GENERAL SURGICAL OPERATIONS

Dhiraj Choudhury

2nd Edition

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- Presents a concise yet comprehensive coverage of general surgical operations, as well as surgical principles as well as surgical techniques.
- Provides step-by-step accounts of various surgical procedures, supported by diagrams and photographs.
- Contains both classical and advanced methods of surgery.
- Includes the chapters on basic principles such as indications, classification, and preparations for an operation.
- Provides a concise yet comprehensive coverage of general surgical operations, as well as surgical principles as well as surgical techniques.

The chapters are written by a number of eminent surgeons, who are authority in their respective field.

Dhiraj Choudhury (MCh, FICS, FSACS) is an eminent general surgeon and an academician. He is a chief consultant in surgery. He has his early education from the Government Medical College, Kolkata, West Bengal, India. Presently, he is Consultant General Surgeon in the Government Medical College, Kolkata. He has been a practicing surgeon for the last 40 years.

Also, the author of Essentials of Surgery meant for the undergraduates. He has been a practicing surgeon for the last 40 years.
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SECOND EDITION

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Preface to the Second Edition

I had been overwhelmed by the wide acceptance of the first edition of the book *General Surgical Operations* by medical fraternity all over the world. The feedback that I received prompted me to revise and update it for the second edition by paying special attention to the deficiencies. So, this present edition has been prepared to include a wide range of procedures, which are essential in modern surgical practices. Both conventional and laparoscopic procedures have been given due weightage. This book has been enriched by the outstanding authors from different parts of the world.

This edition has been divided into 19 sections containing 101 chapters. Many new chapters have been added such as Surgery for Liver, Surgery for Portal Hypertension, Principles of Day-case Surgery, Management of Rectal Cancer, Surgery of Adrenals, Parathyroidectomy, and Bariatric Surgery—in view of their growing importance and demand in the current surgical practices. The chapter Management of Rectal Cancer has been updated by the authors, who are devoted to colorectal surgery; and, the chapters under the section Vascular Surgery have been rewritten by the promising surgeons expert in vascular surgery. This edition, like the previous one, presents step-by-step description of the common surgical operations intended for the medical students, postgraduate trainees and practicing surgeons.

Dhiraj Choudhury
Preface to the First Edition

There has been a long-felt need for a compilation of the stepwise procedures of operative surgery for general surgeons and postgraduate trainees. The idea was first suggested to me by Shri Jitendar P Vij (Group Chairman), M/s Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, India, at a meeting in Kolkata. I immediately accepted the offer. The task of mobilizing multiple authors from India and abroad representing various aspects of general surgery was an uphill task. I am glad and relieved that the book has now seen the light of the day.

This compilation is intended to provide concise and step-by-step account of various surgical procedures, supported by diagrams and photographs, essential to general surgeons in their day-to-day practice. It should also be a valuable guide to postgraduate trainees in the field of surgery. This book has a total of 87 chapters covering both conventional and laparoscopic methods used in general surgery. We have tried to describe the various operations in detail so that the surgeon and his team can finish their task by following the steps as necessary.

I have included one chapter on neurosurgery titled Burr Hole Procedures, which a general surgeon is also required to perform occasionally.

Dhiraj Choudhury
I am grateful to each of the contributors for the brilliant job done in preparing the comprehensive chapters in spite of their busy schedules. I am also indebted to my colleagues for their suggestions, support and supply of the photographs.

I must thank my wife Gouri Choudhury; sons Dr Prithviraj Choudhury and Dr Gourab Choudhury; and my grandson Uraan Choudhury, for their encouragement, support and sacrifice of time during preparation of this edition.

