INTRODUCTION

- Approximately 8 percent of the population have nodular thyroid disease and, of these, half are solitary nodules.
- Thyroid nodules are more common in women and increase in frequency with age
- 10 percent of solitary nodules with cancer

SURGICAL ANATOMY

- Thyroid gland is an endocrine gland regulating BMR, Somatic and Psychic growth and plays important role in calcium metabolism.
- The thyroid gland is made up of two lateral lobes, which extend from the sides of the thyroid cartilage down to the sixth tracheal ring. **Vertebral levels C5,C6, C7 T1 and tracheal rings till 6th.**
- These are joined together in the midline by the isthmus, which overlies the second to fourth tracheal rings.
- Measures **5cm x 2.5cm x 2.5 cm** and isthmus **1.2 x 1.2cm** and weighs about **25gm**.
- Capsule ➔ True and false. True is peripheral condensation of CT of gland and false is Pretracheal fascia.
- Pretracheal fascia thick on inner surface of gland where it forms a **suspensory ligament of berry** which connects lobe to cricoid cartilage.
- In addition, there is often a **pyramidal lobe** which projects up from the isthmus, **usually on the left-hand side**.
- The gland is enclosed in the pretracheal fascia, covered by the strap muscles and overlapped laterally by the SCM muscles.
- The anterior jugular veins cross over the isthmus.
- On the deep aspect of the gland lie the larynx and the trachea with the pharynx and oesophagus behind and the carotid sheath laterally.
- On either side, there are two important nerves. These are the external branch of the superior laryngeal nerve and the recurrent laryngeal nerve, and both lie in close proximity to the gland and its blood supply.
- The external branch of the superior laryngeal nerve lies deep to the upper pole of the gland as it passes to the cricothyroid muscle in the sternothyroaryngeal (Joll's) triangle.
- **JOLL's triangle (Sternothyroaryngeal triangle)** is formed **LATERALLY** by the **upper pole of the gland and the superior thyroid vessels**, **SUPERIORLY** by the attachment of the strap muscles and deep investing layer of fascia to the hyoid and **MEDIANLY** by the midline.
- Its **FLOOR** is the cricothyroid muscle, while its **CONTENTS** are usually the external laryngeal nerve running on cricothyroid and its **ROOF** the strap muscles.
- The recurrent laryngeal nerves run in the tracheo-oesophageal groove and can be in front of, behind or indeed between the branches of the inferior thyroid arteries. This relationship has been used in the past as a method to identify the nerves, but is not usually relied on nowadays.
- The **Inferior thyroid artery** arises from the **thyrocervical trunk** which is a branch of the first part of the subclavian.
It then pierces the prevertebral fascia medial to the carotid sheath to enter the posterior part of the thyroid gland.

At surgery, before any branch of the inferior thyroid artery is divided, the recurrent laryngeal nerve must be identified.

**BEAHR’s Triangle** ➔ Common carotid, Inferior thyroid vessels and RLN

Left side RLN around aortic arch and Right side around Subclavian artery

On the right side, it is important to remember that in approximately 2 percent of patients, the nerve may be non-recurrent and is then found more superiorly in the paracarotid tunnel where it runs with the inferior thyroid vessels en route to the larynx.

There may be extralaryngeal divisions as far as 3-4 cm below the inferior border of the cricoid cartilage.

Venous drainage ➔ Upper, Middle and 4th Vein of Kocher ➔ drain in IJV

Inferior thyroid artery drains into Brachiocephalic vein.

The parathyroid glands lie outside the thyroid capsule beneath the Pretracheal fascia (i.e. between true and false fascia)

Blood supply to **both superior and inferior parathyroid gland** ➔ Inferior thyroid artery.

The **superior glands are more constant** in their location and usually lie near the cricothyroid joint close to the recurrent laryngeal nerve, cephalic to the inferior thyroid artery.

The inferior glands are often more variable in their location, being **caudal to where the recurrent laryngeal nerve and the inferior thyroid artery cross at the apex of Beahrs’ triangle**. The inferior parathyroid glands are found in and around the lower pole of the thyroid gland

Healthy parathyroid usually measures on average just under $1 \text{ cm}^3$ and is usually oval, varying in colour from light yellow in older patients to a reddish brownish colour in younger ones.

