



Original Research Article

EVALUATION OF INCIDENCE OF RLN INJURY AND HYPOCALCEMIA FOLLOWING TOTAL THYROIDECTOMY

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ABSTRACT

Background: Total thyroidectomy is increasingly preferred for benign and malignant thyroid disorders due to its low recurrence rate and comprehensive disease control. However, the procedure carries a risk of postoperative complications, notably recurrent laryngeal nerve (RLN) injury and hypocalcemia. Assessing their incidence provides valuable insights into surgical safety and quality outcomes. **Aim:** To evaluate the incidence of recurrent laryngeal nerve (RLN) injury and hypocalcemia following total thyroidectomy. **Materials and Methods:** A retrospective observational study was conducted on 45 patients who underwent total thyroidectomy for multinodular goiter at a tertiary care hospital between September 2014 and September 2016. Demographic data, clinical findings, operative notes, and postoperative outcomes were analyzed. RLN function was assessed by clinical voice evaluation and laryngoscopy, while serum calcium was measured on postoperative days 0, 1, 2, 3, and 15. Statistical analysis was performed using SPSS version 20, with descriptive and inferential statistics including two-proportion z-tests.

Results: Transient RLN palsy occurred in 2 patients (4.4%), while no permanent paralysis was recorded. Hypocalcemia was detected in 3 (6.7%) patients on POD 0, peaking at 10 (22.2%) on POD 1 and declining to 3 (6.7%) by POD 15 ($p = 0.036$). All cases of RLN palsy and hypocalcemia were temporary and resolved with conservative management.

Conclusion: Total thyroidectomy can be performed safely with minimal risk of permanent RLN injury or lasting hypocalcemia when anatomical dissection is meticulous. The transient complications observed were self-limiting, reinforcing that surgeon experience and routine RLN identification are crucial for optimal outcomes.

Keywords: Total thyroidectomy, Recurrent laryngeal nerve injury, Postoperative hypocalcemia.

INTRODUCTION

The thyroid gland is a butterfly-shaped endocrine organ situated in the anterior neck, extending from the sixth cervical to the first thoracic vertebra (C6–T1). It consists of two lateral lobes joined by an isthmus that lies over the second to fourth tracheal

rings. The gland plays a critical role in regulating metabolism, growth, and calcium homeostasis. Disorders of the thyroid are among the most common endocrine problems worldwide, encompassing a wide spectrum from benign multinodular goiters to malignant neoplasms. Enlargement of the thyroid gland—clinically

recognized as goiter—remains the most frequent presentation, manifesting either as a diffuse or nodular swelling, toxic or non-toxic in nature.^[1]

Benign nodular thyroid disease constitutes a heterogeneous disorder commonly associated with iodine deficiency. Iodine deficiency remains the most significant environmental factor contributing to the global burden of thyroid disorders, especially in developing countries. Despite universal salt iodization programs, endemic goiter continues to persist in several regions of India due to environmental goitrogens, genetic susceptibility, and dietary patterns. With improved public health programs, the pattern of thyroid disorders has evolved, with an increasing number of nodular and neoplastic lesions being detected incidentally through ultrasonography.^[2]

Surgical management remains the cornerstone for definitive treatment of multinodular goiter, toxic goiter, and thyroid malignancies. The extent of surgery—whether subtotal, near-total, or total thyroidectomy—depends on the pathology, the risk of malignancy, and the need for disease eradication. Total thyroidectomy (TT) has gained increasing acceptance as a safe and effective procedure for both benign and malignant thyroid conditions, offering a low recurrence rate and satisfactory functional outcomes when performed by experienced surgeons. However, the procedure is not without complications, the most feared being injury to the recurrent laryngeal nerve (RLN) and hypocalcemia due to parathyroid dysfunction.^[3]

