Thyroidectomy

127

Geeta Lal

Indications

- Congenital abnormalities
- Goiter
- Hyperthyroidism
- Selected solitary thyroid nodules
- Thyroid carcinoma
- See Chap. 128

Preoperative Preparation

Patients undergoing thyroidectomy for hyperthyroidism require careful preoperative preparation to decrease the vascularity of the thyroid and the risk of thyroid storm. To accomplish this, agents commonly used are antithyroid medications, beta blockers, and Lugol's iodine (or supersaturated potassium iodide SSKI) solution. Because of the long half-life of thyroxine (T_4), treatment with beta blockers is generally continued for 7–10 days postoperatively.

In situations where preexisting vocal cord dysfunction is suspected or patients have had prior neck surgery or a large goiter, either direct or indirect laryngoscopy may be beneficial to assess the baseline function of the vocal cords.

A patient suspected of having medullary carcinoma of the thyroid should undergo preoperative studies to detect a pheochromocytoma or primary hyperparathyroidism, which commonly coexists in the setting of MEN-2 syndrome. It is important to treat the pheochromocytoma before undertaking surgery on the neck.

In case of thyroidectomy for the solitary thyroid nodule, workup may include any or all of the following:

- Thyroid function tests
- Ultrasonography
- Fine-needle aspiration cytology
- Radionuclide scintigraphy
- CT scan

Pitfalls and Danger Points

- Trauma to recurrent laryngeal or superior laryngeal nerves
- Trauma to or inadvertent excision of parathyroid glands
- Inadequate preoperative preparation of the toxic hyperthyroid patient resulting in postoperative thyroid storm
- Inadequate surgery for thyroid cancer

Documentation

The operative note should document the visualization and integrity of the recurrent laryngeal nerves as well as the parathyroid glands. Note must be made of any reimplanted parathyroid glands and their locations. If operating for cancer, note any central (peri- and paratracheal) lymph node abnormalities and results of any intraoperative frozen sections.

Operative Strategy

Performance of thyroidectomy requires careful exposure, meticulous hemostasis, and detailed knowledge of regional anatomy. Variations in anatomy are common, and the thyroid surgeon must progress slowly, carefully, and identifying all structures in a bloodless field.

Preserving the Superior Laryngeal Nerve

The internal branch of the superior laryngeal nerve penetrates the thyrohyoid membrane and is the sensory nerve of

G. Lal (✉)
Department of Surgery, University of Iowa Hospitals and Clinics, Iowa City, IA, USA
e-mail: geeta-lal@uiowa.edu

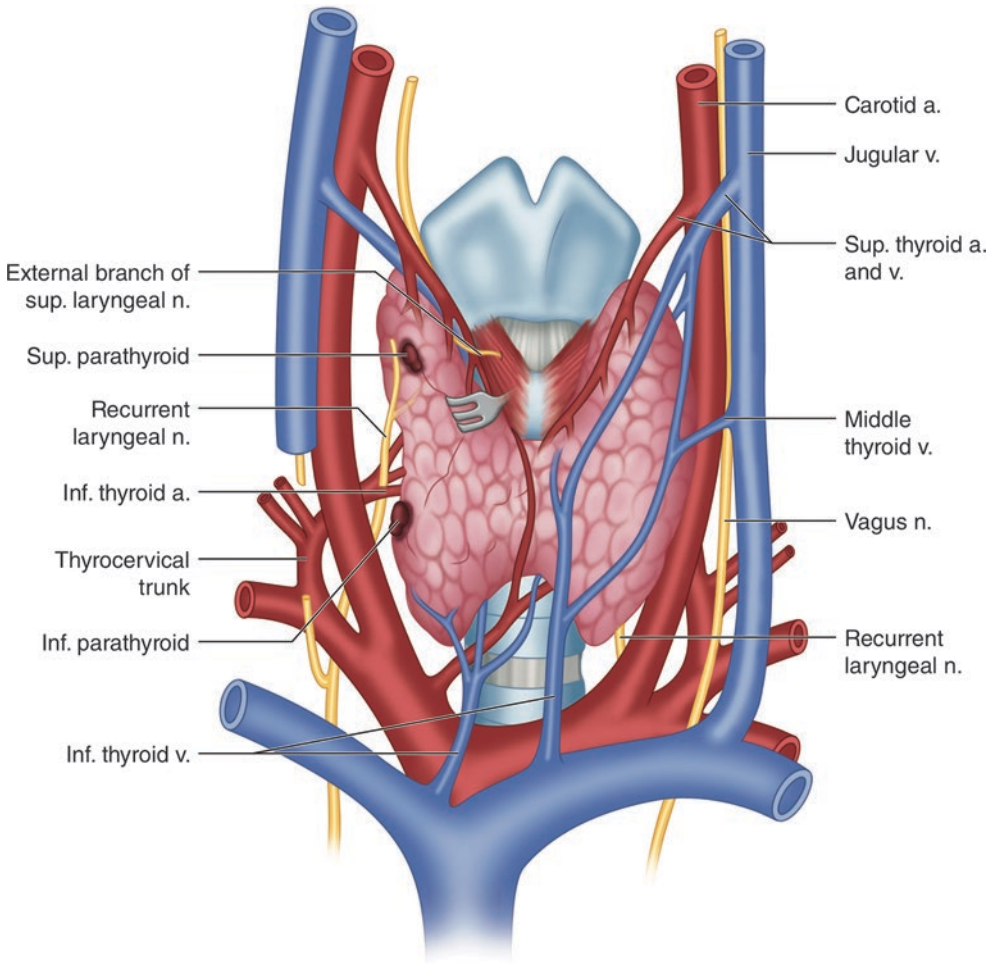
C. E. H. Scott-Conner et al. (eds.), *Chassin's Operative Strategy in General Surgery*,
https://doi.org/10.1007/978-3-030-81415-1_127

