Original Article

The Impact of Uniform Capsular Dissection Technique of Total Thyroidectomy on Postoperative Complications: An Experience of More Than 1000 Total Thyroidectomies from an Endocrine Surgery Training Centre in North India

Gyan Chand, Sudhi Agarwal[1], Anjali Mishra, Gaurav Agarwal, A. K. Verma, Saroj Kumar Mishra, Amit Agarwal, Ashok Kumar[2]

Department of Endocrine Surgery, SGPGIMS, Lucknow, [1]Department of Surgery, Subharti Medical College, Meerut, [2]Department of Medical Genetics, SGPGIMS, Lucknow, Uttar Pradesh, India

Abstract

Background: Total thyroidectomy (TT) with a uniform technique of capsular dissection (CD) is the preferred technique worldwide. The aim of study is to analyze the impact of uniform technique of CD for done as primary surgery at an endocrine surgery training centre. **Patients and Methods:** Retrospective review from 1995 to 2009. Data collected from hospital records and follow-up . **Results:** One thousand and thirty-eight cases were included, with mean age 42.91 ± 13.48 years; male:female – 1:2.2; mean duration of goiter – 99.83 ± 105.1 months; 67.8% were euthyroid and 30.7% – hyperthyroid at initial presentation; 35.5% were malignant. Surgery includes TT alone – 77.7% and TT with lymph nodes dissection – 22.3%; sternotomy required in 1.2% and thoracotomy in 0.1%; tracheomalacia present in 3.9%; however, tracheostomy required in 4.5% and parathyroid autotransplantation in 21%; Peroperative mean gross gland weight was 124.34 ± 129.85 g. Complications include hypocalcemia (temporary – 35.9%; permanent – 1.3%); recurrent laryngeal nerve palsy (temporary – 2.7%; permanent – 91%); hemorrhage – 1.3%; and various others. **Conclusion:** TT with uniform technique of CD is a safe procedure. Certain risk factors may predispose to complications, which can be avoided and managed adequately if anticipated beforehand.

Keywords: Capsular dissection, complications, primary total thyroidectomy, uniform technique

Introduction

There is continuous evolution in the field of thyroid surgery, from a highly morbid to highly sophisticated and refined surgical procedure with minimal morbidity and virtually no mortality.[1,2] The total thyroidectomy (TT) performed with a standard technique of capsular dissection (CD) was initially introduced by Theodre Kocher in 1880;[1] however, it was abandoned due to development of "cachexia strumipriva". Later on, with the availability of thyroxin replacement, this technique was again being adopted by thyroid surgeons and gradually replaced sub-TT (STT) and near TT (NTT) for benign and malignant goiters, respectively, at many centers[3-6] including ours.[7-10]

The aim of the present study is to analyze the impact of uniform technique of CD for TT performed in primary setting, on the complication rates at a specialized thyroid surgery training institute in North India.

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Patients and Methods

We have retrospectively reviewed the medical records of all patients who underwent TT as a primary surgery from 1995 to 2009 and studied in detail with patient's clinicopathological characteristics, indications for surgery, surgical details, intraoperative/postoperative complications, their management, and short- and long-term outcomes. A total of six consultants and endocrine surgery specialty unit trainee residents under the supervision of consultants had performed these surgeries. All

Address for correspondence: Dr. Gyan Chand, Department of Endocrine Surgery, SGPGIMS, Lucknow - 226 014, Uttar Pradesh, India.
E-mail: drgyanchandpgi@gmail.com

