e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(8); 95-100

Original Research Article

Effect of Recurrent Laryngeal Nerve Identification Technique on RLN Paralysis and Hypoparathyroidism in Thyroidectomy

S. Naresh Kumar[1], Devender[2], Gopi Sandeep Raj[3]

[1]Assistant Professor, Department of General Surgery Gandhi Medical College, and Hospital, Secunderabad, Telangana State

[2]Assistant Professor, Department of General Surgery Gandhi Medical College, and Hospital, Secunderabad, Telangana State

[3]Assistant Professor, Department of General Surgery Gandhi Medical College and Hospital, Secunderabad, Telangana State

Received: 25-05-2023 / Revised: 28-06-2023 / Accepted: 21-07-2023

Corresponding author: Dr. S Naresh Kumar

Conflict of interest: Nil

Abstract:

Background: The RLN innervates the abductor and adductor muscles responsible for vocal cord movement, while the external branch of the superior laryngeal nerve EBSLN innervates the cricothyroid muscle, which controls vocal cord tension. Both nerves, located in proximity to the thyroid, are susceptible to damage during thyroidectomy. The current study aim is to investigate the correlation between two techniques for identifying the recurrent laryngeal nerve during thyroidectomy, namely superior-inferior and inferior-superior, and the occurrence of postoperative RLN paralysis.

Methods: In this prospective study, we enrolled all patients who underwent thyroid surgery at both the Department of General Surgery & ENT in Gandhi Hospital, Secunderabad. The study population consisted of 60 patients who underwent surgery for various thyroid disorders within the specified timeframe. Patients with multinodular goiter, uninodular goiter, thyroid cancer, thyroiditis, and recurrent goiter were included in the study.

Results: Symptomatic hypocalcemia was observed in 4 patients out of operated cases,1 case in group I and 2 cases in group 2. One in which RLN was not identified. Out of these patients in 3 cases total serum calcium level was lower than 8.2mg/dl. As a result, RLN palsy was only seen in group 2 i.e., inferior-superior technique, and the incidence of hypocalcemia was 4 cases out of which 2 cases were in group 2.In the group of patients with symptomatic hypocalcemia, the average level of i-PTH 1 hr after surgery was 12.33pg/ml, and the average level of serum calcium after 24 hr was 7.53 mg/dl.

Conclusion: Among these techniques, the superior-inferior approach demonstrates the lowest incidence of RLN injury, as evidenced by the absence of RLN injury in our study. Therefore, we recommend the use of the superior-inferior technique for RLN identification during thyroidectomy. Furthermore, the superior-inferior technique proves effective in preventing postoperative hypoparathyroidism. Estimating intact parathyroid hormone (i-PTH) levels one hour after surgery emerges as a reliable predictor of hypocalcemia following total thyroidectomy.

Keywords: iPTH (Intact Parathyroid Hormone), Hypocalcaemia, Recurrent Laryngeal nerve injury, thyroidectomy.

Introduction

The global prevalence of thyroid disorders exceeds 2 billion, with over 40 million cases reported in India [1]. The diagnosis of thyroid disease is on the rise, making it one of the most commonly observed non-communicable diseases [2]. Thyroid disorders are among the most frequently encountered conditions in the field of General Surgery. Thyroidectomy is a commonly performed surgical procedure but carries the risk of serious postoperative complications, such as Recurrent Laryngeal Nerve (RLN) paralysis and hypoparathyroidism. Thyroidectomy is commonly performed, especially in regions where iodine deficiency is prevalent. [3-6] The optimal surgical approach for multinodular goiters has been a subject of debate; however, total thyroidectomy is increasingly becoming the preferred option. [4, 5] Total thyroidectomy is considered suitable when both lobes of the thyroid are affected and when there is a high risk of recurrence. [4, 5] Recurrent laryngeal nerve (RLN) paralysis and hypoparathyroidism are the most significant complications that can arise after the operation. In total thyroidectomies performed using an extracapsular approach, the identification of the RLN is crucial. However, excessive dissection of the tracheoesophageal groove during RLN search can

compromise the blood supply to the parathyroid gland, resulting in temporary or permanent hypoparathyroidism. Following thyroid surgery, hypoparathyroidism can occur because of inadequate dissection, which may cause damage or complete removal of the parathyroid glands, compromised blood flow, or necrosis resulting from hematoma. [6]

