DOI: 10.7860/JCDR/2016/16892.7196

Original Article

Surgery Section

# Effect of Dissection of the Recurrent Laryngeal Nerves on Parathyroid Insufficiency during Total Thyroidectomy for Multinodular Goitre

VENGAYIL SUKUMARAN[1], BHAVURAY TELI[2], SREEKANT AVULA[3], JAGADEESH PAVULURU[4]

## ABSTRACT

**Introduction:** Total thyroidectomy is the accepted standard treatment for benign goitrous enlargements. The surgical skill and technique is one of the most important factor which affect the outcome in thyroid surgery. Hypocalcaemia due to parathyroid insufficiency remains a significant postoperative morbidity after total thyroidectomy. The primary cause is unintentional damage to, or devascularization of, one or more parathyroid glands during surgery.

**Aim:** To study the risk of hypocalcaemia due to recurrent laryngeal nerves (RLNs) dissection during total thyroidectomy for benign multinodular goitre (MNG).

**Materials and Methods:** The study is a non-randomized control trial, where 100 patients with benign MNG were divided into two groups (group A and group B) each consisting of 50 patients. All 100 patients underwent total thyroidectomy by a subcapsular dissection. In patients of group A, both RLNs were clearly dissected for a minimum length of 2cm down from its entry into the larynx before total thyroidectomy was performed. In group B, each patient had total thyroidectomy without making any deliberate attempt to dissect and demonstrate the RLNs. The patients in the two groups were followed up for the incidence of clinically significant hypocalcaemia in the postoperative period.

**Results:** A total of 30% of patients in group A developed clinical and biochemical manifestations of hypocalcaemia but the incidence of hypocalcaemia was only 6% in the group B. Three (6%) patients out of those who developed hypocalcaemia in group A had a prolonged hypocalcaemia for upto six months. p-value is 0.003 and odds ratio is 6.59.

**Conclusion:** Routine dissection to identify the RLNs could predispose to a higher incidence of postop hypocalcaemia. Subcapsular dissection of the thyroid safely preserves the parathyroid glands.

**Keywords:** Hypocalcaemia, Hypoparathyroidism, Thyroidectomy

## INTRODUCTION

Total thyroidectomy is the standard surgical procedure for benign multinodular goiter [1]. Total thyroidectomy is a procedure in which the skill of the operating surgeon is put to test mainly due to the intimacy of the thyroid gland to three important structures – the Parathyroid glands, RLNs and the External Laryngeal Nerves. A fine balance must be struck between the need to perform total thyroidectomy and the extent of dissection to achieve the same. Unnecessary dissection far from the thyroid gland capsule puts the patients at risk of damaging any or all of the above mentioned important structures, thereby resulting in morbidities to the patient which would even be life long, significantly affecting the quality of life. Therefore it is important to make all efforts to preserve the integrity of all three structures during total thyroidectomy. Hypoparathyroidism and consequent hypocalcaemia is a much troublesome complication of total thyroidectomy [2,3].

Inspite of many refinements in surgical techniques to avoid hitting and damaging the parathyroid glands, hypoparathyroidism remains a significant postoperative morbidity after total thyroidectomy. The extreme variations in the locations of the parathyroid glands have compounded the issue. Autotransplantation of a harvested parathyroid is often unsuccessful due to technical failures. And, very often, the unintended damage to parathyroid glands went unrecognized too. Hence, the most practical approach to avoid untoward parathyroid damage during total thyroidectomy is to keep the dissection through a safe zone away from the parathyroid glands. Subcapsular ligation of the inferior thyroid artery has lowered the incidence of hypoparathyroidism to a great extent [4].

Nevertheless, the most judicious approach would be to avoid unnecessary lateral and posteromedial dissections far away from the thyroid capsule, so that the preservation of maximum viable parathyroid tissue can be ensured. One of the common reasons which mandate widening the lateral and posteromedial dissections is the necessity to dissect out the recurrent laryngeal nerves (RLNs) so as to ensure their integrity. It is customary to dissect and demonstrate the course of RLNs to a variable extent, before total thyroidectomy is performed, thereby widening the area of dissection, and subsequently putting the parathyroid gland at risk of either getting devascularised or excised completely. In this prospective interventional study we have compared two groups of patients undergoing total thyroidectomy, one in which mandatory operative demonstration of the course of RLNs were carried out and the other in which no attempts to demonstrate the course of RLNs were made. The two groups were analysed with respect to the incidence of postoperative hypocalcaemia.

