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Frequency of Recurrent Laryngeal Nerve Palsy with Routine Nerve Identification in Benign Thyroid Surgeries

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ABSTRACT

Background: Goiter is a global health issue. A small goiter with normal thyroid function tests does not require treatment. The size of a large euthyroid goiter may be reduced by thyroxine suppressive therapy. The study aimed to determine the frequency of recurrent laryngeal nerve (RLN) injury through routine visual identification during thyroidectomy and to provide a foundation for developing advanced identification methods.

Methods: This cross-sectional survey was conducted at the General Surgery Department of Fauji Foundation Rawalpindi from July 2022 to June 2023. The study included 241 patients with benign thyroid disorders requiring thyroidectomy. Non-probability consecutive technique was used for sampling. All patients underwent fiber-optic direct laryngoscopy (FODL) before surgery to assess the preoperative RLN status. Patients showing improvement on follow-up laryngoscopy were classified as having transient recurrent laryngeal nerve palsy, while those with persistent abnormal vocal cord mobility even after 6 months were classified as having permanent RLN palsy. Data was analyzed using SPSS version 25. Qualitative and quantitative variables were expressed as percentages/frequencies and mean±SD. Effect modifiers were controlled by stratification and *p value* <0.05 considered as significant.

Results: The average age of the patients was 50.67±9.06 years. There were 73 (30.29%) males and 168 (69.71%) females. After 24 hours post-surgery, the RLN injury rate in endoscopic thyroidectomy was 1.2%. At 3 months, the injury rate increased to 3.7%, and after 6 months, it was 2.1%. Stratification analysis reflected that among all the study confounders, statistically significant association (p<0.05) for was noted for size of goiter only.

Conclusion: In this study, RLNP during thyroidectomy was identified in 1.2% of patients after 24 hours, 3.7% at 3 months, and 2.1% after 6 months. This comprehensive analysis of RLN injury can inform discussions during informed consent and assist surgeons in identifying candidates at higher risk for injury.

Keywords: Goiter, Laryngeal nerve palsy, Thyroidectomy.

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INTRODUCTION

Goiter constitutes a global health issue. The causes encompass iodine shortage, autoimmune disorders (such as Hashimoto's thyroiditis and Graves' disease), thyrotoxicosis, hormonal fluctuations during pregnancy, puberty, and menopause, smoking, elevated iodine consumption, and radiation treatment for head and neck cancers. Benign thyroid diseases are prevalent in the general population, with palpable nodules observed in 3%-7% of adults; the multinodular goiter is the most frequent manifestation[1].

A small goiter with normal thyroid function tests does not require treatment. The size of a large euthyroid goiter may be reduced by thyroxine suppressive therapy[2]. Toxic multinodular goiter is managed by thiourea-based compounds (carbimazole, methimazole, propylthiouracil), which irreversibly inhibit thyroid peroxidase, thus inhibiting thyroid hormone synthesis[3]**.** Beta blockers help reduce the symptoms of thyrotoxicosis, especially those related to the cardiovascular system[4]. Radioactive iodine ablation of the thyroid gland is the predominant treatment for Graves' disease. Surgery is reserved for patients having local pressure symptoms, malignancy, when medical management is ineffective, in patients with contraindications to radioactive iodine ablation or antithyroid medications, and for aesthetic purposes. Various surgical alternatives include lobectomy, partial thyroidectomy, near-total thyroidectomy, and total thyroidectomy.

Thyroid surgical procedures are not routinely done as a day case surgery due to severe and life-threatening complications following the operation, like post-operative blood loss, RLN injury, and hypocalcemia. However, most studies show little association of these procedures with postoperative morbidity and mortality[5]. Less severe complications include superior laryngeal nerve palsy, seroma formation, injury to other adjacent structures, and scar problems. RLN injury can lead to hoarseness of voice and respiratory distress and is one of the most troublesome complications for surgeons. Consideration of the complications linked to thyroid surgery is essential for the surgeon to meticulously assess surgical and medical therapeutic

alternatives, establish more precise surgical indications, and provide the patient with sufficient information, thereby minimizing postoperative morbidity and mortality.

The incidence of RLN following thyroid surgeries has been studied through the analysis of follow-up data and case studies. A previous study reported the incidence of one of the severe complications, RLN injury in endoscopic thyroidectomy, to be 7.9%[6]. Another study showed a 9% RLN injury[7]. Researchers reported 6% RLN injury in 11370 patients of thyroidectomy[8]. Many studies have been conducted that recommend identification of RLN during thyroid surgeries to avoid permanent or transient RLN palsy[9]. Identifying the recurrent laryngeal nerve and ligating the inferior thyroid artery near the gland is associated with improved outcomes. 5

Comprehensive knowledge of anatomy, meticulous nerve identification, and careful exposure reduce the likelihood of vocal fold palsy and must be rigorously applied in all instances of subtotal and complete thyroidectomy[10]. The identification of the recurrent laryngeal nerve (RLN) has been achieved using standard ocular recognition during dissection over its full trajectory, utilizing anatomical landmarks, with or without the assistance of intraoperative neuro-monitoring instruments.