**GOITRE**

Goitre is a relatively imprecise term, which means the clinical observation of an enlarged thyroid gland.

WHO defined goitre as 'a thyroid whose lateral lobes have a volume greater than the terminal phalanges of the thumb of the person being examined

Goitre can be broadly divided into several entities which include goitre in iodine-deficient areas, goitre in iodine-replete areas and thyroid cancer.

Nonmalignant goitres have been classified in the past as simple, nodular or multinodular on pathological grounds.

Simple goiters can form nodules in due course

$F > M = 3:1$
IODINE-DEFICIENT GOITRE

- WHO identifying 7 percent of the world's population as suffering from clinically apparent goiter.
- The goitre is in response to the persisting stimulation of the thyroid by mildly elevated TSH and represents **functional glandular hyperplasia**.
- Goitre is **endemic** when the average ingested iodine is **< 50 µg/day** and **at less than 25 µg/day** of iodine children are at risk of **cretinism**.
- The features of cretinism are mental and growth retardation, thickened skin and tongue. Sometimes there is deaf mutism and spastic diplegia.

IODINE-SUFFICIENT GOITRE

- Premenopausal women and can be physiological in pregnancy.
- The thyroids were assessed and broadly divided into **Normal, Palpable Goitre and Visible goitre**.
- The factors predisposing to goitre formation in iodine replete areas are as follows:
  - Genetic factors
  - Goitrogens: Thiocyanates, isothiocyanates like cassava, maize, sweet potatoes, cigarette smoking, Goitrin, flavinoids like (brassica seeds, millet)
  - Drugs:
    - Amidarone, lithium and antithyroid drugs;
  - Autoimmune thyroid disease.

GENETIC

- **Pendred syndrome** (defect in pendrin gene) ➔ Congenital SNHL with **Mondini** cochlea + Euthyroid goitre
- It has long been recognized that goitre, hyperthyroidism and thyroid cancer have a tendency to occur in many members of the same family.
- A locus on **chromosome 14q** is linked to familial nontoxic multinodular goitre and this is close to a Graves’ disease susceptibility locus.

GOITROGENS

- These predominantly **interfere with iodide transport**, organification of iodide and release of hormone. Goitrogens are present in maize, sweet potatoes and cigarette smoke.
- Amidarone, lithium and carbimazole

GROWTH FACTORS

- Several important growth factors have been identified in the thyroid. The most obvious is the hormone, TSH, which promotes growth in human thyroid cells, but other important cytokines include fibroblast growth factor (**FGF**), epidermal growth factor (**EGF**) and insulin-like growth factor (**IGF**). **Angiogenic growth factors** are also essential for the formation of a large goitre.
THYROID CANCER

- Thyroid cancer is the most common endocrine tumour.
- Most common way for it to present is as a solitary thyroid nodule in a Euthyroid patient when the incidence of malignancy is between **10 and 20 percent**.
- F:M = 4:1
- Rare below 16yrs.
- The median age of diagnosis in most series is between 40 and 50 years.
- **PREDISPOSING FACTORS** for thyroid malignancy include:
  - Prolonged stimulation by elevated TSH
  - Solitary thyroid nodule;
  - Ionizing radiation;
  - Genetic factors;
  - Chronic lymphocytic thyroiditis.

MOLECULAR GENETICS OF THYROID CANCER

- Most malignant thyroid tumours have a monoclonal origin, suggesting that genetic events in a single cell account for their development. These nonprogrammed events may involve the activation of oncogenes, or the inactivation of tumour suppressor genes.
- **Ret** is a proto-oncogene located at chromosome 10q11 which encodes a transmembrane tyrosine kinase receptor.
- Ret has been identified principally in papillary cancer (PTC) and several mutations have been identified. These have been labelled Ret/PTC1-5.
- Ret mutation is restricted to thyroid carcinomas of the papillary subtype and is found at high frequency in small papillary carcinomas, suggesting that the Ret mutation can be an early event in thyroid tumorigenesis.
- **RAS**
  - RAS genes encode a signaling protein
  - RAS mutations are equally prevalent (around 50 percent) in thyroid adenomas, follicular carcinomas and anaplastic tumours, but are less common in papillary thyroid cancer.
- **trk and met**
  - trk is an oncogene, located on chromosome 1, which codes for a transmembrane tyrosine kinase receptor
  - Both trk, met is mutated in 10-25 percent of papillary carcinomas.
- **GoS and gsp**
  - TSH increases cAMP
  - Mutation in GoS leads to increase in cAMP.
  - Although, cAMP is growth stimulatory and might be expected to be a potent oncogenic agent, both TSH-receptor and gsp mutations have a low prevalence in thyroid tumours