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the surgeries were performed with standard uniform technique of CD,[11,12] i.e., all dissections were close to the thyroid, hugging the capsule and dividing the tertiary branches thus sparing the vascular supply to the parathyroid glands. During surgery, we had given the cervical crease incision and raised the subplatysmal flaps from thyroid cartilage till suprasternal notch; thyroid gland was adequately exposed by lateral mobilization of bilateral sternocleidomastoid muscles and dividing or retracting the strap muscles; lateral mobilization of gland was achieved by ligation and division of the middle thyroid vein; and superior pole was mobilized by exposing the space between the cricothyroid muscle and medial surface of superior pole of thyroid. Superior polar vessels were ligated individually close to the thyroid taking care to preserve the external branch of superior laryngeal nerve. Thyroid lobe was rotated medially, superior and inferior parathyroid glands were identified, and gradually dissected out laterally, away from the thyroid capsule along with their vascular pedicles, by individually ligating the tertiary branches of inferior thyroid artery close to the capsule. The recurrent laryngeal nerve (RLN) was carefully identified in the tracheoesophageal groove by visualization of longitudinal vasa nervosum and its direction. Once encountered, it is not dissected out in its entirety, and the dissection remains medially to the nerve, while remaining on and hugging the thyroid capsule. Thyroid is carefully dissected near the ligament of Berry, taking care not to injure the RLN. Similar procedure was performed on contralateral thyroid lobe and finally dissected out from anterior surface of the trachea. We had specifically looked for and removed pyramidal lobe, tubercle of Zuckerkandl and other embryological and anatomical extensions of thyroid such as detached thyroid nodules to avoid future recurrences. We had ensured hemostasis by Valsalva maneuver with the help of anesthetists before closure and closed the wound in layers from strap muscles, platysma to skin. In cases of doubtful vascularity of parathyroid glands, we did either capsulotomy or parathyroid autotransplantation in sternocleidomastoid muscle and marked the site with clips. A uniform protocol was followed up in postoperative period, where serum calcium was measurement on the next day of surgery and subsequently at 24 h interval till the serum calcium stabilized without any clinical or biochemical manifestation of hypocalcemia. In patients who developed biochemical (serum calcium ≤8 mg/dl) or symptomatic hypocalcemia with tingling and perioral numbness, we started calcium carbonate (2–3 g/day) and rapid-acting Vitamin D analog calcitriol 0.5–1 μg/day (Roche, Basle, Switzerland). In patients who developed carpopedal spasm (Trousseau's sign) [Figure 1], we started intravenous calcium gluconolactone at the rate of 1–2 mg/kg/hour which after 24 h was gradually tapered and stopped within next 24–48 h. In follow-up, the serum calcium levels were checked, and vitamin D and calcium supplement tapered off gradually. In patients with persistent symptomatic hypocalcemia, who requiring calcium and vitamin D supplement, even after 6 months of surgery, the serum parathyroid hormone level was analyzed. If it was found to be low or inappropriately low for low serum calcium, then those patients were labeled as permanent hypoparathyroid.

Figure 1: Carpopedal spasm after hypocalcemia (Trousseau's sign)

All patients were assessed preoperatively for vocal cord with indirect laryngoscopy, by an ear-nose-throat surgeon at our institute. We did not perform routine postoperative vocal cord examination in all patients after TT. All patients with new onset of significant hoarseness of voice, following surgery were considered and advised voice rest. They underwent vocal cord assessment after 6 months of surgery for the documentation of permanent vocal cord palsy, if any. The postoperative follow-up data were obtained from departmental database, correspondences, and telephonic/personal communication.

We excluded all the patients with less than TT (hemithyroidectomy, sub-TT, near-TT, and Dunhill procedures), reoperative surgery, and inadequate clinical records. For RLN palsy assessment, all the patients with documented preoperative vocal cord paralysis, intentional resection of RLN during surgery, or permanent tracheostomy were excluded from analysis.

The statistical analysis was performed using SPSS 17.0 forWindows Evaluation Version (SPSS Inc., 1989-2006) (IBM Corporation, Armonk, New York, USA). Datawere analyzed, in terms of mean ± standard deviation, median, range,frequency and percentages. The Chi-square tests, independent sampleStudent's t-test and logistic regression were used for analysis. $P \leq 0.05$ is considered statistically significant.

Results

During 15 years of duration, a total of 1350 patients underwent bilateral thyroid surgery as initial procedure, out of which 1038 underwent TT [Table 1]. The mean age was 42.96 ± 13.5 years. The female:male was 2.2:1. The duration of goiter was 99.8 ± 105 months. Majority of the patients were euthyroid (67.7%) with multinodular goiter (49.1%) on clinical examination. Major indications for surgery were clinically visible goiter, based on patient's demand (47.3%), suspicion of malignancy (39.8%), hyperthyroidism (30.6%),

malignancy (25.4%), compressive symptoms (21.9%), and retrosternal extension (RSE) (12.5%).

