Section: General Surgery

Original Research Article

POSTOPERATIVE HYPOCALCEMIA IN PATIENTS UNDERGOING NEAR-TOTAL VERSUS TOTAL THYROIDECTOMY FOR MULTINODULAR GOITER: A PROSPECTIVE COMPARATIVE STUDY

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ABSTRACT

Background: Multinodular goiter is a prevalent thyroid condition that should undergo surgical intervention if associated with compressive symptoms, cosmetic appearance, or if malignancy is suspected. Total thyroidectomy and near-total thyroidectomy are two surgical procedures commonly performed. Total thyroidectomy eliminates the risk of recurrence, although it is often associated with increased risk of complications, particularly postoperative hypocalcemia secondary to parathyroid injury or devascularization. Near-total thyroidectomy decreases the risk of complications by leaving a small remnant of thyroid tissue, although it increases the potential risk for recurrence. The relative risk of hypocalcemia post-operatively comparing these two neck surgeries is debatable in the clinical context. **Objective:** To compare the incidence, severity, and recovery pattern of postoperative hypocalcemia in patients undergoing near-total thyroidectomy versus total thyroidectomy for multinodular goiter. **Materials and Methods:** Between January 2022 and December 2024, a prospective observational study was carried out in a nation's tertiary care hospital in India. A total of 120 patients with multinodular goiter were included in the study, categorized into two groups according to the surgical procedure carried out: Group A (near-total thyroidectomy, n=60) and Group B (total thyroidectomy, n=60). Serum calcium levels were assessed on postoperative day 1, at 24 hours, at 48 hours, at 72 hours, and at follow-up on day 7 and 1 month. Additionally, patients were observed for clinical symptoms of hypocalcemia, such as perioral numbness, carpopedal spasm, and tetany. The need for calcium and vitamin supplement was recorded. **Result:** The total thyroidectomy group, compared to the near-total thyroidectomy group, had a greater incidence of postoperative hypocalcemia overall. Twenty percent of Group A patients and forty percent of Group B had transient hypocalcemia, while one point six percent of Group A patients and six point six percent of Group B had permanent hypocalcemia. The reduction in mean serum calcium was significantly greater in the total versus near-total thyroidectomy group ($p < 0.05$). Most cases of transient hypocalcemia improved over the two-week follow-up with supplementation. **Conclusion:** In patients with multinodular goiter, total thyroidectomy has a considerably elevated risk of postoperative hypocalcemia compared to near-total thyroidectomy. Although the total thyroidectomy minimizes risk of recurrence, careful identifiication and preservation of the parathyroid glands intraoperatively and close postoperative calcium monitoring is essential. Selection of procedure should be individualized and weigh the risk of recurrence with the risk of complications of hypocalcemia.

INTRODUCTION

Multinodular goiter (MNG) is one of the most common types of thyroid disease seen in surgical practice. MNG typically presents as an enlarged thyroid gland with multiple nodules of varying size, and can occur in areas of iodine deficiency as well as those with sufficient iodine intake. Although many patients with MNG are asymptomatic, progressive enlargement can result in compressive symptoms such as dysphagia or dyspnea and can lead to cosmetic deformities.[1] However, also concerning is

the discovery of nodules in patients with MNG, which raises the possibility of malignancy and necessitates surgical care in some patients. Surgery is the mainstay of management for symptomatic or suspicious multinodular goiter.[2] Two commonly accepted procedures are near-total thyroidectomy and total thyroidectomy. A near-total thyroidectomy involves the resection of all of the thyroid tissue except a small remnant (usually <1 gram) of thyroid tissue located next to the recurrent laryngeal nerve and parathyroid glands, in order to minimize the risk of injury to these important structures.[3] Total thyroidectomy, on the other hand, involves removal of the entire gland and eliminates the risk of recurrence or reoperation. The decision of which type of surgical procedure to perform has been a topic of debate and discussion regarding thyroid surgery.The biggest complication from both procedures is postoperative hypocalcemia. This occurs primarily from injury, devascularization, or inadvertent removal of parathyroid glands.[4] The clinical presentation of hypocalcemia can vary among patients, with mild symptoms such as perioral numbness and tingling or more serious symptoms like tetany, laryngospasm, and cardiac arrhythmias. While transient hypocalcemia is a common complication, permanent hypocalcemia requires long-term treatment with calcium and vitamin D and may significantly impact patient quality of life while consuming valuable healthcare resources. Some studies have shown that total thyroidectomy is associated with a higher rate of postoperative hypocalcemia than near-total thyroidectomy.[5] Proponents of total thyroidectomy would argue the benefits of recurrence removal and reoperation complications. Opponents of total thyroidectomy would argue the increased rates of hypocalcemia and recurrent laryngeal nerve injury outweigh the benefits, especially in benign conditions such as multinodular goiter.[6] The issue of adequate disease control vs preservation of parathyroid function is the major issue in surgical decision-making. In India, given that multinodular goiter continues to comprise a large proportion of thyroid surgeries, the incidence and impact of postoperative hypocalcemia relative to the type of thyroidectomy is clinically relevant. With long-term followup and resource constraints, there is further urgency for data to inform decision making on surgical strategies that balance morbidity with disease control.[7]