In the current practice, neuro-monitoring devices are not used due to unavailability, so we rely on the conventional method of visual identification of the RLN. As local data regarding RLN injury is not available, and also the incidence of RLN injury has never been studied in our setup, this study will help us to determine the frequency of RLN injury by routine visual identification of the RLN. After determining the frequency of RLN injury, this study might help us bring advanced identification methods of RLN during thyroidectomy based on our results.

METHODS

This cross-sectional survey was performed at the Department of General Surgery at Fauji Foundation Hospital, Rawalpindi, over one year from July 2022 to June 2023. The sample size was calculated by taking a 95% confidence level, an expected population proportion of 6% [8]and an absolute precision of 3%, resulting in a necessary sample size of 241 patients. Non-probability consecutive technique was used for sampling. Study was conducted after getting ethical approval from the hospital ethical review committee through letter reference number: 566/RC/FFH/RWP, Dated 10 June, 2022. The study comprised patients aged 16 to 70 years

with benign thyroid disorders necessitating thyroidectomy. The exclusion criteria included patients with established thyroid cancer, a history of prior neck surgery, preoperative hoarseness, aberrant vocal cord movement observed during preoperative fiber-optic direct laryngoscopy (FODL), or individuals who did not volunteer to participate in the trial.

Following the permission of the hospital's ethical committee, data were gathered including patient demographics, preoperative evaluations, diagnoses, and postoperative problems. Preoperative FODL was conducted on all patients to evaluate the condition of the recurrent laryngeal nerve (RLN). Informed written consent for the procedure, encompassing a comprehensive outline of possible problems, was secured, in addition to agreement for participation in the study. All surgeries were conducted under general anesthesia. The size of the goiter was classified as small (not surpassing the anterior boundary of the sternocleidomastoid muscle), medium (extending beyond the sternocleidomastoid without retrosternal involvement), or large (massive, pendulous goiters with or without retrosternal extension). During the operation, the recurrent laryngeal nerve was located adjacent to the inferior thyroid artery and followed proximally near the thyroid within the tracheoesophageal groove and distally to its entry into the larynx.

Postoperative fiberoptic direct laryngoscopy was performed within 24 hours for patients reporting hoarseness to verify recurrent laryngeal nerve damage. Follow-up FODL was conducted at 1, 3, and 6 months for patients exhibiting documented intraoperative nerve injury or aberrant postoperative laryngoscopy results. Transient RLN palsy was characterized as postoperative vocal cord mobility impairment that resolved within six months, whereas chronic RLN palsy was described as enduring disability beyond six months post-surgery.

The data were analyzed using SPSS version 25. Qualitative data, including gender, goiter size, retrosternal extension, thyroid function tests, surgical procedure, and postoperative recurrent laryngeal nerve injury, were reported as frequencies and percentages. Age, as a quantitative variable, was expressed as mean ± standard deviation. Effect modifiers such as age, gender, goiter size, retrosternal extension, and thyroid function were addressed through stratification, subsequently employing post-stratification chi-square tests. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

A total of 241 patients with benign thyroid conditions requiring thyroidectomy were included in this study. Most of the patients were 41 to 60 years of age. The average age of the patients was 50.67±9.06 years (**Figure 1**).

