

Parathyroid Function in Women after Total Thyroidectomy in Thi-Qar, Iraq

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Abstract

Background: Total thyroidectomy is one of the most important operations currently being performed. It is more common in women than in men, where every eight women meet one man. **Objectives:** The current study aims to evaluate the decrease in calcium, parathyroid hormone (PTH), and vitamin D in patients with total thyroidectomy, in relation to the periods after the operation. **Materials and Methods:** The study included the presence of three groups of patients, with different characteristics in terms of time after the total removal of the thyroid gland, and a fourth group as the healthy control group, with each group consisting of 30 samples. **Results:** The results revealed that the concentration of PTH levels showed a significant decrease in the patient groups in comparison with the control group. The results also revealed that the concentration of calcium levels showed a significant decrease in the patient groups in comparison with the control group, and the results showed a significant decrease in the first group of patients when compared with the other group of patients. The concentration of vitamin D levels showed a significant decrease in the patient groups in comparison with the control group. Predictive factors of hypoparathyroidism after thyroidectomy are important because of the role of PTH and its effect on the concentration of calcium and vitamin D. The current study has shown clear changes after total thyroidectomy. **Conclusion:** According to the findings, measuring serum calcium, PTH, and vitamin D after surgery, reducing the duration of surgery, and female gender are among the predictive factors of postoperative hypoparathyroidism after thyroidectomy.

Keywords: Hypocalcemia, hypoparathyroidism, predictive factors

INTRODUCTION

Total thyroidectomy constitutes a feasible therapeutic alternative for a multitude of patients who suffer from thyroid disorders, specifically in situations where surgical intervention is necessary for both thyroid lobes or when the prospect of relapse is a considerable concern, as is frequently the case with benign multinodular goiter, Graves' disease, and cancer. In previous times, the possibility of extensive surgery and the difficulties related to adequate hormone replacement therapy discouraged surgeons from conducting total thyroidectomy.^[1,2] Nevertheless, as we transition into the twenty-first century, we can confidently declare that the technical considerations associated with safe total thyroidectomy have been established, and thyroid hormone replacement and monitoring are now widely accessible and highly

precise. Moving forward, it is probable that total thyroidectomy will increasingly become a common modality for addressing both benign and malignant thyroid diseases.^[1-4]

Thyroidectomy is a well-established and prominent therapeutic intervention for various thyroid diseases. However, the proximity of parathyroid glands to surrounding tissue poses a particular challenge, increasing the risk of inadvertent injury or removal, which can compromise blood supply.^[5,6] Temporary

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postoperative hypoparathyroidism is the most commonly observed complication following thyroidectomy, with an incidence ranging from 20% to 35%, while permanent hyperparathyroidism is a rare occurrence, observed only in 1–5% of cases. The increased risk of hypoparathyroidism is associated with the extent of thyroidectomy, completion of thyroidectomy, reoperative procedures, and central neck dissection. Hypoparathyroidism can lead to hypocalcemia and decreased PTH levels in the plasma.^[5-7]

Patients who undergo total thyroidectomy are faced with a significant risk of calcium imbalance, which is deemed a crucial concern. As an ion, calcium is tightly regulated within the body, and any abnormalities in its levels can result in muscle paralysis. The bone serves as the primary storage site for calcium, while the parathyroid glands, situated at the posterior part of the lobes of the thyroid gland, synthesize the parathyroid hormone (PTH) that regulates calcium reabsorption by the kidneys.^[7-9] The concentration of calcium in the blood controls the secretion of PTH. The control of calcium levels is closely associated with phosphate metabolism and the metabolism of vitamin D, which facilitates the absorption of calcium from the gastrointestinal tract and, to a certain extent, from the kidney.^[8-12]

After undergoing thyroidectomy, the most prevalent complication that may arise is hypocalcemia, typically induced by hypoparathyroidism. The manifestation of hypocalcemia after thyroidectomy necessitates repeated calcium and vitamin D testing in the blood, as well as the management of their levels, leading to increased patient discomfort, care expenses, and potentially prolonged hospital stays.^[13,14] Hypocalcemia-related symptoms commonly manifest within 24–48 h after surgery, with paresthesia being the most typical indication. Hypocalcemia can cause severe and life-threatening conditions, such as chronic renal disease, kidney stones, and cardiac dysfunction. Measuring serum PTH levels after post-thyroidectomy is a sensitive approach to identifying patients at risk for hypocalcemia. Despite low serum PTH levels, administering calcium and active vitamin D treatment may reduce the prevalence of symptomatic hypocalcemia.^[12-15] The aim of conducting this study is to find out the changes that occur after the operation of total thyroidectomy, according to different times, in the concentrations of calcium ions, parathyroid hormone, and vitamin D.