TT alone was performed in 77.7% of patients, while TT with Lymph node dissection was done in 22.3% , which includes TT+ Central Compartment Lymph Node Dissection (CCLND) in 8.8%, TT+ CCLND + Lateral Neck Dissection in 13% and TT+CCLND+ MRND with Mediastinal lymph node dissection in 0.5% [Table 2]. Tracheomalacia was diagnosed, as per the features described by Agarwal *et al*.[13] in 40 (3.9%) cases, out of which tracheostomy was required in 31 and rest managed with prolonged incubation. Tracheostomy was done in 47 (4.5%) cases, out of which 31 had tracheomalacia, 2 had tracheal injury, and 14 had locally advanced thyroid carcinoma with tracheal invasion. Similarly, out of 130 cases with RSE, 8 required sternotomy and 1 required thoracotomy; others were delivered by cervical approach only. Four other cases with sternotomy had locally advanced carcinoma requiring mediastinal lymph node dissection. The mean gross gland weight was 124.34 ± 129.84 (7–963) g. The autotransplantation of at-risk parathyroid gland was done in 21% cases. The final histopathology was benign in 64.5% and malignant in 35.5% cases.

Complications

Peroperative complications

In the present series, tracheal injury occurred in 8 (0.7%) cases (3 - benign and 5 - malignant). Esophageal injury occurred in 03 (0.3%) patients (all were Malignant) [Figure 2]; Accidental RLN injury in 2(0.2%) patients [Figure 3]; Internal Jugular Vein injury developed in 10 (1.0%) patients (1 in benign & 9 in malignant) and carotid injury occurred in one patient with locally advance thyroid cancer. On histopathology, parathyroid gland was identified (inadvertent parathyroidectomy) in 62 (6.0%) cases [Table 3].

Postoperative complications

Postoperatively, 373 (35.9%) cases developed hypocalcemia, where 116 (11.2%) cases had only biochemical hypocalcemia (101 were managed with oral calcium and Vitamin D and 15 with oral calcium only). 257 (24.7%) had clinical hypocalcemia (requiring intravenous calcium in

Figure 2: Esophageal injury during thyroid cancer surgery

Table 1: Clinicopathological profile of the patients

Clinical details	n (%)
Mean age (range) (years)	42.91±13.48 (8-85)
Female:male	718:320 (2.2:1)
Mean duration of goiter±SD (months)	99.83±105.1 (1-720)
Grade of goiter (WHO)	
Grade 1	99 (9.5)
Grade 2	936 (90.2)
Functionality	
Euthyroid	703 (67.8)
Hyperthyroid	320 (30.7)
Hypothyroid	15 (1.5)
Clinical presentation	
Multinodular goiter	510 (49.1)
Solitary thyroid nodule	207 (21.2)
Grave's disease	189 (18.2)
Toxic MNG	129 (12.4)
Autonomous functioning thyroid nodule	3 (0.3)
Neoplasm	
Benign	669 (64.5)
Malignant	369 (35.5)
Compressive symptoms	227 (21.9)
Retrosternal extension	130 (12.5)
Indications for surgery*	
Large goiter	491 (47.3)
Compressive symptoms	227 (21.9)
Retrosternal extension	130 (12.5)
Uncontrolled hyperthyroidism	318 (30.6)
Grave's ophthalmopathy	113 (10.9)
Suspicious of malignancy	413 (39.8)
Malignancy	264 (25.4)

*Aggregate is >100% since many patients had >1 indication for surgery. MNG: Multinodular goiter, SD: Standard deviation

Table 2: Surgical Details

Surgical Procedure	n (%)
Surgery done	
TT alone	807 (77.7)
TT with LND	231 (22.3)
TT + CCLND + MRND	135 (13.0)
TT + CCLND	91 (8.8)
TT + CCLND + MRND + mediastinal LND	5 (0.5)
Parathyroid autotransplantation	218 (21)
Tracheomalacia	40 (3.9)
Sternotomy	12 (1.2)
Thoracotomy	1 (0.1)
Tracheostomy	47 (4.5)
Elective	41 (3.9)
Emergency	8 (0.6)
Gland weight (g)	124.34±129.85 (7-963)

TT: Total thyroidectomy, LND: Lymph nodes dissection, CCLND: Central compartment LND, MRND: Modified radical neck dissection

238 and oral calcium and Vitamin D in 19 cases). On long-term follow-up, normocalcemia was resumed in all patients except for 14 (1.4%) cases with documented permanent hypoparathyroidism, who were managed with lifelong oral calcium and Vitamin D supplement [Table 3]. The significant postoperative hoarseness was present in 28 (2.7%) cases. We did not perform vocal cord examination at that point in time, and all were advised voice rest. After 6 months of surgery, vocal cord examination documented permanent unilateral RLN paralysis in 11 (91%) cases. Other complications were chyle leak in 10 (1%) and wound complications (surgical site infection, seroma) occurred in 40 (3.8%) cases [Table 3].

