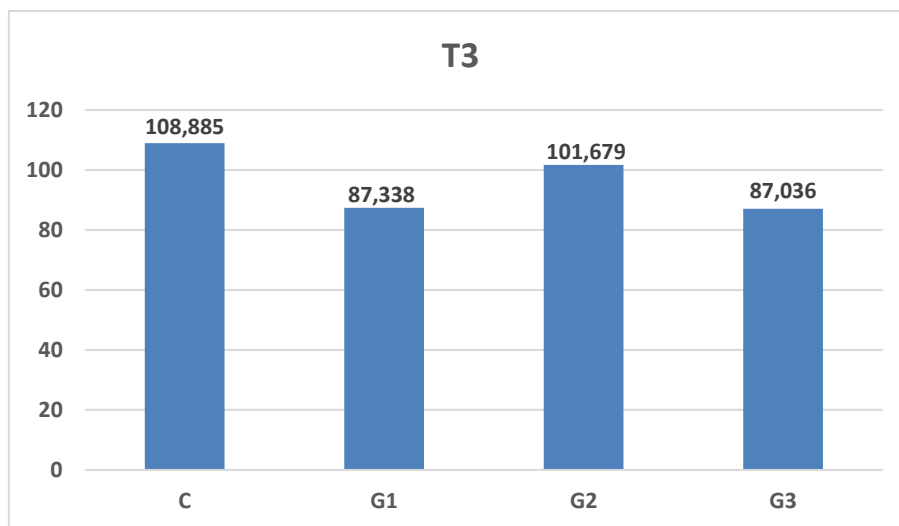


Figure (3) The level of T₃ hormone concentration in the blood serum of the study groups

In the current study, a significant increase in TSH levels was found with a decrease in T₄ and T₃ levels compared to the control group in hypothyroidism patients, and these results are consistent with the results of the study conducted by Hashim et al⁽¹⁰⁾, which indicated a significant increase in TSH levels with a decrease in T₄ and T₃ levels compared to the control group. Also, the results of the current study agree with the results of the recent study, which showed a significant increase in TSH levels with a decrease in T₄ and T₃ levels compared to the control group in hypothyroidism patients ⁽¹¹⁾.

Hypothyroidism, or underactive thyroid, is characterized by impaired perception and metabolism, a pathological condition that results from a lack of thyroid activity and results from a decrease in the concentration of thyroid hormones T₃ and T₄ with an increase in the level of TSH in the blood ^(12,13). Iodine deficiency can lead to a defect in the function of the thyroid gland and cause a deficiency in the formation of its hormones, and to compensate for this deficiency, the secretion of thyroid stimulating hormone (TSH) increasing, which in turn leads to an enlargement of the gland and an increase in its tissue, and this condition is called goiter, and the term goiter is used to refer to an enlarged thyroid gland, and in order to maintain the regulation of the work of the thyroid gland, and its

secretion of its hormones in the natural proportions, iodine must be available in water or in food items that a person eats daily and in small quantities ⁽⁵⁾.

Thyroid stimulating hormone (TSH) is the hormone responsible for the activation of many proteins and thus stimulates the response of the systems, so the process of transmitting signals in the thyroid gland is a stimulus for the production of thyroid hormones, and any defect in this immune response leads to a disturbance in the secretion of thyroid hormone ⁽¹⁴⁾. Some studies that the cause of the high level of TSH with a decrease in the levels of T₄ and T₃ in humans and animals is due to the intake of large amounts of fluoride through drinking water, green tea and ambient air pollution. In other words, the higher the amount of fluoride in the water, the higher the level of TSH, as it was found that fluorine affects the thyroid hormones, especially TSH and T₃, even at the standard concentration of less than 0.5 mg / liter. ^(14,15). The increase in the level of T₃ in (G2) indicates that the treatment of levothyroxine at a concentration of 200 µg/day of levothyroxine has returned the level of T₃ to its normal level in this group.

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