MATERIALS AND METHODS

This study was conducted at Nasiriyah Teaching Hospital and the Endocrine Glands Center in Thi-Qar governorate, from August 2022 to April 2023. It included 120 patients, (control 30 and patients 90), divided into three groups, each group containing 30 patients. There were 120 women subjects, including both controls and patients with

hyperthyroid goiter, aged 25–45 years. They were divided into four groups as follows:

Group A (control): It included 30 healthy subjects aged (25–45).

Group B (patients, after thyroidectomy): It included patients from one day to one month after thyroidectomy.

Group C (patients, after thyroidectomy): It included patients from one month and one day to one year after thyroidectomy.

Group D (patients, after thyroidectomy): This group included patients from one year, one day, and more after thyroidectomy. Medical tests were performed on the patient's blood, including calcium, PTH, and vitamin D, using the Moorhead and Briggs-derived CPC (O-Cresol Phtalein Complexone) method, which allows to determine total calcium concentration in serum (Elabscience, China), plasma, or urine. The DRG intact PTH immunoassay is a two-site enzyme-linked immunosorbent assay (ELISA) for the measurement of the biologically intact 84 amino acid chain of PTH (SIGMA-ALDRICH, USA), and this ELISA kit uses the competitive-ELISA principle determination of VD concentrations in serum, plasma, and other biological fluids (Elabscience, China).

Collection of blood sample

A total of 6mL blood samples from patients (after thyroidectomy) and controls were taken and allowed to clot at room temperature in empty disposable tubes. To separate the serum, the blood was centrifuged at 3000 revolutions per minute (rpm) for 10 min. Samples were separated and stored at –20°C for later measurement of biochemical parameters unless used immediately.

Statistical analysis

The statistical analysis was carried out using statistical package for the social sciences (SPSS) version 25.0 (SPSS, IBM Company, Chicago, IL 60606, USA). The statistical analysis proceeded in all groups of the study. Descriptive statistics were analyzed by using Microsoft Excel 2010, and a one-way analysis of variance (ANOVA) test with the least significant difference (LSD) was performed using mean and standard deviation (SD) for continuous variables.

Ethical approval

The samples were collected from Al-Nasiriyah Teaching Hospital after obtaining official approval from the Thi-Qar Health Department according to Document No. Dhi Qar/2022204 on August 7, 2022.

RESULTS

These studies' findings point to hypoparathyroidism following thyroid surgery. Following a thyroidectomy, hypoparathyroidism may be temporary or persistent.

PTH's primary function is to control calcium. Life-threatening conditions such as chronic renal disease, kidney stones, and cardiac failure can result from low blood calcium levels. Therefore, by giving calcium and active vitamin D, the risk of hypocalcemia can be decreased by measuring serum PTH promptly after thyroidectomy and identifying those at risk. The outcomes are displayed in Table 1.

Calcium: Group B

This group is considered the lowest in calcium, as it is less than Group C, Group D, and Group A (control). This means that this group has more hypocalcemia than the other groups. The order of the groups is based on the severity of the hypocalcemia $B > C > D > A$. There are significant differences between the three groups and the control group. This agrees with findings from previous studies^[16-18] [Figure 1].

PTH: Group B

This group is considered the lowest in PTH, as it is less than Group C, Group D, and Group A (control). This means that this group has more severe hypoparathyroidism than the other groups. The order of the groups is based on the severity of the hypoparathyroidism $B > C > D > A$. There are significant differences between the three groups and the control group. This agrees with the previous studies^[16-20] [Figure 2].

Table 1: Results of the parameters involved in the study

Parameters	Calcium mg/dL	PTH pg/mL	Vitamin D ng/mL
Groups			
Group 1	7.67 ± 1.34 ^c	13.73 ± 2.36 ^c	16.54 ± 2.69 ^b
Group 2	8.20 ± 3.77 ^b	16.91 ± 3.45 ^{bc}	16.75 ± 3.74 ^b
Group 3	8.29 ± 2.79 ^b	23.35 ± 4.40 ^b	17.02 ± 2.99 ^b
Control	9.08 ± 3.48 ^a	56.83 ± 5.88 ^a	32.81 ± 7.54 ^a
LSD	dd	7.79	2.17

*Results represent mean ± standard deviation (SD),

*Means having different letters in the same column differed significantly ($P \leq 0.05$),

