Chapter 1
Total Thyroidectomy and Thyroid Lobectomy

Insoo Suh and Wen T. Shen

Abstract The key to a safe thyroidectomy is to dissect in the correct cervical planes using absolutely meticulous, bloodless technique. This optimizes the surgeon's ability to identify and preserve delicate perithyroidal structures such as the recurrent laryngeal nerve and parathyroid glands, as well as minimize the risk of life-threatening postoperative neck hematoma. This chapter describes the technique of a conventional thyroidectomy performed via an anterior cervical incision. An overview of preoperative workup and postoperative care is also included.

Keywords Thyroid • Thyroidectomy • Thyroid nodule • Thyroid cancer • Goiter • Hyperthyroidism • Hypothyroidism • Recurrent laryngeal nerve • Parathyroid

I. Suh, MD • W.T. Shen, MD (✉)
Endocrine Surgery Section, Department of Surgery,
UCSF Medical Center – Mount Zion, University of California,
San Francisco, Campus Box 1674, San Francisco,
CA 94115, USA
e-mail: insoo.suh@ucsf.edu; wen.shen@ucsfmedctr.org

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Indications

The indications for thyroidectomy encompass a wide spectrum of thyroid disorders, but the majority fall under three categories:

1. Hyperthyroidism or thyroiditis refractory to nonsurgical management [1, 2]
2. goiters with or without local compressive symptoms [3, 4], and
3. thyroid nodules and cancers [5].

The decision to perform a total thyroidectomy versus unilateral lobectomy or other more limited procedure depends on the underlying disease, the patient's clinical profile, suspicion of intraoperative recurrent laryngeal nerve injury, and in some instances on surgeon or patient preference.

Preoperative Preparation

All patients undergoing thyroidectomy should have preoperative biochemical thyroid function tests as well as a neck ultrasound with fine-needle aspiration biopsies of suspicious nodules [6]. Depending on the type and extent of disease, selected patients may require further imaging studies such as CT, MRI, thyroid scintigraphy, and endoscopy [7]. Patients should ideally be euthyroid at the time of operation, either with antithyroid medication and/or Lugol's solution for hyperthyroidism or exogenous thyroid hormone supplementation for hypothyroidism.

Preoperative laryngoscopy must be performed on any patient with hoarseness or a prior history of neck operations in order to assess preoperative vocal cord function. Preanesthetic evaluation should be a routine step prior to any procedure requiring general anesthesia.

Positioning and Anesthesia

Most thyroidectomies are performed under general anesthesia with endotracheal intubation. The patient is placed supine in a 20° reverse Trendelenburg position, with both arms tucked. The neck is extended by placing a beanbag or soft roll behind the scapulae and a foam ring under the head. This places the thyroid in a more anterior position. The head must be well-supported to prevent neck hyperextension and postoperative posterior neck pain.

The use of intraoperative nerve monitoring (IONM) for recurrent laryngeal nerve (RLN) function has become increasingly common in many endocrine surgical practices despite ongoing controversy over the true effectiveness of IONM in reducing the incidence of RLN injury and vocal cord palsy [8]. Proponents of IONM use cite its value in, among other things, tracing the anatomic course of nerves (particularly for challenging situations such as reoperations), more sensitively detecting injury in the intraoperative setting, and enabling the detection of vagal and superior laryngeal nerve function. If the use of IONM is planned, an appropriate endotracheal tube with contact electrodes for the vocal cords is used, and grounding and return surface electrodes are applied per the individual manufacturer's instructions. The remainder of this chapter will assume and describe the use of IONM during the relevant steps of the operation.

We routinely perform a bilateral superficial cervical anesthetic block with 0.25 % bupivacaine, as this provides excellent anesthesia in the postoperative setting [9]. In addition, prior to surgical prep, we routinely perform our own intraoperative neck ultrasound in order to (1) confirm the findings of the preoperative study, (2) identify any new findings, and (3) assess the overall anatomy of the gland to facilitate incision placement and operative planning. The surgical area is prepared with 1 % iodine or chlorhexidine and sterilely draped.

