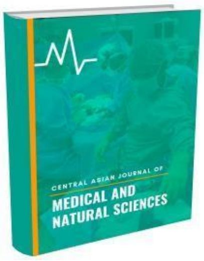

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Article

Evaluation of Thyroid Hormone Levels in Women after Total Thyroidectomy for Thyroid Cancer

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Abstract: Thyroid cancer often necessitates total thyroidectomy, a procedure that significantly alters thyroid hormone levels and can lead to hypothyroidism if not properly managed.This study aimed to evaluate thyroid hormone levels in patients who have undergone total thyroidectomy for thyroid cancer, compared to healthy individuals, to understand the physiological effects of the surgery. A total of 100 participants aged 25 to 45 from Dhi Qar Province were enrolled and evenly divided into two groups: patients who had undergone total thyroidectomy (Group A) and healthy controls. After a 12-hour fast, blood samples were collected, and serum levels of T3, T4, and TSH were measured using ELISA kits. Statistical analysis was performed using ANOVA and the LSD test, with significance set at $P < 0.05$. Group A showed significantly lower levels of T3 (0.47 ± 0.10 ng/ml) and T4 (88.11 ± 8.73 nmol/l) compared to the control group (T3: 1.23 ± 0.27 ng/ml; T4: 115.69 ± 15.75 nmol/l). Conversely, TSH levels were markedly higher in Group A (8.27 ± 1.03 μIU/ml) than in the control group, indicating postoperative hypothyroidism. These differences were statistically significant ($P < 0.05$).

Keywords: Thyroid cancer, Total thyroidectomy, Thyroid hormones, T3, T4, TSH, Hypothyroidism

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1. Introduction

Total thyroidectomy is the most effective procedure for treating multinodular goiter, Graves' disease, and thyroid cancer. It eradicates the lesion entirely, reduces the likelihood of local recurrence, and avoids the high risk of re-operation. Total thyroidectomy is both safe and effective, with a low rate of complications that is comparable to the highest medical centers in the world. Traditionally, the dangers of major surgery for thyroid disease and the complexity of administering hormones have prevented surgeons from performing a total thyroidectomy. Actually, thyroid surgery was uncommon until the late 19th century, and total thyroidectomy was uncommon for other than cancer purposes until the latter half of the 20th century [1], [2], [3], [4].

Thyroid cancer is the most common form of endocrine cancer, and its prevalence is increasing at a faster rate than any other cancer type in both men and women.

Thyroid cancer is the 9th most common cancer in the U.S., it represents 3.8% of all cancers and 0.3% of all cancer-related fatalities. The most common histological type of thyroid cancer is papillary thyroid carcinoma (PTC), which represents over 80% of all thyroid cancers. The cause of thyroid cancer is unknown. Known risk factors for thyroid cancer include advanced age, female gender, exposure to radioactive radiation, a history of healthy thyroid disease, and a family history of thyroid cancer. Recent research has indicated that obesity and being overweight are associated with the development of thyroid cancer [4], [5], [6], [7], [8].

Thyroid stimulating hormone (TSH) is the primary growth factor for thyroid cells and controls the function of the thyroid. It controls the processes that result in increased production and secretion of thyroid hormones. The concentrations of thyroid hormones in the blood (triiodothyronine (T3) and its precursor thyroxine (T4)) are responsible for negative feedback at the pituitary level. Today, also known as the treatment of suppressed thyroid-stimulating hormones, this procedure is used to treat patients with differentiated thyroid cancer (DTC) and has been demonstrated to have a positive effect on patient survival. Other thyroid hormones are also hypothesized to have cancer-promoting effects on various cancers, including breast, ovarian, and prostate. However, the findings of epidemiological studies regarding the association between TSH, thyroid hormones, and thyroid cancer risk have been inconsistent [9], [10], [11], [12], [13].

