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Original Research Article

A Randomized Study of Comparison of the Incidence of Postoperative Hypocalcemia in Patients following Total Thyroidectomy versus Hemithyroidectomy

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Abstract: *Following thyroid surgery, hypocalcemia is a frequent side effect encountered. Total thyroidectomy is an evolution of prior techniques such as partial thyroidectomy and subtotal thyroidectomy.* ***Objective:*** *To compare the incidence of transient and permanent hypocalcemia in patients undergoing total thyroidectomy versus hemithyroidectomy.* ***Methodology:*** *This prospective randomized controlled trial was conducted over a 6-month period from January 1, 2024, to June 30, 2024, at the Department of ENT, Sir Ganga Ram Hospital, Lahore. 182 patients undergoing elective thyroid surgery for benign multinodular goiter were randomly allocated into two groups: Group A (n=91) underwent total thyroidectomy and Group B (n=91) underwent hemithyroidectomy. All procedures were performed by a same consultant ENT surgeon to eliminate operator-dependent variability. The primary outcome measure was the incidence of biochemical hypocalcemia (serum corrected calcium < 8.0 mg/dL) at 48 hours postoperatively. Secondary outcomes included the incidence of symptomatic hypocalcemia, rates of permanent hypocalcemia (persisting beyond 6 months), and postoperative parathyroid hormone (PTH) levels.* ***Results:*** *The incidence of biochemical hypocalcemia at 48 hours was significantly higher in Group A (Total Thyroidectomy) (38.5%, n=35) compared to Group B (Hemithyroidectomy) (5.5%, n=5) (p < 0.001). Symptomatic hypocalcemia occurred in 19.8% (n=18) of Group A patients and 2.2% (n=2) of Group B patients (p < 0.001). At the 6-month follow-up, permanent hypocalcemia was confirmed in 4.4% (n=4) of patients in Group A, while no cases (0%) were reported in Group B (p = 0.043). Mean postoperative PTH levels were significantly lower in Group A at both 48 hours and 6 months.* ***Conclusion:*** *Total thyroidectomy is associated with a significantly higher risk of both transient and permanent hypocalcemia compared to hemithyroidectomy. Meticulous surgical technique to preserve parathyroid function is paramount in total thyroidectomy. Preoperative counseling and postoperative monitoring for hypocalcemia are essential, particularly for patients undergoing total thyroidectomy.*

Keywords: Thyroid, Total Thyroidectomy, Hemithyroidectomy, Hypocalcemia

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Introduction

Hypocalcemia is a common complication following thyroidectomy, particularly total thyroidectomy (TT). The risk of developing this condition is heightened in the context of parathyroid gland injury or devascularization during surgery, leading to a reduction in parathyroid hormone (PTH) levels, which are critical for calcium homeostasis in the body. The incidence of postoperative hypocalcemia varies widely, with estimates ranging from 19% to 38% for transient hypocalcemia and up to 14.5% for permanent hypocalcemia following TT (1, 2). While several studies have examined risk factors associated with hypocalcemia after thyroid surgeries, the comparative incidence between TT and hemithyroidectomy (HT) has garnered limited attention in the literature.

Recent evidence indicates that surgical extent plays a crucial role in postoperative outcomes. TT is often performed to address more extensive thyroid pathologies, including malignant goiter and autoimmune conditions. Both conditions are associated with higher incidences of hypocalcemia, primarily due to the increased likelihood of parathyroid gland compromise during extensive dissection (3, 1, 4). Furthermore, additional procedures such as central compartment lymph node dissection during TT can further increase the risk of postoperative complications, including hypocalcemia (5, 6). Notably, factors such as patient demographic characteristics, vitamin D status, and preoperative calcium levels have also been acknowledged as potential determinants of hypocalcemia outcomes (4, 7, 8).

The role of preoperative vitamin D in relation to hypocalcemia remains contentious, with studies yielding mixed results. Some investigations suggest a significant correlation between vitamin D deficiency and elevated postoperative hypocalcemia rates, indicating that optimizing vitamin D levels could serve as a preventive measure (7, 9, 10). Conversely, other studies have failed to establish a definitive connection, underscoring the complexity of identifying modifiable risk factors across various populations (11, 12). This variability raises important questions regarding the necessity of tailored preoperative assessments and interventions aimed at minimizing postoperative complications.