the larynx; the external branch controls the cricothyroid muscle. Although it is possible to damage both branches of the superior laryngeal nerve by passing a mass ligature around the superior thyroid artery and vein above the superior pole of the thyroid, the external branch is the one most often injured. Transection of the external branch impairs the patient's ability to voice high-pitched sounds and may also lead to voice fatigue. Because the external branch may be intertwined with branches of the superior thyroid artery and vein as shown in Fig. 127.1, avoiding damage to this nerve requires that each branch of the superior thyroid vessels be isolated, ligated, and divided individually at the point where it enters the thyroid gland. If the superior thyroid artery and vein are dissected *above* the superior pole of the thyroid, it is necessary to identify and preserve the superior laryngeal nerve and its branches. This step is not necessary if the terminal branches of the superior thyroid vessels are individually isolated and ligated at the surface of the gland.

Identification and Preservation of Recurrent Laryngeal Nerve

The recurrent laryngeal nerve ascends slightly lateral to the tracheoesophageal groove. The nerve almost always makes contact with the inferior thyroid artery, passing directly under or over the artery. Sometimes the nerve passes between the branches of the inferior thyroid vessel. Above the level of the artery, the nerve ascends to enter the larynx between the cricoid cartilage and the inferior cornu of the thyroid cartilage. In this area, the nerve lies in close proximity to the posterior capsule of the thyroid gland. It may divide into two or more branches prior to entering the larynx. On rare occasions, the recurrent nerve does not recur but travels from the vagus directly medially to enter the larynx near the superior thyroid vessels or at a slightly lower level relative to the thyroid gland. Nonrecurrent nerves are more common on the right side.

Fig. 127.1



Preserving Parathyroid Glands

Preventing damage to the parathyroid glands requires the surgeon to achieve thorough familiarity with the anatomic location and appearance of these structures. The surgeon who takes the time to identify the parathyroid glands during every thyroid operation soon finds that this maneuver can be accomplished with progressively more efficiency. The inferior parathyroid gland is frequently found in the fat that surrounds the inferior thyroid artery at the point where it divides into several branches. Normally, the inferior gland is anteromedial to the recurrent laryngeal nerve, and the superior parathyroid is posterolateral to the nerve. With the thyroid gland retracted anteriorly, both parathyroids may assume an anteromedial position relative to the nerve. The superior gland is generally situated on the posterior surface of the upper third of the thyroid gland, fairly close to the cricoid cartilage. Frequently, the parathyroids are loosely surrounded by fat and are golden yellow in color. Measuring only about 5–8 mm in maximum diameter, the average gland weighs about 30 mg.

One method for protecting the parathyroid glands is to preserve the posterior capsule of the thyroid gland by incising the thyroid along the line sketched in Fig. 127.2 (subtotal lobectomy, leaving 3–4 g of thyroid tissue). Also, divide the branches of the inferior thyroid artery at a point distal to the origin of the blood supply to the parathyroids. Alternatively, parathyroid glands can also be preserved by performing a near-total thyroidectomy leaving <1 g of thyroid tissue. When a total lobectomy is performed, the only means of ensuring preservation of the parathyroid glands is to identify the inferior and superior glands positively. Then, dissect each gland carefully away from the thyroid without impairing its blood supply.

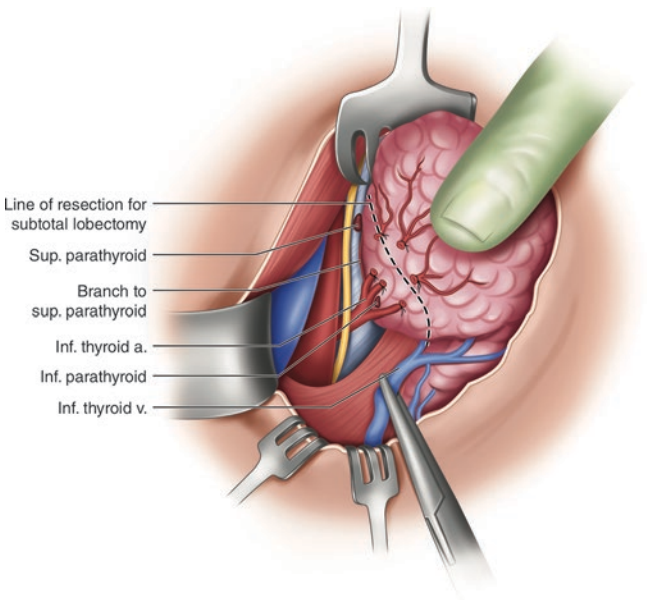


Fig. 127.2

Operative Technique

Intraoperative Preparation

Position the patient supine on the operating room table. Place a shoulder roll, if necessary, to assist with extension of the neck. Tuck the arms by the patient's side and pad all pressure points. Then, place the operating table in a modified "beach-chair" position with slight reverse Trendelenburg. Antibiotics are not typically indicated for thyroid operations.

