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Original Article

Hypocalcemia Following Thyroid Surgery

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Abstract

Background: Postoperative hypocalcemia is a common thyroidectomy complication, especially after total thyroidectomy. Recognizing its incidence, risk factors, and resolution is key to optimizing patient care.

Methods: This prospective observational study was conducted at Department of Otolaryngology-Head & Neck Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh from October 2021 to March, 2022 to evaluate the incidence, risk factors, and clinical manifestations of hypocalcemia following thyroid surgery. A total of 50 patients undergoing total thyroidectomy and subtotal thyroidectomy for benign or malignant thyroid conditions were included.

Results: Postoperative hypocalcemia was observed in 18 patients (36%), with total thyroidectomy (p = 0.032), malignant thyroid diagnosis (p = 0.038), and intraoperative blood loss >100 mL (p = 0.045) significantly associated with increased risk. Parathyroid preservation significantly reduced hypocalcemia risk (p = 0.012), while lack of preservation was associated with higher hypocalcemia rates (p = 0.008). Serum calcium levels significantly improved from POD 1 (8.2 ± 0.6 mg/dL) to POD 5 (8.8 ± 0.5 mg/dL, p = 0.034), with symptomatic hypocalcemia decreasing from 30% on POD 1 to 14% on POD 5 (p = 0.029). Surgery duration >2 hours showed a trend toward increased hypocalcemia risk but was not statistically significant (p = 0.067).

Conclusion: Postoperative hypocalcemia is a common but transient complication of thyroidectomy, with total thyroidectomy, malignancy, and poor parathyroid preservation as key risk factors. Careful monitoring, early calcium supplementation, and perioperative parathyroid preservation can minimize its incidence and improve its outcomes.

Keywords: Thyroidectomy, Postoperative Hypocalcemia, Parathyroid Preservation

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Introduction

Thyroid disorders are among the most prevalent endocrine conditions globally, with an increasing burden due to rising detection rates and improved healthcare access. The worldwide incidence of thyroid diseases, particularly thyroid cancer and multinodular goiter, has escalated significantly over the past few decades, necessitating surgical interventions such as total thyroidectomy and near-total thyroidectomy as definitive treatment options.[1] This trend is particularly notable in low- and middle-income countries, where advancements in diagnostic modalities and surgical capabilities have contributed to a surge in thyroid surgeries.[2] While thyroidectomy is generally a safe procedure, postoperative complications remain a significant concern, with hypocalcemia being one of the most frequent and clinically impactful sequelae.[3]

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Post-thyroidectomy hypocalcemia arises primarily due to injury, devascularization, or inadvertent removal of the parathyroid glands, leading to transient or, in some cases, permanent hypoparathyroidism. The reported incidence of hypocalcemia following thyroid surgery varies widely in literature, ranging from 1.2% to 40% for transient hypocalcemia and 0.4% to 10% for permanent hypocalcemia, depending on surgical technique, patient characteristics, and institutional protocols.[4]

The risk is notably higher in cases involving total thyroidectomy, central lymph node dissection, or reoperative neck surgeries, where the likelihood of parathyroid gland trauma is increased.[3] Additionally, factors such as hyperthyroidism, vitamin D deficiency, and the extent of surgical dissection have been implicated as contributing risk factors for post-thyroidectomy hypocalcemia.[5] Despite advancements in surgical techniques, variability in reported rates across studies highlights inconsistencies in definitions, diagnostic criteria, and management approaches.[6] The pathophysiology of post-thyroidectomy hypocalcemia is rooted in disruptions to parathyroid function. Parathyroid hormone (PTH) plays a critical role in calcium homeostasis by regulating renal calcium reabsorption and bone resorption. Surgical trauma or devascularization of the parathyroid glands impairs PTH secretion, leading to a rapid decline in serum calcium levels, often manifesting within 24–48 hours postoperatively.[7]