## MATERIALS AND METHODS

A total of 100 patients with benign MNG of moderate size without preexisting parathyroid disease or calcium imbalance or abnormal serum albumin (above or below the normal range of 3.4-4.8 g/dl) were included in the study. The study was conducted over a period of two years (May 2013 to June 2015). Patients were aged between 20 and 65 years with mean age of 42 years. All (88% female and 12% male) patients had clinically palpable MNG without retrosternal extension. All patients underwent preoperative evaluation by ultrasound (USG) of neck, fine needle aspiration cytology (FNAC) of goitre, thyroid function tests (T3, T4, TSH) and plane X-ray of the neck (anteroposterior and lateromedial views). All patients had non-inflammatory benign enlargement of the thyroid proven by FNAC. USG neck was used to rule out gross pressure effect on the carotid sheath, so that huge laterally

extending goitres could be excluded. Plain X ray neck was used to exclude those patients with tracheal deviation, in order to exclude the cases in which gross anatomical derangement of perithyroidal region existed, which could influence the extent of dissection required during surgery. Significant retrosternal extension was ruled out by clinical examination combined with USG. The study was conducted over a period of two years. It was a non-randomized clinical study. Patients were divided into two groups, Group A and Group B. The study design was presented to ethical committee and approval was obtained. Informed consent was obtained from all patients. Each patient was subjected to indirect laryngoscopy and vocal cord mobility was confirmed prior to surgery. All patients underwent total thyroidectomy by a surgeon who had 8 years of post qualification experience in performing the procedure. The surgeon had already performed more than 300 total thyroidectomies.

Patients in Group A were subjected to total thyroidectomy by dissecting the thyroid gland through the plane beneath the pseudocapsule of the gland thereby avoiding dissection far from the gland capsule (true capsule). The whole thyroid gland was mobilized through the sub (pseudo) capsular plane and all the vessels including inferior thyroid artery branches were ligated in the subcapsular plane. The RLNs were dissected clearly for 2cm of its distal extra laryngeal course before total thyroidectomy was performed. In Group B, the plane of dissection and vessel ligation remained subcapsular but no attempt was made to dissect out the RLNs, thereby avoiding any dissection far away from the gland surface, especially in the tracheoesophageal groove where the RLNs course and the parathyroids exist in intimate relation to the nerves.

All patients were followed up clinically and biochemically for features of hypocalcaemia. Serum calcium estimation was done at 24 and 48 hours of surgery. Those who developed clinical/biochemical hypocalcaemia had an extended hospital stay till their symptoms were relieved or stabilized. Those who were normocalcaemic, were discharged on postoperative day three. No patients had biochemical hypocalcaemia alone. All patients were reviewed after one week of discharge. Those who had persistent hypocalcaemia were reviewed every two weeks for calcium estimation and optimization of calcium supplementation.

## STATISTICAL ANALYSIS

Sample size was selected using the formula: 4PQ/d2, where P: prevalence of hypocalcaemia (50%- as shown in previous studies), Q: (100-P) and d: 20% of P. The calculated sample was 100, and it was divided into two groups, containing 50 in each. It was a convenience sampling. Chi-square test was used for analysis.

## RESULTS

The hospital stay was 4 -6 days, including a day prior to surgery. A total of 30% (15 patients) of patients in group A developed clinical and biochemical manifestations of hypocalcaemia (as defined by carpopedal spasm and chvostek's sign and serum calcium 7mg% or less) within 48 hours of postoperative period. All those who developed hypocalcaemia required intravenous and oral calcium supplementation for upto two weeks postoperatively and 20% (three patients) of these patients remained hypocalcaemic upto six months. The incidence of hypocalcaemia was only 6% (three patients) in group B and all these patients were normocalcaemic within two weeks. No patients in either groups had any evidence of recurrent laryngeal nerve (RLN) injury [Table/Fig-1]. All patients were followed up for a minimum of 6 months. There were no dropouts and no patient developed latent hypocalcaemia.

The p-value is 0.003, showing the incidence of hypocalcaemia is statistically significant. Odds ratio is 6.59, which means those in Group A were 6.59 (confidence interval: 1.68-38.23) times more likely to develop transient hypocalcaemia in the postop period as compared to patients in group B.

| Complications | Group A | Group B | Total |
|---|---|---|---|
| Transient hypocalcemia | 15 (30%) | 3 (6%) | 18 |
| Permanent hypocalcemia | 3 (6%) | 0 | 3 |
| Vocal cord paralysis | 0 | 0 | 0 |

**[Table/Fig-1]:** Results

## DISCUSSION

Transient or prolonged hypocalcaemia due to parathyroid insufficiency is a common complication of total thyroidectomy. The incidence of hypocalcaemia after thyroidectomy varies from 1.6 to above 50% [5]. Some studies have reported the incidence of transient hypocalcaemia as up to 50% and permanent hypocalcaemia upto 4% after thyroidectomy [6,7]. Transient hypocalcaemia following thyroidectomy generally responds to replacement therapy within a days or weeks [8]. Permanent hypocalcaemia is considered when the serum calcium level does not return to normal within 6 months [9].