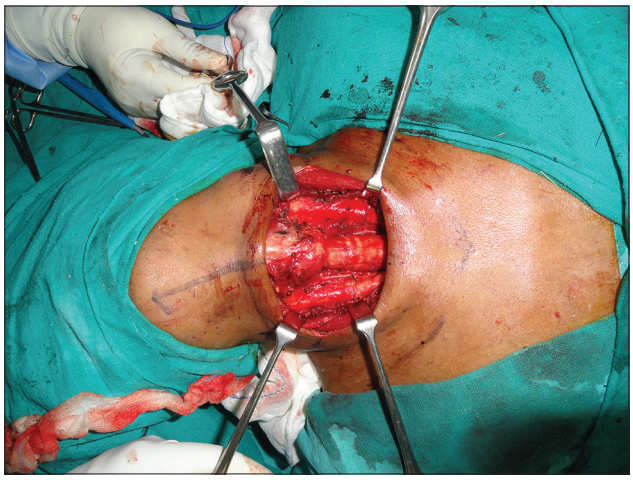

Figure 3: Recurrent laryngeal nerve injury during total thyroidectomy

Table 3: Peroperative and postoperative complications of total thyroidectomy

	Complications	*n* (%)
Peroperative	Tracheal injury	8 (0.7)
	Esophageal injury	3 (0.3)
	Recurrent laryngeal nerve injury	2 (0.2)
	Internal jugular vein injury	10 (1)
	Carotid artery injury	1 (0.1)
	Inadvertent parathyroidectomy	62 (6)
Postoperative	Hypocalcemia	373 (35.9)
	Hoarseness	28 (2.7)
	Wound complications	40 (3.8)
	Chyle leak	10 (1)
	Hematoma	6 (0.6)
	Permanent hypoparathyroidism	14 (1.4)
	Permanent RLN palsy	11 (91)
	Stitch granuloma	15 (2.2)
	Tracheal stenosis	1 (0.1)
	Foreign body granuloma	2 (0.2)
Mortality	-	1 (0.1)

RLN: Recurrent laryngeal nerve

One patient who underwent temporary tracheostomy for tracheomalacia, developed tracheal stenosis after five years. Similarly, two patients operated for nodular goiter presented with recurrent thyroid bed swelling after 5 and 9 years, respectively. The histopathology report revealed foreign body granuloma.

The rates of complications were comparable between consultants versus trainees, benign versus malignant goiters, and small goiters (gross gland weight <400 g) versus huge goiters (gross gland weight ≥400 g) [Table 4].

Mortality

We did not have surgery-related mortality except for one case with locally advanced thyroid carcinoma with RSE in posterior mediastinum, who succumbed due to hemorrhage.

Discussion

The extra CD for thyroidectomy was first described by Theodor Kocher in 1880s, which dramatically reduced the complications of hypoparathyroidism and RLN injury in that era; however, he himself stopped removing complete gland due to apprehension for "cachexia strumipriva."[1,2] George Murray and Fox et al develop exogenous thyroxin, which help to overcome the problem of post thyroidectomy hypothyroidism, this invention revived the interest of total thyroidectomy among the thyroid surgeons.[1,2] With theaspiration from surgeons like, Halsted who introduced theimportance of preservation ofparathyroid gland'svascular supplyby ligating the tertiary branches of inferior thyroid arteryclose tothe thyroid capsule; Coller and Boyden advocated thepreservation of external branch of superior laryngeal nerve byindividual ligation of superior thyroid vessels branches, aftermobilizing the potential space between the cricothyroid muscleand the medial part of the superior pole of the thyroid andThompson who advocated the total extracapsular lobectomy,by dissecting the plane between thyroid capsule and thyroidartery. The present technique of CD for TT was describedby Delbridge *et al.*[11] They published their experience of 825 cases with TT using

