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Conventional thyroidectomy

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Thyroidectomy can be a diagnostic and therapeutic procedure for thyroid nodules carrying a risk of thyroid cancer or causing local symptoms, or for hyperfunction. The technical approach for a safe conventional thyroidectomy is a replicable procedure guided by some basic principles and anatomic understanding. One safe approach is detailed here.
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Indications

Thyroidectomy is performed as a diagnostic and therapeutic procedure for thyroid nodules carrying a risk of thyroid cancer or causing local symptoms, or for hyperfunction. The procedure can include unilateral or bilateral thyroid resection. Unilateral procedures generally are reserved for isolated thyroid nodules for which preoperative diagnostic approaches, such as ultrasound and fine-needle aspiration cytology, were not successful in characterizing the nodule as benign or malignant, or more rarely for dominant benign unilateral masses causing symptoms. For a minority of patients with thyroid carcinoma, or with a solitary toxic adenoma, thyroid lobectomy can be definitive therapy. For most patients with bilateral nodules or thyroid carcinoma, a bilateral procedure is more appropriate.

The technique for total thyroidectomy is the same as thyroid lobectomy but is repeated for the contralateral lobe. The steps outlined in this article for a unilateral right lobectomy are applied to the left lobe to complete a bilateral procedure.[1]

Complications

The complications of thyroidectomy are the usual complications of operation (ie, infection, bleeding, and anesthetic reactions) as well as damage to nearby structures in the neck.[2] Infection, bleeding, and anesthetic reactions are each relatively uncommon. The most significant issues are damage to the nerves that supply the musculature of the larynx (the recurrent laryngeal nerve, and the external branch of the superior laryngeal nerve) or damage to the parathyroid glands. There are 4 parathyroid glands and, in a unilateral thyroid lobectomy, there should be no risk of permanent hypoparathyroidism. For a total thyroidectomy, there is a risk of causing damage to each parathyroid gland, resulting in temporary or permanent hypoparathyroidism. Each parathyroid gland should be treated with care, as even after lobectomy, the patient may require contralateral operation in the future, and hypoparathyroidism from damage to the parathyroid glands at that operation could be obviated by preservation of the glands during the initial procedure. For the bilateral version of thyroid resection, the risk of permanent hypoparathyroidism exists but should be limited with the careful dissection of the parathyroid glands, and the liberal use of parathyroid autograft.[3]

Parathyroid glands are vulnerable to injury during thyroid operations. Glands may be inadvertently removed, devascularized after ligation of the inferior thyroid artery, or destroyed by direct trauma. Injury may be prevented by identifying ipsilateral parathyroid glands during lobectomy, dissecting close the thyroid to preserve parathyroid blood supply, and avoiding excessive parathyroid gland manipulation. Whenever a gland is devascularized or separated from the surrounding tissues during the course of an operation, parathyroid autotransplantation is the best method of preservation.[4] In this

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Figure 1 Positioning of patient and incision. (Reprinted with permission.[1])

procedure, the injured parathyroid is removed and finely sectioned with a scalpel into 2- to 3-mm pieces. A frozen section of a small piece of the gland may be analyzed to confirm the nature of the tissue. The pieces are then placed in individual pockets within the ipsilateral sternocleidomastoid muscle. Each pocket is oversewn with a single 3-0 absorbable suture. The reimplanted gland should begin to function within 4 to 6 weeks.

Damage to the external branch of the superior laryngeal nerve can lead to the patient's inability in lengthening the vocal fold and difficulty with shouting loudly or singing high notes. Damage to the recurrent laryngeal nerve can paralyze the ipsilateral vocal cord, causing a breathy or raspy voice, weak cough, and aspiration of liquids during drinking.[5] Paralysis of both vocal cords can occur with bilateral damage during bilateral thyroidectomy. With both vocal cords paralyzed, the patient's ability to inhale can be very limited, and temporary or permanent tracheostomy can be required.

Dysfunction that results from damage to these nerves during thyroidectomy can be either temporary or permanent. Temporary effects can last for days to months, and even with late recovery, can be followed by complete recovery. Therefore, patience is useful when following people with nerve injuries. If permanent injury does occur, then vocal fold medialization procedures can be helpful to restore laryngeal function and voice quality.