*LSD: least significant difference

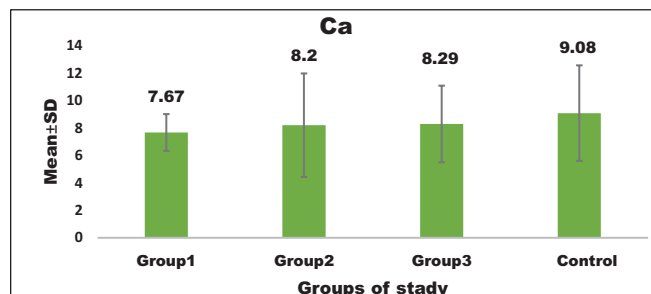


Figure 1: Calcium changes in four groups

Vitamin: Group B

This group is considered the lowest in vitamin D, as it is less than Group C, Group D, and Group A (control). This means that this group has the lowest levels of vitamin D compared to the other groups. The order of the groups is based on the severity of the lowest vitamin D ($B > C > D > A$). There are significant differences between the three groups and the control group. This agrees with the previous study^[16-18] [Figure 3]. As a final outcome, some patients who had kidneys removed from the thyroid gland found that some patients continue to have low calcium, parathyroid hormone, and vitamin D, and this is consistent with Keane *et al.*^[20]

DISCUSSION

This study investigated the prevalence and predictive factors of hypoparathyroidism following thyroidectomy. It was reported that after total thyroidectomy, hypoparathyroidism is a common clinical complication.^[21] Moreover, several biological, clinical, and surgical complications may be affected by total thyroidectomy due to hypoparathyroidism.^[22] In addition to causing very unpleasant symptoms, patients have a longer hospitalization and thus increase hospitalization costs for the patient and the treatment system.^[21] Patients with persistent hypoparathyroidism, which is one of the most serious postoperative complications, often, experience paresthesia of the face and hands. In very severe cases, tetany and even suffocation due to Laryngospasm occur, which is currently not an effective treatment. In these patients, due to long-term consumption of oral calcium

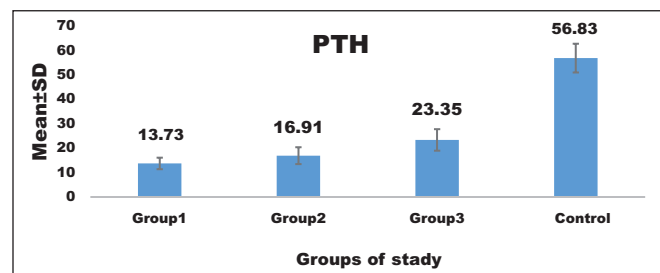


Figure 2: Parathyroid hormone (PTH) changes in four groups

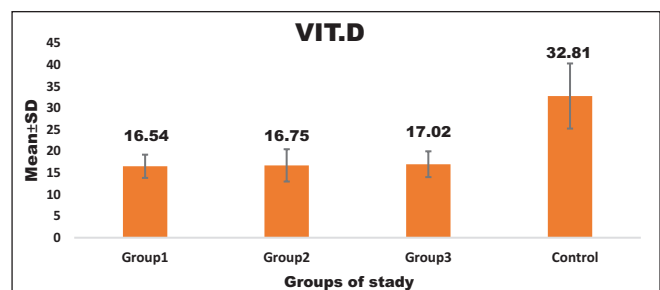


Figure 3: Vitamin D changes in four groups

and calcitriol, medical and therapeutic costs increase, and as a result, the quality of life of these patients is both physically and mentally affected.^[12]

According to those study, half of the patients developed hypoparathyroidism in the first 24 h after the thyroidectomy, indicating a high prevalence of the disease.^[23] According to a study by Su *et al.*, about half of the patients developed transient hypoparathyroidism and a very small number of patients developed persistent hypoparathyroidism.^[24] Wang *et al.* described the incidence of persistent hypoparathyroidism.^[12] Although hypoparathyroidism may be asymptomatic and self-limiting in nature, it can cause hypocalcemia and paresthesia-like symptoms and muscle spasms during the first 24 h following surgery.^[23] Hypocalcemia is caused by a disturbance in the metabolism of the parathyroid, which can also develop as a side effect after a thyroidectomy.^[23]

Many surgeons regularly prescribe calcium and vitamin D to all patients who have had total thyroidectomy. Although it is efficient in lowering the number of patients who exhibit symptoms, some people may find it difficult to tolerate and find the cost to be prohibitive. This can make the treatment uncomfortable. In addition, the effectiveness of this medication is not guaranteed to be one hundred percent, and individuals suffering from severe hypocalcemia may continue to undergo tetanic contractions after receiving treatment. However, a significant number of individuals are given medication when it is not necessary.