Incision and Exposure

Make a slightly curved incision in a natural skin crease approximately 1 cm caudal to the cricoid cartilage. The incision should extend approximately 4–5 cm for a normal-sized gland. Take care to ensure symmetry. A longer incision may be needed in patients with large goiters. Using a scalpel or electrocautery, carry the incision down through the skin and subcutaneous tissue to the platysma muscle. The latter is easier to identify in the lateral portions of the incision.

Divide the platysma using electrocautery. Place skin hooks or Kelly clamps in the dermis to assist with the creation of subplatysmal flaps. Using a gauze sponge to provide countertraction, begin medially and carry the dissection out laterally. If the plane of dissection is carried down to the cervical fascia, a number of veins are encountered that produce unnecessary bleeding. There is a thin layer of fat deep to the platysma muscle, and leaving this layer on these veins avoids this problem. Continue the dissection along the deep surface of the platysma muscle in a cephalad direction using both sharp and blunt maneuvers. Follow the avascular areolar plane superiorly to the thyroid cartilage and inferiorly to the suprasternal notch. A self-retaining retractor may be placed to hold back the skin flaps.

Palpate the prominence of the thyroid cartilage to identify the midline. Make an incision through the cervical fascia in the midline and extend the incision to expose the full length of the strap muscles (sternothyroid muscle and sternohyoid muscle). Elevate the sternohyoid muscle in the midline; then, elevate the sternothyroid muscle and dissect the thyroid capsule away from it on both sides. This permits adequate digital exploration of the entire thyroid gland. In most cases, retracting the strap muscles laterally while the thyroid lobe is retracted in the opposite direction provides good exposure for thyroidectomy. If the gland is unusually large or the exposure is inadequate, do not hesitate to transect the sternohyoid and sternothyroid muscles. Transect them in their

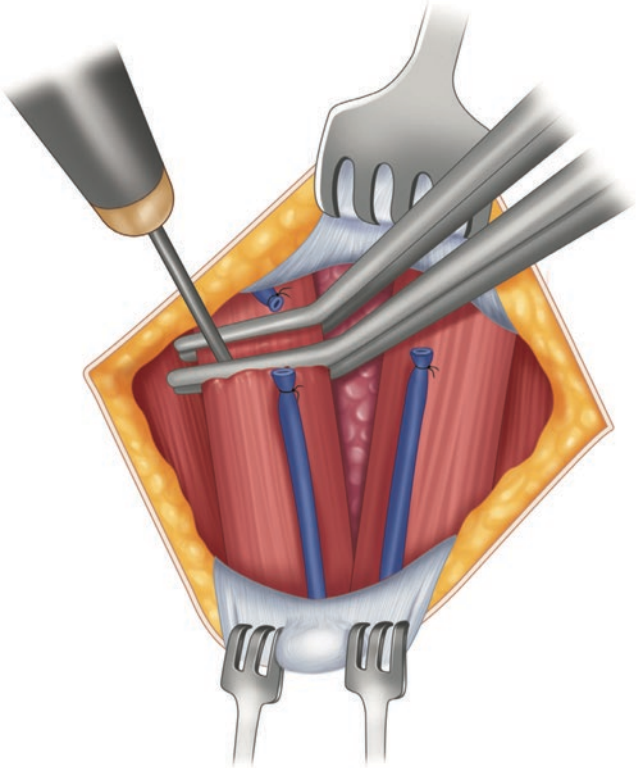


Fig. 127.3

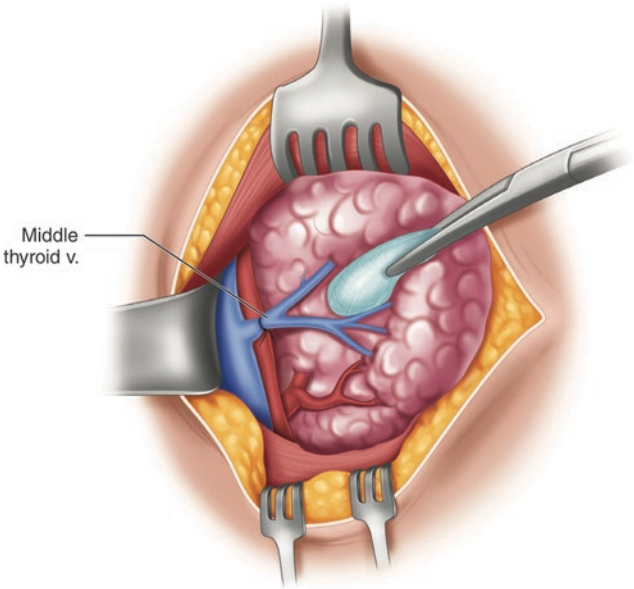


Fig. 127.4

upper thirds as their innervation from the ansa cervicalis enters from below (Fig. 127.3).

Identification and Ligation of the Isthmus and Middle Thyroid Vein

At this point, some surgeons opt to transect the isthmus of the thyroid. After placing self-retaining retractors to hold back the strap muscles, identify the isthmus. Dissect the isthmus off of the trachea both inferiorly and superiorly using blunt dissection and electrocautery. The isthmus may be divided between clamps and vascular control obtained by suture ligation or oversewing of the cut ends. Devices such as a harmonic scalpel or vessel-sealing system may be used to transect the isthmus and may be used throughout the procedure in place of suture ligatures. The isthmus may also be divided last, when entire dissection is completed.