Numerous studies have investigated the correlation between specific types of surgery (total, subtotal, or near-total thyroidectomy) and the prevention of major complications, such as damage to the recurrent laryngeal nerve (RLN) and hypoparathyroidism. These studies examined whether the nerve is identified during surgery and whether nerve monitoring techniques are utilized. A comprehensive review by Hermann et al. [7], which included 16,443 patients who underwent thyroidectomy, demonstrated that the occurrence of temporary and permanent recurrent laryngeal nerve (RLN) paralysis significantly decreased when the nerve was identified during the procedure. Similarly, Heuer et al. reported a three to four-fold higher incidence of nerve paralysis when the recurrent nerve was not localized than when it was identified. However, no prospective study has directly compared the different RLN identification techniques. During thyroidectomy, two distinct methods were employed for RLN identification. The first is the superior-inferior technique, which involves identifying the nerve as it enters the larynx following superior pedicle ligation. The second is the inferior-superior technique, in which the nerve is traced in the superior direction after initial identification in the tracheoesophageal groove. This study aimed to compare the incidence of RLN paralysis and hypocalcemia in thyroidectomies performed using two different techniques for RLN identification, as well as in cases where the RLN was not identified.

Material and Methods

In this prospective study, we enrolled all patients who underwent thyroid surgery at the Department of General Surgery and ENT in Gandhi Hospital, Secunderabad. The study population consisted of 60 patients who had undergone surgery for various thyroid disorders within a specified timeframe. Patients with multinodular goiter, uninodular goiter, thyroid cancer, thyroiditis, or recurrent goiter were included in the study. The research protocol was approved by the Ethics Committee of the Helsinki Training and Research Hospital, and the study adhered to the principles outlined in the Declaration of Helsinki. Patients were provided with detailed information regarding the surgical procedure and written consent was obtained from each participant.

Prospective follow-up was conducted on all patients who were admitted for thyroid surgery. A comprehensive preoperative assessment was performed, including routine laboratory tests, such as complete blood count (CBC), serum creatinine, serum electrolytes, random blood sugar (RBS), and blood urea. Patients with hypertension and diabetes received appropriate antihypertensive medications and underwent daily fasting blood sugar (FBS) monitoring to ensure their readiness for surgery. Thyroid profiles were obtained for all patients and confirmed to be in a euthyroid state. Before surgery, all patients underwent fine-needle aspiration cytology (FNAC) and neck ultrasonography. Guided FNAC was performed when indeterminate or suspicious areas were identified. An X-ray of the neck was conducted to assess tracheal deviation and compression. Additionally, indirect laryngoscopy was performed for all patients to record preoperative vocal cord movement. The method used to identify the recurrent laryngeal nerve (RLN) was determined according to the attending surgeon's preference. Furthermore, it was noted that the RLN was identified during surgery.

Patients were divided into two groups based on the method employed to identify the recurrent laryngeal nerve (RLN). The first group comprised thyroidectomies performed using a superior-inferior technique, in which the RLN was located at its entry point into the larynx and secured, followed by superior pedicle ligation. In this group, 10 total and 35 lobiosthemetctomies were performed in 55 RLN dissections. The second group consisted of thyroidectomies conducted using an inferior-superior approach involving inferior pedicle ligation and nerve identification within the tracheoesophageal groove. In this group 1 total thyroidectomy and 14 loboisthemectomies were performed; hence, 16 RLN dissections were performed.

Postoperatively, the function of the vocal cords was evaluated by the anesthetist at the operating table and later by indirect laryngoscopy (IDL) before the patient's discharge. Information regarding the occurrence of wound infection and hemorrhage was also collected. The patients were followed up until discharge. This study aimed to compare the rates of complications associated with the two different surgical techniques.