Table 4: Comparison of complications rates between various known risk factors, *n* (%)

Complications	Benign (*n*=669)	Malignant (*n*=369)	*P*	Small goiters*	Large goiters*	*P*	Consultants	Residents	*P*
Temporary hypocalcemia	36.7	35.1	0.64	38.6	33.4	0.09	35	39.7	0.19
Permanent hypocalcemia	1.6	1.7	1.00	1.2	1.9	0.43	1.1	1.6	0.52
Temporary hoarseness	2.8	1.9	0.53	2	3.1	0.32	2.5	2.4	1.00
Permanent RLN palsy	0.9	2	0.20	1.3	1.2	1.00	0.8	0.8	1.00

*Small goiter with gross gland weight <400 g and large goiter with gross gland weight ≥400 g. RLN: Recurrent laryngeal nerve

Table 5: Comparison of complication rates (%) of the present study with published series

Complications	Present study (*n*=1038)	Khadra *et al*.[14] (*n*=825)	Serpell and Phan[18] (*n*=336)	Bhattacharyya and Fried[19] (*n*=517)	Efremidou *et al*.[20] (*n*=932)
Temporary hypocalcemia	35.9	-	38.9	6.2	7.3
Temporary hoarseness	2.7	-	-	1.16	1.3
Permanent hypoparathyroidism	1.4	0.6	1.8	-	0.3
Permanent recurrent laryngeal nerve palsy	1.0	0.5	0.3	1.0	0.2
Wound complications	3.8	1.2	1.5	0.2	0.0
Hemorrhage	0.6	1.9	0.9	1.0	0.2
Deaths	0.1	0.0	0.0	0.2	0.0

similar technique with permanent hypoparathyroidism in 0.6% and permanent RLN palsy in 0.5% cases.[14] After them, different centers including ours had initially attempted in some cases and gradually adopted the technique for bilateral thyroid disorders against STT, NTT, and Dunhill procedures.[8-10] Since total thyroidectomy with capsular dissection, aims to remove all visible thyroid tissue completely, thus avoiding long term of thyroid bed recurrence. It is desired as the redosurgery in a scarred thyroid bed due to previous surgery is a nightmare to any surgeon and it is associated with more chances of RLN injury and permanent hypoparathyroidism than the surgery performed in primary setting both for benign or malignant thyroid disorders.[15]

Being a tertiary care referral center catering an iodine endemic region, we use to manage patients with long-standing (mean duration of goiter 99.83 ± 105.1 months) and large (mean gross gland weight 124.34 ± 129.85 g) neglected goiters. Approximately one-third (35.5%) of our cases were malignant, one-fifth (21.9%) had compressive symptoms, one-eighth (12.5%) had retrosternal extension, and 3.9% had tracheomalacia. Furthermore, being a world-renowned endocrine surgery training center, the patients were being operated by six consultants and trainee residents; despite such complexity and diversity, we observed that if the uniform standard policy of technique of TT is followed, which includes CD with attempt to removal of all gross thyroid tissue, identification and preservation of all parathyroid glands, RLN s and external branch of superior laryngeal nerves, high index of suspicion for tracheomalacia in long-standing goiters and appropriate action, and postoperative monitoring especially with regard to hypocalcemia and hematoma, one can keep the complication rates to minimum and comparable between trainees versus consultants,[16] malignant versus benign, and large goiters versus small goiters [Table 4]. This signifies that this technique can be easily learned by general surgeons, and if performed with dexterity, even the trainees can do it with acceptably low morbidity. Similar results were observed by Reeve *et al*.[17-20]

The complication rates of the present series have been compared with other published series, which shows comparable results [Table 5].

The strong factors with our study are its large number of sample size with uniform technique of similar procedure, from an iodine-deficient endemic region and a longer duration of study and follow-up. However, it has some limitations, which are inherent to any retrospective study.

Conclusion

TT with a uniform standard technique of CD is increasingly being preferred by thyroid surgeons for bilateral thyroid disorders. This technique can be easily learned by general surgeons, and despite complex and diverse situations, if the uniform standard technique is followed, one can keep the complication rates to acceptably low limits, even in the hands of surgical trainees.

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Conflicts of interest

There are no conflicts of interest.

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