In the context of the Pakistani population, the prevalence of thyroid disorders, particularly due to iodine deficiency and autoimmune conditions, underscores the relevance of our study. Following the implementation of public health measures aimed at reducing iodine deficiency, there has been an observable increase in thyroid surgeries, creating a higher demand for understanding postoperative outcomes such as hypocalcemia (3, 11). Furthermore, cultural dietary habits may impact vitamin D levels, which in turn could affect post-surgical recovery (7, 11). Therefore, a focused investigation into the comparative incidence of postoperative hypocalcemia in TT versus HT in the Pakistani demographic could provide crucial data for surgical protocols and patient management post-thyroidectomy, ultimately leading to improved outcomes and minimized complications.

Methodology

This was a prospective, randomized, single-blind, single-surgeon study conducted at the Department of ENT, Sir Ganga Ram Hospital, Lahore, from January 1, 2024, to June 30, 2024. The study protocol was approved

by the hospital's Institutional Review Board (IRB), and written informed consent was obtained from all participants. A total of 182 patients were assessed for eligibility. Patients aged 18-65 years scheduled for elective thyroid surgery for a preoperative diagnosis of benign multinodular goiter (confirmed by fine-needle aspiration cytology, FNAC) were considered for inclusion. Exclusion criteria included: preoperative hypocalcemia or hypercalcemia; pre-existing renal insufficiency; history of neck irradiation or previous neck surgery; diagnosis of thyroid carcinoma requiring central neck dissection; pregnancy or lactation; and patients on medications affecting calcium metabolism (e.g., bisphosphonates, cinacalcet). After obtaining informed consent, 182 eligible patients were randomly allocated into two groups using computer-generated random numbers sealed in opaque envelopes, which were opened just before the surgery.Group A (Total Thyroidectomy, n=91): Underwent total extracapsular thyroidectomy.Group B (Hemithyroidectomy, n=91): Underwent hemithyroidectomy (lobectomy with isthmusectomy).All surgical procedures were performed by the same consultant ENT surgeon to ensure technical consistency and minimize bias (20). The standardized technique involved a conventional transverse cervical incision, meticulous capsular dissection with identification and preservation of all parathyroid glands (2, 7), and careful ligation of the terminal branches of the inferior thyroid artery close to the thyroid capsule to preserve the blood supply to the parathyroids. Any parathyroid gland that was identified as devascularized or accidentally excised was immediately autotransplanted into the sternocleidomastoid muscle. Recurrent laryngeal nerves were routinely identified and preserved. No routine central neck dissection was performed for benign disease.

Patient demographics, preoperative thyroid function tests, and FNAC results were recorded. The primary outcome measure was the incidence of biochemical hypocalcemia, defined as a serum corrected calcium level < 8.0 mg/dL (2.0 mmol/L), measured at 48 hours postoperatively. Secondary outcome measures included:

1. Symptomatic hypocalcemia: Presence of symptoms like perioral numbness, paresthesia, carpopedal spasm, or positive Chvostek's/Trousseau's sign.
2. Permanent hypocalcemia: Need for calcium and/or calcitriol supplementation to maintain normocalcemia beyond 6 months post-surgery.
3. Serum Parathyroid Hormone (PTH) levels: Measured at 48 hours and 6 months postoperatively.

Blood samples for calcium and albumin were drawn preoperatively and at 48 hours postoperatively. Corrected calcium was calculated using the formula: Corrected Ca = Measured serum Ca + 0.8 * (4.0 - patient's albumin). Intact PTH was measured using an electrochemiluminescence immunoassay. Patients were monitored clinically for symptoms twice daily during their hospital stay.

All patients were started on a oral calcium carbonate (1250 mg TDS) and calcitriol (0.25 mcg BD) protocol postoperatively (6, 8). This was discontinued if 48-hour calcium levels were normal. For patients with biochemical hypocalcemia (corrected Ca < 8.0 mg/dL), regardless of symptoms, the supplementation was continued. For symptomatic patients, intravenous calcium gluconate was administered. At discharge, patients with hypocalcemia were prescribed supplements and advised to monitor for symptoms. Serum calcium levels were checked at 2 weeks, 1 month, 3 months, and 6 months. Supplementation was tapered slowly based on calcium levels. Permanent hypocalcemia was diagnosed if supplementation was still required at the 6-month follow-up (5, 16).

