



## ASSESSING THE RISK OF HYPOCALCEMIA FOLLOWING TOTAL THYROIDECTOMY: A PROSPECTIVE STUDY

### Surgery

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### ABSTRACT

**Introduction:** Hypocalcemia is a major post-thyroidectomy complication. Early detection via serum calcium measurement is crucial to prevent severe symptoms and prolonged hospitalization. This study aims to assess the severity, incidence, and timing of hypocalcemia in total thyroidectomy patients. **Methods And Objective:** This prospective study enrolled 30 patients undergoing total thyroidectomy. Preoperative and postoperative (days 1-3) serum calcium levels were measured. Hypocalcemia ( $<8.0$  mg/dl) was treated with IV calcium gluconate and oral supplementation. The degree of calcium drop was correlated with hypocalcemia development. **Results:** This study analyzed 30 patients, predominantly middle-aged women with multinodular goiter. Forty percent developed postoperative hypocalcemia, most commonly on the third postoperative day. Preoperative and postoperative serum calcium levels can predict the risk of hypocalcemia. Early detection and treatment can mitigate severe symptoms and complications. **Conclusion:** Postoperative hypocalcemia remains a significant complication following total thyroidectomy. Meticulous surgical technique, including careful identification and preservation of parathyroid glands, is crucial to minimize this risk. Preoperative and postoperative serum calcium monitoring can help identify patients at risk and initiate timely intervention. Early detection and appropriate calcium supplementation can effectively manage hypocalcemia and prevent severe complications.

### KEYWORDS

hypocalcemia, total thyroidectomy, post thyroidectomy , calcium supplementation

### INTRODUCTION:

Hypocalcemia, a common postoperative complication of total thyroidectomy, can lead to severe symptoms and prolonged hospital stays. Early detection is crucial for timely intervention and prevention of complications. While PTH measurement is best for early detection, its limited availability in many settings makes serum calcium estimation the most practical tool. This study aims to determine the incidence of hypocalcemia after total thyroidectomy, analyze the post-operative decline in serum calcium levels, and identify the most common day of occurrence to optimize post-operative management and prevent hypocalcemic complications.

Calcium, essential for cellular processes like division, movement, and signaling, is primarily stored in bones and teeth. In the blood, it exists as ionized (active) and protein-bound (inactive) forms. Maintaining optimal calcium levels, especially ionized calcium ( $4.4$ - $5.2$  mg/dL), is crucial for overall health, particularly bone health (1). Adequate dietary intake and vitamin D are key for calcium absorption and utilization. A 1-unit rise in pH will decrease the ionized calcium level by  $0.36$  mmol/L (2).

Calcium levels are meticulously regulated by hormones like PTH, calcitonin, and vitamin D. PTH primarily elevates blood calcium by stimulating bone breakdown, kidney reabsorption, and intestinal absorption via vitamin D activation. Calcitonin, conversely, reduces blood calcium by inhibiting bone resorption and increasing renal calcium excretion. Post-thyroidectomy hypocalcemia, a potential surgical complication, arises from parathyroid gland damage. Acute symptoms include paresthesias, muscle cramps, tetany, seizures, and neuropsychiatric disturbances. Chronic effects encompass dental, ocular, skin, and neurological issues. Diagnosis involves physical examination (Chvostek's sign, Trousseau's sign), laboratory tests (decreased calcium, altered PTH), and ECG (prolonged QT interval) (3).

Postoperative hypocalcemia is a common complication after thyroidectomy. Mild cases (serum calcium  $7.5$ - $8.0$  mg/dL) can be managed with oral calcium and vitamin D. Severe hypocalcemia ( $<7.5$  mg/dL or severe symptoms) requires immediate intravenous calcium gluconate. Close monitoring and timely adjustment of treatment are crucial. Preventive measures include routine preoperative and postoperative supplementation with calcium and vitamin D, along with meticulous surgical technique.

### METHODOLOGY: PATIENTS AND METHODS

This prospective study enrolled 30 patients undergoing total thyroidectomy at Osmania General Hospital between October 2019 and September 2021. Patients aged 15-75 years who consented to the study and met specific inclusion criteria were included. Preoperative and postoperative serum calcium levels were measured on days 1, 2, and 3. The degree of calcium drop was calculated, and patients were monitored for signs and symptoms of hypocalcemia. Hypocalcemic patients were treated with intravenous calcium gluconate followed by oral supplementation. The study aimed to determine the incidence of hypocalcemia, analyze the degree of calcium drop, and identify the most common day of occurrence to optimize post-operative management.

