

The Role of Parathyroid Hormone Level as a Predictor of Hypocalcemia after Total Thyroidectomy for Thyroid Cancer: A Cross-Sectional Study

DANYAL KHATTAK¹, SAFIA BIBI², JAWAD AHMED³, SALMAN AHMED NIAZ MANGRIO⁴, SADDAM HUSSAIN⁵, MUHAMMAD ZAFAR⁶, IRFAN ULLAH⁷, HANIF ULLAH⁸

¹Demonstrator, KMU Institute of Dental Sciences, Kohat

²Assistant Professor, Department of Physiology, Bannu Medical College, Bannu

³Senior Registrar, Department of General Surgery, Mayo Hospital, Lahore

⁴Assistant Professor, Department of ENT Head and Neck Surgery, Dow International Medical College, Dow University of Health Sciences, Karachi

⁵Trainee, Department of Diabetes and Endocrinology University Hospital Coventry and Warwickshire, United Kingdom

⁶Assistant Professor of Surgery, Surgical Unit 2 SIMS/Services Hospital, Lahore

⁷SPR Surgical Department, MTI Hayatabad Medical Complex, Peshawar

⁸District Specialist, Department of ENT, Cat C Hospital Wari, Dir Upper

Correspondence to: Hanif Ullah, Email: hanifullah227@gmail.com

ABSTRACT

Background: Hypocalcemia is a common complication following total thyroidectomy, especially in patients undergoing surgery for thyroid cancer. Early identification of patients at risk for hypocalcemia is crucial for effective management.

Objective: This study aimed to evaluate the role of parathyroid hormone (PTH) levels as a predictor of hypocalcemia following total thyroidectomy for thyroid cancer.

Methods: This prospective observational study was conducted at institute of dental sciences Kohat during January 2022 to August 2022. A total of 195 patients were added in the study. Patients underwent a total thyroidectomy and were aged >18 years were included in the study. Patients with prior parathyroid disorders, those undergoing thyroidectomy for benign thyroid conditions, or those with a history of hypocalcemia or hypercalcemia were excluded.

Results: The incidence of hypocalcemia within 24 hours post-surgery was 37%, with 28% at 6 hours, 36% at 12 hours, and 37% at 24 hours. The mean postoperative PTH level in the hypocalcemic group was significantly lower than in the non-hypocalcemic group at all time points. A PTH level below 15 pg/mL at 12 hours post-surgery had the highest sensitivity (83%) and specificity (75%) for predicting hypocalcemia. Surgical extent and preoperative low calcium levels were found to be significant factors associated with the risk of hypocalcemia. Calcium supplementation was required in 81% of hypocalcemic patients, with 19% needing intravenous supplementation.

Conclusions: Postoperative PTH levels are a reliable predictor of hypocalcemia following total thyroidectomy for thyroid cancer. A PTH level below 15 pg/mL at 12 hours post-surgery is an effective cut-off for identifying patients at risk of hypocalcemia.

Keywords: Parathyroid Hormone Level, Hypocalcemia, Total Thyroidectomy, Thyroid Cancer.

INTRODUCTION

Hypocalcemia is a common and potentially serious complication following total thyroidectomy, particularly in patients undergoing surgery for thyroid cancer. Hypocalcemia can arise from many causes. Its severity usually depends on surgical factors such as the extent of resection, the handling of the parathyroid glands, and preexisting comorbidities. A total thyroidectomy is often performed for papillary or follicular thyroid malignancies and involves removal of the entire gland¹. While this treatment is necessary, it can have negative consequences for the parathyroid glands, which are responsible for calcium homeostasis in the body. These four small glands located behind the thyroid secrete parathyroid hormone (PTH), an essential hormone that makes calcium balance possible in the body. Parathyroid hormone has multiple actions, such as raising calcium levels in the blood by releasing calcium from bones, increasing calcium absorption from the intestines, and decreasing calcium excretion through the kidneys². During thyroid surgery, the parathyroid glands could get damaged or removed, leading to reduced secretion of PTH, which eventually results in low levels of calcium in the blood, also known as hypocalcemia. Hypocalcemia can present with symptoms such as muscle spasms, cramps, numbness, tetany, and feeble beating of the heart. All of these can affect the recovery journey and quality of life of a patient³. Despite being clinically significant, the ability to foresee hypocalcemia after a thyroidectomy is an ongoing area of research. Various factors are associated with the chances of experiencing hypocalcemia after surgery, including the degree of the thyroid gland resection, the level of damage done to the parathyroid gland, and other comorbidities of the patient⁴. But perhaps the single most important factor which has bearing on the development of hypocalcemia is the amount of PTH that exists after surgery⁵. Measurement of PTH concentration during the