Early studies that reported a higher probability of thyroid cancer associated with higher TSH levels, while some reported no association and one reported a decreased probability. All investigations that found a positive association between TSH and thyroid cancer were retrospective or case-control studies. As a result, because the TSH levels were recorded after the diagnosis, there is the potential for causation to be reversed or the effect to be reversed. Previous prospective studies of this nature have only been conducted three times. One study reported that increased TSH levels were inversely proportional to the risk of thyroid cancer. Two smaller studies reported lower concentrations of TSH in thyroid cancer patients compared to controls, these differences were not significant. The association between thyroid hormones and the risk of thyroid cancer has been mixed. Two studies reported that low thyroid hormones were linked to a higher probability of thyroid cancer, however, the other five studies failed to demonstrate a link [14], [15], [16].

2. Materials and Methods

The investigation was carried out on women between the ages of 25 and 45 from Dhi Qar territory. The women were split into two groups equally. Group A included 50 patients that had total thyroidectomies for cancer of the thyroid. Group B comprised of 50 healthy women that had no prior history of thyroid issues, they served as a control group. Blood was procured from all participants in a standardized manner. To reduce the fluctuations of hormones, samples were collected in the morning following a 12-hour fast. The serum was then centrifuged and stored at -20°C until analysis. Thyroid activity was measured by determining the serum levels of T3 (triiodothyronine), T4 (thyroxine), and TSH (thyroid stimulating hormone) using commercially available ELISA (enzyme linked immunosorbent assay) kits. All procedures were conducted according to the manufacturer's recommendations and in standard laboratory settings. Values are reported as the mean plus or minus the standard deviation (SD). The statistical analysis was conducted using anova and LSD to assess the differences between groups that were significant. P values of 0.05 or less were considered to have a significant statistical significance.

This approach enables the accurate measurement of thyroid function and the comparison of control and patient groups in a true manner..

3. Results

The study included 100 female patients aged between 25 and 45 years old, all from Dhi Qar Governorate, and were divided equally into two groups: Group A were patients with total thyroidectomy for thyroid cancer and Group B were healthy females with normal thyroid function. The mean ages for both groups were comparable (34.96 ± 6.00 for Group A and 35.06 ± 5.6 for Group B) so age would not be a confounding variable. Thyroid function tests did reveal significant differences between the two groups. Group A also showed very low levels of serum triiodothyronine (T3) and thyroxine (T4) as 0.47 ± 0.10 ng/ml and 88.11 ± 8.73 nmol/L, respectively, compared to control group values of 1.23 ± 0.27 ng/ml for T3 and 115.69 ± 15.75 nmol/L for T4. On the contrary, levels of thyroid-stimulating hormone (TSH) were highly elevated in the group of patients (8.27 ± 1.03 μIU/mL) compared to the control group (2.84 ± 0.09 μIU/mL). These values were statistically significant ($P \leq 0.05$), as evident from LSD testing and denoted by varying letter notations within the results. This hormonal pattern within Group A suggests that the individual is suffering from hypothyroidism, as would be expected following removal of the thyroid gland through surgical intervention. The depressed T3 and T4 levels are the loss of endogenous hormone secretion, and the elevated TSH is secondary to the pituitary's compensatory attempt to stimulate a non-existent or non-functioning thyroid. These findings validate the physiological consequence of thyroidectomy and the utility of postoperative hormone monitoring.

Table 1. Characteristic data for studied groups

Groups	No	Age Mean±SD	Thyroid condition
A	50	34.96±6.00	total thyroidectomy for cancer
B	50	35.06±5.6	A healthy body and a healthy thyroid gland

Table 2. Thyroid Function Tests for studied groups

Groups / Parameters	NO.	T3 (ng/ml) Mean± SD	T4 (nmol/L) Mean± SD	TSH (μIU/mL) Mean± SD
A	50	0.47 ± 0.10[b]	88.11 ± 8.73[b]	8.27 ± 1.03[a]
B	50	1.23 ± 0.27[a]	115.69 ± 15.75[a]	2.84 ± 0.09 [b]
LSD		0.19	17.40	3.35