Once the upper portion of the thyroid isthmus is identified, a fingerlike projection of thyroid tissue may be seen extending from the region of the isthmus in a cephalad direction. It represents the pyramidal lobe of the thyroid, a vestigial remnant of the thyroglossal tract. If a thyroidectomy is being performed for Graves' disease, it is especially important to remove the pyramidal lobe. Otherwise, postoperatively it may become markedly hypertrophied and cause a significant cosmetic deformity overlying the thyroid cartilage. It is also essential to remove the pyramidal lobe when operating for cancer as it may affect postoperative tumor marker levels and radioactive iodine uptake levels.

Once this is accomplished, retract the lobe medially and identify and ligate the middle thyroid vein. This may improve the mobility of the thyroid and assist in exposure. Retract the strap muscles laterally and the thyroid medially. Using blunt and sharp dissection, sweep the lateral tissue away from the lateral most aspect of the thyroid. The middle thyroid vein should be visible in this plane. Ligate the vein using silk ties or other devices, as indicated above (Fig. 127.4).

Dissecting the Superior Pole and Superior Parathyroid Gland

With a retractor drawing the upper portion of the strap muscles in a cephalad direction, retract the superior pole of the thyroid laterally and use a peanut sponge dissector to sweep the upper pole of the thyroid away from the larynx. This maneuver separates the upper pole from the external branch of the superior laryngeal nerve, which is closely applied to the cricothyroid muscle at this level (discussed below). Also free the lateral portion of the superior pole by blunt dissection. One or two small veins may be entering the posterior portion of the upper pole. Be careful to identify and ligate these branches if encountered. Then, identify the terminal branches of the superior thyroid artery and vein. Ligate and divide each of these vessels between suture ligatures or other vessel-sealing devices. After they have been ligated and

divided, the superior pole of the thyroid is completely liberated and can be lifted out of the neck.

Now search along the posterior surface of the upper third of the thyroid lobe for the superior parathyroid gland. The typical anatomy is shown in greater detail in Fig. 127.1. Variations are extremely common. Dissect the parathyroid gland away from the thyroid into the neck, carefully protecting it.

Identification of Inferior Pole Vessels

Next, attention turns to identification and ligation of the inferior pole vessels. Staying close to the thyroid tissue, dissect from medial to lateral and take care not to injure the recurrent laryngeal nerve. Locate the inferior thyroid vessels and ligate these vessels using suture ligature or vessel-sealing devices (Fig. 127.5). In some cases, the thyroid ima artery may be encountered at this point. Ligate this vessel in a similar fashion.

Identification of the Recurrent Laryngeal Nerve and Inferior Parathyroid Gland

With both the superior and inferior poles of the thyroid mobilized, the recurrent laryngeal nerve is able to be identified. Dissection may be carried out lateral to medial or vice versa based on the surgeon's preference.

For most surgeons, the best way to locate the recurrent laryngeal nerve is to trace the inferior thyroid artery from the point where it emerges behind the carotid artery to the point where it crosses over or under the recurrent nerve. Often a very slim vessel can be seen along the nerve. Using the inferior thyroid artery as a guide, locate the recurrent nerve immediately deep to or superficial to this artery and carefully dissect the nerve in a cephalad direction until it reaches the cricothyroid membrane just below the inferior cornu of the thyroid cartilage. Remember that the nerve may divide into two or more branches in the area cephalad to the inferior thyroid artery. Once the nerve has been exposed throughout its course behind the thyroid gland, it is a simple matter to avoid damaging it.

A nerve stimulator may be used to assess function of the nerve at various stages of the dissection. This is done by placing an index finger deep along the posterior lamina of the cricoid and stimulating the recurrent laryngeal nerve with a neurostimulator to feel for contraction of the cricoarytenoid muscle through the wall of the hypopharynx. Additional methods to assess functions of the nerve include direct laryngoscopy or continuous monitoring by electromyography. Intraoperative neural monitoring has gained acceptance as an adjunct to the gold standard of visual identification of the recurrent laryngeal nerve. It does have some limitations and additional research and standardization of techniques and results are needed.

Identify the inferior parathyroid gland, generally located close to the point at which the inferior thyroid artery divides into its branches (Fig. 127.6). Divide each of these branches of the inferior thyroid artery between ligatures medial to the parathyroid gland so the blood supply to the parathyroid is not impaired.

At this point, the thyroid may be elevated off of the trachea using either blunt or sharp dissection. Dissection may