### RESULTS

This study was performed in a series of 30 patients of which 2 were male and 28 were female. Most commonly middle aged groups (30 - 50 years ) were affected by thyroid diseases (Table 1). Incidence of thyroid disorders is most commonly seen in females. Female to male ratio of affected patients is 14:1. Majority of the patients had Non toxic multinodular goitre (Table 2). Incidence of hypocalcemia following total thyroidectomy was 40% (Table 3). Incidence of post op hypocalcemia was more common with thyroid malignancy. Incidence of post op hypocalcemia was commonly reported on postoperative day 3 (Table 4,5 ) with perioral numbness as the most common symptom. Patients are treated with oral or IV calcium supplementation according to serum calcium levels and severity.

Table 1 : Age Wise Distribution Of Cases

| Age(years) | Number | %(~) |
|------------|--------|------|
| <30        | 5      | 16   |
| 31-40      | 9      | 30   |
| 41-50      | 10     | 34   |
| >50        | 6      | 20   |

The most commonly affected age group with thyroid disorders are middle aged patients (31-50 years) which accounts for 64%.

**Distribution Of Patients According To Diagnosis**  
**Table 2: Disease Distribution Of Patients**

| Diagnosis              | Number | %  |
|------------------------|--------|----|
| Multinodular goitre    | 15     | 50 |
| Diffuse colloid goitre | 06     | 20 |
| Thyroid malignancy     | 09     | 30 |

The most common thyroid disorder for which patients underwent total thyroidectomy is multinodular goitre which is around 50% which was followed by thyroid malignancies (30%) and diffuse colloid goitre (20%).

#### Incidence Of Hypocalcemia

**Table-3: Frequency Of Hypocalcemia And Normocalcemia Post-thyroidectomy**

|               |    |      |
|---------------|----|------|
| Total number  | 30 | 100% |
| Hypocalcemic  | 12 | 40%  |
| Normocalcemic | 18 | 60%  |

The incidence of hypocalcemia is 12/30 which is around 40%. Out of which symptomatic patients are 9/12, asymptomatic 3/12.

#### Distribution Of Appearance Of Hypocalcemia According To The Day Of Occurrence

**Table-4 : Distribution Of Appearance Of Hypocalcemia According To Day Of Occurrence.**

| Day of occurrence | Number of patients |
|-------------------|--------------------|
| Day 1             | 1                  |
| Day 2             | 2                  |
| Day 3             | 8                  |
| Day 4             | 1                  |
| Day 5             | 0                  |

Most common postoperative day of occurrence of hypocalcemia was found to be day 3 (66.6%).

#### Difference In Calcium Levels Of Preop And Postop Day 1, Day2

In hypocalcemia patients, the difference between preoperative and post op day 1, day 2 difference is calculated.

**Table-5: Difference In Preop And Postop Day 1, Day2**

| Sl no | Preop (mg/dl) | POD 1 (mg/dl) | Preop and day-1 difference | POD 2 (mg/dl) | Preop and day-2 difference |
|-------|---------------|---------------|----------------------------|---------------|----------------------------|
| 1     | 9.0           | 7.8           | 1.2                        | —             | —                          |
| 2     | 9.6           | 8.6           | 1.0                        | 8.2           | 1.4                        |
| 3     | 9.2           | 8.2           | 1.0                        | 8.0           | 1.2                        |
| 4     | 9.4           | 8.6           | 0.8                        | 8.2           | 1.2                        |
| 5     | 9.2           | 8.4           | 0.8                        | 8.2           | 1.0                        |

|    |      |     |     |     |     |
|----|------|-----|-----|-----|-----|
| 6  | 9.5  | 8.7 | 0.8 | 8.3 | 1.2 |
| 7  | 10   | 8.8 | 1.2 | 8.6 | 1.4 |
| 8  | 10.4 | 9.2 | 1.2 | 9.0 | 1.4 |
| 9  | 9.6  | 8.9 | 0.7 | 8.8 | 0.8 |
| 10 | 9.8  | 8.5 | 1.3 | 8.4 | 1.4 |
| 11 | 9.5  | 8.8 | 0.8 | 8.6 | 1.0 |
| 12 | 9.6  | 8.4 | 1.2 | 8.2 | 1.4 |

The mean difference of Serum Ca<sup>2+</sup> in postoperative day 1 is 1. The mean difference of Serum Ca<sup>2+</sup> in postoperative day 2 is 1.2. By taking mean value of difference between preoperative and postoperative day 1 serum calcium levels, Sensitivity of developing hypocalcemia : 58% Specificity of developing hypocalcemia : 88.8% PPV : 77.7% NPV : 76.1%