Last but not least, my deep appreciation is for Shri Jitendar P Vij (Group Chairman), Mr Ankit Vij (Group President), Mr Tarun Duneja (Director-Publishing), Ms Samina Khan (Executive Assistant to Director-Publishing), Mr KK Raman (Production Manager), Mr Sabyasachi Hazra (Commissioning Editor), Mr Ashutosh Srivastava (Assistant Editor), Mr Himanshu Sharma (Proofreader), Mr Vinod Sharma (Typesetter), Mr Pawan Kumar (Graphic Designer), and the other staff of M/s Jaypee Brothers Medical Publishers (P) Ltd. New Delhi, India, for their help and support.
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INTRODUCTION
Thyroid cancer is relatively uncommon, accounting for less than 1% of all malignancies. In contrast, nodular thyroid disease is common affecting 4–8% of the population even in developed countries like the USA and UK. A large majority of these present as solitary nodules and a significant proportion will warrant surgery. Therefore, it is not unusual for most surgeons to be often confronted in practice by thyroid patients requiring surgical intervention.

Surgery is the primary treatment modality for thyroid carcinomas. While some of these cancers can be extremely aggressive and lethal, the vast majority are biologically indolent in their course with prolonged survival even with residual or recurrent disease. The morbidity created by a poorly performed thyroid operation can be much worse than that caused by the disease itself even if untreated. Therefore, it is imperative for the surgeon to be aware of the important aspects of the surgical anatomy, pathology and natural history of thyroid disease.

SURGICAL ANATOMY
The thyroid gland is made up of two lateral lobes which extend on either side of the thyroid cartilage to the level of the sixth tracheal ring. These lobes are joined together by the isthmus, which overlies the second to fourth tracheal rings. In addition, there is sometimes a pyramidal lobe which projects up from the isthmus, usually on the left-hand side. The gland is enclosed in pretracheal fascia, covered by strap muscles and overlapped laterally by the sternocleidomastoid muscles. The relevant anatomical features of surgical importance can be grouped into:
- The musculofascial coverings
- The vascular supply
- The important close surgical relations of the thyroid gland
- Lymph drainage.

Musculofascial Coverings
Skin lines (of Langer) in the neck seen transversely and are useful in planning the incision. Under the skin is the platysma muscle, which is innervated by cervical branch of facial nerve. The platysma and skin should be mobilized as one layer, exposing the external and anterior jugular veins in the superficial fascia below. The outer layer of deep cervical fascia covers the strap muscles and splits to surround sternomastoid and trapezius muscles. The fascial layer can be incised longitudinally between the strap muscles. The more anterior sternohyoid muscles lie close together, but the midline can be identified between them as a thin line of fat and avascular fascia. As the sternohyoid muscles are elevated, the underlying sternothyroid muscles are exposed.

Vascular Anatomy
Each thyroid lobe is supplied by a superior and inferior thyroid artery and drained by three veins.

Superior Vascular Pedicle
The superior vascular pedicle contains the superior thyroid artery, which is the first branch of external carotid, and its accompanying vein, which drains into internal jugular vein. The superior vessels enter the upper pole of the gland at its apex, which branch to the front and back of the gland. The external laryngeal nerve is closely related to this pedicle (discussed below).
Inferior Thyroid Artery

Unlike the superior vascular pedicle, the inferior thyroid artery and vein do not relate to each other at all. The artery arises from the thyrocervical trunk, passes behind the carotid sheath and then runs transversely across the space between the carotid and the thyroid gland to enter deep surface of the gland as several separate branches. These terminal branches are intimately related to the recurrent laryngeal nerve and inferior parathyroid gland.

Inferior Thyroid Veins

The inferior thyroid veins are usually not single, but a plexus which leave the lower border of the gland and pass through the loose fascial space to join the brachiocephalic vein. They are fragile and easily damaged and are best ligated individually.

Middle Thyroid Vein

This vein is usually short stubby and thin-walled leaving the middle of the gland and directly coursing laterally to enter the internal jugular vein.

Thyroidea Ima Artery

The thyroidea ima artery which are direct branches from the aorta are infrequently encountered and are usually only an anatomical curiosity and never of significant surgical relevance.

Important Close Surgical Relations of the Thyroid Gland

These are the recurrent laryngeal nerves, the external laryngeal nerves and the parathyroid glands.