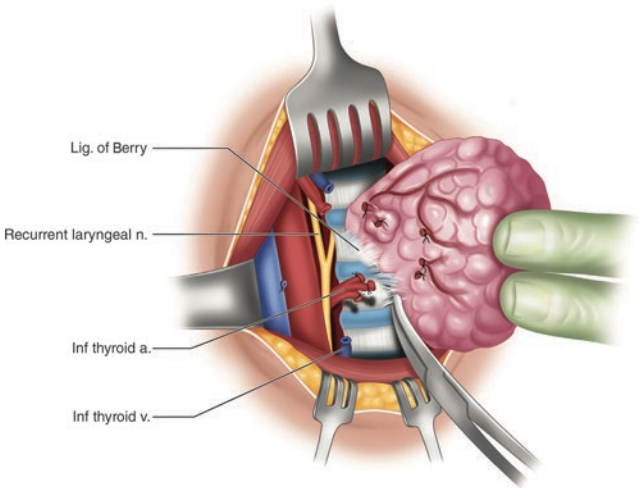


Fig. 127.5

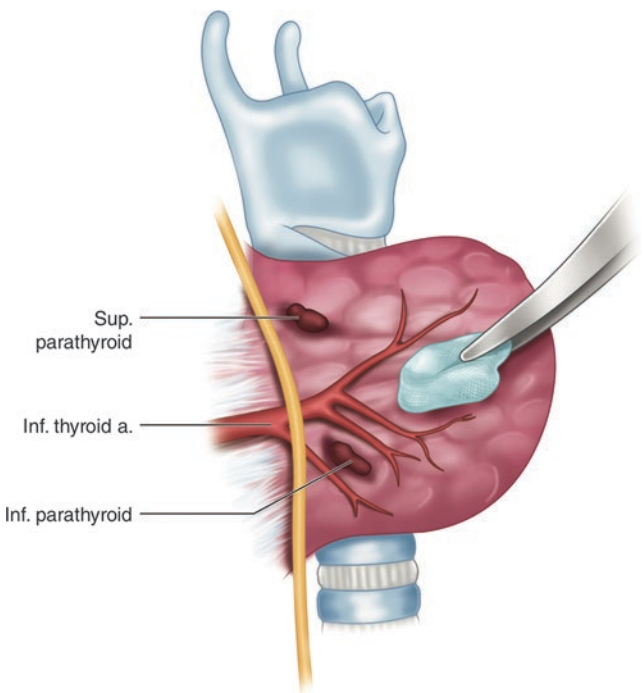


Fig. 127.6

be carried out from a lateral to medial fashion, transecting the ligament of Berry to elevate the thyroid from the trachea. Care is taken to ensure preservation of the recurrent laryngeal nerve throughout this dissection.

Reimplantation of Parathyroid Glands

If a parathyroid gland has been inadvertently excised, and this is recognized during the operation, it is possible to reimplant the parathyroid. The parathyroid should be placed in a container filled with normal saline and then placed on ice. When ready for reimplantation, cut the gland into small segments (approximately 1 × 1 mm) using a scalpel. These segments may then be placed or injected into a pocket of the sternocleidomastoid or brachioradialis muscle. Generally, a permanent suture to close the pocket and clips are placed to mark the site. In addition, glands without visible vascular supply should be reimplanted. Intraoperative measurements of PTH levels (less than 10 pg/mL) during total thyroidectomy may suggest the need for reimplantation.

Subtotal Thyroid Lobectomy

If subtotal resection of the lobe is the operation elected, free the upper pole completely and divide the lobe along the line of resection as outlined in Fig. 127.2. At this level of the dissection, both parathyroid glands and the recurrent nerve, all of which have been previously identified, may be left in their normal locations. Divide the remaining gland between hemostats or using a vascular sealing device until the anterior surface of the trachea has been reached. If hemostats are used, the cut surface will need to be oversewn. At this point, transect the isthmus as described below if this maneuver was not performed earlier in the surgery. Some surgeons suture the lateral margin of the residual segment of thyroid to the trachea, but this step is not essential. When subtotal thyroidectomy is being performed for Graves' disease, leave no more than 2–4 g of thyroid tissue on each side.

Total Thyroid Lobectomy

Before considering total lobectomy, be certain you have positively identified the recurrent nerve and the superior and inferior parathyroid glands. After these structures have been dissected away from the thyroid, proceed with the total lobectomy. The gland is firmly attached to the two upper tracheal rings by dense fibrous tissue that constitutes the ligament of Berry (Fig. 127.5). The upper portion of the recurrent laryngeal nerve passes close to the point where this ligament attaches to the trachea. Moreover, often there is a small artery passing close to the recurrent nerve in this ligament. Be careful to control this vessel without injuring the nerve before dividing the ligament. After this ligament has been freed, the thyroid lobe can easily be liberated from the trachea by clamping and dividing several small blood vessels until the isthmus has been elevated.

The isthmus may be divided serially between hemostats, leaving the other lobe of the thyroid in place, and then oversewn for hemostasis as seen in Figs. 127.7 and 127.8. If the isthmus has been divided earlier in the surgery, the thyroid just needs to be dissected off the trachea using scalpel or electrocautery.

Partial Thyroid Lobectomy

On some occasions, what appears to be an obviously benign lesion occupies a small portion of the thyroid gland. Under these conditions, local excision or partial lobectomy may be indicated. The stapling device is sometimes useful under these conditions. Figs. 127.9 and 127.10 illustrate removal of the lower half of the right thyroid lobe, a stapling device having been used first to close and control bleeding from the remaining segment of thyroid, and then, to divide the isthmus. Remember that *identification and preservation* of the recurrent nerve must be achieved early in the dissection. If the gland is fairly thick, use 4.8 mm staples.