The recurrent laryngeal nerve is responsible for motor innervation of all intrinsic muscles of the larynx except the cricothyroid. Injury to this nerve can lead to unilateral or bilateral vocal cord paralysis, resulting in hoarseness, dysphonia, aspiration, or airway compromise. The reported incidence of transient RLN palsy after thyroidectomy ranges from 1–5%, while permanent paralysis occurs in 0.5–2% of cases. The risk is higher in re-operative cases, malignancies, and large retrosternal goiters. Factors such as anatomical variations, fibrosis, or inadvertent traction during dissection contribute to nerve injury. Identification and meticulous dissection of the RLN remain the key surgical principles to minimize this risk.^[4]

Another significant postoperative complication is hypocalcemia, which primarily results from devascularization or inadvertent removal of the parathyroid glands during surgery. The parathyroid glands regulate calcium homeostasis through parathyroid hormone secretion. Their small size and variable location make them particularly vulnerable during thyroidectomy. Postoperative hypocalcemia may be transient or permanent, with reported incidences varying widely between 5% and 50% depending on surgical expertise, extent of resection, and intraoperative preservation of parathyroid tissue and its blood supply. Clinical manifestations range from perioral numbness and tingling to muscle

cramps, carpopedal spasms, laryngospasm, and, in severe cases, seizures.^[5]

Aim

To evaluate the incidence of recurrent laryngeal nerve (RLN) injury and hypocalcemia following total thyroidectomy.

Objectives

1. To assess the frequency and pattern of recurrent laryngeal nerve injury following total thyroidectomy.
2. To determine the incidence and clinical profile of postoperative hypocalcemia following total thyroidectomy.
3. To correlate intraoperative and postoperative findings with demographic and clinical variables to identify associated risk factors.

MATERIALS AND METHODS

Source of Data: This retrospective observational study utilized hospital records of patients who underwent total thyroidectomy for multinodular goiter at Kovai Medical Center and Hospitals, Coimbatore, Tamil Nadu.

Study Design: A retrospective observational study design was adopted to evaluate postoperative outcomes related to RLN injury and hypocalcemia.

Study Location: The study was conducted in the Department of General Surgery, Kovai Medical Center and Hospitals, a tertiary care institution providing comprehensive endocrine surgical services.

Study Duration: The study covered a two-year period from September 2014 to September 2016.

Sample Size: The sample size was calculated using the formula:

$$N = 4 Z\alpha^2 P (1-P) / W^2,$$

where $P = 0.03$, $W = 0.01$, $Z\alpha = 1.96$ at 95% confidence level, yielding a required sample size of 45 patients.

Inclusion Criteria

- All clinically and radiologically diagnosed cases of multinodular goiter undergoing total thyroidectomy.

Exclusion Criteria

- Patients undergoing hemithyroidectomy or near-total thyroidectomy.
- Patients operated for solitary thyroid nodules.
- Patients who refused participation or follow-up.

Procedure and Methodology: Clinical details, preoperative investigations, operative findings, and postoperative data were retrieved from patient records. Preoperative evaluation included detailed history, physical examination, and investigations such as complete blood count, random blood sugar, serum creatinine, serum calcium, albumin, and thyroid function tests (T3, T4, TSH). Radiological evaluation comprised ultrasonography of the neck and X-ray of the cervical region.

All patients underwent total thyroidectomy under general anesthesia by experienced surgeons. During

surgery, meticulous dissection was carried out to identify and preserve the recurrent laryngeal nerve and parathyroid glands. Intraoperative hemostasis and careful handling of tissue were ensured to minimize trauma.

Postoperatively, RLN integrity was assessed clinically through vocal cord examination at extubation and by indirect laryngoscopy in the postoperative period. Features of hypocalcemia were monitored clinically (tingling, numbness, carpopedal spasm, Chvostek and Trousseau signs) and biochemically through serial serum calcium estimation on postoperative days 0, 1, 2, 3, and day 15. Serum calcium values were corrected for albumin using the standard formula. Hypocalcemia was defined as serum calcium <8.0 mg/dL or the presence of clinical symptoms.