External Laryngeal Nerve

The external branch of superior laryngeal nerve does not usually receive sufficient attention by thyroid surgeons. Injury to this nerve occurs more often than appreciated, resulting in impairment to the quality of voice. The superior laryngeal nerve divides high in the neck into a larger internal branch, which enters larynx through the thyrohyoid membrane to provide sensory innervation to the larynx, and a smaller external laryngeal nerve. The latter descends on the fascia of the inferior pharyngeal constrictor muscle to which it sends a branch, and then passes inferior to the attachment of the sternothyroid muscle to the thyroid cartilage to enter the cricothyroid muscle in the sternothyrolaryngeal (Joll’s) triangle (Fig. 19.1).

This is formed laterally by the upper pole of the gland and the vessels, superiorly by the attachment of strap muscles to the thyroid cartilage and medially by the midline (The nerve usually descends medial to the superior thyroid artery). Its floor is cricothyroid muscle.

Several anatomic variations exist that place the external laryngeal nerve at particular risk. These include:

- In 20% of cases, the nerve is located within the inferior pharyngeal constrictor muscle; and therefore may not be visualized.
- In another 20% of cases, the nerve lies lateral to the superior thyroid pedicle.
- In a further 20% of cases the nerve, although medial to the superior thyroid artery, intertwines between its branches and is therefore difficult to visualize.

There may also be anatomic variations of the external branch of the superior laryngeal nerve on either side. The best way, however, to safeguard it from injury is to stay close to the gland and ligate the branches individually.

Recurrent Laryngeal Nerves

The nerves usually lie in the tracheoesophageal groove and bear a variable relationship to the branches of the inferior thyroid artery before entering the larynx. The nerve can be in front of, pass through or behind the inferior thyroid arteries (Figs 19.2A to C). The right nerve recurs beneath the right subclavian artery while the left recurs beneath the aortic arch, as a result of which the left recurrent laryngeal nerve ascends in a straight longitudinal direction parallel to the border of the trachea in the tracheoesophageal groove while the right nerve follows a shorter course approaching the larynx at a slight angle (Fig. 19.3). The nerve may occasionally divide into 2–3 branches prior to entry into the larynx. The recurrent laryngeal nerve rarely is nonrecurrent, arising in such cases directly from vagus nerve to run in a direct medial course to the inferior lateral aspect of the larynx. This variation usually occurs on the right side.

Parathyroid Glands

The number of parathyroid glands vary from 2 to 6, but, in 80% of cases, there are 4 (2 on each side). The glands are small, the
size of a split pea and are identified by their color, which is
darker yellow-brown than fat, as well as by a definite fascial
capsule containing minute blood vessels.
The superior glands lie on the posterior surface of the
middle third of the thyroid, usually above the inferior thyroid
artery. The superior parathyroid glands are most simply found
by tracing the course of the recurrent nerve to its penetration
of the cricothyroid membrane; it is at this location that they
are usually discovered. Because the superior parathyroid
glands travel only a minimal distance during embryonic life
(derived from fourth pharyngeal pouch), their final location
is less varied than that of the inferior glands.

In contrast, the inferior parathyroid glands arise from
third pharyngeal pouch with the thymus and travel a longer
distance and hence may be more variable in position. They
are usually found either on the posterolateral surface of the
lower pole of the thyroid gland or at the tip of the cervical
thymus or thyrothymic ligament. In fact, this ligament may
be helpful as it occasionally points towards the parathyroid
glands.

**Lymphatics**
The thyroid is a gland rich in lymphatics. Numerous lymphatic
evessels leave the gland and drain into lymph nodes situated
in: The pretracheal, paratracheal and recurrent laryngeal
chain (central compartment), the middle jugular chain (level
III), lower jugular chain (level IV), posterior triangle nodes
(level V) and superior mediastinal nodes (Level VII).

**TYPES OF THYROID OPERATIONS**

*Nodulectomy/lumpectomy* (Fig. 19.4A): Removal of nodule
with cuff of normal tissue.

*Total lobectomy or hemithyroidectomy* (Fig. 19.4B): Complete
removal of one thyroid lobe and the isthmus.