Description of Procedure

In general, thyroid operations should be performed in a bloodless field so that vital structures can be identified. Bleeding obscures the normal color of the parathyroids and RLN, placing these important structures at greater risk for injury. If bleeding does occur, application of manual pressure is the preferred hemostatic maneuver; vessels should be clamped only if they are precisely identified, or shown to not be in close proximity to the RLN.

A centrally placed, 4–5 cm Kocher transverse incision is made typically 1 cm caudad to the cricoid cartilage, paralleling the normal skin lines of the neck (Fig. 1.1). The incision is

FIGURE 1.1 Skin incision. The pen marks, from top to bottom, denote the thyroid cartilage, cricoid cartilage, and suprasternal notch, respectively. A centrally placed, 4–6 cm Kocher transverse incision is made 1 cm caudad to the cricoid cartilage, paralleling the normal skin lines of the neck (*white dotted line*)

extended through the platysma, and subplatysmal flaps are raised, first cephalad to the level of the thyroid cartilage and then caudad to the suprasternal notch. Five straight Kelly clamps placed on the dermis of each flap aid in retraction for this dissection.

In a cancer operation, dissection of the thyroid gland is generally begun on the side of the suspected tumor, since problems with the dissection on this side (e.g. concern for RLN injury) could allow the surgeon the option to perform a less-than-total thyroidectomy on the contralateral side in order to avoid bilateral injury and resultant complications. One exception is the large bulky tumor, in which case the surgeon may choose to resect the contralateral side first in order to more easily mobilize the larger lobe.

The strap muscles are separated in the midline via an incision through the superficial layer of the deep cervical fascia starting at the suprasternal notch and extending cephalad to the thyroid cartilage. On the side of the suspected tumor, the more superficial sternohyoid is separated from the deeper sternothyroid muscle by blunt dissection, proceeding laterally until the ansa cervicalis is visible at the lateral border of the sternothyroid muscle. The sternothyroid is then dissected from the underlying thyroid capsule until the middle thyroid vein is encountered laterally. The thyroid is retracted anteromedially, and the carotid sheath and strap muscles are retracted laterally. A peanut sponge can be used to facilitate retraction and exposure of the area posterolateral to the thyroid. The middle thyroid vein is optimally exposed for division at this time (Fig. 1.2). For those that use IONM, a pre-RLN dissection vagus signal (denoted V1) is obtained by stimulating the vagus nerve which is typically located posterolateral to the carotid.

In the case of thyroid lobectomy, the isthmus is usually divided early in the dissection to facilitate mobilization. The isthmus is clamped and divided lateral to the midline, taking care to not leave residual tissue anterior to the

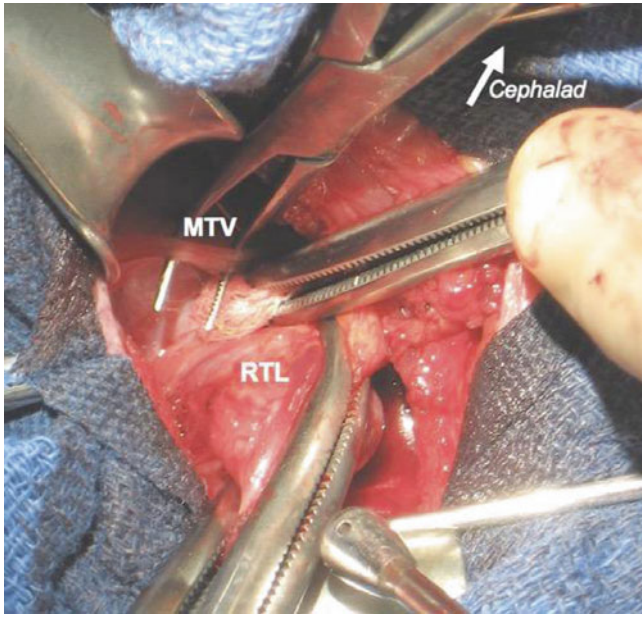

FIGURE 1.2 Identification of the middle thyroid vein (MTV). On this side, the right thyroid lobe (RTL) is retracted antero-medially to expose the MTV, which is isolated in preparation for division and ligation