The severity of hypocalcemia is influenced by the number of preserved parathyroid glands, intraoperative blood supply maintenance, and the extent of lymph node dissection. In high-risk patients, early postoperative PTH measurement has emerged as a reliable predictor for the development of symptomatic hypocalcemia, enabling prompt calcium and vitamin D supplementation to mitigate complications. Preservation of parathyroid glands through meticulous surgical techniques, including the capsular dissection method, has been shown to reduce the risk of postoperative hypocalcemia significantly. Clinically, hypocalcemia presents with a spectrum of symptoms ranging from mild paresthesia and muscle cramps to severe manifestations such as tetany, laryngospasm, and seizures.[8] Patients with acute hypocalcemia may experience perioral numbness, carpopedal spasms, and Chvostek's or Trousseau's signs, while chronic hypocalcemia can lead to neuromuscular irritability, cognitive disturbances, and cataract formation.[9] The burden of hypocalcemia extends beyond clinical symptoms, significantly impacting patient outcomes, healthcare costs, and hospital resource utilization. Studies have demonstrated that post-thyroidectomy hypocalcemia is a major contributor to prolonged hospital stays, increased readmission rates, and higher treatment costs due to the need for prolonged calcium and vitamin D therapy.[10] In patients with permanent hypoparathyroidism, lifelong calcium and vitamin D supplementation become necessary, imposing additional financial and quality-of-life burdens.[11] Variability in reported risk factors and management approaches remains a major challenge in the field of thyroid surgery. Established risk factors for post-thyroidectomy hypocalcemia include female sex, younger age, Graves' disease, extent of surgical resection, and surgeon experience. However, inconsistencies in defining hypocalcemia, diagnostic thresholds, and follow-up protocols contribute to discrepancies in incidence rates across different studies and regions.[6] A significant proportion of studies lack standardized definitions for transient versus permanent hypocalcemia, complicating the ability to compare outcomes across institutions.[12]

This underscores the need for uniform guidelines on perioperative parathyroid gland preservation, calcium monitoring, and supplementation strategies to optimize patient outcomes and reduce postoperative complications.[13] In the context of Bangladesh, thyroid disorders are a growing health concern, influenced by historical iodine deficiency, environmental factors, and an increasing burden of thyroid malignancies. While the introduction of universal salt iodization has significantly reduced goiter prevalence, thyroid nodules and malignancies continue to rise, necessitating higher rates of thyroidectomy. However, the country faces infrastructural and healthcare challenges, including limited access to specialized ENT surgeons, variable postoperative monitoring capabilities, and inconsistent implementation of calcium management protocols. Given these factors, there is a pressing need to evaluate local trends in post-thyroidectomy hypocalcemia, risk factors, and patient outcomes to develop evidence-based, region-specific strategies for improving perioperative care. This study aims to assess the incidence, risk factors, and clinical impact of hypocalcemia following thyroid surgery in Bangladesh, with a focus on identifying predictors of transient and permanent hypocalcemia. Findings from this study will contribute to improving clinical guidelines, reducing postoperative complications, and enhancing patient care in Bangladesh's growing thyroid surgery landscape.

Methods

This prospective observational study was conducted at Department of Otolaryngology-Head & Neck Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh from October 2021 to March 2022 to evaluate the incidence, risk factors, and clinical manifestations of hypocalcemia following thyroid surgery. Patients older than 18 years undergo total thyroidectomy and subtotal thyroidectomy, for benign or malignant thyroid conditions were included. Those with pre-existing calcium metabolism disorders, abnormal renal or liver function, or those on preoperative calcium or vitamin D supplementation were excluded. All patients underwent preoperative assessments, including

serum calcium, phosphorus, magnesium, and albumin levels, thyroid function tests, parathyroid hormone levels, neck ultrasound, and laryngoscopic evaluation when indicated. Surgical procedures included total thyroidectomy and subtotal thyroidectomy, all performed under general anesthesia by experienced ENT surgeons with an emphasis on preserving the parathyroid glands and their vascular supply. Postoperatively, patients were closely monitored for clinical and biochemical evidence of hypocalcemia. All signs of hypocalcemia, including muscle cramps, fatigue, tetany, seizures, oral or perioral paresthesia, acral paresthesia, Chvostek's sign, and Trousseau's sign, were assessed. Biochemical monitoring involved measuring serum calcium, phosphorus, magnesium, and albumin levels on postoperative days 1 and 5. Corrected calcium levels were calculated using the formula: Corrected $[Ca^{2+}]$ = Serum $[Ca^{2+}]$ + {0.8 × (4 - Serum albumin)}, with values less than 8.5 mg/dL classified as hypocalcemia. Data analysis examined the incidence of hypocalcemia and its association with surgical factors, including the extent of surgery, preoperative calcium levels, and parathyroid preservation.