In addition, calcium and vitamin D intake in normal patients can lead to the following: (1) inhibits the function of the parathyroid glands, (2) overestimating patients who need calcium and magnesium replacement, and (3) in the event of definitive hypoparathyroidism; it can obscure the hypoparathyroidism that this prevents the surgeons from creating the optimal treatment. Another solution is to treat only symptomatic patients, but this requires a longer hospital stay, which is very difficult. The best solution is to have a reliable way to predict the factors that cause hypoparathyroidism after thyroidectomy so that only those who need treatment can be treated.^[21]

Many studies have assessed the potential risk factors for hypoparathyroidism-causing factors after thyroidectomy, some of which have been generally accepted. However, there is no reliable way to predict the factors that cause hypoparathyroidism after thyroidectomy, and it is still a challenge. Previous studies have described measuring PTH using a blood sample on the morning after surgery as an affordable way to diagnose hypoparathyroidism after thyroidectomy. As a result, the need for calcium and vitamin D supplementation for patients using PTH measurement is identified.^[12,25] It was also demonstrated by Suwannasarn *et al.* that a measurement of PTH 4 h after surgery and its decline might identify patients

who were at risk for persistent hypoparathyroidism and hypocalcemia after thyroidectomy. When it comes to detecting hypocalcemia following thyroidectomy, this approach provides prompt results and is cost-effective.^[26]

However, in a prior analytical investigation, Rosa *et al.* noted that in patients with thyroidectomy, the levels of ionized blood calcium in the morning could be considered as an alternative to PTH levels in the prevention of hypoparathyroidism. This was done in the context of trying to avoid developing hypoparathyroidism after thyroidectomy surgery. On the first day following surgery, there is a direct correlation between PTH and calcium levels; nonetheless, neither one is preferable to the other. However, as PTH is not available in most centers and is expensive, serum calcium levels, due to their availability in most centers and affordability, are a good diagnostic factor for preventing hypoparathyroidism after thyroidectomy.^[21]

According to the findings of the research conducted by Cho *et al.*, hypocalcemia is found in much more female patients. Despite the fact that there were 865 more females than males in their study group, researchers found that the female gender factor was associated with the highest risk for hypocalcemia following thyroidectomy (95% confidence interval). They believed the reason for the report was that women were more likely to have a hormone-related illness, such as menopausal syndrome or osteoporosis, which could be linked to calcium or vitamin D deficiency, as these factors can be disruptive.^[27-29] In addition, they did not control these possible disruptive factors, which could explain some of the conflicting results.^[20] In addition, Su *et al.* identified the female gender as an important factor for transient hypoparathyroidism after thyroidectomy.^[24]

On the other hand, the research carried out by Suwannasarn *et al.* found that women had a lower rate of persistent hypoparathyroidism than men did.^[24] Both prolonged surgery and younger age at the time of thyroidectomy were found to increase the likelihood of developing hypoparathyroidism in a study that was carried out by Sonne-Holm *et al.* and analyzed retrospectively. They indicated that surgery lasting more than 120 min induces ischemia in the parathyroid glands due to restricted blood flow. This raises the chance of hypoparathyroidism, which is a very important factor, so it is vital to avoid surgeries that take longer than 120 min. In addition, the researchers discovered that the level of experience of the surgeon played no part in the onset of hypoparathyroidism.^[23]

Cho *et al.* also revealed that the time of surgery is usually longer in patients with hypocalcemia.^[22] In a previous analytical study, Su *et al.* showed that carbon nanoparticles were not used as an important factor in transient hypoparathyroidism after thyroidectomy. The non-use of carbon nanoparticles is a significant risk factor in the development of persistent hypoparathyroidism after thyroidectomy. In this study, it was found that

women were almost twice as likely as men to develop transient hypoparathyroidism after thyroid surgery. Therefore, women may take calcium supplements earlier and possibly before surgery to reduce the symptoms of hypocalcemia.

CONCLUSION

According to the findings, measuring serum calcium, PTH, and vitamin D after surgery, reducing the duration of surgery, and female gender are among the predictive factors of hypoparathyroidism after thyroidectomy. The decrease in calcium, vitamin D, and parathyroid hormone in the group that was measured immediately after the operation was lower than in the other groups.

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Conflicts of interest

There are no conflicts of interest.

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