*Results represent mean ± standard deviation (S.D)
* Means that have different letters in the same row are considered to be different ($p \leq 0.05$)..
*(L.S.D) least significant difference.
* (a, b, c): Different symbols show a significant decrease in results

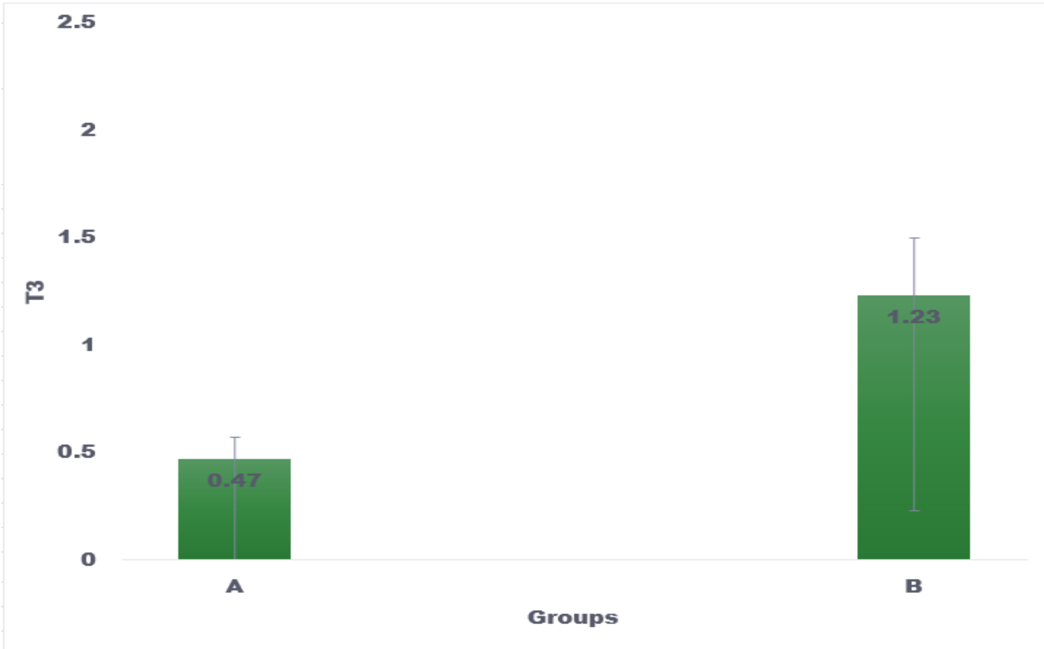

Figure 1. T3 serum level of patient group and control group

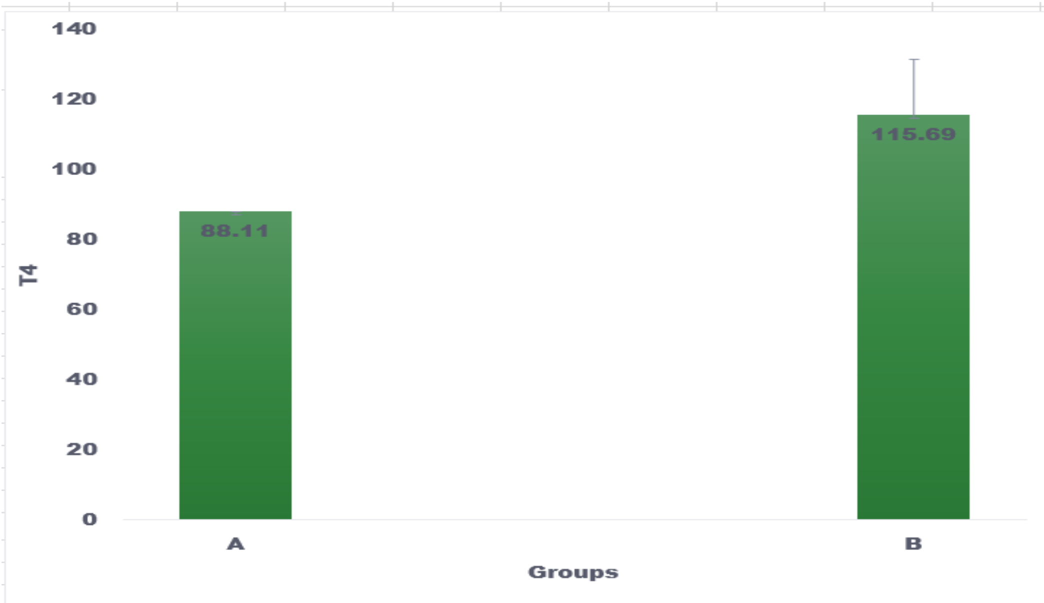

Figure 2. T4 serum level of patient group and control group

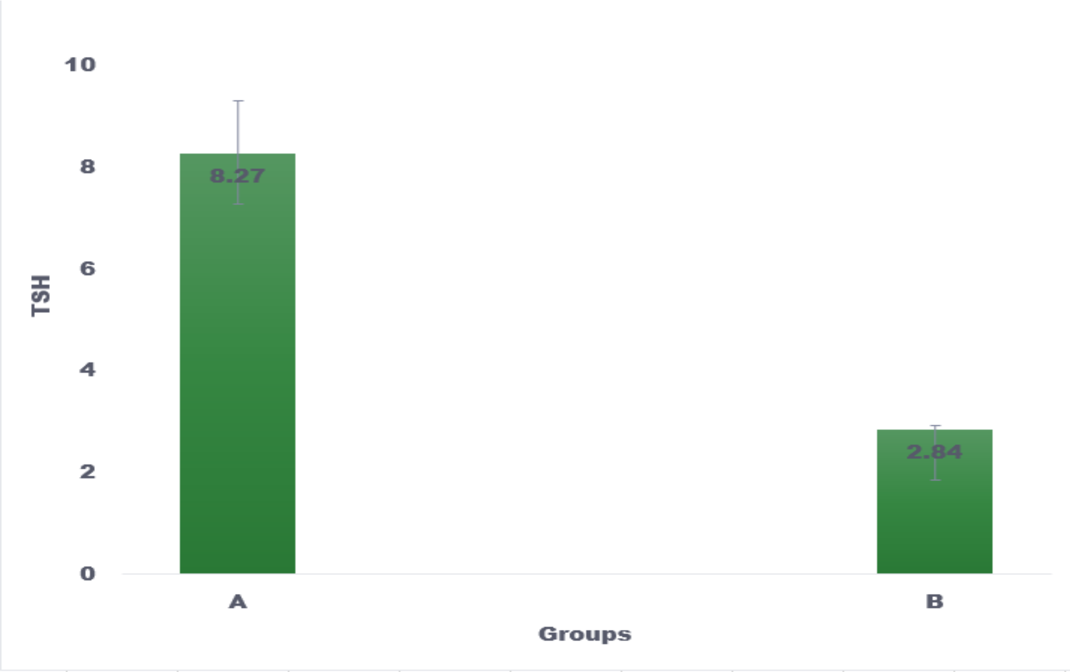

Figure 3. TSH serum level of patient group and control group

4. Discussion

Thyroid cancer surgery is primarily employed to address recurring neck metastases and to have selected metastases removed. The recurrence of neck symptoms is typically caused by the thyroid bed or other lymph nodes in the region. Despite this, late recurrence is uncommon after a diagnosis is made. In one study with a 40-year follow-up period, 35% of the patients experienced a recurrence. Two-thirds of the recurrences that occurred after ten years of treatment were located in this region. For patients with large lymphadenopathy or who have recurring neck issues, the first-line treatment is surgery. After surgery, additional radioactive iodine therapy (if the recurring tumor has already taken up radioactive iodine) and thyroid hormonesuppressing therapy can be employed. One-third to one-half of patients will have no disease with a short term follow up. If the larger tumor cannot be located on the post-treatment mammography or the preoperative radioiodine scan is negative, additional therapy with radioiodine following surgery is of less value and may lead to additional side effects of biotin. The adverse effects of additional radioiodine therapy include mouth dryness, nasolacrimal duct blockage, and secondary tumors [17], [18].