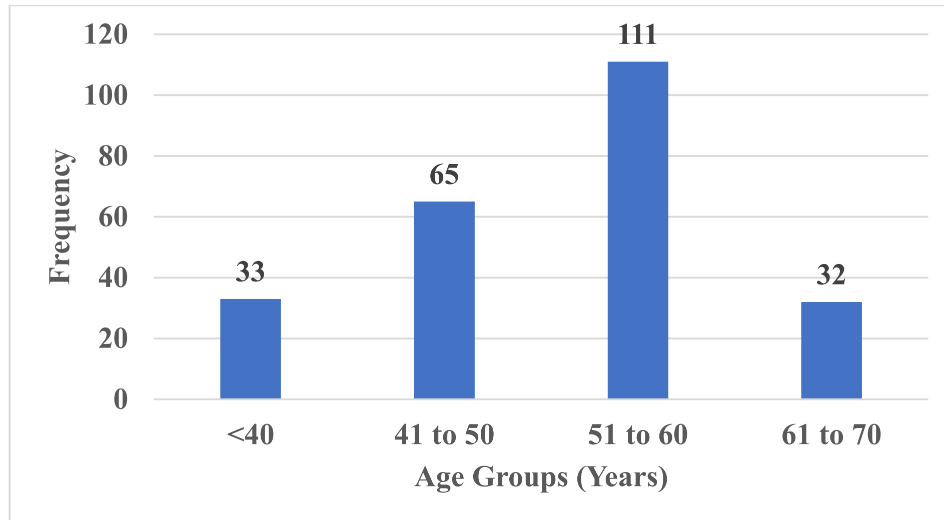

Figure 1: Age Distribution and Quantitative Details of the Patients n=241

There were 73(30.29%) male and 168(69.71%) female. Almost 59.4% (n=143) of patients had simple MNG, and 40.6% (n=98) had toxic MNG. Regarding the size of goiter, there were 82(34.02%) patients had a small size of goiter, 100(41.5%) had a medium size of goiter, and 59(24.5%) had a large size of goiter **(Figure 2).**

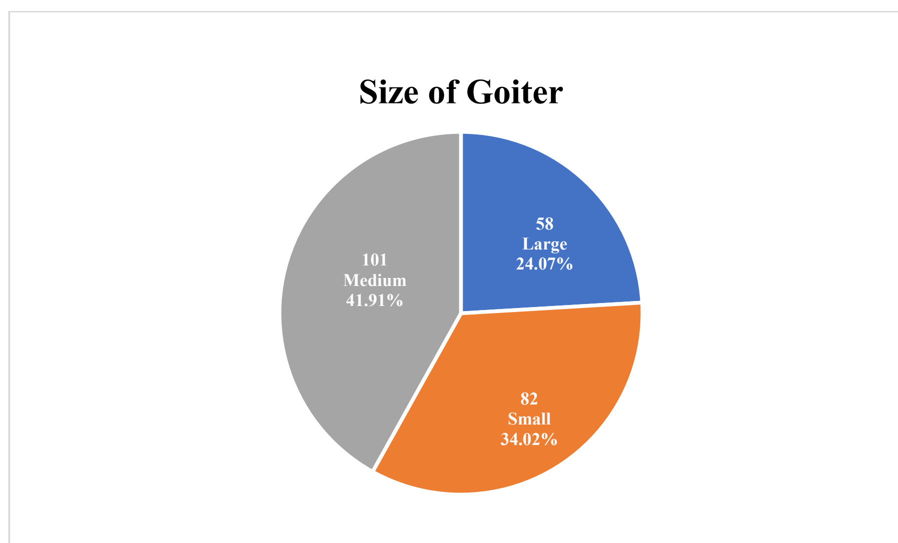

Figure 2: Size of Goiter n=241

Table 1: Frequency of Recurrent Laryngeal Nerve Palsy During Thyroidectomy with Per-Operative Nerve Identification

Recurrent laryngeal nerve palsy		Count	%
After 24 hours RLN injury	Yes	9	3.7%
	No	234	97.1%
After 3 months RLN injury	Yes	4	1.7%
	No	237	98.3%
After 6 months RLN injury	Yes	2	0.8%
	No	239	99.2%

Retrosternal extension was observed in 27.39% cases. Out of 241 cases, total thyroidectomy was performed in 52.7% patients, unilateral lobectomy and isthmectomy was done in 47.3% cases. Pre-operative FODL showed normal RNL status in all of the patients included in the study. The incidence of recurrent laryngeal nerve palsy during thyroidectomy with intraoperative nerve identification is presented in **Table 1.**

Table 2: Stratification of Recurrent Laryngeal Nerve Palsy During Thyroidectomy with Per-Operative Nerve Identification Based on Various Study Confounders n=241

Confounding Variables		RLN Palsy during Thyroidectomy		p-Value (x2-test)
		Yes	No	
Gender	**Male**	2 (2.74%)	71 (97.26%)	0.591
	Female	7 (4.16%)	161 (95.83%)	
Size of Goiter	**Small**	1 (1.2%)	81 (980.8%)	0.011
	Medium	2 (2%)	98 (98%)	
	Large	6 (10.34%)	53 (91.37%)	
Type of MNG	**Simple**	4 (2.81%)	138 (97.18%)	0.368
	Toxic	5 (5.05%)	94 (94.94%)	
Retrosternal Extension	**Yes**	1 (1.51%)	65 (98.48%)	0.264
	No	8 (4.57%)	167 (95.43%)	
Age Groups (Years)	**≤ 40**	2 (6.1%)	31 (93.9%)	0.690
	41-50	2 (3.07%)	63 (96.92%)	
	51-60	3 (2.7%)	108 (97.3%)	
	61-70	2 (6.3%)	30 (93.7%)	