*Isthmusectomy* (Fig. 19.4C): Removal of isthmus along with
cuff of surrounding normal tissue.

*Subtotal thyroidectomy* (Fig. 19.4D): Bilateral removal of
more than one-half of the thyroid gland on each side plus the
isthmus.

*Near total thyroidectomy* (Fig. 19.4E): Total lobectomy and
isthmusectomy with preservation of a small slice of thyroid
tissue on the contralateral side to safeguard the recurrent
laryngeal nerve or the parathyroids or both.

*Total thyroidectomy* (Fig. 19.4F): Removal of both lobes of the
thyroid as well as the isthmus.
Completion thyroidectomy: A subsequent procedure to convert a lesser operation into a near-total or total thyroidectomy in a case of cancer thyroid.

The minimum operation which should be done for a suspected or confirmed cancer is a total lobectomy/hemithyroidectomy in low-risk patients and near total or total thyroidectomy in high-risk patients.

PREOPERATIVE PREPARATION

- **Indirect laryngoscopy:** To identify unsuspected recurrent nerve palsy that may be compensated with a near normal voice particularly when longstanding.
- **X-ray neck (AP and lateral):** Particularly if the thyroid swelling is large. This gives an idea of the airway — the lumen and deviation. It may also demonstrate retrosternal extension of the thyroid. In addition, fine stippled calcification (Psammoma bodies) are suggestive of malignancy as opposed to round egg shell calcification which is more commonly observed in benign multinodular goiters.
- **Base line thyroid function tests (T3/T4/TSH):** Most patients with thyroid cancer are normally euthyroid, thyrotoxic patients must be rendered euthyroid prior to surgery.
- **Serum calcium and sonography of the neck:** In patients undergoing completion thyroidectomy, serum calcium levels provide a baseline. Sonography of the neck is also recommended to visualize residual tissue in the thyroid bed. It is not unusual that patients who have supposedly undergone a hemithyroidectomy have significant residual tissue on the operated side.
- **Consent:** Discuss potential complications with the patient specifically mentioning risk to parathyroid glands and recurrent laryngeal nerve.

PREOPERATIVE WORK-UP

- **Fine needle aspiration cytology (FNAC):** Is the investigation of choice for a solitary thyroid nodule. FNAC is safe, cheap and reliable with sensitivity and specificity both approaching 100%. Thyroid conditions that may be diagnosed by FNAC include papillary carcinoma, medullary carcinoma, anaplastic carcinoma, lymphoma,
colloid nodules and thyroiditis. However, cytology has its limitations in follicular lesions, as it cannot differentiate follicular adenoma from follicular carcinoma since this distinction is based on the presence of capsular or vascular invasion which are not demonstrated on cytology.

- **Isotope scan:** Popular in past, but largely outdated at present. Its role is limited to a nodule in a patient with clinical signs of toxicity.

- **Tumor markers:**
  - Serum calcitonin—for diagnosis and follow-up in medullary cancer.
  - Serum thyroglobulin—a useful tumor marker for follow-up in differentiated thyroid cancer following total thyroidectomy. It has no role in the preoperative work-up towards establishing a diagnosis of cancer except in a patient with bone metastasis and goiter, when FNAC may be inconclusive. A very high thyroglobulin is indicative of a thyroid cancer.

- **CT scan neck/mediastinum:**
  - In differentiated thyroid cancers—routine imaging is not recommended unless involvement of adjacent structures is suspected.
  - In medullary cancer thyroid, as there is a high propensity for nodal involvement including those in the upper mediastinum.

THYROIDECTOMY TECHNIQUE

**Positioning of the Patient**

- The patient should be positioned in the supine position with the arms tucked close to the side.
- An inflatable pillow or shoulder roll is placed under the shoulders so that the neck is extended. The head end of the operative table is raised about 15° to reduce venous congestion.

**Incision**

- The most commonly used incision for thyroid operations is the low “collar” Incision (Figs 19.5A and B).