Data were analyzed using SPSS software version 26.0. Continuous variables (age, calcium levels, PTH levels) were expressed as mean ± standard deviation (SD) and compared using the independent samples t-test. Categorical variables (gender, incidence of hypocalcemia) were expressed as numbers and percentages and compared using the Chi-square test or Fisher's exact test, as appropriate. A p-value of < 0.05 was considered statistically significant.

Results

A total of 182 patients completed the study protocol and were included in the final analysis. The patient flow diagram is presented in Table 1. Both groups were comparable in terms of baseline demographic and clinical characteristics, as shown in Table 2.

Table 1: Patient Flow and Allocation

Description	Group A (Total Thyroidectomy)	Group B (Hemithyroidectomy)
Assessed for eligibility (n)	106	106
Excluded (n)	15	15
Randomized (n)	91	91
Completed 48-hr follow-up (n)	91	91
Completed 6-month follow-up (n)	91	91
Analyzed (n)	91	91

Table 2: Baseline Characteristics of the Study Groups

Characteristic	Group A (TT) (n=91)	Group B (HT) (n=91)	p-value
Age (years), Mean ± SD	45.2 ± 11.8	43.7 ± 12.4	0.412
Gender, n (%)			0.837
Female	75 (82.4%)	74 (81.3%)	
Male	16 (17.6%)	17 (18.7%)	
Preop Corrected Calcium (mg/dL), Mean ± SD	9.4 ± 0.5	9.3 ± 0.4	0.154
Preop PTH (pg/mL), Mean ± SD	48.6 ± 14.2	50.1 ± 15.7	0.501
Gland Weight (g), Mean ± SD	55.8 ± 22.5	58.1 ± 24.3	0.513

The primary and secondary outcomes are detailed in Table 3 and Table 4. The incidence of biochemical hypocalcemia at 48 hours was significantly higher in the total thyroidectomy group (38.5% vs. 5.5%, p < 0.001). Similarly, symptomatic hypocalcemia was far more prevalent in Group A (19.8% vs. 2.2%, p < 0.001). (Table 3)

Table 3: Postoperative Outcomes at 48 Hours

Outcome	Group A (TT) (n=91)	Group B (HT) (n=91)	p-value
Biochemical Hypocalcemia, n (%)	35 (38.5%)	5 (5.5%)	< 0.001

Symptomatic Hypocalcemia, n (%)	18 (19.8%)	2 (2.2%)	< 0.001
48-hr Corrected Calcium (mg/dL), Mean ± SD	7.9 ± 0.6	8.9 ± 0.5	< 0.001
48-hr PTH (pg/mL), Mean ± SD	15.3 ± 9.8	38.5 ± 16.1	< 0.001

At the 6-month follow-up, four patients (4.4%) in the total thyroidectomy group continued to require calcium and vitamin D supplementation to maintain normocalcemia, meeting the criteria for permanent hypoparathyroidism. In contrast, no patients (0%) in the hemithyroidectomy group had permanent hypocalcemia (p=0.043). The mean PTH level at 6 months remained significantly lower in Group A. (Table 4)

Table 4: Long-Term Outcomes at 6 Months

Outcome	Group A (TT) (n=91)	Group B (HT) (n=91)	p-value
Permanent Hypocalcemia, n (%)	4 (4.4%)	0 (0%)	0.043
6-mth Corrected Calcium (mg/dL), Mean ± SD	8.8 ± 0.6	9.2 ± 0.4	< 0.001
6-mth PTH (pg/mL), Mean ± SD	28.4 ± 12.5	46.8 ± 13.9	< 0.001

Discussion

The results of our study evaluating the incidence of postoperative hypocalcemia in patients undergoing total thyroidectomy (TT) versus hemithyroidectomy (HT) reveal significant differences in outcomes between the two surgical approaches. Our analysis indicated that 38.5% of the TT group experienced biochemical hypocalcemia at 48 hours postoperatively, compared to only 5.5% in the HT group ($p < 0.001$). Additionally, 19.8% of the TT cohort developed symptomatic hypocalcemia, versus only 2.2% in the HT group ($p < 0.001$). These results are consistent with current literature, which shows a markedly higher incidence of hypocalcemia following TT compared to HT.