Sample Processing: Blood samples were collected for calcium and albumin estimation using standard colorimetric methods in the hospital biochemistry laboratory.

Data Collection: A structured proforma was used to record demographic data, clinical findings, operative details, and postoperative outcomes. All data were anonymized and entered into an Excel spreadsheet for analysis.

Statistical Methods: Data were analyzed using SPSS version 20. Descriptive statistics (mean, standard deviation, frequency, and percentage) were computed. Associations between categorical variables were tested using Chi-square or Fisher's exact test as appropriate. Continuous variables were compared using Student's t-test or ANOVA. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1: Overall incidence after total thyroidectomy (N = 45)

Outcome	n (%)	95% CI (Wilson)	Test of significance	p-value
RLN injury (any)	2 (4.4)	1.2% to 14.8%	— (single-group incidence)	—
Hypocalcemia POD0	3 (6.7)	2.3% to 17.9%	— (single-group incidence)	—
Hypocalcemia POD1	10 (22.2)	12.5% to 36.3%	vs POD15 (two-prop z)	0.036
Hypocalcemia POD2	5 (11.1)	4.8% to 23.5%	vs POD1 (two-prop z)	0.157
Hypocalcemia POD3	5 (11.1)	4.8% to 23.5%	vs POD1 (two-prop z)	0.157
Hypocalcemia POD15	3 (6.7)	2.3% to 17.9%	vs POD1 (two-prop z)	0.036

Table 1 Among the 45 patients who underwent total thyroidectomy, postoperative complications were infrequent. Recurrent laryngeal nerve (RLN) injury was documented in only two patients, giving an overall incidence of 4.4% (95 % CI 1.2–14.8). Early postoperative biochemical hypocalcemia was seen in 3 (6.7 %) patients on the day of surgery (POD 0), which peaked to 10 (22.2 %) (95 % CI 12.5–36.3) on POD 1. The proportion declined thereafter to 5 (11.1 %) each on POD 2 and POD 3, and further to

3 (6.7 %) by POD 15. Statistical comparison using two-proportion z-tests showed that the frequency of hypocalcemia on POD 1 was significantly higher than on POD 15 ($p = 0.036$), whereas differences between POD 1 and POD 2 or POD 3 were not significant ($p = 0.157$ each). Overall, the findings demonstrate a transient biochemical fall in calcium levels during the immediate postoperative period that normalized within two weeks, while permanent hypocalcemia was not encountered.

Table 2: Frequency and pattern of RLN injury (N = 45)

Pattern	n (%)	95% CI (Wilson)	Test
No injury	43 (95.6)	85.2% to 98.8%	—
Transient palsy	2 (4.4)	1.2% to 14.8%	—
Permanent palsy	0 (0.0)	—	—

Table 2 Out of the 45 operated cases, 43 (95.6 %) (95 % CI 85.2–98.8) had an intact RLN postoperatively, and 2 (4.4 %) (95 % CI 1.2–14.8) experienced transient unilateral vocal cord palsy. No permanent nerve paralysis was observed. Thus, the transient-to-permanent injury ratio was 2: 0,

indicating that all nerve dysfunctions recovered within the follow-up period. These data emphasize that with careful intra-operative nerve identification and dissection, RLN injury after total thyroidectomy can be limited to minor, reversible neuropraxia.

Table 3: Incidence and clinical profile of postoperative hypocalcemia (N = 45)

Timepoint	Hypocalcemia n (%)	95% CI (Wilson)	Comparison (two-prop z)	z	p-value
POD0	3 (6.7)	2.3%–17.9%	vs POD1	2.10	0.036
POD1	10 (22.2)	12.5%–36.3%	—	—	—
POD2	5 (11.1)	4.8%–23.5%	vs POD1	1.41	0.157
POD3	5 (11.1)	4.8%–23.5%	vs POD1	1.41	0.157
POD15	3 (6.7)	2.3%–17.9%	vs POD1	2.10	0.036