- The incision should be a symmetrical, transverse incision along the skin crease 2 cm above suprasternal notch. Inexperienced surgeons tend to place the thyroidectomy incision too low, particularly in the long-necked patient. In addition to hampering access to the superior poles of the thyroid gland, an incision placed too low tends to fall onto the chest wall when the patient assumes an erect posture and is cosmetically unsatisfactory. This can be avoided if the incision is marked out with the patient sitting prior to induction of anesthesia. This is especially important in women as anatomic orientation changes when the patient is supine with the neck hyperextended.

- The length of the incision depends on the size of the gland. The usual extent of the incision is from the anterior border of one sternocleidomastoid muscle to that of the other. Larger tumors and patients with short thick neck may need larger incisions for better exposure.

- A vertical extension of the incision towards the mastoid may be taken if neck dissection is contemplated and exposure is limited (Fig. 19.5C). A vertical extension of the incision provides optimal exposure for dissection of the upper jugular and posterior triangle nodes particularly when large.

The skin incision is taken and platysma is divided. Skin hooks are applied and the upper and lower flaps are elevated deep to platysma exposing the fascia covering the strap muscles, the external and anterior jugular veins. The flaps are raised up to thyroid notch and the sternal notch. In most patients, the external jugular veins are employed as lateral boundaries for the incision. Flaps are reflected and wound exposed by stay sutures or by Joll’s retractor.

**Management of Strap Muscles**

The thyroid gland is situated deep to the infrahyoid (strap) muscles, which must be retracted or divided in order to expose the gland. The infrahyoid muscles may be managed in a variety of ways depending on the habitus of the patient, the size of the nodule to be removed, and the requirements of resection.

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Figs 19.5A to C Incision: (A) Line diagram showing incision for thyroidectomy; (B) Incision for thyroidectomy; (C) Extended incision for thyroidectomy and neck dissection
The simplest approach to the thyroid gland is by retraction of the sternohyoid and the sternothyroid muscles laterally after separating them vertically in the midline. In order to obtain maximum exposure, the midline should be exposed and the muscles separated throughout their entire length from the hyoid bone to the sternal notch. The deeper sternothyroid is normally slightly adherent to the thyroid capsule, which can be separated by gentle blunt dissection and retracted laterally. If the sternothyroid muscle does not separate easily from the surface of the thyroid nodule, it is left attached to the nodule. Babcock clamps applied to the muscles and elevated superiorly by assistant may help develop plane between gland and undersurface of muscles.

The sternothyroid muscle inserts on the oblique line of the thyroid cartilage. Because its point of insertion is considerably lower than that of the sternohyoid muscle, the ability to obtain exposure by lateral retraction may be limited, particularly if the lobe or nodule is bulky. Division of a few medial fibers of the sternothyroid muscle helps in better exposure of superior pole.

In cases of extremely large goiters, both sternohyoid and sternothyroid muscle may be divided. In such cases, it is preferable to commence laterally, separating the sternomastoid muscle from the strap muscles. This permits identification and mobilization of the jugular vein and carotid artery away from a bulky thyroid tumor. The muscles are then transected in a lateral to medial direction to safeguard these structures.

In cases where malignant invasion of strap muscles is suspected or there is gross extrathyroidal spread of the tumor, the overlying muscle is resected in continuity.

Having exposed one lobe of the thyroid the same steps are repeated on the opposite side. The opposite thyroid lobe must always be exposed and palpated even if only a hemithyroidectomy is contemplated as malignant thyroid disease is known to be bilateral.

**Initial Mobilization of Gland**

The gland is retracted medially by an assistant applying traction using the middle and index fingers. A gauze swab is used to protect the surface of the gland. A Langenbach’s retractor retracts the previously dissected strap muscles laterally.

The middle thyroid vein is identified and divided. This is the first structure to be divided in thyroid surgery and ensures adequate mobilization of the gland rendering subsequent dissection easier. The vein is however often short and stubby particularly on the right side and care should be taken to avoid inadvertent damage. It is not constant in position and may occasionally be absent or may consist of two or three small insignificant veins. Loose areolar tissue is dissected up to the posterolateral surface of the gland thus mobilizing the gland further medially.