**TUMOUR SUPPRESSOR GENES**

- **p53** mutations rare except in anaplastic carcinomas,
- p53 inactivation may be a key event in progression from differentiated to anaplastic carcinoma.
Radiation

- Low-dose ionizing radiation is a well-recognized aetiological factor in differentiated thyroid cancer.
- DNA major target
- Radiation induces tumours are usually multifocal.
- **Radiation-associated thyroid cancer** is usually well differentiated and the majority of lesions are papillary.

**FAMILY HISTORY**

- Patients with **Gardner's syndrome** or **familial adenomatous polyposis coli** have a 100-fold increased risk of developing papillary thyroid carcinoma, with its characteristic multifocality.
- Medullary thyroid carcinoma arises from the parafollicular C cells and accounts for 5 percent of thyroid cancers. The majority are sporadic, although patients should be screened for one of the multiple endocrine neoplasm (MEN) syndromes.

*(MEN 1 = WERMER'S SYNDROME):*

**Hyperparathyroidism + Pituitary adenoma (Prolactinoma) + Pancreatic islet cell tumour**

**MEN 2A = SIPPLE**

- AD with complete penetrance but variable expression

**Hyperparathyroidism + Medullary Carcinoma of Thyroid + Pheochromocytoma + Hirchsprungs disease + Amyloidosis**

- Medullary cancer develops in all affected family members and is usually detectable by the second decade of life.
- In patients with known familial disease, the genetic mutation on the Ret oncogene should be sought.
- **MEN 2B (Wagenmann–Froboese syndrome)** is characterized by a more aggressive medullary thyroid cancer, pheochromocytoma, a Marfanoid appearance with multiple mucosal neuromas affecting the lips, tongue and oropharynx, and ganglioneuromas of the gastrointestinal tract, lack of tears, craniosynostosis, myopathy.

**PRE-EXISTING THYROID DISEASE**

- Thyroid lymphoma occurs against a background of autoimmune lymphocytic thyroiditis (Hashimoto's disease).

**DIETARY IODINE CONSUMPTION**

- **Low iodine areas have a relatively higher incidence of follicular and anaplastic tumours, whereas high iodine areas have a higher incidence of papillary cancer.**
- Malignancy cannot usually be excluded by cytological or microscopic patterns, but is diagnosed by capsular or vascular invasion.
- Malignant tumours of the thyroid gland can originate from any of the cellular components of the gland follicular and parafollicular cells, lymphoid cells and stromal cells.
Follicular  ➔ Papillary Ca, Follicular Ca, Anaplastic Ca
The only known neoplasm of parafollicular cell origin is the medullary carcinoma

**PAPILLARY ADENOCARCINOMA**

- Papillary adenocarcinoma accounts for 80 percent of thyroid malignancy.

**Only thyroid cancer of children**

- Most commonly between 40 to 49 years.
- Presents as solitary nodule of thyroid.
- Macroscopically, it is a **firm** and **unencapsulated** tumour which is **sharply circumscribed by the surrounding normal thyroid tissue**.
- It is **multicentric** in 80 percent of cases and frequently involves both lobes.
- Referred as micro adenoma if < 1 cm in diameter.

**TYPES**:

- **Intrathyroidal** tumours ➔ measure greater than 1 cm, but are confined to the gland while **extrathyroidal** tumours ➔ extend outside the capsule of the gland to involve the soft tissues of the neck or regional lymph nodes.

**HISTOLOGICALLY** these cancers are divided into **pure papillary**, **mixed papillary-follicular** and the **follicular variant of papillary carcinoma**.