trachea to minimize the chances of hypertrophy of the thyroid remnant. Energy sealing devices such as the Ligasure (Covidien, New Haven, CT) or Harmonic scalpel (Ethicon, Cincinnati, OH) are useful for dividing the thyroid parenchyma in a hemostatic manner; alternatively, the isthmus can be divided with a scalpel between clamps and the thyroid remnant oversewn at the cut edge. The pyramidal lobe, present in 80 % of patients, drapes cephalad over the anterior midline just right or left of the cricoid cartilage, and can extend as superiorly as the hyoid bone. It is dissected until it tapers into a fibrous band, divided, and ligated.

The superior pole is dissected mostly in a blunt fashion with a small peanut sponge on a clamp. The dissection is carried out superolaterally and posteriorly, with countertraction of the thyroid inferomedially. This exposes the superior thyroid vessels, as well as some connective tissue lateral to the superior pole. These tissues are carefully mobilized below the level of the cricothyroid muscle, since the RLN passes through Berry's ligament and dive deep to the inferior constrictor muscle at the level of the cricoid cartilage. The superior pole is similarly separated from the cricothyroid muscle medially with gentle blunt sweeping (into the so-called avascular space of Reeve). The superior pole vessels are dissected, double- or triple-clamped, and ligated (Fig. 1.3); again, the use of energy sealing devices may augment or replace manual ligation. They are then divided close to the surface of the thyroid in order to prevent injury to the external branch of the superior laryngeal nerve as it traverses the anterior surface of the cricothyroid muscle. Division of these vessels allows for easy sweeping of the remaining filmy tissues away from the posterior aspect of the superior pole via blunt dissection. The superior parathyroid gland is often identified behind the superior pole during this dissection, at the level of the cricoid cartilage (Fig. 1.3).

The mobilization of the lateral and inferior aspects of the thyroid lobe includes the definitive identification of the inferior parathyroid gland (Fig. 1.4). With the inferior thyroid lobe retracted anteromedially and the carotid sheath laterally, dissection should proceed cephalad along the lateral edge of the thyroid. Fatty and lymphatic tissues immediately adjacent to the thyroid are swept laterally with a peanut sponge, and small vessels are ligated with clips. The inferior parathyroid is usually encountered during this lateral mobilization, and care must be taken to not transect any tissues in this area until these vital structures are identified. The location of the inferior parathyroid gland is less constant than that of the superior gland, but it is invariably located anterior

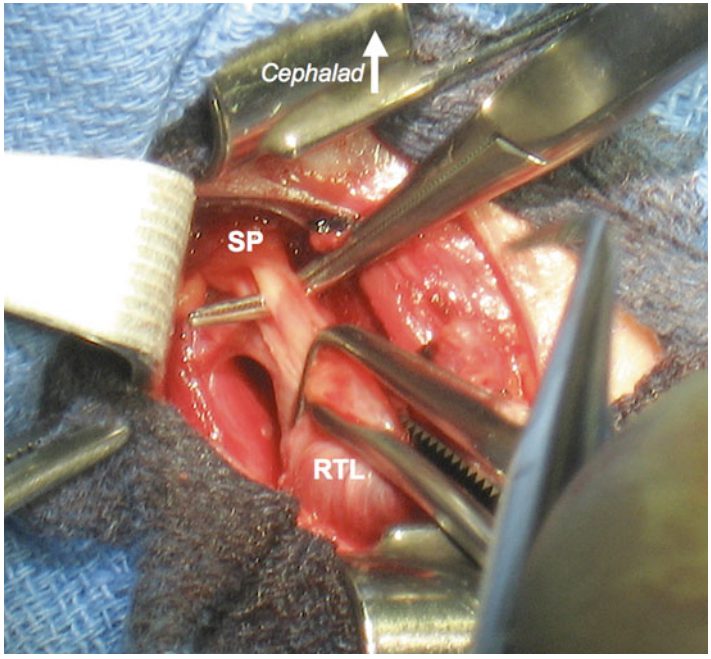

FIGURE 1.3 Dissection of the superior pole (*SP*). In the image, counter-traction of the right thyroid lobe (*RTL*) infero-medially exposes the SP vessels, which are individually skeletonized, clamped, and ligated