Results

Table 1: Basic Characteristics of Patients (n=50)

Characteristic	Frequency (n)	Percentage (%)
Age > 18 years	50	100
Male	20	40
Female	30	60
Benign diagnosis	35	70
Malignant diagnosis	15	30

A total of 50 patients who underwent thyroid surgery were included in this study. All patients were above 18 years of age (100%). The majority of the study population were female (60%), while males constituted 40% of the participants. Regarding the underlying thyroid condition, benign thyroid disorders were the predominant diagnosis (70%), whereas malignant thyroid conditions were observed in 30% of cases.

Table 2: Incidence of Hypocalcemia (n=50)

Hypocalcemia Status	Frequency (n)	Percentage (%)
Present	18	36
Absent	32	64

Among the 50 patients included in the study, 18 patients (36%) developed postoperative hypocalcemia, while 32 patients (64%) remained normocalcemic.

Table 3: Association of Hypocalcemia with Surgical and Clinical Factors

Factor	Hypocalcemia Present (n)	Hypocalcemia Absent (n)	p-value
Blood Loss > 100ml	12	10	0.045
Duration of Surgery > 2hr	14	18	0.067
Total Thyroidectomy	16	20	0.032
Subtotal Thyroidectomy	2	12	0.015
Malignant Diagnosis	10	5	0.038

*There were multiple attributes

The study findings indicate that several surgical and clinical factors were significantly associated with the development of postoperative hypocalcemia. Patients who experienced blood loss exceeding 100 mL had a significantly higher incidence of hypocalcemia ($p = 0.045$). Similarly, total thyroidectomy was strongly associated with hypocalcemia, with 16 out of 36 cases occurring in this group ($p = 0.032$), whereas subtotal thyroidectomy was significantly less associated with hypocalcemia ($p = 0.015$). Moreover, patients diagnosed with malignant thyroid conditions were more likely to develop hypocalcemia ($p = 0.038$). Although longer surgical duration (>2 hours) was observed more frequently among hypocalcemic patients, this association did not reach statistical significance ($p = 0.067$).

Table 4: Serum Calcium Levels on Postoperative Days 1 and 5

Day	Mean Serum Calcium (mg/dL)	Standard Deviation	p-value
1	8.2	0.6	0.021
5	8.8	0.5	0.034

The mean serum calcium level on postoperative day 1 was 8.2 mg/dL (SD = 0.6), which showed a significant increase to 8.8 mg/dL (SD = 0.5) on postoperative day 5 ($p = 0.034$). The observed improvement in serum calcium levels over time suggests a gradual recovery of

calcium homeostasis in most patients, although initial postoperative hypocalcemia was statistically significant ($p = 0.021$).

Table 5: Association of Hypocalcemia with Parathyroid Preservation

Parathyroid Preservation	Hypocalcemia Present (n)	Hypocalcemia Absent (n)	p-value
Preserved	5	22	0.012
Not Preserved	13	10	0.008

Parathyroid gland preservation was found to have a significant impact on the incidence of postoperative hypocalcemia. Among patients in whom the parathyroid glands were preserved, only 5 (18.5%) developed hypocalcemia, whereas 22 (81.5%) remained normocalcemic ($p = 0.012$). In contrast, patients with unpreserved parathyroid glands had a substantially higher incidence of hypocalcemia (13 out of 23 cases, 56.5%), with significantly fewer normocalcemic outcomes ($p = 0.008$). These findings highlight the crucial role of intraoperative parathyroid preservation in reducing the risk of postoperative hypocalcemia, emphasizing the need for meticulous surgical techniques to maintain parathyroid gland function.

Table 6: Symptoms of Hypocalcemia in Affected Patients

Symptom	Frequency (n)	Percentage (%)
Muscle cramps	12	67
Fatigue	10	56
Tetany	5	28
Seizures	3	17
Perioral paresthesia	14	78
Acral paresthesia	11	61
Chvostek's sign	9	50
Trousseau's sign	7	39

Among patients who developed postoperative hypocalcemia, perioral paresthesia was the most frequently reported symptom, affecting 14 patients (78%). This was followed by muscle cramps (67%), acral paresthesia (61%), and fatigue (56%). Clinical signs of neuromuscular excitability were also observed, with Chvostek's sign present in 50% of cases and Trousseau's sign in 39%. More severe manifestations of hypocalcemia, such as tetany (28%) and seizures (17%), were less common but still clinically significant.