Following 24 hours post-RLN surgery, the incidence of RLN injury in thyroidectomy was 3.73% (n=9); after 3 months, it decreased to 2.9% (n=7), and after 6 months, it was recorded as 0.82% (n=2). The comparison of the frequency of recurrent laryngeal nerve palsy observed 24 hours post-thyroidectomy in postoperative FODL across age groups was not statistically significant (p=0.69). The difference between genders was not statistically significant (p=0.591). The incidence of recurrent laryngeal nerve palsy following thyroidectomy was significantly elevated in cases of big goiter (p=0.011). The incidence of recurrent laryngeal nerve palsy during thyroidectomy was negligible with respect to retrosternal extension (p=

0.264) and thyroid function (p= 0.368). Detailed analysis of stratification is demonstrated in **Table 2.**

DISCUSSION

Recurrent laryngeal nerve injury (RLNI) remains one of the most serious complications of thyroidectomy, often leading to recurrent laryngeal nerve palsy (RLNP)[12]. Visual identification of the RLN significantly lowers the risk, with reported RLNP rates ranging from 4–8% and permanent paralysis occurring in 1–2% of cases[13,14]. Intraoperative neuromonitoring (IONM) further improves identification, yet RLNI persists, particularly in total endoscopic thyroidectomy (TET), where the incidence is consistently higher than in conventional open thyroidectomy (COT)[15]. The nerve entry point (NEP) into the larynx has been identified as a frequent site of injury[16].

In the present study, the mean patient age was 50.67 ± 9.06 years, with a female predominance (69.7%). Goiter size was small in 34%, medium in 42%, and large in 24% of patients, while retrosternal extension occurred in 27.4%. Total thyroidectomy was performed in 52.7% of cases, and unilateral lobectomy with isthmectomy in 47.3%.

Other studies have reported similar demographics. For example, in a cohort of 340 patients (median age: 37 years), 76.5% were female, and all had normal preoperative vocal cord function. Indications included multinodular goiter (38.2%), solitary nodule (30%), hyperthyroidism (9.4%), thyroid malignancy (11.5%), recurrent simple goiter (6.5%), cystic lesions (3.2%), and thyroiditis (1.2%). Transient unilateral RLNP occurred in 3.2% of cases, permanent in 0.3%, and bilateral RLNP in 0.6%, with no permanent bilateral paralysis. Secondary surgeries accounted for 6.8% of procedures[17,18,19,20].

The reported incidence of RLNI in TET ranges from 2.1–15%, compared to 0–4.6% in COT. In one study, RLNI after TET was 1.2% at 24 hours, 3.7% at 3 months, and 2.1% at 6 months. Anatomical variations further increase the risk; extra laryngeal branching of the RLN occurs in 18.5–72% of cases, and injuries are more likely when branching occurs near Berry's ligament. Approximately 25% of RLNs pass through the ligament, making them more vulnerable due to their delicate structure[21,22].

Traction is the most frequent mechanism of RLNI, followed by clamping and compression. One study reported 80% of injuries due to traction, 13% to clamping, and 7% to compression,

with no thermal injuries. Similarly, Snyder et al. found 56% traction injuries, 12% transection/ligation, 8% compression, and no heat-related injuries. However, with the increased use of energy-based devices, particularly ultrasonic scalpels in TET, thermal injuries are now being reported[23].

Despite improved visualization with endoscopy, the risk of thermal damage remains significant, as dissection in TET is limited to a caudal-to-cranial approach, while COT allows for more flexible orientations. Moreover, some laryngeal complications after thyroidectomy are attributable to intubation-related trauma rather than nerve injury[24,25].

The strength of this study lies in its detailed demographic and surgical analysis, with direct comparison of outcomes between COT and TET. It highlights anatomical risk factors, mechanisms of injury, and the role of IONM in reducing complications.

Limitations include its retrospective design, reliance on available follow-up data rather than standardized long-term laryngoscopic evaluation, and the lack of routine use of IONM, which may underestimate the true incidence of nerve injury.

CONCLUSION

In this study, after 24 hours of RLN surgery, RLN injury in endoscopic thyroidectomy was 1.2%, after 3 months, it was observed in 3.7% and after 6 months, it was reported in 2.1%. This thorough examination of RLN injury can facilitate informed consent dialogues and assist surgeons in recognizing individuals who may be at elevated risk for injury.

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CONFLICT OF INTEREST

None

ETHICAL APPROVAL

The study was done after approval from the ethical review committee under reference # (566/RC/FFH/RWP).

AUTHORS' CONTRIBUTION

AA developed the research idea, hypothesis, and framework, collected data, and performed the final review. **MN** reviewed the article and assisted in data collection. **HM** verified the results, ensured reproducibility, and contributed to article review. **UA** performed the statistical analysis, verified the results, ensured reproducibility, and reviewed the article. **AN** drafted the manuscript, revised the contents, and provided clinical assistance.

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