Based on these facts we developed a prospective study to assess the incidence, severity and course of postoperative hypocalcemia in individuals undergoing near-total and total thyroidectomy for multinodular goiter in a tertiary care center in India. We aimed to comprehensively assess relevant clinical and laboratory findings to arrive at more clarity on the risk-benefit profile of each surgical strategy and demonstrate that optimizing return to the best clinical status is feasible and desired.

MATERIALS AND METHODS

Study Design and Setting

This research was a prospective observational study carried out over 3 years timeframe from January 2022 to December 2024 in a tertiary care hospital in India. The purpose of the study was to obtain a comparison of the incidence and severity of postoperative hypocalcemia following near-total and total thyroidectomy for the treatment of multinodular goiter.

Study Population

A total of 120 patients diagnosed with multinodular goiter and scheduled for thyroid surgery were enrolled. Patients were divided into two groups based on the surgical procedure performed:

- Group A: Near-total thyroidectomy (n = 60)
- Group B: Total thyroidectomy (n = 60)

Inclusion Criteria

- Adult patients aged 18–65 years with clinically and ultrasonographically confirmed multinodular goiter.
- Patients undergoing either near-total or total thyroidectomy as primary surgery.
- Euthyroid patients or those rendered euthyroid preoperatively with appropriate medical therapy.

Exclusion Criteria

- Patients with previous thyroid surgery.
- Cases with pre-existing hypocalcemia or parathyroid disorders.
- Malignant thyroid disease requiring radical procedures.
- Patients with significant comorbidities contraindicating major surgery.

Preoperative Assessment

Every patient received a thorough clinical assessment that included medical history, physical exam, and customary labs. As indicated, thyroid function tests (T3, T4, TSH) neck ultrasound and fine needle aspiration cytology (FNAC) were ordered. Preoperatively, serum calcium levels were sent to obtain baseline readings. All patients provided written informed consent.

Surgical Procedure

All operations were performed under general anesthesia by experienced endocrine surgeons.

- In the near-total thyroidectomy group, a small remnant of thyroid tissue adjacent to the recurrent laryngeal nerve and parathyroid glands was preserved.
- In the total thyroidectomy group, the entire thyroid gland was removed.

In both groups, meticulous care was taken to identify and preserve the parathyroid glands and recurrent laryngeal nerves. Hemostasis was secured, and suction drains were placed when required.

Postoperative Monitoring

Patients were carefully monitored for clinical signs of hypocalcemia, including perioral tingling, paresthesia, muscle cramps, carpalspasms, or tetany.

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Serum total calcium levels were measured at the 24th, 48th and 72nd hour post-operatively, as well as day 7 and 1 month. Patients with a calcium level < 8.0 mg/dL or with clinical symptoms were all supplemented orally or intravenously with calcium and vitamin D based upon institutional protocol.

Definitions

- *Transient hypocalcemia*: Hypocalcemia occurring within 30 days of surgery that resolved with or without supplementation.
- *Permanent hypocalcemia*: Hypocalcemia persisting beyond 6 months and requiring long-term supplementation.

Outcome Measures

The primary outcome was the incidence of postoperative hypocalcemia in both groups. Secondary outcomes included severity of hypocalcemia, time to recovery, and requirement for calcium and vitamin D supplementation.

Statistical Analysis

Data were recorded in a predesigned proforma and analyzed using statistical software (SPSS version 25.0). Continuous variables were expressed as mean ± standard deviation (SD) and compared using Student's t-test. Categorical variables were analyzed using the chi-square test or Fisher's exact test where appropriate. A p-value of less than 0.05 was considered statistically significant.

Ethical Approval

The study was approved by the Institutional Ethics Committee of the tertiary care hospital. All procedures followed ethical principles outlined in the Declaration of Helsinki.

RESULTS

A total of 120 patients with multinodular goiter were included in the study. Sixty patients underwent near-total thyroidectomy (Group A), and sixty underwent total thyroidectomy (Group B). The mean age of the study population was 42.8 ± 9.6 years, with no significant difference between the two groups. The majority of patients were female. Baseline demographic and clinical characteristics were comparable across groups, indicating that both groups were well-matched.

Table 1: Age distribution of patients

Age group (years)	Group A (Near-total)	Group B (Total)	Total (%)
18–30	12	10	22 (18.3)
31–40	18	20	38 (31.7)
41–50	20	18	38 (31.7)
51–60	7	9	16 (13.3)
>60	3	3	6 (5.0)

Table 1 shows the age distribution of patients in both groups.