- Mixed pattern is most common with pure papillary least common.
- The papillary component is characterized by a fibrous stalk with a periphery of follicular epithelium. Laminated calcifications called 'Psammoma bodies' are often found in the stalk region.
- The biological behavior and prognosis for all three types is the same. The features of papillary carcinoma are as follows.

**HISTOLOGICAL VARIANTS INCLUDE:**

- Papillary micro carcinoma –
  - Occult sclerosing
  - Occult papillary
    - < 1 cm (WHO definition)
    - 4-30 percent incidence at autopsy

- Encapsulated papillary carcinoma:
  - 10 percent of all papillary tumours;
  - 25 percent associated with nodal metastases.

- Follicular variant of papillary carcinoma
  - Typical papillary cytology
- Tall cell and columnar –
  - Older patients, bigger more aggressive tumours
  - Vascular and extrathyroid invasion common
  - Associated with a worse prognosis.
- High incidence of lymph node metastasis
- Young adults affected F:M = 3:1
- Nodal enlargement at presentation.
- One in five patients have pulmonary metastases at presentation.
- In the older age groups, the tumour tends to behave in a more aggressive fashion and may invade the larynx and trachea.
- 10 yr survival for Intrathyroidal – 90% but for extrathyroidal is only 60%.

**FOLLICULAR ADENOCARCINOMA**
- 50 and 59 years, and seldom being seen under the age of 30 years.
- 10-20 percent of all cases of thyroid malignancy.
- Follicular carcinoma most commonly presents as a solitary thyroid nodule
- Alternatively follicular cancers may present with symptoms or signs of metastases.
- Bone involvement seen (in papillary it was not seen)
- Lymph node involvement is less common (about 10 percent)
- Typically, follicular cancer has a well-defined capsule and cases can be divided into TWO SUBGROUPS depending on whether the capsule is breached or not.
- Histologically, it is a carcinoma composed of follicles with no papillary structures.
- No Psammoma bodies
- Although follicular neoplasms can be identified on fine needle aspiration (FNA) cytology, it is generally not possible to distinguish an adenoma from a carcinoma.
- Histological features of malignancy include capsular and vascular invasion.

**HURTHLE CELL TUMOURS**
- The Hurthle cell, which is also known as the Eosinophilic cell, Oncocyte or Oxyphilic cell. (EOO)
- It is derived from follicular epithelium and possesses a limited ability to produce thyroglobulin, but does not usually concentrate iodine.
- Hurthle cells are found in nodular goitres, chronic lymphocytic thyroiditis, diffuse toxic goitre, after radiation and chemotherapy, as part of the ageing process, as well as in Hurthle cell adenomas and carcinomas.
- Hurthle cell tumours are extremely uncommon
- Some authors to recommend TOTAL THYROIDECTOMY for all Hurthle cell tumours more than 2 cm in size.

**MEDULLARY CARCINOMA OF THYROID**
- Medullary thyroid carcinoma (MTC) accounts for about 5 percent of all cases of thyroid malignancy.
- It may occur as part of the MEN syndrome, as familial non-MEN disease or it be sporadic.
- Sporadic MTC ➔ Unifocal
- MEN asso MTC ➔ Bilateral and multifocal.
Cervical node metastases occur in up to 50 percent of cases.

Medullary cancers arise from the parafollicular or C cells which secrete Calcitonin, which is a valuable tumour marker.

Medullary carcinoma of the thyroid can be of several types:
• MEN 2A;
• MEN 2B;
• Familial non-MEN;
• Sporadic.

Macrosopically, the tumour is grey or white with a gritty texture and areas of haemorrhage, necrosis, fibrosis and calcification.

Histologically, it consists of uniform, spindle-shaped cells within a variable fibrous stroma which may contain amyloid.

LYMPHOMA

They usually present as a rapidly increasing swelling of the neck in elderly women. This clinical presentation can be very similar to that of anaplastic thyroid carcinoma and so histological confirmation of the diagnosis is necessary. Immunocytochemistry is essential to distinguish the two diseases.

The response to treatment and prognosis of lymphoma is excellent and very much better than that of anaplastic cancer.

Grossly, most thyroid lymphomas appear as large grey fleshy masses, often extending outside the capsule.

Histologically, the majority of lymphomas are high-grade B cell non-Hodgkin's lymphomas.