Results

A total of 11 thyroidectomies and 49 Lobiosthemetctomies were done in this study. In the first group, thyroidectomies were carried out using a superior-inferior direction. The nerve was identified at its entry into the larynx, followed by superior pedicle ligation. In the second group, thyroidectomies were performed using an inferior-superior direction. This involved inferior pedicle ligation and identification of the nerve within the tracheoesophageal groove. In about 20 cases RLN

was not identified during surgery. Post-operative RLN paralysis was observed in 2 patients both in group 2 i.e. inferior-superior approach. None of the patients developed post-op hemorrhage or wound infections depicted in Table 1.

Table 1: Showing Thyroidectomy complications in cases of the study

Complication	S-I Group 1	I-S Group 2	RLN – not identified	Total
Wound infection	0	0	0	0
Hemorrhage	0	0	0	0
RLN paralysis	0	2	0	2
Hypocalcemia	1	2	1	4

S-I = superior-inferior technique; I-S = inferior-superior technique

Symptomatic hypocalcemia was observed in 4 patients out of operated cases,1 in group I, 2 cases in group 2, and 1 in which RLN was not identified. Out of these patients in 3 cases total serum calcium level was lower than 8.2mg/dl. As a result, RLN palsy was only seen in group 2 i.e., inferior-superior technique, and the incidence of hypocalcemia was 4 cases out of which 2 cases were in group 2.In the group of patients with symptomatic hypocalcemia, the average level of i-PTH 1 hr after surgery was 12.33pg/ml, and the average level of serum calcium after 24 hr was 7.53 mg/dl (Figure 1 and Figure 2).

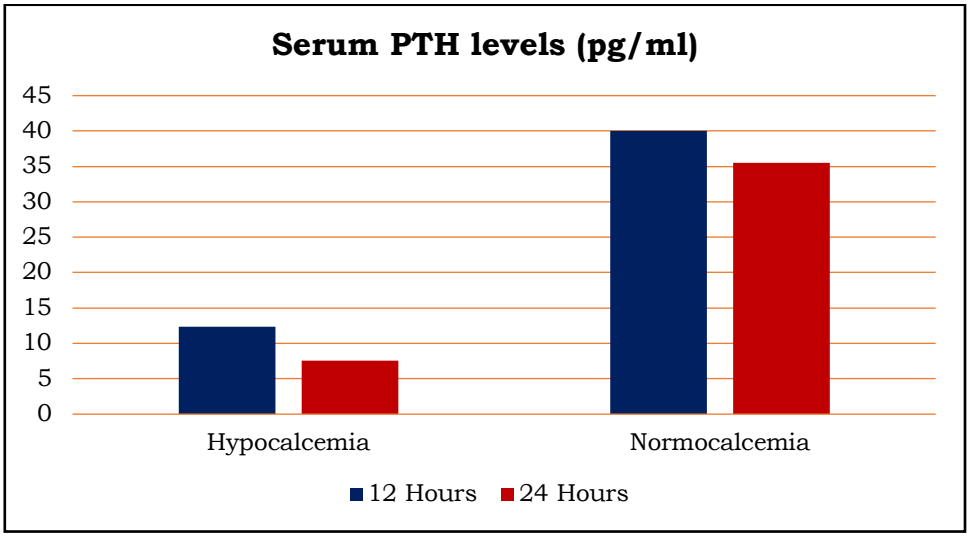

Figure 1: **Serum iPTH levels (pg/ml) at different intervals following the surgery**