to the RLN and inferior to the inferior thyroid artery as it crosses the RLN. In its "normal" location, it is often adherent to the posterolateral surface of the inferior lobe. All normal parathyroid glands should be carefully swept away from the thyroid on as broad a vascular pedicle as possible to prevent devascularization, since this would necessitate autotransplantation of the gland.

Once the superior pole and inferior aspect of the lobe are dissected and mobilized, the majority of the gland aside from its tracheal attachments and ligament of Berry can be delivered out of the incision with anteromedial retraction. This

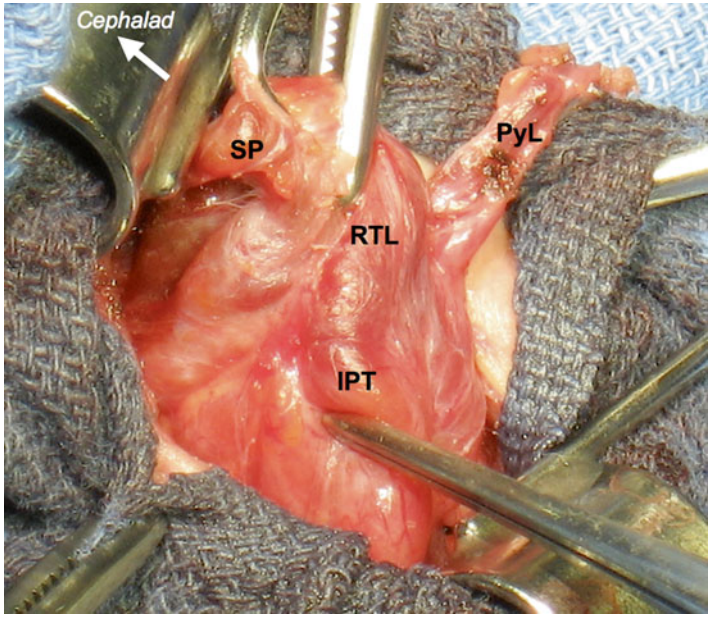

FIGURE 1.4 Identification of the inferior parathyroid (*IPT*). After the superior pole (*SP*) has been dissected and mobilized, the right thyroid lobe (*RTL*) is retracted supero-medially to begin the inferior pole dissection. The IPT is often variable in position, but is invariably anterior to the recurrent laryngeal nerve. The pyramidal lobe (*PyL*) is also seen medially

judicious retraction (either with a finger or with an atraumatic sponge) is imperative for controlled dissection and protection of the RLN. Care must be taken not to use excessive force, which may place the nerve under stretch and increase the risk of injury. The course of the right and left RLN can vary considerably. The left RLN is usually situated deeper and more medially, running in the tracheoesophageal groove, while the right RLN takes a more superficial and oblique course and may pass either anterior or posterior to the inferior thyroid artery. Two commonly-used rules of thumb are used for RLN identification: (1) it is located within