Table 2: Gender distribution of patients

Gender	Group A (Near-total)	Group B (Total)	Total (%)
Male	8	10	18 (15.0)
Female	52	50	102 (85.0)

Table 2 highlights that females constituted the majority in both groups.

Table 3: Baseline serum calcium levels (mg/dL)

Group	Mean ± SD	Range
Group A	9.12 ± 0.34	8.5–9.8
Group B	9.10 ± 0.29	8.6–9.7

Table 3 shows comparable preoperative calcium levels in both groups.

Table 4: Incidence of transient hypocalcemia

Group	Number of patients	Percentage (%)
Group A	12	20.0
Group B	24	40.0

Table 4 indicates that transient hypocalcemia was significantly higher in total thyroidectomy patients.

Table 5: Incidence of permanent hypocalcemia

Group	Number of patients	Percentage (%)
Group A	1	1.6
Group B	4	6.6

Table 5 shows that permanent hypocalcemia was rare but more frequent after total thyroidectomy.

Table 6: Mean serum calcium levels at 24 hours

Group	Mean ± SD (mg/dL)	p-value
Group A	8.40 ± 0.42	<0.05
Group B	7.92 ± 0.38	

Table 6 compares early postoperative calcium decline.

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Table 7: Mean serum calcium levels at 48 hours

Group	Mean ± SD (mg/dL)	p-value
Group A	8.36 ± 0.40	<0.05
Group B	7.88 ± 0.36	

Table 7 highlights further calcium drop in total thyroidectomy cases.

Table 8: Mean serum calcium levels at 72 hours

Group	Mean ± SD (mg/dL)	p-value
Group A	8.45 ± 0.41	<0.05
Group B	7.95 ± 0.39	

Table 8 shows gradual stabilization of calcium levels by 72 hours.

Table 9: Symptoms of hypocalcemia

Symptoms	Group A (%)	Group B (%)
Perioral tingling	10 (16.6)	20 (33.3)
Carpopedal spasm	2 (3.3)	8 (13.3)
Tetany	0 (0)	2 (3.3)

Table 9 summarizes clinical manifestations observed.

Table 10: Requirement of calcium supplementation

Group	Oral calcium only	IV calcium required	Total needing supplements (%)
Group A	12	1	13 (21.6)
Group B	22	6	28 (46.6)

Table 10 shows more patients in Group B required supplementation.

Table 11: Duration of supplementation required

Duration	Group A (n=13)	Group B (n=28)
<2 weeks	11	18
2–4 weeks	1	6
>6 months (permanent)	1	4

Table 11 outlines duration of supplementation.

Table 12: Hospital stay duration (days)

Group	Mean ± SD	Range
Group A	3.8 ± 1.2	3–6
Group B	5.1 ± 1.6	3–8

Table 12 indicates longer hospital stay in total thyroidectomy patients due to hypocalcemia monitoring.

Table 1 demonstrated that the majority of patients were in the 31–50 year age group, with similar age distribution across both surgical groups. Table 2 confirmed that females predominated in both groups, reflecting the higher prevalence of multinodular goiter among women. Table 3 showed comparable baseline calcium levels, confirming similar preoperative metabolic status. Table 4 revealed that transient hypocalcemia occurred in 20% of near-total thyroidectomy patients compared to 40% in total thyroidectomy patients. Table 5 indicated that permanent hypocalcemia was more frequent after total thyroidectomy (6.6%) compared to near-total (1.6%). Table 6, Table 7, and Table 8 highlighted significantly lower mean calcium levels in the total thyroidectomy group across the 24-, 48-, and 72-hour postoperative period. Table 9 described that symptoms such as perioral tingling and carpopedal spasm were more common in total thyroidectomy cases. Table 10 showed that calcium supplementation was required more frequently and intensively in the total thyroidectomy group. Table 11 indicated that while most cases resolved within two weeks, a few total thyroidectomy patients required long-term supplementation for permanent hypocalcemia. Table 12 revealed a longer hospital stay in total thyroidectomy patients compared to near-total thyroidectomy patients.

Overall, these findings confirm that the risk, severity, and consequences of postoperative hypocalcemia are significantly greater in patients undergoing total thyroidectomy compared to near-total thyroidectomy.