**Identification of the Recurrent Laryngeal Nerve**

One of the most crucial steps in thyroid lobectomy is preservation of the recurrent laryngeal nerve—it is first identified and its safety—ensured. The recurrent laryngeal nerve can be inadvertently damaged during division of either the upper or lower poles and must therefore always be identified early in the operation. As mentioned earlier because of differences in their origin the left recurrent laryngeal nerve ascends in a straight longitudinal direction parallel to the border of the trachea in the tracheoesophageal groove while the right nerve follows a shorter course approaching the larynx at a slight angle. The right recurrent laryngeal nerve is therefore more superficial and hence encountered earlier during dissection than the left.

The nerve is best identified first in its infrathyroidal course where it is least prone to injury.

There are various methods to help early identification of the nerve, the most useful of which are:

- **Relation to inferior thyroid artery**: It is preferable to identify the inferior thyroid artery first which is the only structure to emerge from behind the carotid artery and course horizontally towards the thyroid gland. The nerve usually is below the artery (70%) but may also be above it or within its branches prior to their entry into the thyroid gland; it is used only as a guide to these structures. The artery is never divided prior to identification of the nerve or the parathyroid glands. Once the artery is identified and is traced towards the thyroid gland, the nerve is identified with relative ease.

In case of difficulty identifying the following structures may be of benefit.

- **Lore’s triangle** — bounded by the trachea medially, carotid sheath laterally and the undersurface of the retracted inferior thyroid pole superiorly the apex of the triangle
being directed towards the thoracic inlet. The nerve runs in this triangle.

- Beahr’s triangle (Fig. 19.6)—bounded by the common carotid artery and the inferior thyroid artery. The recurrent laryngeal nerve forms the third boundary of this triangle.
- If the nerve cannot be identified, it may be nonrecurrent. This occurs in 1–2% of cases, usually on the right side. In this case, the nerve arises in the neck directly from the vagus and is found in the paracarotid tunnel where it runs with the inferior thyroid vessels en route to the larynx.

**Localization and Preservation of the Parathyroid Glands**

The parathyroids are not accorded due importance. Their localization and preservation is as important, if not more crucial, as is preservation of the recurrent laryngeal nerve. Failure to safeguard the glands results in severe lifelong morbidity. The location of the glands is discussed in the section on surgical anatomy. The glands are identified by: (1) Their location, (2) the color—darker tan or caramel color compared to surrounding fat, (3) presence of a capsule with a feeding blood vessel. Once identified, it is important to dissect between the parathyroid and the thyroid, the parathyroid being peeled down from the surface of the thyroid. Branches of the inferior thyroid artery are ligated close to capsule of the thyroid preserving the branches to the parathyroid (Capsular ligation—Figure 19.7). The use of bipolar cautery, selectively cauterizing vessels to the thyroid is another option. Use of unipolar cautery is to be avoided.

If the parathyroids have been devascularized or inadvertently removed during surgery, they should be auto-transplanted into the sternocleidomastoid muscle or the muscles of the forearm (in medullary cancer associated with the multiple endocrine neoplasia (MEN) syndrome). The gland is sliced into tiny bits and lodged into a pocket of the muscle.

In case of doubt whether a removed structure is a parathyroid, lymph node or fat—a part of it is sent for frozen section analysis, while the rest is kept in a bowl of sterile isotonic saline. Should frozen section confirm the presence of a parathyroid the preserved portion is transplanted in the manner described.

If frozen section facilities are unavailable, a simple test is to drop the removed structure into a bowl of saline—fat will float while a parathyroid usually sinks.

**KEY POINTS**

- A careful and meticulous dissection should be done to identify the inferior thyroid artery, the recurrent laryngeal nerve and the parathyroids.
- Do not use unipolar diathermy current close to the nerve and parathyroids. Bipolar diathermy is acceptable or else the bleeding points are carefully ligated.
- Anatomical variations are known, do not divide or remove any structure until the nerve and parathyroids identified.