Avoidance of injury to the recurrent laryngeal nerve (RLN) is paramount. To protect the nerve, great care must be taken during the dissection. The principles of safe dissection are:

1. **Avoid dividing any structures in the tracheoesophageal groove until the nerve is definitively identified**. Small branches of the inferior thyroid artery may seem like they can clearly be safely transected; however, the distortion of tumor, retraction, or previous scar may lead the surgeon to mistakenly divide a branch of the RLN. The identifying feature of the RLN is that the more it is dissected, the more it looks like the correct structure, based upon morphologic appearance and anatomic course.
2. **Identify the nerve low in the neck at or caudad to the level of the lower pole of the thyroid gland (Figure 1)**. This identification allows dissection of the nerve at a site where it is not tethered by its attachments to the larynx or its relation to the inferior thyroid artery. Traction injuries to the nerve can occur when the nerve is manipulated near a site of fixation.
3. **Keep the nerve constantly in view during the subsequent dissection of the thyroid from the larynx**. Once identified, the dissection generally can proceed from inferior to superior along the nerve, dividing the inferior thyroid artery branches and preserving the parathyroid glands. This allows careful dissection of the tissues with minimal manipulation of the RLN.
4. **Minimize the use of powered dissection posterior to the thyroid**. Although the electrocautery and high-frequency ultrasonic scalpel are useful tools in dissection, they have some risk of lateral thermal spread, which can damage adjacent tissues. Careful cold dissection and hemostasis with ligatures or clips will avoid this risk. This is particularly important at the entry of the RLN to the larynx, immediately adjacent to the ligament of Berry and its vessels.

The use of nerve stimulators and laryngeal muscle electromyography monitors has been investigated as a tool to try to limit or avoid nerve injuries. The data do not support the use of these devices as the standard of care, though many experienced surgeons use them.[6] The monitor can help to identify the nerve; however, the portion of the operation most likely to produce damage in experienced hands is the dissection of the RLN at the fixed point of the cricothyroid muscle insertion.

Positioning of patient and incision (Figure 1)

General anesthesia is preferred with the patient supine, hands in the lap, and neck extended by a support placed transversely beneath the shoulders. To minimize postoperative discomfort and to keep the overlying strap muscles lax, avoid extreme neck extension. A transverse cervical incision of 4 to 5 cm in length is needed, depending on the habitus of the patient. Larger incisions should only be necessary if the thyroid lesion is too large to extract through a smaller opening. The incision illustrated here is larger than that typically used, for demonstration purposes. Optimal exposure of the thyroid gland is achieved by placing the incision over the thyroid isthmus, which is consistently positioned 1 fingerbreadth below the cricoid cartilage. The incision is slightly curved, symmetric, and incorporates normal skin creases to ensure good postoperative cosmesis.

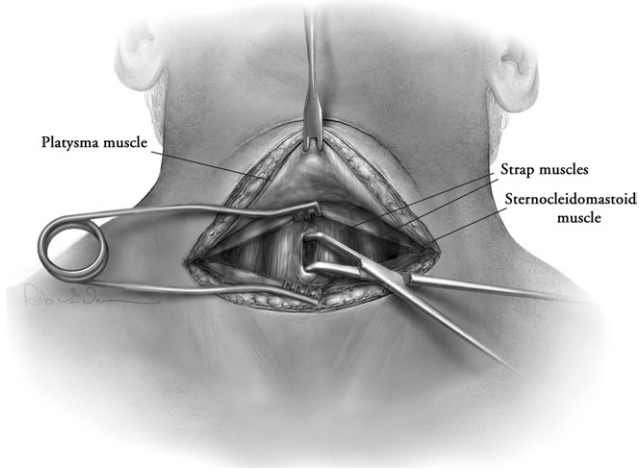

Figure 2 The strap muscles are separated in the midline, exposing the thyroid gland. (Reprinted with permission.[1])

The strap muscles are separated in the midline, exposing the thyroid gland (Figure 2)

The incision is carried through the subcutaneous fat and platysma muscle. Upper and lower subplatysmal flaps are raised. The anterior jugular veins may be used to define the deep limit of the plane of dissection when the platysma cannot be easily identified. The superior flap is elevated to the notch of the thyroid cartilage in the midline of the dissection; the inferior flap is dissected down to the sternal notch. A bloodless plane within the investing layer of the deep cervical fascia is identified between the paired anterior jugular veins and is incised with electrocautery from the thyroid cartilage superiorly to the sternal notch inferiorly. The paired sternohyoid and sternothyroid muscles are elevated and dissected away from the thyroid capsule. Should greater exposure of a large gland or nodule be needed, the strap muscles may be transected superiorly to preserve their innervation by the ansa cervicalis nerves. Transection of the strap muscles is rarely required.