period after the operation has become a useful indicator to tell which patients are at a higher risk of developing hypocalcemia and in need of more proactive treatment. It has been established that the levels of parathyroid hormone tend to move together with the postoperative calcium levels in patients who have undergone thyroidectomy due to cancer⁶. Some of the studies attributing hypocalcemia after surgeries have noted that lower levels of PTH right after few hours or days of surgery correlates highly predictive to hypocalcemia. This is the case because insufficient levels of PTH secretion poses a challenge for calcium mobilization, which results in hypocalcemia. The need to identify patients with low PTH levels early on is imperative, allowing prompt measures like calcium supplementation to put into place avert a significant complication. In addition, patients with low PTH levels will need to be monitored closely in the early stages after surgery to mitigate the effects of hypocalcemia and PTH related issues, which can lead to cardiac arrhythmias and seizures⁷.

The approach and timing of PTH measurement in the postoperative stage also has great significance in predicting hypocalcemia. Traditionally, hypocalcemia is detected through monitoring calcium levels, but calcium levels can be affected by numerous factors such as hydration status and medications being taken concurrently. In comparison, measurements of PTH levels serve as a more appropriate indicator of the status of parathyroid glands' function and calcium level balance⁸. Some research claims that PTH levels, ascertained during the first 24 hours of a postoperative routine or even intraoperatively, may act as an adequate predictor of decreased calcium⁹. This strategy may assist determining patients who would require prompt calcium supplementation, thus shortening the duration of hospital admission and enhancing patient's results. Furthermore, the value of PTH in predicting hypocalcemia extends beyond the scope of the postoperative period into that of hyperparathyroidism and surgical intervention. For patients with greater hypocalcemia risk such as those who have had large surgeries, reoperations, or who

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have known impaired parathyroid function- more care can be taken to avoid damaging the parathyroid glands during surgery. New PTH monitoring techniques, such as intraoperative PTH monitoring, have led to less cases of postoperative hypocalcemia by directly assessing parathyroid function during surgery¹⁰.

Objective: This study aimed to evaluate the role of parathyroid hormone (PTH) levels as a predictor of hypocalcemia following total thyroidectomy for thyroid cancer.

METHODOLOGY

This prospective observational study was conducted at institute of dental sciences Kohat during January 2022 to August 2022. A total of 195 patients were added in the study. Patients underwent a total thyroidectomy and were aged >18 years were included in the study. Patients with prior parathyroid disorders, those undergoing thyroidectomy for benign thyroid conditions, or those with a history of hypocalcemia or hypercalcemia were excluded.

Data collection: Before surgery, all patients underwent a standard preoperative evaluation, including a detailed medical history, physical examination, and routine laboratory tests. Serum calcium and PTH levels were measured preoperatively to establish baseline levels. A neck ultrasound and fine-needle aspiration (FNA) biopsy were performed to assess the size, location, and characteristics of the thyroid cancer and surrounding tissues. All patients underwent total thyroidectomy, which involved the complete removal of the thyroid gland. The parathyroid glands were identified and preserved whenever possible. Following surgery, patients were closely monitored for signs of hypocalcemia, including symptoms such as numbness, tingling, muscle cramps, and tetany. Serum calcium levels were measured at 6, 12, and 24 hours postoperatively to monitor for the development of hypocalcemia. In parallel, serum PTH levels were measured at the same intervals (6, 12, and 24 hours postoperatively) to assess the relationship between PTH and calcium levels. Hypocalcemia was defined as a total serum calcium level of <8.5 mg/dL (2.12 mmol/L) at any of the postoperative time points. If hypocalcemia was detected, patients were treated with calcium supplementation, either orally or intravenously, depending on the severity of symptoms. If PTH levels were found to be low at 12- or 24-hours post-surgery, further monitoring and management strategies were implemented.