ANAPLASTIC CANCERS

Anaplastic tumours are more common in the elderly and in women

Increases in size rapidly and is associated with OTALGIA, HOARSENESS AND STRIDOR.

They are aggressively malignant, have a high metastatic potential and rapidly invade surrounding structures, such as the larynx, pharynx and oesophagus.

Majority of patients die within one year of presentation

HISTOLOGICALLY ➔ Uncommon small cell carcinoma AND Giant cell or spindle cell carcinoma

If metastatic neoplasms from other sites involve the thyroid, the most common sources are the kidney and breast.

CLINICAL ASSESSMENT

HISTORY

The majority of patients with thyroid tumours will present with a solitary thyroid nodule

A truly solitary thyroid nodule in a patient under 30 years of age has a 10-20 percent chance of malignancy. Of the ones that are malignant, up to 80 percent may have cervical lymph node micro metastases.

The incidence of anaplastic thyroid cancer increases after the age of 50 years.
The presenting symptoms of thyroid tumours are:
- Solitary thyroid nodule
- Cervical lymphadenopathy
- Rapidly enlarging goitre
- Pain in the neck
- Stridor due to tracheal compression
- Dysphagia due to oesophageal compression
- Hoarseness due to vocal cord palsy
- Distant metastases

**EXAMINATION**
- Surgery book

**RADIOLOGY**
- Look for micro calcifications, Psammoma bodies (papillary ca of thyroid), distant mets.
- The appearance of a rim or eggshell calcification suggests a benign lesion.
- Bilateral calcification at the upper lateral portion of the gland suggests medullary carcinoma, whereas heavy irregular calcification suggests a multinodular goitre.
- An ultrasound is helpful in measuring tumour size, diagnosing multinodular goitres and excluding contralateral disease.
- **COLD NODULE** indicates malignancy but very non specific.
- Only rarely is a cystic nodule associated with thyroid cancer
- Fibreoptic endoscopy to look for vocal cord paralysis
- Majority of nodules greater than 5 mm in diameter can be visualized on Tc99 scintigraphy. (T121 is best)
- More than 90 percent of lesions identified will not concentrate the radionuclide ( 'cold' nodules). These clinically solitary nonfunctional nodules may be an adenoma, a carcinoma, a cyst, a dominant nodule in a palpable multinodular goitre
- The likelihood of malignancy in a 'cold' nodule is only about 20 percent.
- If a cyst has been excluded on ultrasound, then the likelihood of a solid cold nodule being malignant rises to about 50 percent.
- In suspected MEN syndrome MIBG scanning done.
- Computed tomography of the neck and thorax

**LABORATORY INVESTIGATIONS**
- T3, T4, TSH, Serum calcium, Thyroid antibodies, Calcitonin (if MTC suspected)
- Preoperative measurement of thyroglobulin is not usually helpful unless the patient has had previous treatment
- FNAC → not possible to distinguish between benign and malignant follicular neoplasms.
- FNA should not be relied upon to exclude a malignancy in Patients with a history of radiation exposure, because a cancer may be present in up to 40 percent of cases) is often multifocal and can easily be missed by aspiration cytology.
**PROGNOSTIC FACTORS**

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<th>Prognostic factors associated with differentiated thyroid cancer</th>
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- Women prog better
- Age < 45 yrs better
- The tall cell variant of papillary carcinoma is particularly aggressive
- Papillary fare better than follicular
- Worse Medullary.

**INM classification for carcinoma of the thyroid gland.**

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- **ANAPLASTIC CARCINOMA HAS ONLY T4a and T4b stages.** Intrathyroidal is T4a and Extra is T4b
- **Another thing to notice only N1a and N1b 😊😊**
TREATMENT

- Treatment modalities for thyroid malignancy include:
  - Surgery
  - Radioactive iodine
  - External beam radiotherapy
  - Thyroxine therapy
  - Chemotherapy.