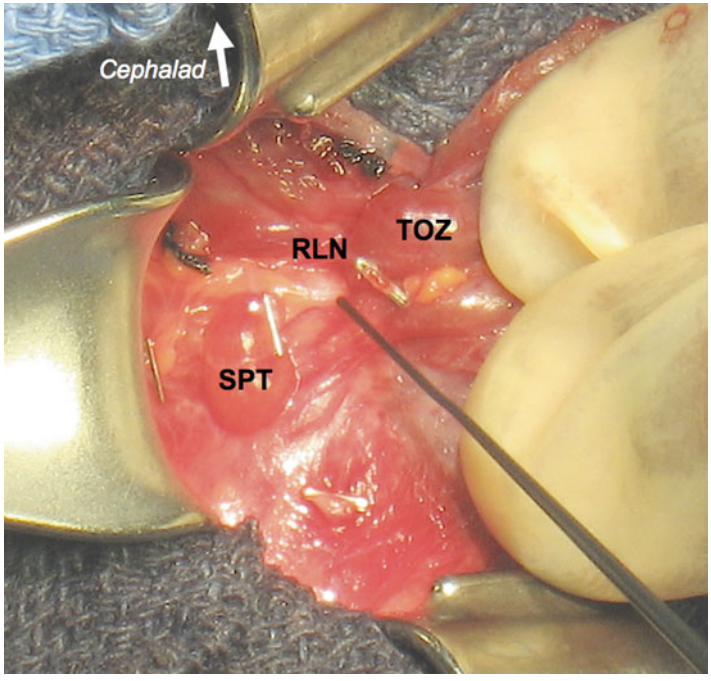

FIGURE 1.5 Identification of the superior parathyroid gland (*SPT*) and recurrent laryngeal nerve (*RLN*). The SPT is usually posterolateral to the RLN (shown here with the nerve monitoring probe), at the level of the cricoid cartilage. The right thyroid lobe, including the tubercle of Zuckerkandl (*TOZ*), is retracted medially for optimal exposure of the RLN

1 cm anteromedial to the superior parathyroid, at the level where the nerve crosses the inferior thyroid artery; and (2) its course through the ligament of Berry is also situated just posteromedial to a small posterolateral protuberance of the thyroid lobe known as the tubercle of Zuckerkandl (Fig. 1.5). Once the nerve is dissected and visually identified, the IONM may be used to obtain an initial signal (denoted R1).

Once the parathyroids and RLN are identified and preserved, the remainder of the thyroid is easily dissected in a

more superficial plane off of the trachea. Occasionally, the course of the RLN at the ligament of Berry is intimately associated with the thyroid tissue at the tubercle of Zuckerkandl; in these circumstances, it would be appropriate to leave a small amount of thyroid tissue behind in the interest of protecting the nerve. The entire thyroid lobe should now be completely freed.

Meticulous hemostasis is obtained, and post-resection RLN and vagus signals (denoted R2 and V2, respectively) are confirmed with the IONM system. If a total thyroidectomy is to be performed, the same steps described above apply for the contralateral lobe.

For closure, the sternothyroid and sternohyoid muscles are re-approximated with 3-0 absorbable sutures, with a small opening left in the midline at the suprasternal notch to allow any blood to exit. The platysma layer is approximated with similar sutures, and the skin is closed with a 4-0 subcuticular monofilament absorbable suture.

Postoperative Care

Though relatively uncommon in experienced centers, significant complications can occur after thyroidectomy, including RLN injury, hypoparathyroidism, bleeding and neck hematoma leading to life-threatening airway compromise, injury to the external branch of the superior laryngeal nerve, infection, seroma, and keloid formation. Because of the small but serious risk of neck hematoma, postoperative patients are usually admitted overnight to the hospital ward for observation. They are positioned in a low Fowler position with the head and shoulders elevated 10–20° for the first 6–12 postoperative hours, in order to maintain negative pressure in the veins. Eating is resumed within 4 h. For patients who have undergone bilateral exploration, serum calcium levels are measured 6 h after operation and again the next morning; a serum phosphorus level is also measured at the latter time point. Since calcium levels may not nadir for several days after

surgery, a parathyroid hormone level may be obtained postoperatively to help assess the risk of hypocalcemia. Patients who have undergone unilateral first-time exploration do not require biochemical evaluation. Oral calcium supplements are administered for signs of biochemical and/or symptomatic hypocalcemia.

The vast majority of patients are discharged on the first postoperative day; they are given a prescription for thyroid hormone supplementation if the procedure was more extensive than a lobectomy, and are instructed to take calcium tablets for symptoms of hypocalcemia. Most patients can return to work or full activity within 1 week. They are seen in the outpatient clinic within 2 weeks after discharge, at which time further management is discussed in light of the pathology findings as well as the results of any relevant follow-up laboratory evaluation.

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