Table 7: Follow-Up of Hypocalcemia on Postoperative Day 1 and 5

Follow-Up Parameter	POD 1 (n=50)	POD 5 (n=50)	p-value
Hypocalcemia Present	18	10	0.041
Hypocalcemia Absent	32	40	0.041
Mean Corrected Calcium (mg/dL)	8.2	8.8	0.034
Patients with Symptoms	15	7	0.029

The follow-up assessment of hypocalcemia from postoperative day (POD) 1 to POD 5 demonstrated a significant improvement in calcium levels and symptom resolution over time. On POD 1, 18 patients (36%) had hypocalcemia, which decreased to 10 patients (20%) by POD 5 ($p = 0.041$). Concurrently, the number of patients without hypocalcemia increased from 32 (64%) on POD 1 to 40 (80%) on POD 5 ($p = 0.041$). The mean corrected calcium level significantly improved from 8.2 mg/dL on POD 1 to 8.8 mg/dL on POD 5 ($p = 0.034$), indicating progressive recovery of calcium homeostasis. Additionally, the number of patients experiencing symptoms of hypocalcemia reduced from 15 (30%) on POD 1 to 7 (14%) on POD 5 ($p = 0.029$), suggesting effective biochemical stabilization

Discussion

Postoperative hypocalcemia is a well-documented and frequent complication following thyroid surgery, particularly after total thyroidectomy. In this study, 36% of patients developed hypocalcemia following thyroidectomy, a rate consistent with previous literature that reported a wide-ranging incidence of postoperative hypocalcemia, from 1.2% to 40%, depending on surgical technique, perioperative management, and definitions used.[3] The findings of this study reaffirm that the extent of surgery, intraoperative blood loss, malignancy, and parathyroid preservation significantly influence the risk of post-thyroidectomy hypocalcemia. The results demonstrated that total thyroidectomy was strongly associated with hypocalcemia ($p = 0.032$), while subtotal thyroidectomy had a significantly lower risk ($p = 0.015$). This aligns with findings from multiple studies that indicate total thyroidectomy presents the highest risk for postoperative hypocalcemia due to greater parathyroid gland manipulation.[12, 14] Furthermore, patients with malignant thyroid conditions had a significantly higher hypocalcemia risk ($p = 0.038$), reinforcing previous literature that identified malignancy as a key risk factor due to the necessity for aggressive resection and possible lymph node dissection. Studies have also highlighted that more extensive surgeries, particularly those involving central neck dissection, increase the likelihood of parathyroid devascularization, thus elevating hypocalcemia risk.[12, 14] In addition to surgical extent,

blood loss exceeding 100 mL was significantly associated with hypocalcemia ($p = 0.045$), emphasizing the impact of intraoperative factors on calcium homeostasis. This finding is supported by prior research, which reported that greater intraoperative blood loss may lead to transient ischemia of the parathyroid glands and hemodynamic instability, further increasing the risk of calcium dysregulation. Conversely, longer surgery