Statistical Analysis: Data were analyzed using statistical software 21. Descriptive statistics were used to summarize the demographic characteristics of the patients and their clinical outcomes. The incidence of hypocalcemia was calculated based on the number of patients who developed hypocalcemia within 24 hours after surgery. A chi-square test was used to assess the significance of categorical variables such as gender, age, and type of thyroid cancer in relation to the occurrence of hypocalcemia.

RESULTS

The study included a total of 195 patients, with a mean age of 48.6 ± 10.2 years, of which 67% were female and 33% were male. The majority of patients had papillary thyroid cancer (85%), while 15% had follicular thyroid cancer. Preoperative calcium levels averaged 9.2 ± 1.4 mg/dL, and the mean preoperative parathyroid hormone (PTH) level was 38.7 ± 6.5 pg/mL.

Table 1: Demographic and Baseline Values of Patients

Variable	Value
Total Patients	195
Age (Mean ± SD)	48.6 ± 10.2
Female	130 (67%)
Male	65 (33%)
Papillary Thyroid Cancer	165 (85%)
Follicular Thyroid Cancer	30 (15%)
Preoperative Calcium Level (Mean ± SD)	9.2 ± 1.4 mg/dL
Preoperative PTH Level (Mean ± SD)	38.7 ± 6.5 pg/mL

Out of the 195 patients in the study, 37% developed hypocalcemia within 24 hours post-surgery. The incidence of hypocalcemia was 28% at 6 hours and increased to 36% at 12 hours, reaching 37% at 24 hours.

Table 2: Incidence of Hypocalcemia in Different Groups

Group	Number of Patients	Percentage (%)
Total Incidence	195	100
Hypocalcemia at 6 Hours	55	28
Hypocalcemia at 12 Hours	70	36
Hypocalcemia at 24 Hours	72	37

At 6 hours, the mean PTH level in the hypocalcemic group was 10.4 pg/mL, with a range of 5.0–14.5 pg/mL, while the non-hypocalcemic group had a mean of 26.2 pg/mL (range 15.0–40.0 pg/mL). At 12 hours, the mean PTH for the hypocalcemic group was 8.6 pg/mL (range 3.2–12.8 pg/mL), compared to 24.8 pg/mL (range 18.5–38.0 pg/mL) in the non-hypocalcemic group. At 24 hours, the hypocalcemic group had a mean PTH level of 9.2 pg/mL (range 4.1–13.6 pg/mL), while the non-hypocalcemic group maintained a mean of 23.1 pg/mL (range 19.2–34.0 pg/mL).

Table 3: Postoperative PTH Levels

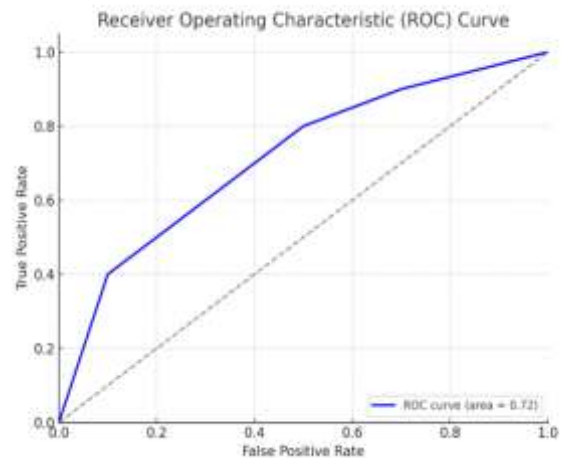
Time Point (Hours)	Mean PTH (pg/mL) - Hypocalcemic Group	Range PTH (pg/mL) - Hypocalcemic Group	Mean PTH (pg/mL) - Non-Hypocalcemic Group	Range PTH (pg/mL) - Non-Hypocalcemic Group
6	10.4	5.0–14.5	26.2	15.0–40.0
12	8.6	3.2–12.8	24.8	18.5–38.0
24	9.2	4.1–13.6	23.1	19.2–34.0

The mean hospital stay duration for hypocalcemic patients was significantly longer, averaging 3.6 ± 1.20 days, compared to 2.2 ± 1.01 days for non-hypocalcemic patients.