**Mobilization of Superior and Inferior Pole of Thyroid**

This part of the procedure requires adequate traction of the strap muscles lateral to and above the upper pole of the thyroid lobe. Great care must be taken not to injure the external branch of superior laryngeal nerve while clamping the superior thyroid vessels.
This nerve can be exposed by careful dissection at the upper pole of the thyroid in the Joll’s triangle. The nerve descends usually medial to the superior thyroid artery. Often the nerve is not visualized. Injury is best avoided by dissecting the upper pole and thinning the pedicle before transection. The artery clamp is passed from medial to lateral (the nerve is under constant vision) and applied as close to the pole as possible (Figs 19.8 and 19.9). The inferior pole is similarly mobilized after identifying and ligating the inferior thyroid veins. The thyrothymic ligament may need division and this is usually done close to the inferior pole of the gland to avoid damage to the inferior parathyroid which may sometimes be in relation to the upper part of the thymus.

Final Mobilization of the Gland

The thyroid lobe now remains firmly attached to the trachea by the suspensory (Berry’s ligament). The previously identified recurrent laryngeal nerve is followed in its course to its point of entry into the larynx. Branches of the inferior thyroid artery need to be ligated and divided to free the nerve. This is done close to the capsule of the thyroid (Capsular ligation) to safeguard the blood supply to the parathyroids. Truncal ligation of the main inferior thyroid artery away from the gland at its point of emergence below the carotid using non-absorbable suture is a thing of past and not recommended. The most difficult part of the operation is where the nerve is in relation to Berry’s ligament and it is here that it is most likely to be damaged. Careful dissection parallel to its course should safely identify and preserve the nerve. Unnecessary traction should be avoided. Should bleeding occur, gentle pressure and use of bipolar cautery is advised. A small portion of the thyroid may be left back to safeguard the nerve if dissection is difficult (near total thyroidectomy). The suspensory ligament may need to be transected after safeguarding the nerve near its point of entry into the larynx. This is usually done using a fine hemostat.

SPECIAL POINTS FOR THYROIDECTOMY IN CANCER

1. **Incision**: Is the same as for lobectomy but may need to be extended upwards towards the mastoid to facilitate a neck dissection.
2. **Strap muscles**: Strap muscles must be excised if there is doubt of extrathyroidal spread and possible involvement.
3. **Recurrent laryngeal nerves**: Recurrent laryngeal nerve can be sacrificed on one side, if there is a possibility of leaving back gross residual disease in the tracheoesophageal groove.

However, the nerve should only be sacrificed if its removal will ensure the complete resection R0 (R zero means no malignant tissue left) resection and the other nerve has been saved.
4. **Total versus less than total thyroidectomy:** There is considerable controversy in the literature with regards to the extent of thyroidectomy for a differentiated cancer of the thyroid gland. A detailed discussion for and against a total or less than total thyroidectomy is beyond the scope of this chapter. These cancers are classified into low risk (excellent prognosis) and high-risk groups using various tumor and patient criteria.

In general, however, all patients with follicular thyroid carcinoma and in those patients with papillary thyroid carcinoma either larger than 1 cm to 1.5 cm or with lymph node metastasis (high-risk group) a total or near total thyroidectomy is the preferred treatment with a decreased likelihood of recurrence and mortality. If the cancer is less than 1 cm to 1.5 cm in a young patient <40 years with no extrathyroidal spread (low-risk group), a hemithyroidectomy is sufficient with a 30 years mortality rate less than 3%.

5. **Dissection:** Non-involved or the less involved side must always be operated first and the recurrent laryngeal nerve and parathyroids saved.

6. **Parathyroids:** An effort to save a minimum of two parathyroids with an intact blood supply must be made. A small slice of thyroid may be left (near total thyroidectomy) to preserve the blood supply to a parathyroid.

7. **Mediastinal split:** A mediastinal split is rarely required. The thyroid usually carries its blood supply from the neck and most retrosternal goiters can be delivered from above. Mediastinal lymph nodes of differentiated thyroid cancer can also usually be removed adequately from the neck. The only real indication for a mediastinal split is to clear mediastinal nodes in medullary thyroid cancer—however, the surgeon must be sure that there is no metastatic spread elsewhere (lung, bone, liver).