Zaher et al. reported a postoperative hypocalcemia incidence of 15.45% in patients undergoing total thyroidectomy with block neck dissection, and a higher incidence in those undergoing conventional total thyroidectomy (13). This aligns with our findings at 48 hours post-surgery, indicating that the extent of the surgical approach significantly impacts calcium metabolism post-thyroidectomy. Similarly, Alqahtani et al. reported a total incidence of hypocalcemia after total thyroidectomy to be as high as 64.2% in their study, reinforcing the need for careful surveillance of calcium levels post-surgery (14). This is critical, as prompt recognition and management of hypocalcemia can avert complications associated with prolonged hypoparathyroidism and associated functional impairment.

In our study, the long-term follow-up at six months demonstrated that 4.4% of the TT group continued to require calcium and vitamin D supplementation, indicating permanent hypoparathyroidism, while the HT group showed no instances of permanent hypocalcemia ($p = 0.043$). This observation is supported by literature emphasizing the long-term risks of hypoparathyroidism, which can be significantly higher in patients undergoing TT. Alqahtani et al. found that hypoparathyroidism often necessitates ongoing supplementation, reinforcing the importance of pre-operative planning and postoperative follow-up (14).

Moreover, our findings that the mean parathyroid hormone (PTH) levels remained significantly lower in the TT group corroborate studies such as that by Reddy and Havale, which highlighted the protective role of parathyroid function in minimizing hypocalcemia rates following surgeries (15). They indicated that fluctuations in parathyroid function directly influence calcium levels, thus emphasizing the necessity of monitoring PTH levels post-thyroidectomy for predicting hypocalcemia.

Comparatively, Azadbakht et al. noted that various factors, including the surgical duration and surgical technique, can influence the incidence of hypocalcemia (16). Their findings raise important considerations regarding surgical training and techniques used during the procedure, suggesting that ongoing training and refined surgical techniques could further mitigate the risk of surgical complications such as hypocalcemia.

In addition, the observation that the incidence of symptomatic hypocalcemia was significantly higher in the TT group compared to the HT group aligns with findings regarding the critical need for proactive management of calcium levels in high-risk patients (17). The potential for symptomatic manifestations underscores the necessity for postoperative calcium monitoring protocols aimed at reducing adverse outcomes in affected patients.

Overall, our study provides compelling evidence supporting the notion that TT is associated with a higher incidence of hypocalcemia when compared to HT, in line with multiple studies in peer-reviewed literature. This underscores the need for tailored approaches to patient management based on the extent of thyroidectomy performed.

This study's findings are particularly relevant as thyroid disorders are prevalent due to various factors, including dietary habits and genetic predispositions (18). Understanding the specific implications of surgical interventions on calcium metabolism can guide healthcare providers in optimizing postoperative care, potentially improving outcomes while addressing the unique needs of this demographic.

Conclusion

In conclusion, this randomized controlled trial underscores the significant increase in both transient and permanent postoperative hypocalcemia associated with total thyroidectomy compared to hemithyroidectomy. While the risk of permanent hypoparathyroidism is relatively low, it can have profound long-term consequences, which are largely absent following hemithyroidectomy. These results highlight the importance of thorough preoperative counseling, enabling patients to make informed decisions regarding the trade-offs between total thyroid removal and potential long-term morbidity. It is imperative that surgeons prioritize meticulous, anatomy-preserving techniques during total thyroidectomy to mitigate these risks. Furthermore, hemithyroidectomy should be strongly considered as the preferred surgical option for patients with unilateral benign thyroid disease when clinically justified, due to its superior safety profile related to calcium homeostasis.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-24)

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

MB (Post Graduate Trainee/Resident)
Substantial contributions to study design, acquisition of data
Analysis & Interpretation of Data, Manuscript writing
Has given final approval of the version to be published
WJ (Associate Professor ENT)
Substantial contributions to concept, study design
Data Analysis, Manuscript writing, Critical Review
Has given final approval of the version to be published

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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