#### DISCUSSION

The aim of the present study was not only to investigate the causes of hypocalcemia following total thyroidectomy but to identify, at an early stage, patients at high risk of developing postoperative hypocalcemia, in order to start treatment and thereby avoid the clinical manifestations of the condition and permit a reduction in hospitalization time. In the literature, incidence of hypocalcemia is around 50% (temporary hypocalcemia), permanent hypocalcemia is around 2%. (4) In this study the incidence of hypocalcemia in the early postop period is 40%. Most common postoperative day of occurrence of hypocalcemia in this study is postoperative day 3. The mean difference in the Preoperative and Postoperative Day 1 Serum calcium levels is 1 mg/dl. By taking the above mean difference (preoperative and postoperative day 1 serum calcium levels) Sensitivity of developing hypocalcemia : 58%. Specificity of developing hypocalcemia : 88.8%. PPV : 77.7%. NPV : 76.1%. The mean difference of preoperative and postoperative day 2 serum calcium levels is 1.2mg/dl.

#### Comparison With Other Studies

P. Tredici et al. (6) proposed a strategy to predict and manage post-thyroidectomy hypocalcemia, identifying a significant drop in serum calcium levels ( $\geq 1.1$  mg/dL) as a strong predictor. By implementing early calcium supplementation for high-risk patients, they reduced symptomatic hypocalcemia and hospital stays. While intraoperative iPTH monitoring is a potential tool, its cost and availability limit its widespread use. In contrast, serum calcium monitoring offers a practical and cost-effective approach. A significant decrease in post-operative serum calcium levels is a reliable predictor of hypocalcemia. Applying a threshold of  $\geq 1.1$  mg/dL can identify high-risk patients and guide early intervention, reducing hospital stays and healthcare costs (6). There is significant debate about the optimal timing and measurements to predict post-thyroidectomy hypoparathyroidism. Some studies suggest that intraoperative and peri-operative monitoring of parathyroid hormone (PTH) levels, as demonstrated by Asari et al. (7), can accurately predict hypoparathyroidism. However, the feasibility and cost-effectiveness of this approach remain under discussion. However, some studies suggested no significant correlation was found between PTH levels 24 hours after surgery and the development of significant hypocalcemia (8). Some centres repeat serum calcium measurements for several days until a rising trend is observed, others discharge 56 patients early on calcium replacement without prolonged calcium monitoring. Nahas et al (9) ., recommended an algorithm involving calcium measurements, 6 and 12 hours postoperatively, to identify patients at risk of developing hypocalcemia studies. According to the study by Asari et al (10) ., 2003 the estimation of total serum calcium level at 1st postoperative day, 2nd and 3rd postoperative day and found any decrease in serum calcium level which is used as a predictor of postoperative hypoparathyroidism. The study conducted by Ancuta leahu et al(11) ., 2009 found patients with positive calcium trend like rise of postoperative calcium levels on serial estimation shows normocalcemic pattern and excluded hypocalcemia successfully in 96.2% patients. The patients with negative calcium trends like that serial fall in post-operative calcium level results in hypocalcemia in

51.6% patients. From this result pattern he concluded that patients can be discharged earlier in a positive calcium trend pattern and serial monitoring is required for negative trends. According to the study conducted by Lo et al (13) parathyroid.

Autotransplantation decreases the incidence of hypocalcemia after a total thyroidectomy. More importantly, a marked decrease in serum calcium compared to preoperative levels on the first postoperative measurement (morning of first postoperative day) was a reliable predictor of subsequent hypocalcemia. Thus, it can be used as a predictor to identify the patients at high risk of developing hypocalcemia following total thyroidectomy.

#### Strengths And Weakness Of The Study :

Due to the unavailability and cost effectiveness PTH monitoring could not be done. A conclusion is drawn after measuring a difference of both the postoperative days and calculating the sensitivity, specificity of the mean value. Sample size was less due to decreased number of surgeries and patients couldn't be followed up as a part of covid crisis. Large scale studies can give a more specific approach to our hypothesis.

#### CONCLUSION

Postoperative hypocalcemia is a common complication following total thyroidectomy, often leading to significant patient morbidity. Our study found a 40% incidence of hypocalcemia, primarily affecting middle-aged individuals. The most common cause is inadvertent parathyroid gland injury during surgery. To minimize this risk, meticulous surgical technique, including precise localization and preservation of parathyroid gland vascularity, is crucial. Postoperative monitoring of serum calcium levels is essential for early detection and timely intervention. A significant drop in pre- and post-operative serum calcium levels ( $>1.2$  mg/dL) can identify patients at high risk for hypocalcemia. Prophylactic calcium supplementation can be initiated in these patients to prevent the development of symptoms. By implementing these strategies, we can effectively reduce the incidence and severity of post-thyroidectomy hypocalcemia.

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