SURGERY:

- The risk stratification treatment based on the TNM classification (gender included) is:
  - Age
  - Gender
  - Tumour size
  - Tumour histology
  - Nodal and distant metastases.
  - Solitary papillary cancers measuring less than 1.0 cm and which are surrounded by an adequate cuff of normal thyroid tissue, in the absence of multi focality and cervical or distant metastases, can be safely treated by unilateral lobectomy, TSH suppression with thyroxine and sequential thyroglobulin measurements. Recommended Near-total or total thyroidectomy for papillary microcarcinoma.
  - TUMOURS OF ISTHMUS \( \Rightarrow \) < 1 cm size = Isthmectomy with 1 cm margin BUT if > 1cm then near total thyroidectomy. (NTT)
  - This means that for many patients, the operation of choice is a total thyroidectomy with parathyroid preservation.
  - In the clinically N\(_0\) neck, level VI should be routinely dissected in high-risk patients and levels II-V and VII palpated at the time of surgery. Suspicious nodes can be subjected to frozen section and, if
involved, a selective neck dissection (at least levels III, IV and lower V below the accessory nerve) should be performed with preservation of the sternomastoid muscle, internal jugular vein and the accessory nerve.

**FOLLICULAR CARCINOMA**

- The management of follicular carcinoma is similar to that of papillary tumours.
- > 1cm → Near total or total thyroidectomy ± radioactive Iodine therapy + routine thyroglobulin level measurement.
- Haematogenous spread is more common with follicular than with papillary carcinoma. The most frequently affected sites are lung and bone.
- About half of those receiving radioiodine for pulmonary deposits alone will survive for 10 or 15 years. The prognosis is, however, much worse for those with osseous disease and in patients whose tumours fail to concentrate radioactive iodine and are often aggressive.
- Hurthle cell cancers should be managed as follicular cancers but tend to be more aggressive and uptake of radioiodine is less common

**MEDULLARY CARCINOMA**

- The principal treatment is surgery.
- Rule out MEN syndrome
- Thymus usually removed as well
- The surgery should be radical and involve at least a total thyroidectomy and elective, selective level 6 and 7 neck dissection, from the level of the hyoid bone down to the brachiocephalic vein.
- Palpable neck disease usually requires modified radical or radical neck dissection
- LIKE HURTHLE Cell tumour they do not accumulate radioiodine
- POSTOPERATIVE RADIOTHERAPY is indicated if there is any suggestion of macroscopic residual disease in the neck and/or multiple large nodal metastases with extracapsular extension.
- Patients with disease considered inoperable either due to the advanced nature of the primary tumour or nodal disease, or because of serious intercurrent illness, should be considered for radiotherapy.
- Though more chemosensitive than Follicular neoplasms, no routine regimen there.
- A proportion of medullary thyroid cancers take up MIBG and I\(^{131}\)MIBG therapy is a possible treatment for recurrent or metastatic disease untreatable by other modalities.
- Ret gene mutation (if absent then chances of MEN2A is near impossible)
- The finding of multiple foci of tumours together with definite 'C' cell hyperplasia virtually guarantees the diagnosis of familial disease
- If genetic abnormality found then other family members should be screened

**THYROID LYMPHOMA**

- There are a number of investigations that are essential for staging thyroid lymphoma and these are as follows:
  - TFT
  - Thyroid antibodies
  - FNAC and open biopsy (or tru-cut)
Rx is principally **Radiotherapy**

**Surgical removal of bulky disease** has been shown to improve both local control and survival in patients with thyroid lymphoma.

Patients with high-grade tumours and more advanced disease should receive appropriate chemotherapy. The prognosis for patients with thyroid lymphoma is usually excellent.

### ANAPLASTIC TUMOURS

- A biopsy is mandatory to confirm that a patient suspected of having an anaplastic carcinoma does not have lymphoma which may be curable.
- **Tracheostomy** may be required
- **SURGERY & RADIOIODINE HAVE NO ROLE IN ANAPLASTIC TUMOURS**

Regression may be achieved by radical radiotherapy, but early recurrence is common and usually leads to death within 6-12 months.

Even chemo not recommended.