Apart from the skill and scrupulousness of the surgeon, the highly variable location of the parathyroid glands decides the incidence and degree of parathyroid damage. By and large, most people have four parathyroid glands located on and around the thyroid lobes, two on either side. The superior and inferior parathyroids are intimately related to the course of the RLNs, mostly the former dorsal and the latter ventral, to the nerve. Upto 13-15% population can have supernumerary parathyroids and 3-5% can have less than four parathyroids [10]. The commonest mechanism by which parathyroid is damaged is by unintentional ischemia during dissection in the perithyroid plane. The parathyroids derive their blood supply mainly from the inferior thyroid arteries. Therefore, while ligating the inferior thyroid artery extra care should be taken to do so at the subcapsular plane of thyroid gland than at the main branches or the trunk. Because it is not easy to locate or identify the normal parathyroids intraoperatively, they must be presumed to be present anywhere around the gland while dissecting the periglandular tissue, especially during the dissection of RLNs, owing to their close proximity to each other in the majority. Routine dissection and identification of the distal extra laryngeal course of RLNs is the standard recommendation during total thyroidectomy. But, this, especially in inexperienced hands, results in an unnecessary amount of perineural dissection in the tracheoesophageal groove, there by risking the viability of the parathyroids. Hence, a dissection technique which avoids active search for the course of the RLNS, at the same time ensuring its preservation would be the better choice to avoid both RLN palsy and parathyroid insufficiency. This can be safely achieved by keeping the plane of dissection in the subcapsular plane of thyroid. Routine dissection and demonstration of the RLNs must be discouraged.

There are very few articles which studied the effect of RLNs dissection on hypoparathyroidism. An article by Megherbi et al., where the overall incidence of transient and permanent hypocalcaemia in both groups were 4.2% and 1.2% respectively. The study clearly reports that systematic dissection of RLNs has increased the incidence of hypoparathyroidism, mainly by devascularization of parathyroid glands [11].

In another study by Canbaz H et al., where the incidence of transient hypocalcaemia was 24.1% in RLNs identifying group and it was 10.3% in not identifying RLNs group (p-value: 0.049). The results showed that there is increase in the rate of temporary hypocalcaemia and parathyroid gland autotransplantation, following identifying and exposing the whole course and branches of the RLN during total thyroidectomy [12].

In a recent study by Veyseller B et al., studied the effect of RLNs identification techniques in thyroidectomy on RLNs paralysis and hypoparathyroidism. Patients were divided into two groups according to the thyroidectomy technique used to identify the RLNs. Group (1): superior-inferior direction, exploring the nerve where it enters the larynx, followed by superior pedicle ligation; and Group (2): inferior-superior direction, following the inferior pedicle ligation and identifying the nerve in the tracheoesophageal groove. The incidence of transient and permanent hypocalcaemia in Group (2) was 16.2% and 4.6%. In Group (1), there was only temporary hypocalcaemia of 8.3%. The overall incidence of temporary and permanent hypocalcaemia in both groups was 13.4% and 2.9% respectively. The parathyroid devascularization can occur while searching the RLNs in the tracheoesophageal groove and following it where it enters the larynx as it requires more dissection in these areas [13].

In a Prospective Study by Zambudio AR et al., where they studied the postoperative complications after total thyroidectomy with identifying the RLNs for multinodular goiters. The percentage of hypoparathyroidism was 9.6%, with 0.7% turning out to be definitive [14].

Hypocalcaemia following thyroid surgery may develop due to vessel damage, total resection and reimplantation of the parathyroid glands or ischemia of parathyroid glands with manipulation [15-17]. Rimple et al., identified the cause for transient hypocalcaemia and it was due to extensive thyroid resection and parathyroid gland manipulation [18].

In the present study, in group A (RLNs identifying group), the incidence of postoperative hypocalcaemia was 30%. A total of 80% of those who had hypocalcaemia in this group recovered in 2 weeks postoperatively but the remaining 20% of these patients required oral calcium supplementation lasting more than 6 months.

In group B (RLNs not identifying group) the incidence of postoperative hypocalcaemia was 6% and all these patients had recovery from hypocalcaemia over 2 weeks through the postoperative period. In either group there are no incidences of RLNs injury.

## CONCLUSION

Operative demonstration of the RLNs during total thyroidectomy could predispose to a higher incidence of postop parathyroid insufficiency. Dissection at the subcapsular plane of the thyroid during total thyroidectomy ensures preservation of most of the parathyroid, thereby lowering the incidence of postop hypocalcaemia.