duration (>2 hours) did not reach statistical significance in predicting hypocalcemia (p = 0.067), although other studies have reported a potential correlation between prolonged operative time and increased risk.[12] These findings suggest that while operative time may contribute to hypocalcemia, it is likely confounded by other intraoperative variables such as blood loss and surgical complexity. Parathyroid gland preservation was found to be a critical protective factor against hypocalcemia. Only 5 patients (18.5%) developed hypocalcemia when parathyroid glands were preserved (p = 0.012), whereas lack of preservation significantly increased the risk (p = 0.008), with 56.5% of cases experiencing hypocalcemia in this group. These results are strongly corroborated by previous studies emphasizing that parathyroid preservation through meticulous surgical technique, capsular dissection, and minimal manipulation is essential in preventing transient and permanent hypocalcemia.[5, 7] Furthermore, literature supports parathyroid autotransplantation as a potential method to prevent permanent hypoparathyroidism, though its efficacy in reducing transient hypocalcemia remains debated.[15] The study also assessed the evolution of hypocalcemia over time, revealing that the number of patients classified as hypocalcemic decreased from 18 (36%) on postoperative day (POD) 1 to 10 (20%) on POD 5 (p = 0.041), indicating significant resolution over time. This trend is consistent with findings from previous studies, which reported that transient hypocalcemia is the most common form and typically resolves within the first postoperative week.[16] Mean serum calcium levels significantly improved from 8.2 mg/dL on POD 1 to 8.8 mg/dL on POD 5 (p = 0.034), demonstrating progressive calcium homeostasis restoration, a finding echoed by studies emphasizing postoperative calcium supplementation and monitoring as key factors in recovery. Moreover, the incidence of symptomatic hypocalcemia decreased significantly, with cases reducing from 15 (30%) on POD 1 to 7 (14%) on POD 5 (p = 0.029), supporting the hypothesis that transient ischemia or edema affecting the parathyroid glands resolves over time. Literature suggests that early postoperative calcium supplementation and careful biochemical monitoring can further accelerate symptom resolution and prevent readmissions. Additionally, studies have identified that routine postoperative parathyroid hormone (PTH) measurement is a highly sensitive predictor of hypocalcemia resolution, allowing early identification of high-risk patients and targeted supplementation.[17] Analysis of hypocalcemia symptoms revealed that perioral paresthesia (78%) and muscle

cramps (67%) were the most frequently reported symptoms, followed by acral paresthesia (61%) and fatigue (56%). These findings align with existing literature indicating that neuromuscular symptoms such as paresthesia, cramps, and fatigue are hallmark features of hypocalcemia due to increased neuronal excitability.[8, 9] Additionally, Chvostek's sign (50%) and Trousseau's

sign (39%) were observed in a significant proportion of patients, which are well-established clinical indicators of hypocalcemia related neuromuscular hyperexcitability.[18] Severe manifestations such as tetany (28%) and seizures (17%) occurred in a smaller subset of patients, consistent with reports that only a minority of hypocalcemic patients progress to life-threatening complications.[19-25] The results of this study highlight the importance of careful surgical technique, perioperative calcium monitoring, and postoperative supplementation in reducing the burden of hypocalcemia after thyroidectomy. Given the significant impact of total thyroidectomy, malignancy, and parathyroid preservation on hypocalcemia incidence, future efforts should focus on standardizing intraoperative strategies to minimize parathyroid damage and ensure structured postoperative calcium supplementation protocols. While transient hypocalcemia remains a frequent occurrence, this study reinforces that most cases resolve within the first postoperative week, underscoring the need for vigilant biochemical surveillance rather than immediate aggressive intervention. Further research should investigate long-term outcomes and the potential role of intraoperative PTH measurement in predicting hypocalcemia risk more accurately.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

Conclusion

This study highlights the significant burden of postoperative hypocalcemia following thyroid surgery, with an incidence of 36%, particularly among patients undergoing total thyroidectomy and those with malignant thyroid conditions. The findings reinforce the critical role of intraoperative factors, including blood loss and parathyroid preservation, in influencing hypocalcemia risk. Notably, preservation of the parathyroid glands was strongly protective (p = 0.012), whereas lack of preservation significantly increased hypocalcemia risk (p = 0.008). The study also demonstrated a significant improvement in serum calcium levels from postoperative day 1 to day 5 (p = 0.034), with a corresponding reduction in symptomatic hypocalcemia cases (p = 0.029), confirming that most cases of postoperative hypocalcemia are transient. While longer surgery duration (>2 hours) showed a trend toward increased hypocalcemia risk, it was not statistically significant (p = 0.067). These results

emphasize the need for meticulous surgical techniques that prioritize parathyroid preservation, perioperative biochemical monitoring, and structured postoperative calcium management protocols. Given the transient nature of most hypocalcemia cases, early identification

strategies can help mitigate complications and optimize patient outcomes. Future research should explore the role of intraoperative parathyroid hormone (PTH) measurement and long-term outcomes of post-thyroidectomy calcium homeostasis, further refining strategies for preventing and managing hypocalcemia in thyroid surgery patients.

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