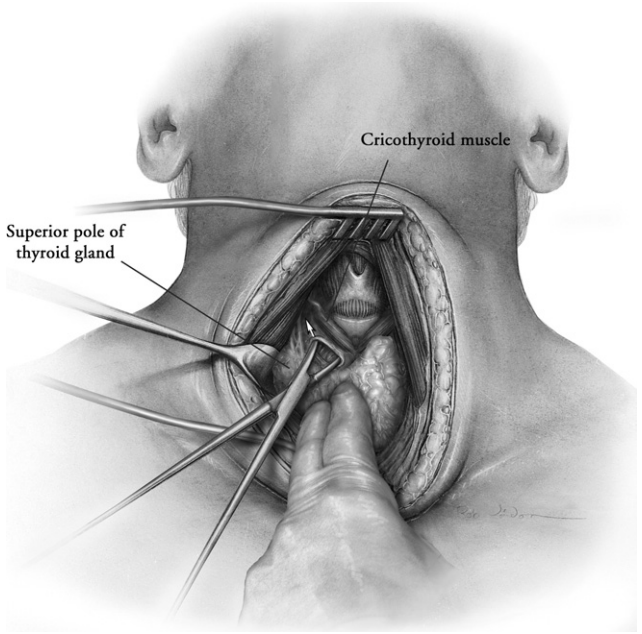

Figure 3 Exposure of upper pole vessels by dissecting between cricothyroid muscle and thyroid. (Reprinted with permission.[1])

Exposure of upper pole vessels by dissecting between cricothyroid muscle and thyroid (Figure 3)

With the strap muscles and carotid artery retracted with a small Richardson retractor, inferolateral tension is placed on the upper pole of the thyroid lobe. A fascial window in the cricothyroid space is exposed between the medial aspect of the upper pole and the lateral aspect of the cricothyroid muscle. The upper pole is separated from the larynx by dissecting from inferior to superior, isolating the superior thyroid vessels away from the external branch of the superior laryngeal nerve. The dissection is carried down through the fibrous tissue along the lateral surface of the cricothyroid muscle to the prevertebral fascia.

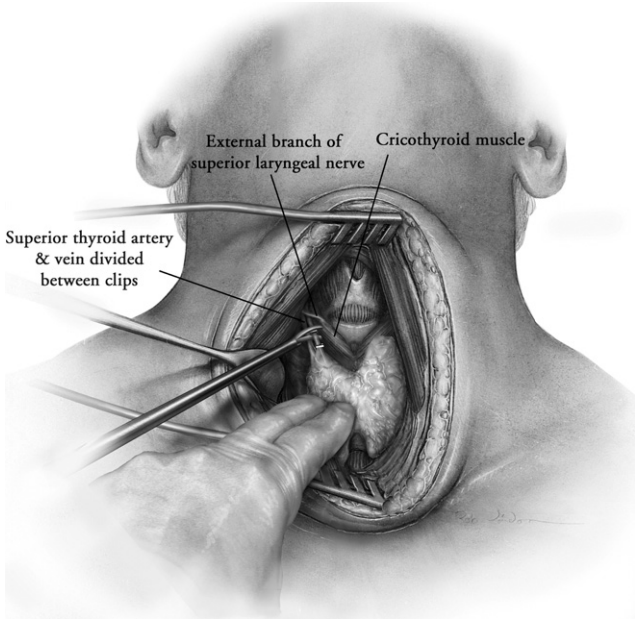

Figure 4 Division of upper pole vessels. (Reprinted with permission.[1])

Division of upper pole vessels (Figure 4)

The superior pedicle may be divided with the harmonic scalpel, or between clips or ties. The vessels must be carefully divided adjacent to their site of penetration of the thyroid capsule to avoid injury to the external branch of the superior laryngeal nerve and devascularization of a superior parathyroid gland that can be supplied in part by the superior thyroid artery.