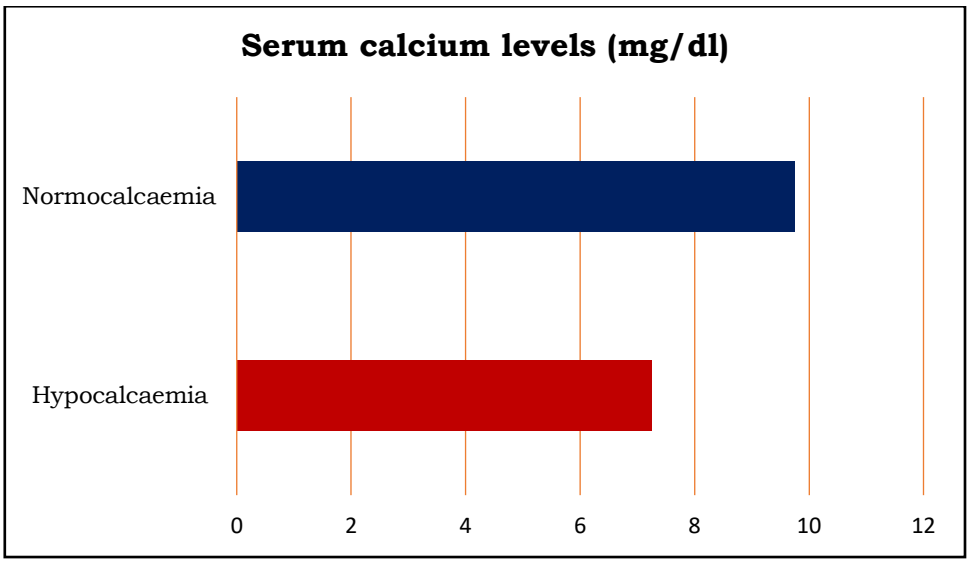

Figure 2: Serum calcium levels at the end of 24 hours following surgery

Most of the patients in this study are in the age group 21- 30yrs (33.33%). Among the 60 cases of thyroid surgery, the majority of them were females with a male-to-female ratio of 1:5 Solitary nodule is the

most common indication for thyroidectomy in this study(65%).Incidence of Hypocalcemia:In this study out of 11 patients who underwent total thyroidectomy, 3/11 patients developed hypocalcemia in the postoperative period. The incidence of hypocalcemia following total thyroidectomy is 13.63%.In this study, among the 03 patients who developed hypocalcemia (serum calcium levels <8mg/dl), symptoms of hypocalcemia were observed in all 3 patients (100%). During this study, symptoms and signs of hypocalcemia were observed in 2 out of 3 cases (66.33%) on the 2nd postoperative day. Tingling and numbness were observed to be the initial presenting symptom of hypocalcemia in 66.33% of cases and carpopedal spasm (33.3%).

Discussion

Thyroidectomy is a commonly performed surgical procedure associated with two significant postoperative complications: recurrent laryngeal nerve (RLN) paralysis and hypoparathyroidism. There is a divergence of opinion regarding the optimal technique to prevent RLN injury during thyroid surgery. Two distinct methods have been used for RLN identification during thyroidectomy. The first method is the superior-inferior technique, which involves identifying the nerve at the point where it enters the larynx after ligating the superior pedicle. The second method is the inferior-superior technique, which involves initially locating the nerve within the tracheoesophageal groove and then tracing it in the superior direction. The incidence of RLN paralysis in this study was 13.26% in the patients who underwent total thyroidectomy. Notably, a higher rate of RLN paralysis was observed in thyroidectomies performed using the inferior-superior technique. According to existing literature, the reported frequencies of recurrent laryngeal nerve (RLN) paralysis and permanent hypoparathyroidism in total thyroidectomies range from 0.3% to 1.7% and 0.7% to 3.0%, respectively. [9-11] In cases of non-total thyroidectomies performed for multinodular goiters, the frequency of RLN complications falls within the range of 12% to 20%. [12] Approximately half of the patients with recurrent benign goiter require revision surgery and are at a significantly higher risk of developing permanent complications. [3] Even highly experienced surgeons have reported RLN nerve paralysis due to accidental injury in approximately 1–2% of cases. [9-11] The reported frequency of hypoparathyroidism varies across studies and ranges from 1.6% to 50.0%. [10-12] Due to the risks associated with incomplete resection and the favorable safety profile of total thyroidectomy when employing appropriate surgical techniques, it is common to opt for total thyroidectomy in cases of benign disease. [3, 5]

The technique of searching for the RLN in the tracheoesophageal groove and following it to its entry point in the larynx requires more extensive dissection, which increases the risk of nerve injury. Conversely, the superior-inferior approach to RLN identification allows direct access to the region with less dissection and a reduced risk of RLN injury. [13] The study's findings showed lower rates of RLN palsy in thyroidectomies utilizing the superior-inferior technique, which is in line with the study conducted by Bayram Veyseller et al., [14] where the RLN paralysis incidence was 1.5% in the inferior-superior technique and absent in the superior-inferior technique.Nerve monitoring is a valuable tool during surgery because it aids in identifying the recurrent laryngeal nerve (RLN) and provides a significant advantage in assessing nerve integrity postoperatively. However, owing to the cost associated with nerve monitoring, its routine use is not recommended in all cases. Instead, it is specifically recommended in situations such as revision surgery, thyroid cancer, patients with retrosternal extension or giant goiter, and individuals who have previously undergone radiotherapy.