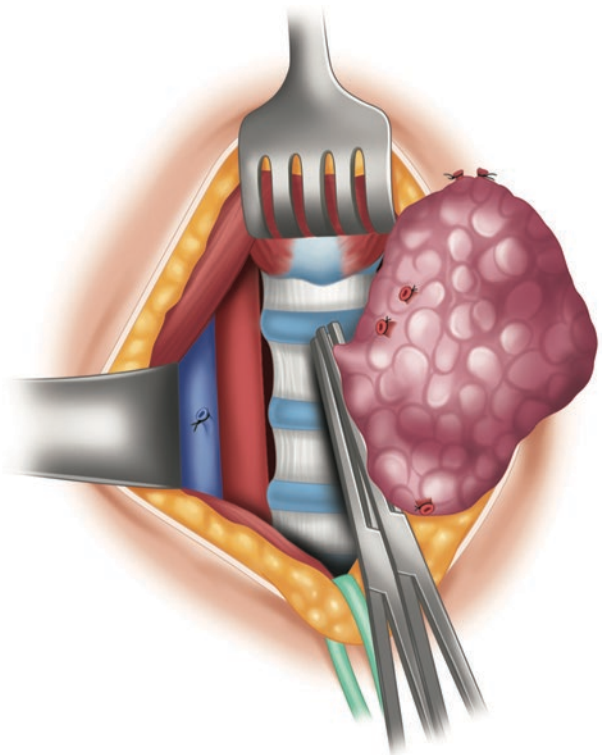


Fig. 127.7

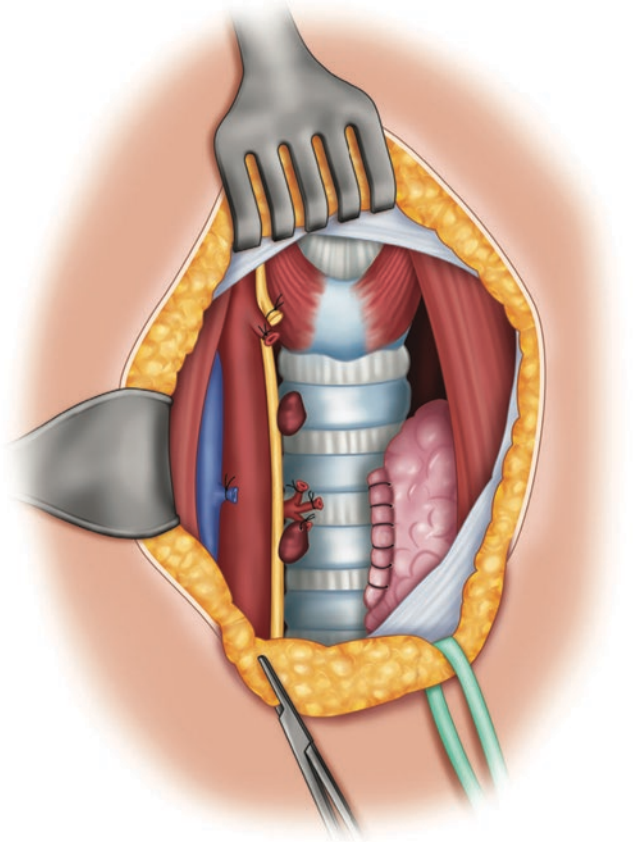


Fig. 127.8

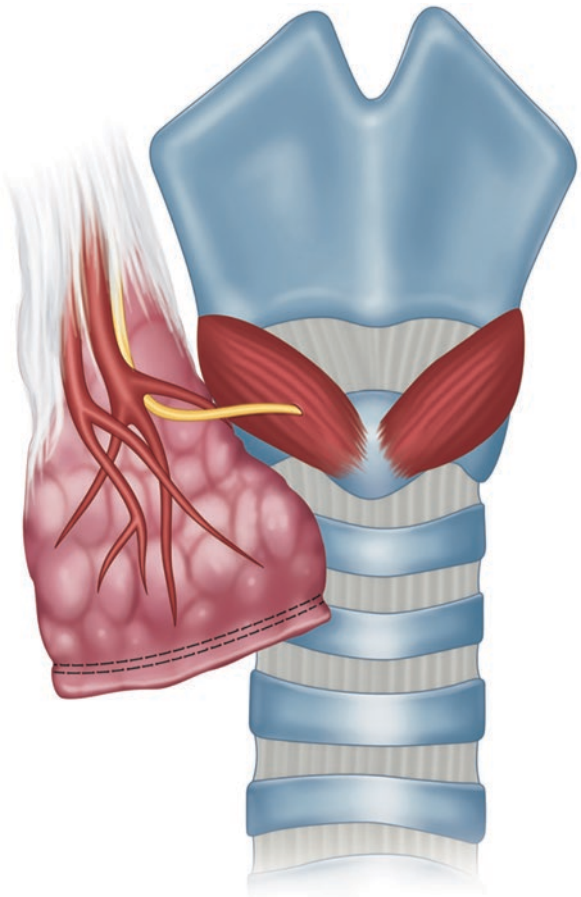


Fig. 127.9

Closure

Prior to closure, irrigate the operative field with saline and obtain *complete* hemostasis by ligatures, clips, or electrocautery. Always keep the recurrent nerve and the parathyroid glands in view while taking these steps. In the situation where the strap muscles have been transected, reapproximate these two muscles by means of sutures of 2-0 Vicryl, as illustrated in Fig. 127.11. In other cases simply suture the right and left strap muscles together loosely with interrupted 3-0 Vicryl sutures. It is not necessary to place drains in the thyroidectomy bed. After the strap muscles have been reapproximated, suture the divided platysma muscle together using interrupted 3-0 Vicryl stitches. Close the skin using a running subcuticular 4-0 absorbable suture. Skin glue may also be used.