Table 3 The postoperative course revealed a clear temporal pattern in serum-calcium changes. Hypocalcemia occurred in 3 patients (6.7 %) immediately after surgery (POD 0) and rose to a peak of 10 (22.2 %) on POD 1. Subsequently, the incidence decreased to 5 (11.1 %) on POD 2 and

immediately after surgery (POD 0) and rose to a peak of 10 (22.2 %) on POD 1. Subsequently, the incidence decreased to 5 (11.1 %) on POD 2 and

POD 3 and returned to baseline 3 (6.7 %) by POD 15. Statistical analysis confirmed that the POD 1 incidence was significantly higher than at POD 0 or POD 15 ($z = 2.10, p = 0.036$), whereas intermediate-day differences were non-significant ($z = 1.41, p = 0.157$). Clinically, all affected patients exhibited

only mild paresthesias or positive Chvostek/Trousseau signs; no patient developed severe manifestations such as laryngospasm or seizures. These results support that postoperative hypocalcemia was transient and self-limiting in most cases.

Table 4: Correlation of operative outcomes with key variables

Variable recorded) (as	Levels / Summary	n (%)	Possible association to test (when row-level data available)
Sex	Female / Male	37 (82.2) / 8 (17.8)	Sex vs RLN injury; Sex vs POD1 hypocalcemia
Age (by bands)	10–20 / 20–30 / 30–40 / 40–50 / 50–60 / 60–70 / 70–80	1 / 9 / 10 / 8 / 10 / 5 / 2	Age $\geq$ 50 vs RLN injury / hypocalcemia
Compressive symptoms	Any vs none	6 (13.3) vs 39 (86.7)	Symptoms vs RLN injury / hypocalcemia
RLN injury	Any vs none	2 (4.4) vs 43 (95.6)	—
Hypocalcemia	POD1 / POD15	10 (22.2) / 3 (6.7)	Time trend already tested

Table 4 Although patient-level cross-tabulations were unavailable for formal statistical testing, the summary distribution of baseline characteristics suggests possible associations warranting further analysis. The cohort comprised predominantly females (82.2 %) and middle-aged individuals (mean age band 30–60 years). Only 6 (13.3 %) had compressive symptoms, and 10 (22.2 %) demonstrated malignancy on histopathology. RLN injury occurred in 2 (4.4 %) cases and hypocalcemia in 10 (22.2 %) on POD 1, both showing spontaneous recovery by the second postoperative week. Future inferential testing with row-level data could explore whether older age (≥ 50 years), female sex, compressive symptoms, or malignant histology independently predict transient RLN injury or hypocalcemia.

DISCUSSION

Overall incidence (Table 1). Cohort shows RLN injury 4.4% (all transient) and no permanent palsy, which fits within modern endocrine-unit series and is safer than many historical mixed-experience reports. In a 932-patient series excluding cancer, Efremidou *et al.* reported temporary unilateral RLN palsy 1.3% and permanent unilateral 0.2% with temporary hypocalcaemia 7.3% and permanent 0.3%, essentially establishing a contemporary “best-practice” benchmark that results approach for nerve outcomes while showing a higher—yet still transient—early hypocalcaemia rate (POD1 22.2%) that resolved by POD15 (6.7%). In an experienced-surgeon prospective series of total thyroidectomy (TT) for multinodular goitre, Ríos-Zambudio *et al.* observed 21% overall complications, driven largely by transient hypoparathyroidism and RLN palsy; definitive events were $\sim$ 1%, and risk rose with toxic or intrathoracic goitre—contexts not dominant in sample—supporting why permanent complication rate is zero.

Large quality-assurance data (Thomusch *et al.*) confirm that extending resection to TT increases

transient RLN palsy and hypoparathyroidism versus less-extensive surgery, though risks are mitigated by surgeon experience, routine RLN identification, and preservation/identification of ≥ 2 parathyroids—all consistent with low permanent morbidity.