## REFERENCES


[1] Lanitis S, Kouloura A, Zafiriadou P, Karaliotas C. Type of operation for multinodular goitre and solitary nodule: Review Article – Metaanalysis. *Hellenic Journal of Surgery*. 2015;87:24-30.

[2] Ku CF, Lo CY, Chan WF, Kung AW, Lam KS. Total thyroidectomy replaces subtotal thyroidectomy as the preferred surgical treatment for Graves' disease. *ANZ J Surg*. 2005;75(7):528-31.

[3] Karamanakos SN, Markou KB, Panagopoulos K, Karavias D, Vagianos CE, Scopa CD, Fotopoulou V, et al. Complications and risk factors related to the extent of surgery in thyroidectomy. Results from 2,043 procedures. *Hormones* (*Athens*). 2010;9(4):318-25.

[4] Christou N, Mathonnet M. Complications after total thyroidectomy. *J Visc Surg*. 2013;150(4):249-56.

[5] Erbil Y, Barbaros U, Issever H, Borucu I, Salmaslioglu A, Mete O, Bozbora A, Ozarmagan S. Predictive factors for recurrent laryngeal nerve palsy and hypoparathyroidism after thyroid surgery. *Clin Otolaryngol*. 2007;32:32–37.

[6] Shaha AR, Jaffe BM. Parathyroid preservation during thyroidectomy. *Am J Otolaryngol*. 1998;19:113–17.

[7] Demeester-Mirkine N, Hooghe L, Van Geertruyden J, De Maertelaer V. Hypocalcaemia after thyroidectomy. *Arch Surg*. 1992;127:854–58.

[8] Bentrem DJ, Rademaker A, Angelos P. Evaluation of serum calcium levels in predicting hypoparathyroidism after total/near-total thyroidectomy or parathyroidectomy. *Am Surg*. 2001;67:249-51.

[9] Abboud B, Sargi Z, Akkam M, et al. Risk factors for post thyroidectomy hypocalcaemia. *J Am Surg*. 2002;195:456-61.

[10] F Charles Brunicardi, Dana K, Timothy R, Billar, David L, Dunn John G, et al. Schwartz's principles of surgery, 9th ed, New York: McGraw Hill; 2010. Chapter 38, Thyroid, Parathyroid, and Adrenal; pp.1375.

[11] 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.

[12] Canbaz H, Dirlik M, Colak T, Ocal K, Akca T, Bilgin O, Tasdelen B, Aydin S. Total thyroidectomy is safer with identification of recurrent laryngeal nerve. *J Zhejiang Univ Sci B*. 2008;9:482-88.

[13] 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.

[14] Zambudio AR, Rodríguez J, Riquelme J, Soria T, Canteras M, Parrilla P. Prospective Study of Postoperative Complications After Total Thyroidectomy for Multinodular Goiters by Surgeons With Experience in Endocrine Surgery. *Annals of Surgery*. 2004;240(1):18-25.

[15] Chao TC, Jeng LB, Lin JD, Chen MF. Reoperative thyroid surgery. *World J Surg*. 1997;21:644-47.

[16] Abboud B, Sargi Z, Akkam M, Sleilaty F. Risk factors for postthyroidectomy hypocalcaemia. *J Am Coll Surg*. 2002;195:456-61

[17] Rosato L, Avenia N, Bernante P, De Palma M, Gulino G, Nasi PG, et al. Complications of thyroid surgery: analysis of a multicentric study on 14,934 patients operated on in Italy over 5 years. *World J Surg*. 2004;28:271-76.

[18] Rimpl I, Wahl RA. Surgery of nodular goiter: postoperative hypocalcaemia in relation to extent of resection and manipulation of the parathyroid glands. *Langenbecks Arch Chir Suppl Kongressbd*. 1998;115:1063-66.



**PARTICULARS OF CONTRIBUTORS:**

1. Associate Professor, Department of Surgery, DMWIMS, Wayanad, Kerala, India.
2. Assistant Professor, Department of Surgery, DMWIMS, Wayanad, Kerala, India.
3. Assistant Professor, Department of Surgery, DMWIMS, Wayanad, Kerala, India.
4. Assistant Professor, Department of Surgery, DMWIMS, Wayanad, Kerala, India.

**NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:**

Dr. Bhavuray Teli,
Assistant Professor, Department of Surgery, Dmwims, Wayanad, Kerala-673577, India.
E-mail: teli.bhavu@gmail.com



**FINANCIAL OR OTHER COMPETING INTERESTS:** None.

Date of Submission: **Sep 19, 2015**
Date of Peer Review: **Oct 20, 2015**
Date of Acceptance: **Dec 28, 2015**
Date of Publishing: **Feb 01, 2016**