Postoperative Care

- Carefully observe the patient's neck for signs of swelling or ecchymosis. Active bleeding in the bed of the excised thyroid gland can rapidly compress the trachea and cause respiratory obstruction, especially if the bleeding is due to a major artery. Under rare circumstances, it is necessary to remove all sutures in the skin and strap muscles to release the blood clot at the patient's bedside. In most cases, evacuate the blood clot in the operating room. After removing a large goiter, occasionally there is gradual swelling of the tissues of the neck due to slow venous bleeding that infiltrates the tissues. It may produce respiratory distress due to laryngeal edema. This patient requires orotracheal intubation and evacuation of the clot in the operating room. It is rare that exploration or a tracheostomy must be done at the patient's bedside.
- Following total thyroidectomy, check for hypocalcemia by measuring the serum calcium level (typically twice daily) until the patient is discharged. Hypocalcemia may occur due to inadvertent damage to the parathyroid glands. Observe for signs and symptoms of hypocalcemia: paresthesia of the extremities or face, Trousseau's sign, or Chvostek's sign. These generally appear when the calcium level drops below 7–8 mg/dL. Give oral calcium carbonate tablets (2–8 g/day) as required to maintain the serum calcium level. If calcium administration alone does not control the symptoms, supplemental vitamin D may be given (typically as calcitrol). Treat

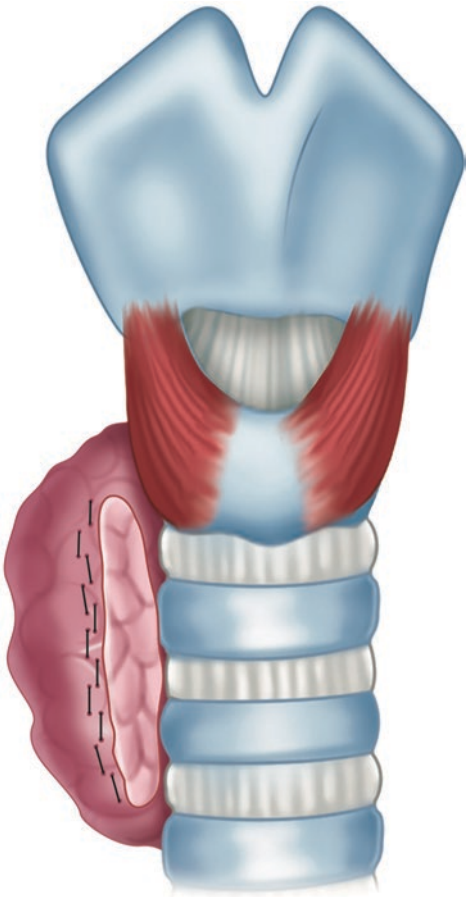


Fig. 127.10

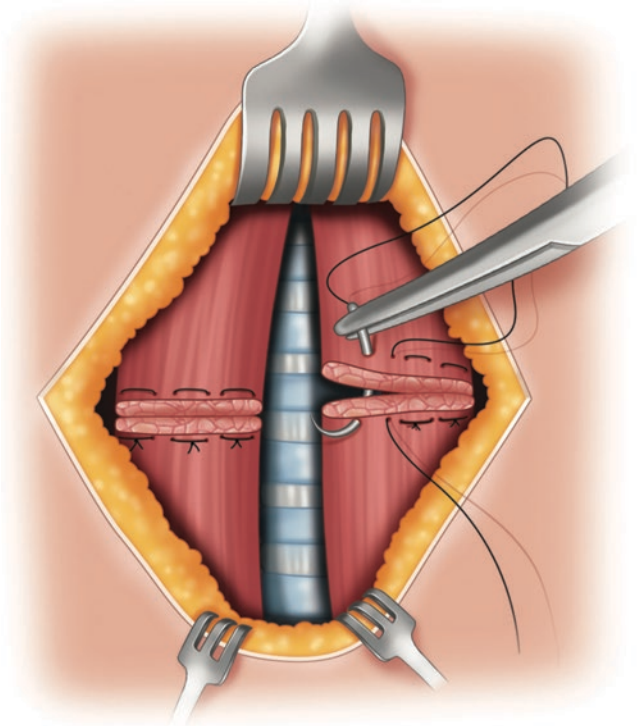


Fig. 127.11

the symptoms with intravenous calcium gluconate (1 g of a 10% solution several times a day or a continuous intravenous infusion) if the symptoms persist despite oral supplementation. The milder form of hypocalcemia following thyroid surgery is usually transient because it is caused by minor trauma to the parathyroid glands. Severe postoperative hypoparathyroidism is often permanent.

- Patients undergoing total thyroidectomy will also develop hypothyroidism and require thyroid hormone supplementation. Replace with levothyroxine (synthetic T4) starting at a dose of 1.6 μg/kg. TSH levels should be reassessed after 6 weeks of therapy. Patients undergoing lobectomy or bilateral subtotal thyroidectomy may also need thyroid hormone supplementation, depending on the volume of thyroid tissue remaining, and especially, if there is underlying Hashimoto's thyroiditis. Monitoring of these patients' TSH levels at periodic intervals is advised.
- In patients with Graves' disease, carefully monitor vital signs to detect early evidence of *thyroid storm*. Patients who were prepared for operation with propranolol require treatment with this medication for 7–10 days following the operation.

Complications

- *Infections* are rare, however, cellulitis and abscesses may occur. Antibiotics and drainage may be needed.
- *Hematoma* with possible tracheal compression and respiratory distress requiring bedside evacuation may occur. Getting control of the airway and bleeding is best performed in the operating room as indicated above.
- There may be *injury to the recurrent laryngeal nerve*. Recurrent nerve injury may be transient or permanent. If the injury is unilateral, it generally produces some degree of hoarseness and weakness of the voice. Postoperative hoarseness may be also due to transient vocal cord edema or vocal cord injury caused by the endotracheal tube used for anesthesia. The patient who has undergone trauma to both recurrent laryngeal nerves may develop complete *airway obstruction* from marked narrowing of the glottis requiring prompt endotracheal intubation and then tracheostomy. This complication may become evident immediately after extubation in the operating room with the development of stridor or hours later. If this occurs, immediate reintubation is necessary. This complication is rare. The airway may later be improved by an arytenoidectomy.
- *Superior laryngeal nerve injury* may result in the patient being unable to utter high-pitched sounds and voice fatigue.