In this study, the incidence of hypocalcemia was lower in the superior-inferior technique than in the inferior-superior technique. This finding is consistent with the study conducted by Bayram Veyseller et al. [14], in which the incidence of hypocalcemia was 7.4% in the superior-inferior technique and 22% in the inferior-superior technique. Rimpl et al. [15] demonstrated that postoperative hypocalcemia could be attributed to extensive thyroid resection and manipulation of the parathyroid gland. Searching for the recurrent laryngeal nerve (RLN) in the tracheoesophageal groove and following it to its entry point in the larynx requires more dissection and can lead to devascularization of the parathyroid gland, resulting in ischemia, necrosis, and subsequent hypoparathyroidism. In contrast, the superior-inferior approach to RLN identification allows direct access to the region with less dissection and reduced damage to the parathyroid glands. Achieving meticulous hemostasis and employing delicate techniques are crucial for preventing nerve and parathyroid gland injuries. Systematic dissection of the RLN decreases the incidence of RLN paralysis, but increases the risk of hypoparathyroidism, primarily due to devascularization of the parathyroid glands. [16] This study demonstrates that estimating intact parathyroid hormone (i-PTH) levels 1 h after total thyroidectomy is a reliable indicator for predicting hypocalcemia. Therefore, measuring i-PTH levels at this time point can effectively identify patients at risk of developing hypocalcemia. Similar findings were observed in a study by Proczko et al. [17] Performing a prospective analysis of perioperative i-PTH kinetics can contribute to

understanding the underlying mechanism of postoperative hypoparathyroidism and determining the i-PTH cutoff levels that serve as prognostic indicators for postoperative hypocalcemia. Robert et al. suggested that early postoperative total or ionized calcium levels could predict hypoparathyroidism following total thyroidectomy. Intraoperative i-PTH levels are considered a reliable predictor of symptomatic hypocalcemia, although this method may not be feasible in many surgical centers due to financial constraints. [18]An alternative approach could involve measuring i-PTH levels shortly after surgery to identify patients at risk of developing hypocalcemia. In our study, intact parathyroid hormone (i-PTH) levels were measured one hour after the surgical procedure, specifically after skin suturing, and a strong correlation was observed between these early postoperative i-PTH levels and hypocalcemia development. We believe that the early measurement of PTH shortly after surgery may be as accurate as obtaining results several hours later, considering the short half-life of PTH, which ranges from 2 to 5 min. In other trials, various combinations of PTH and calcium measurements at different time points have been utilized. Payne RJ et al. [19] published findings based on PTH measurements taken at 6, 12, and 20 hours after thyroidectomy, concluding that PTH and calcium levels at 6 hours accurately identified patients at risk of developing PTH-related complications following the surgical procedure. Additionally, other studies have compared PTH levels assessed within 1–12 hours postoperatively with those measured at the 24-hour mark, finding that the early results were equally reliable. As a result, measuring PTH levels one hour after surgery proved to be a valuable predictor of postoperative hypocalcemia, exhibiting a sensitivity of 100% in this study. Notably, no cases of hypocalcemia were observed among study participants with reference PTH levels.

Conclusion

Various techniques have been employed by surgeons to identify the recurrent laryngeal nerves during thyroidectomy. Among these techniques, the superior-inferior approach demonstrated the lowest incidence of RLN injury, as evidenced by the absence of RLN injury in our study. Therefore, we recommend the use of the superior-inferior technique for RLN identification during thyroidectomy. Furthermore, the superior-inferior technique proved effective in preventing postoperative hypoparathyroidism. Estimating intact parathyroid hormone (i-PTH) levels one hour after surgery is a reliable predictor of hypocalcemia following total thyroidectomy. Consequently, measuring i-PTH levels at this early time point enables the identification of patients at risk of developing hypocalcemia. This timely identification facilitates the management and prevention of hypocalcemia and its associated complications.