Reflecting the thyroid medially and beginning dissection on the lateral aspect of gland (Figure 5)

With the superior pole of the thyroid free of fascial attachments, the thyroid lobe is retracted medially, rotating the larynx to expose the tracheoesophageal groove, and commencing dissection on the lateral aspect of the lobe. One or more middle thyroid veins may be encountered along the lateral aspect of the thyroid. The vein is ligated and transected to allow further mobilization and rotation of the thyroid lobe.

Identify the inferior thyroid artery, recurrent laryngeal nerve, and parathyroid glands in the tracheoesophageal groove (Figure 6)

The thyroid lobe is reflected anteriorly to expose the tracheoesophageal groove. The dissection is carried down along the medial surface of the carotid artery to the prevertebral fascia. The inferior thyroid artery can be identified passing deep to the carotid in its course toward the lower pole of the thyroid. Careful dissection is necessary around the inferior thyroid artery to identify the recurrent laryngeal nerve as it passes underneath, or less commonly, anterior to the artery. If the recurrent nerve is not visible, it can usually be identified caudally (in previously undissected areas) as it ascends in the tracheoesophageal groove. The cephalad course of the nerve is defined, taking care to preserve branches that arise proximal to its disappearance under the caudal border of the cricothyroid muscle. The right recurrent laryngeal nerve arises more laterally in the chest than the left, leading to a more oblique course.

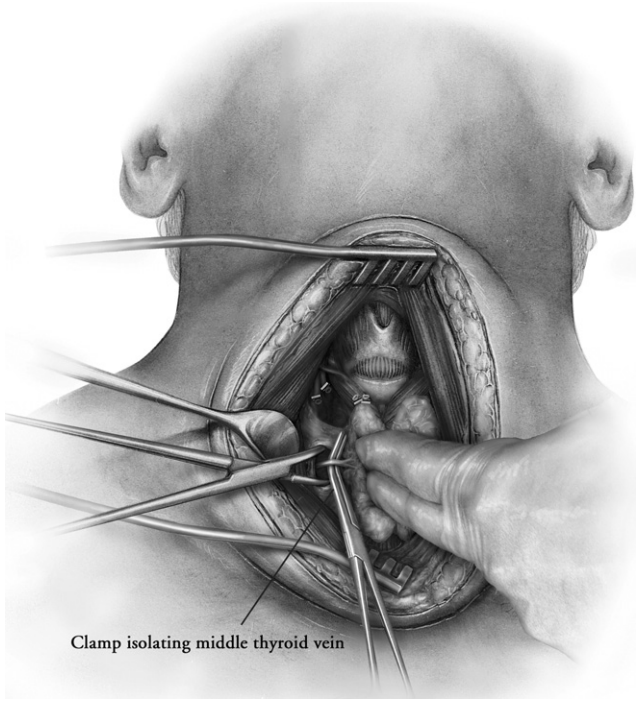

Figure 5 Reflecting the thyroid medially and beginning dissection on the lateral aspect of gland. (Reprinted with permission.[1])

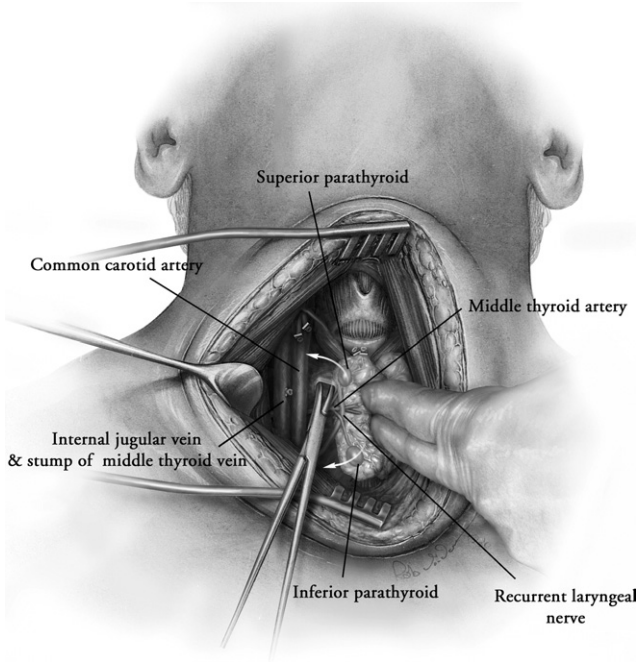

Figure 6 Identify the inferior thyroid artery, recurrent laryngeal nerve, and parathyroid glands in the tracheoesophageal groove. (Reprinted with permission.[1])

The superior and inferior parathyroid glands can be preserved by dissected them away from the posterior capsule of the thyroid gland with their vascular pedicles. The superior glands are most commonly located on the dorsal surface of the thyroid lobe at the level of the upper two-thirds of the gland. While their location is more variable, the lower glands usually lie caudal to the inferior thyroid artery.