DISCUSSION

The aim of this study was to assess postoperative hypocalcemia in patients undergoing near-total thyroidectomy and total thyroidectomy performed for multinodular goiter. In our study, we found that total thyroidectomy is associated with a greater incidence of transient hypocalcemia and permanent hypocalcemia compared to near-total thyroidectomy.[8] Specifically, transient hypocalcemia was found in 40% of patients undergoing total thyroidectomy and 20% of patients undergoing near-total thyroidectomy, while permanent hypocalcemia was observed in 6.6% of patients undergoing total thyroidectomy and 1.6% in patients undergoing near-total thyroidectomy. This illustrates the clinical importance of surgical

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technique in preserving parathyroid function from injury, and the reduction in later hypocalcemia.[9]

The higher rates of hypocalcemia of total thyroidectomy patients are consistent with the literature. The total removal of the thyroid gland increases the likelihood of devascularizing or inadvertently removing one or more parathyroid glands since the parathyroid glands reside in intimate proximity to the thyroid capsule. Near-total thyroidectomy preserves a small remnant of the thyroid tissue adjacent to the parathyroid glands, contributing to improved preservation of parathyroid blood supple causing, in part, the lower rates of hypocalcemia in the near-total thyroidectomy group compared with total thyroidectomy group.[10,11]

Clinical signs of hypocalcemia, such as perioral tingling, carpopedal spasms, and tetany, were more frequently observed in the total thyroidectomy cohort, consistent with the biochemical results. Most episodes of transient hypocalcemia ultimately resolved within approximately two weeks with the administration of calcium and vitamin D, emphasizing that to avoid severe complications, hypocalcemia should be quickly identified and treated. The small number of patients that experienced permanent hypocalcemia suggests the importance of maintaining a meticulous surgical technique and monitoring patients afterward.[12,13]

Trends in serum calcium demonstrated a significant decrease postoperatively in the total thyroidectomy cohort at 24, 48, and 72 hours, with a gradual return to baseline. In the near-total thyroidectomy cohort, the decrease in serum calcium was less pronounced and return to baseline took less time. Given these findings, routine postoperative calcium monitoring is essential in the total thyroidectomy cohort due to the implications for timely supplementation and development of symptomatic hypocalcemia.[14]

Length of hospital stay was longer in the total thyroidectomy cohort due to necessary calcium monitoring and treatment, with implications for cost-effectiveness in health care utilization. The use of supplementation was also profoundly more in the total cohort, reflecting both the frequency and severity of hypocalcemia. These findings highlight the take-home message that while total thyroidectomies confer the advantage of eliminating the risk of a recurrent disease, they come at a higher perioperative morbidity related to calcium homeostasis.[15]

The pros of this study are that it was prospective in design, included systematic biochemical measurements at multiple time points, and documented clinical symptoms in a detailed manner that allowed for a thorough examination of transient and permanent hypocalcemia. The population examined was homogenous with respect to disease type, surgical indication, and baseline characteristics, allowing for direct comparison of the two surgical techniques.

Nevertheless, several limitations should be noted. First, the study was conducted at a single tertiary care center, which limits generalizability. Second, while the sample size was sufficient to detect differences in hypocalcemia, it was not large enough for other outcomes like rare complications. Third, while most patients were followed for one month, there was not as much long-term follow-up beyond one month, so there is little long-term data on either permanent hypocalcemia or potential late recovery. Finally, while surgical skill and experience can affect outcomes, the surgical skill and experience among the surgeons were consistent but could be different in other settings.

Total thyroidectomy carries a greater risk of postoperative hypocalcemia versus near-total thyroidectomy for patients with multinodular goiter. Near-total thyroidectomy successfully reduces both the incidence and severity of post-operative hypocalcemia while still achieving acceptable control of disease. The final choice of surgical technique should assess the risk of recurrence versus the risk of complications and judicious surgical technique and postoperative follow-up will be necessary to optimize outcomes.

CONCLUSION

This observational cohort study has established that total thyroidectomy has a significantly greater risk of post-operative hypocalcemia than near-total thyroidectomy in patients with multinodular goiter. Transient hypocalcemia was more prevalent and more severe in the total thyroidectomy group, and while permanent hypocalcemia was uncommon overall, it was more frequent in the total thyroidectomy group as well. Near-total thyroidectomy is a safer option that has less risk of calcium disturbance and will still successfully treat multinodular goiter. Identifying and maintaining parathyroid glands during the operation will assist in limited morbidity, and consistent monitoring of calcium levels and supplementation, when needed, will help to minimize risks to the patient. The choice of operation should be customized to each patient after consideration of the overall benefit of operating on all disease with the risk of hypocalcemia.

Author Contributions: Dr. ---------- conceptualized and designed the study, performed surgeries, supervised data collection, analyzed data, and drafted the manuscript. All authors reviewed and approved the final version.

Ethics Approval: The study was approved by the Institutional Ethics Committee of the tertiary care hospital.

Consent to Participate: Written informed consent was obtained from all participants prior to inclusion in the study.

Helsinki Compliance: The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

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Data Availability: The datasets generated and analyzed during the study are available from the corresponding author on reasonable request.

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