References

1. Shah SN, Joshi SR. The thyroid is an endocrine organ. JAPI 2000;48(Supp 1):7-8.
2. Shah SN, Joshi SR. Goiter and Goitrogenesis have some insights. JAPI 2000;48(Supp 1):13-4.
3. Mishra A, Agarwal A, Agarwal G, Mishra SK. Total thyroidectomy for benign thyroid disorders in an endemic region. World J Surg. 2001;25(3):307-31011343181.
4. Bron LP, O'Brien CJ. Total thyroidectomy for clinically benign disease of the thyroid gland. Br J Surg. 2004;91(5):569-574.
5. Bellantone R, Lombardi CP, Bossola M, et al. Total thyroidectomy for management of benign thyroid disease: review of 526 cases. World J Surg. 2002;26(12):1468-147.
6. Giles Y, Boztepe H, Terzioglu T, Tezelman S. The advantage of total thyroidectomy to avoid reoperation for incidental thyroid cancer in multinodular goiter. Arch Surg. 2004; 139(2):179-182.
7. Hermann M, Keminger K, Kober F. Risk factors of recurrent nerve palsy: a statistical analysis of 7566 thyroid operations. Chirurgie 1991; 62:182-188.
8. RJ Heuer, RT Sataloff, E Emerich, R Rulnick, et al. Unilateral recurrent laryngeal nerve paralysis: the importance of preoperative voice therapy. Journal of Voice 1997; 11(1): 88-94.
9. Friedman M, Pacella BL Jr. Total versus subtotal thyroidectomy: arguments, approaches, and recommendations. Otolaryngol Clin North Am. 1990;23(3):413-427.
10. Bhattacharyya N, Fried MP. Assessment of the morbidity and complications of total thyroidectomy. Arch Otolaryngol Head Neck Surg. 2002;128(4):389-392.
11. Thomusch O, Machens A, Sekulla C, et al. Multivariate analysis of risk factors for postoperative complications in benign goiter surgery: a prospective multicenter study in Germany. World J Surg. 2000;24(11):1335-1341.
12. Erbil Y, Barbaros U, Salmaslioğlu A, Yanik BT, Bozbora A, Ozarmağan S. The advantage of near-total thyroidectomy to avoid postoperative hypoparathyroidism in benign multi nodular goiter. Langenbecks Arch Surg. 2006;391(6):567-573.
13. Butskiy O, Chang BA, Luu K, McKenzie RM, Anderson DW. A systematic approach to the recurrent laryngeal nerve dissection at the cricothyroid junction. J Otolaryngol Head Neck Surg. 2018 Sep 17;47(1):57.
14. Veyseller B, Aksoy F, Yildirim YS, Karatas A, Özturan O. Effect of Recurrent Laryngeal

Nerve Identification Technique in Thyroidectomy on Recurrent Laryngeal Nerve Paralysis and Hypoparathyroidism. Arch Otolaryngol Head Neck Surg. 2011;137:897–900.
15. Rimpl I, Wahl RA. Surgery of nodular goiter: postoperative hypocalcemia in relation to the extent of resection and manipulation of the parathyroid glands. Langenbecks Arch Chir Suppl Kongressbd. 1998;115:1063–66.
16. Megherbi MT, Graba A, Abid L, Oulmane D, Saidani M, Benabadji R. Complications and squeal of benign thyroid surgery. J Chir (Paris) 1992;129:41–46.
17. Proczko-Markuszewska M, Kobiela J, Stefaniak T, Lachinski AJ, Sledzinski Z.Postoperative PTH measurement as a predictor of hypocalcemia after thyroidectomy. Acta Chir Belg 2010;110:40–44.
18. AlQahtani A, Parsyan A, Payne R, Tabah R. Parathyroid hormone levels 1 hour after thyroidectomy: an early predictor of postoperative hypocalcemia. Can J Surg. 2014 Aug;57(4):237-40.
19. Payne RJ, Hier MP, Tamilia M, Mac Namara E, Young J, Black MJ. Same-day discharge after total thyroidectomy: the value of 6-h serum parathyroid hormone and calcium levels. Head Neck 2005; 27:1–7.