Division of the inferior thyroid artery and inferior pole vessels (Figure 7)

With the course of the recurrent nerve directly identified, the branches of the inferior thyroid artery are divided adjacent

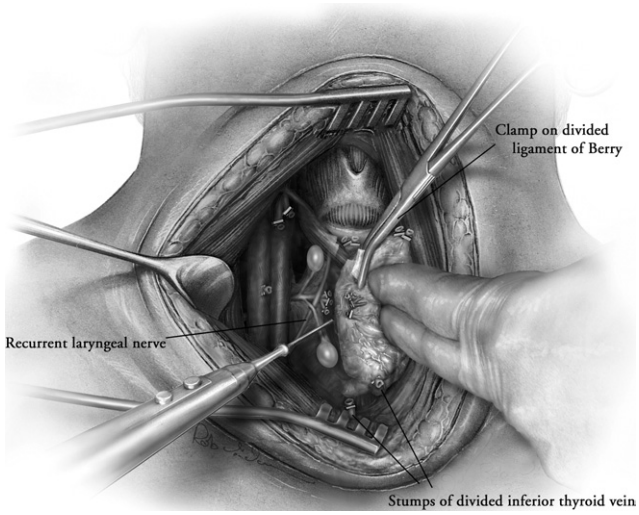

Figure 7 Division of the inferior thyroid artery and inferior pole vessels. (Reprinted with permission.[1])

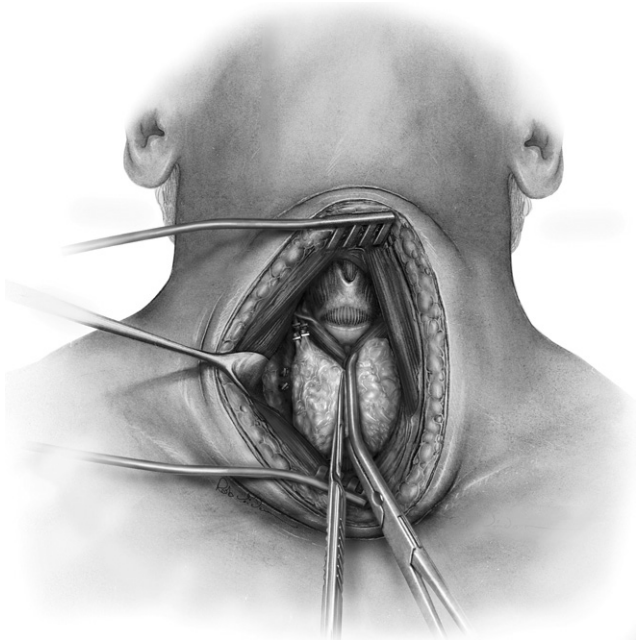

Figure 8 The isthmus is divided. (Reprinted with permission.[1])

to their entrance into the thyroid gland to preserve the parathyroid blood supply. The inferior pole is then dissected. A variable number of inferior thyroid veins and in some cases a small artery are divided. The recurrent nerve is also vulnerable to injury in this area. With its upper and lower poles free, the thyroid lobe remains fixed to the trachea by the ligament of Berry. The thyroid gland is rolled medially and with the recurrent nerve separated from the thyroid gland and in clear view, the ligament is encircled, ligated and divided.

The isthmus is divided (Figure 8)

The thyroid isthmus is clamped and transected. The free edge of the remaining lobe may be oversewn with 3-0 nonabsorbable suture. The thyroid lobe is then removed and meticulous hemostasis is obtained in the neck. Closure: after reapproximating the strap muscles and the platysma muscle with interrupted 3-0 absorbable sutures, the skin is closed with a running 3-0 monofilament subcuticular stitch and topical skin adhesive (2-octyl cyanoacrylate). In lieu of anchoring knots, the trailing end is temporarily stabilized with a hemostat. After allowing the adhesive to set for 2 minutes, the suture is removed.

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