TSH, its nuclear and cell surface receptors, and anti-thyroid antibodies play a central role in the carcinogenesis and growth of most cancers, opening new avenues for research and drug development to further improve existing therapies. The thyroid hormones triiodothyronine (T3) and thyroxine (T4) are important regulators of metabolism, growth, and development. However, their true mechanisms in cancer initiation and progression are not fully understood. Studies have demonstrated that TH regulates tumor cell function through various genomic and non-genomic pathways. Through genomic pathways, T3 acts on the thyroid hormone receptor (THR) and interacts with the thyroid hormone response element (TRE) on target genes, thereby regulating gene expression [19], [20].

This outcome is in agreement with the evidence that thyroid hormones have a significant role in regulating weight [21]. This investigation examined which body composition components have an effect on the weight changes following total thyroidectomy. The participants were not aged differently, had no gender discrepancies, preoperatively had normal thyroid function, or postoperatively had a healthy thyroid. Complete thyroidectomy leads to a decrease in thyroid hormones. Studies have demonstrated that thyroid hormone replacement therapy is typically accomplished by giving patients levothyroxine (T4) to increase their low endogenous thyroid hormones [22], [23]. The determination of the optimal T4 dosing regimen (low T4) is crucial in patients following thyroid surgery, as hypothyroidism typically persists for many years in the majority of patients [24].

Thyroid hormone replacement therapy (THRT) is a procedure used to treat all types of thyroid disease, including hypothyroidism, subtotal thyroidectomy, or total thyroidectomy. Typically, hormone replacement therapy involves replacing the missing hormone with a sufficient amount that it produces a physiological response. Today, the practice of total thyroidectomy is more common, but the utilization of total or near-total thyroidectomy in place of subtotal thyroidectomy for the treatment of thyroid conditions has increased significantly [25], [26], [27]. One investigation [28], [29] concluded that 28% of patients who had permanent hypothyroidism following hemithyroidectomy, compared to 100% of patients who had this condition following near total thyroidectomy and 87% of patients who had this condition following sub total thyroidectomy at a follow-up period of 2-15 years. Transient hypothyroidism was present in 46 percent of patients who underwent hemithyroidectomy, as opposed to 100 percent of patients who underwent near total thyroidectomy and 93% of patients who underwent sub total thyroidectomy, respectively. Hypothyroidism is the most common long-term complication of total thyroidectomy [30], [31].

This research is in line with our results. The total amount of thyroidectomy has increased in importance with the progression of thyroid disease. In some hospitals, the total number of thyroidectomies is almost half of the total number of thyroid surgeries. However, the importance of total thyroidectomy in the treatment of disease that is considered benign is still debatable. Total thyroidectomy is more likely to be considered appropriate treatment for patients with MNG if the disease is primarily composed of both lobes. If a single lobe is of normal size, the probability of having to take total thyroidectomy is less certain. About 10% of patients with unilateral disease will have a long-term recurrence, but only half of them require surgery. Hemithyroidectomy is appropriate for this type of patient [32], [33], [34].

5. Conclusion

This research shows that total thyroid excision leads to significant hormonal properties that are consistent with hypothyroidism. Patients who had thyroidectomies (group A) had lower concentrations of T3 and T4 in their serum and higher concentrations of TSH in comparison to healthy individuals (group B). These discrepancies were significant and concurred with the expected medical effects of thyroidectomy. The outcomes demonstrate the value of frequent thyroid function monitoring following thyroidectomy in order to prevent and treat the after effects of postoperative hypothyroidism.

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