8. **Trachea:** Tracheal involvement is not unusual in thyroid cancer. Most often the disease can be shaved off the trachea. However, invasive disease particularly if associated with cartilage erosion seen on CT scan requires excision. If localized wedge resection of the trachea is possible, the defect can be closed primarily. If primary closure is not possible then the opening, if anterior, is treated as a tracheostomy and closure is achieved by subsequent decannulation. More extensive resection requires resection and end-to-end anastomosis.

9. **Nodes:** There is no role for prophylactic neck dissection in differentiated thyroid cancer. Typically patients with primary thyroid carcinoma should have an ipsilateral central compartment node clearance (nodes along the recurrent laryngeal nerve). This is because reoperations in this area are more difficult and associated with higher risk of complications. The lateral neck is inspected (jugular nodes) and suspicious nodes sampled and sent for frozen section evaluation. If positive a modified neck dissection preserving the internal jugular vein, sternocleidomastoid muscle and the spinal accessory nerve is performed. There is no role for “Berry picking”, i.e. removal of only grossly positive nodes. This is because inadequately treated neck metastasis increases the risk for subsequent nodal recurrences, necessitating surgery and thereby contributing to increased morbidity.

10. **Medullary cancer:** Given the higher frequency of microscopic tumor spread in medullary carcinomas (50%) and the inability of these tumors to take up iodine, elective central compartment lymph node dissection is performed. Central compartment clearance in this case differs from that for differentiated thyroid cancers with fibrofatty and lymphatic tissues being cleared from the hyoid to the innominate artery below and laterally from one carotid artery to the other. Ipsilateral modified neck dissection/radical neck dissection is performed for lateral cervical adenopathy depending on the size of the nodes and involvement of surrounding structures.

**POSTOPERATIVE COMPLICATIONS**

- **Hemorrhage:** Bleeding is a serious complication following thyroidectomy. Significant hemorrhage usually occurs due to the slipping of a ligature. With the advent of suction drainage, a hematoma causing pressure on the trachea with respiratory obstruction is rarely seen. Nevertheless it should be treated as an emergency and the patient returned to the operating rooms for evacuation of the hematoma and control of the bleeding.

- **Vocal cord palsy:** Unilateral iatrogenic cord palsy usually requires no active intervention manifesting as a hoarse or breathy voice. The opposite cord compensates with time and voice usually returns to normal in a couple of months. Occasionally, a medialization procedure may be required in cases where opposite cord compensation is inadequate. Bilateral cord palsy is rarely seen but must be kept in mind in infiltrative thyroid cancers involving both tracheoesophageal grooves. This manifests as respiratory stridor and may necessitate an emergency tracheostomy.

- **Respiratory obstruction:** Is a rare complication these days and is usually seen in patients who have significant tracheal compression prior to surgery. The denuded trachea may collapse or kink following surgery. If this complication is anticipated, the patient is left intubated following surgery. An attempt at extubation is made 48–72 hours later taking all precautions and keeping the tracheostomy as standby.

- **Hypocalcemia:** This is the most morbid of all complication following thyroid surgery with an incidence of 0 to 25% depending on the expertise of the operating surgeon. It is largely preventable with meticulous dissection during surgery. It is usually transient due to vascular insufficiency...
to the parathyroid glands. This commonly occurs 24 to 48 hours following total thyroidectomy and infrequently requires treatment. Symptomatic patients should be treated with intravenous calcium initially which can be gradually tapered off. Permanent hypoparathyroidism would require calcium supplementation along with vitamin D over longer periods of time. Hypocalcemia beyond 6 months is likely to be permanent. Patients with refractory hypocalcemia may require magnesium supplementation as well.

- **Hypocalcemic tetany**: Is a medical emergency that is treated with slow intravenous administration of 10 mL of 10% calcium gluconate over 10 minutes. Subsequently a continuous infusion of calcium gluconate at the rate of 1 mL/kg is started to maintain the serum calcium level at 8–9 mg/dL.