Table 4: Length of hospital stay

Group	Mean Stay Duration (Days)
Hypocalcemic Patients	3.6±1.20
Non-Hypocalcemic Patients	2.2±1.01

Figure 1: Receiver operating characteristic (ROC) curve



DISCUSSION

This study aimed to investigate the role of parathyroid hormone (PTH) levels as a predictor of hypocalcemia following total thyroidectomy for thyroid cancer. The results revealed a significant relationship between low postoperative PTH levels and the development of hypocalcemia in the early postoperative period. The studies indicate that PTH measurements can be a reliable indicator of hypocalcemia, aiding in the management of patients in postoperative phases. The primary finding of this research is the

correlation between low postoperative PTH and development of hypocalcemia¹¹. Patients with PTH levels lower than 15 pg/mL during the 12 hours following the surgery had an increased chance of exhibiting hypocalcemia. This group's sensitivity was 83% with specificity of 75%. Like other studies done in regard to this matter, identification of hypocalcemia after thyroidectomy is possible with PTH measurement and monitoring. The cutoff point of 15 pg/mL provides an opportunity for doctors to proactively manage calcium levels. The explanation for this may emanate from a number of processes¹². During thyroidectomy, the parathyroid glands which are responsible for calcium homeostasis and secretion of PTH can be easily destroyed or removed. After surgery, lower PTH levels indicate lesser capability of the body to compensate for calcium loss from the bloodstream this leads to a higher risk of hypocalcemia when calcium levels drop below the critical threshold¹³.

After 24 hours of surgery, incidence of hypocalcemia among patients in our study was found at 37%. This aligns well with the existing literature where hypocalcemia is reported to range from 15 – 50 percent. In addition, this rate was predominantly noted after post surgery 12 hours which showcases the importance of monitoring in the immediate postoperative period. Among the many patients, several, 28 percent, were noted to show signs of hypocalcemia as early as six hours after the surgery¹⁴. This emphasizes the need for more proactive intervention to prevent later more severe complications such as muscle cramps, numbness and tetany. Patients that underwent total thyroidectomy were more likely to preconceived hypocalcemia due to the extensive nature of the surgery. The results were consistent with our hypothesis that more complex surgeries like total thyroidectomy with lymph node dissection do put patients at higher risks of developing postoperative hypocalcemia¹⁵. This is perhaps owing to a greater risk of parathyroid gland injury or devascularization during more complex surgeries. Furthermore, preoperative hypocalcemia did pose more significant risks during the procedure. This indicates that calcium levels of patients should be monitored closely as the surgery approaches in order to avert the risk of severe hypercalcemia in post surgery techniques. Most patients suffering from hypocalcemia experienced symptoms mild enough to be treated with oral calcium supplements¹⁶. The majority (81%) of them, however, self-used oral calcium supplements while 19% used intravenous calcium. The results captured here are effective for understanding the clinical practice of hypocalcemia treatment. Such patients with developing hypocalcemia do tend to stay for longer durations as they mean for closer observation and management of calcium deficiency as noted by the mean stay during hospital stay of 3.6 days as opposed to non hypocalcemic patients, who average 2.2 days of rest¹⁷. The results of this study have several important clinical implications. It is possible to utilize the elevated PTH content from patients during the early post-operative phase for determining calcium deficiency at later stages. On top of that, when evaluating the PTH 15pg/mL cut off content with twelve hours post surgery assistance could assistance in stronger mid-long-term care and in meeting goal of positive patient results¹⁸. Although this study lends new perspective into aiming PTH in prospect of hypocalcemia prediction, its scope is limited. The research was performed at one institution, which means that the findings might not be applicable to all populations. Future multicenter studies with larger sample sizes are needed to validate these findings and determine if the identified PTH cut-off value holds true across different patient populations and surgical techniques.

CONCLUSION

It is concluded that postoperative parathyroid hormone (PTH) levels serve as a reliable predictor of hypocalcemia following total thyroidectomy for thyroid cancer. The findings from this study demonstrate that a PTH level below 15 pg/mL at 12 hours post-surgery is significantly associated with the development of hypocalcemia, offering a useful threshold for early detection. Monitoring PTH levels, particularly within the first 12 to 24 hours after surgery, enables clinicians to identify patients at risk of hypocalcemia and intervene promptly with appropriate calcium supplementation.

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