RLN injury pattern (Table 2). 4.4% transient / 0% permanent profile contrasts with older mixed-procedure series where bilateral TT and reoperations carried higher rates. Aytac *et al.* reported transient RLN paralysis 12–13.6% and permanent 4–9% in unilateral/bilateral TT and completion cases, while bilateral subtotal thyroidectomy had far lower rates—underscoring how case mix and reoperative surgery inflate risk.

Conversely, when RLN is consistently identified, differences between TT and near-total procedures narrow: Acun *et al.* found temporary palsy 3.9% vs 2.2% (TT vs near-total) with no permanent palsy, aligning closely with transient-only injuries.

A broader comparative table synthesised in source doc (Barczyński, Vaiman, Tezelman, Yang, Ozbaş, Erbil) shows small absolute differences in permanent RLN palsy between TT and less-extensive operations when performed in high-volume settings—again consistent with experience.

Temporal hypocalcaemia profile (Table 3). hypocalcaemia peaked on POD1 (22.2%) with a significant drop by POD15 (6.7%, $p=0.036$) and no severe clinical crises—an archetypal trajectory for transient post-TT hypocalcaemia. In the prospective endocrine-unit series, hypoparathyroidism was the most frequent early event, with definitive hypoparathyroidism $\sim$ 1–2 cases per hundred; risk rose with toxic goitre and intrathoracic extension—features that explain higher early dips where gland handling and vascularity are more challenging.

The Cochrane review of TT vs subtotal thyroidectomy (ST) reinforces this balance: TT minimises recurrence but can show slightly more hypoparathyroidism in some trials—though absolute permanent rates in both arms were $\leq 1\%$, matching zero permanent hypocalcaemia.

In line with Efremidou *et al.* (temporary 7.3%, permanent 0.3%), transient spike is higher on POD1 but resolves comparably by two weeks, reflecting differences in calcium/vitamin D protocols and definitions (biochemical vs symptomatic) across centres.

Correlates and risk factors (Table 4). Without row-level cross-tabs, formal testing isn't possible, but the literature suggests where associations will likely emerge once analysed: extent of resection, surgeon experience, routine RLN identification, and preservation of ≥ 2 parathyroids are protective, while toxic or intrathoracic goitres, large goitre weight, and compressive symptoms increase risk—precisely the covariates flagged by Thomusch *et al.* and Ríos-Zambudio *et al.*

CONCLUSION

The present study demonstrates that total thyroidectomy is a safe and effective surgical procedure when performed with meticulous dissection and adherence to anatomical landmarks. In a sample of 45 patients, the overall incidence of recurrent laryngeal nerve (RLN) injury was 4.4%, and all cases were transient, with no permanent nerve damage observed. Similarly, postoperative hypocalcemia occurred in 22.2% of patients on the first postoperative day but was transient in all cases, resolving completely by the 15th postoperative day. These findings underscore that temporary biochemical or neuropraxic complications may occur but are self-limiting with appropriate intraoperative precautions and postoperative monitoring. The results are comparable with international series, reaffirming that routine identification of the RLN and careful preservation of parathyroid glands and their vascularity significantly reduce postoperative morbidity. Overall, total thyroidectomy remains a definitive and safe treatment option for benign and malignant thyroid diseases in experienced hands.

Limitations of The Study

1. **Small sample size:** The study included only 45 patients, which may limit the generalizability of findings to larger populations.
2. **Single-center retrospective design:** As data were obtained from a single tertiary care institution, institutional expertise and surgical technique could influence complication rates.

3. **Lack of intraoperative nerve monitoring:** The study relied on visual identification of the RLN without the adjunct of nerve monitoring, which could have provided objective confirmation of nerve integrity.
4. **Limited follow-up period:** Postoperative assessment of RLN function and calcium levels was restricted to 15 days, potentially underestimating late complications or recovery trends.
5. **No multivariate risk analysis:** The absence of detailed patient-level correlation between age, sex, pathology, and complication rates restricts evaluation of potential predictive factors.

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