- *Hypoparathyroidism*, transient or permanent, results from inadvertent removal of or trauma to several of the parathyroid glands. If during operation it is noted that one or more parathyroid glands have been removed, they should be reimplanted. If the fragments are sufficiently small, satisfactory function may develop. Transient hypoparathyroidism, lasting as long as several months, may result from manipulation of the parathyroid glands without permanent damage.
- *Thyroid storm* may develop following thyroidectomy for Graves' disease, especially if the preoperative preparation has not been adequate. This condition is characterized by fever, severe tachycardia, mental confusion, delirium, and restlessness. Rarely seen today, postoperative thyroid storm may be treated by supportive care including IV fluids, beta blockers, and steroids. A hypothermia blanket may be required to manage the high fever.

Other rare complications of thyroidectomy include injury to surrounding structures such as the carotid artery, jugular vein, trachea, esophagus, and cervical sympathetic trunk, which may result in Horner's syndrome.

Minimally Invasive Thyroidectomy

As the field of minimally invasive surgery has evolved, these techniques have been applied to thyroidectomy. The scope of minimally invasive thyroidectomy encompasses mini-incision open, video-assisted, and complete endoscopic thyroidectomy. The latter can be performed via the neck or transaxillary approach and with or without robotic assistance. Similar to other minimally invasive approaches, minimally invasive thyroidectomy has been reported to provide less tissue trauma, less postoperative pain, shorter hospital stay, improved patient comfort, and improved cosmesis. Additionally, visualization using video assistance provides a magnified view of important structures. The endoscopic approach utilizes the same basic principles of conventional thyroidectomy and can be carried out under either general or local anesthesia. More recently, transoral approaches, especially using robotic techniques, have shown promising results. General contraindications to the endoscopic approach include overall large size of the thyroid (>50 mL), nodules greater than 30 mm, history of thyroiditis or prior neck surgery, and advanced stage cancers. Although these techniques have been shown to be feasible, further long-term studies are needed to determine their advantages and cost-effectiveness over the more traditional open approach.

Further Reading

Block MA. Surgery of thyroid nodules and malignancy. Curr Probl Surg. 1983;20:137.

Dhiman SV, Inabnet WB. Minimally invasive surgery for thyroid diseases and thyroid cancer. J Surg Oncol. 2008;97(8):665–8.

Dionigi G, Wu CW, Kim HY, Liu X, Liu R, Randolph GW, Anuwong A. Safety of energy based devices for hemostasis in thyroid surgery. Gland Surg. 2016;5(5):490–4.

Dralle H, Machens A, Thanh PN. Minimally invasive compared with conventional thyroidectomy for nodular goitre. Best Pract Res Clin Endocrinol Metab. 2014;28(4):589–99.

Friedman M, Vidyasagar R, et al. Intraoperative intact parathyroid hormone level monitoring as a guide to parathyroid reimplantation after thyroidectomy. Laryngoscope. 2005;115(1):34–8.

Jonklaas J, Davidson B, et al. Triiodothyronine levels in athyreotic individuals during levothyroxine therapy. JAMA. 2008;299(7):769–77.

Katz AD, Nemiroff P. Anastamoses and bifurcations of the recurrent laryngeal nerve: report of 1177 nerves visualized. Am Surg. 1993;54:188.

Lekacos NL, Tzardis PJ, Sfikakis PG, Patoulis SD, Restos SD. Course of the recurrent laryngeal nerve relative to the inferior thyroid artery and the suspensory ligament of berry. Int Surg. 1992;77:287.

Levin KE, Clark AH, Duh Q-Y, et al. Reoperative thyroid surgery. Surgery. 1992;111:604.

Malik R, Linos D. Intraoperative neuromonitoring in thyroid surgery: a systematic review. World J Surg. 2016;40(8):2051–8.

Mamais C, Charaklias N, et al. Introduction of a new surgical technique: minimally invasive video-assisted thyroid surgery. Clin Otolaryngol. 2011;36(1):51–6.

Mitchem JB, Gillanders WE. Endoscopic and robotic thyroidectomy for cancer. Surg Oncol Clin N Am. 2013;22(1):1–13.

Randolph GW, Dralle H, et al. Electrophysiologic recurrent laryngeal nerve monitoring during thyroid and parathyroid surgery: international standards guideline statement. Laryngoscope. 2011;121 Suppl 1:S1–16.

Ruggieri M, Straniero A, Genderini M, D'Armiento M, Fumarola A, Trimboli P, et al. The size criteria in minimally invasive video-assisted thyroidectomy. BMC Surg. 2007;7:2.

Schwartz AE, Friedman EW. Preservation of the parathyroid glands in total thyroidectomy. Surg Gynecol Obstet. 1987;165:327.

Soh EY, Clark OH. Surgical considerations and approach to thyroid cancer. Endocrinol Metab Clin N Am. 1996;25:115.

Wells SA Jr, Ross AJ, Dale JK, et al. Transplantation of the parathyroid glands: current status. Surg Clin North Am. 1979;59:167.