### THYROID LOBECTOMY

- **INCISION**
  - Neck extended with shoulder bag in place
  - A collar incision placed 2 cm above sterna notch → Skin platysma cut through → flap elevated till upper part of thyroid cartilage and down till sterna notch

### GLAND MOBILIZATION

- Flap elevation → Deep investing layer of fascia divided → Anterior jugular veins may be ligated → gland mobilized from strap muscles (if division of strap muscles required then it should be done high up as **Ansa cervicalis** i.e. nerve supply of Straps enters from lower down)
- Next middle thyroid vein located and ligated
- Now access the paracarotid tunnel, retract the carotid artery laterally and the thyroid medially to identify the posterior capsule of the gland and Beahrs’ triangle (common carotid, inferior thyroid artery and RLN)
- Preserve RLN with both parathyroid glands.
- RLN in TE groove and forms boundary of BEAHR’s triangle.
- Right RLN encountered earlier than left.
Before entering the larynx, the nerve may divide into two or three branches which should be identified and preserved. One of these branches is usually a sensory branch (THE LOOP OF GALEN).

If the recurrent laryngeal nerve cannot be identified, it may be non recurrent. This occurs in 1-2 percent of cases on the right side.

The nerve is located running with the inferior thyroid vessels and is preserved in the conventional manner.

LOCALIZATION AND PRESERVATION OF THE PARATHYROID GLANDS

Once the parathyroids have been localized, they are peeled off the thyroid together with their blood supply and pretracheal fascia.

Devascularized parathyroids should be transplanted into the sternomastoid muscle.
Lower parathyroid is particularly vulnerable to ischemia, so there should be a low threshold to transplant it.

MOBILIZATION OF THE UPPER AND LOWER POLES

Once the recurrent laryngeal nerve has been identified, the gland should be mobilized top and bottom.

Superior thyroid vessels ligated close to the gland.

The external branch of the superior laryngeal nerve should be identified and preserved as it runs in Joll's triangle. medial to the upper pole vessels where it lies on cricothyroid.

REMOVAL OF THE GLAND

Bipolar diathermy is perfectly acceptable to use near the nerve, otherwise tie all bleeding points.

Once the gland is mobilized, the whole lobe can be swung medially. The inferior thyroid artery is preserved, together with its parathyroid branches.

Berry’s ligament is dissected by sharp dissection.

TOTAL THYROIDECTOMY FOR CANCER

Same Incision ➔ Divide straps (superiorly) ➔ Preserve both RLN’s ➔ Operate noninvolved side first ➔ Tumour ideally should be peeled off the nerve (the microdeposits left should be managed by Radio Iodine) ➔ if nerve involved resect ➔ Try preserving atleast 2 parathyroids ➔ level 6 LN dissection ➔ Neck disease requires at least a selective neck dissection (levels II-V) ➔ The sternomastoid muscle is preserved and the dissection may be performed with it intact by dividing its lower attachments and resuturing the muscle at the end of the operation. This does not seem to cause any longterm sequelae.

If disease just on to the larynx then can shave it off, if larynx involved then have do total laryngectomy.

Similarly look for inv of trachea, oesophagus, pharynx etc.

The internal jugular vein is the most common vessel involved and can be resected in the conventional way.
POSTOP

- Look for airway compromise or bleeding
- Ca levels
- TFT 6 weeks following Sx.
- Thyroxine started immediately unless Radioiodine ablation planned in next month.

COMPLICATIONS FOLLOWING THYROID SURGERY

EARLY

- Haemorrhage
- Voice change
- Airway obstruction
- Temporary Hypoparathyroidism

INTERMEDIATE

- Seroma
- Infection
- Wound dehisecence
- Temp palsy of RLN, SLN

LATE

- Subclinical Hypothyroidism
- Permanent hypothyroidism
- Permanent RLN, ELN palsy
- Poor Scar

The mechanisms for intraoperative recurrent laryngeal nerve injury include:

- Division
- Laceration
- Stretching or traction
- Pressure
- Crush
- Electrical
- Heat
- Ligature entrapment
- Ischaemia
- Nerve manipulation

Two common sites for bleeding after thyroidectomy are the inferior thyroid veins and the branches of the inferior thyroid artery in the vicinity of the recurrent laryngeal nerve (triangle of concern).

PAEDIATRIC THYROID CANCER

- Thyroid cancer in children is rare and the most common histological type is papillary carcinoma
- Nodules in children are more likely to be malignant and previous radiation exposure is a significant risk factor.
- Children aged ten years or less tend to have a more aggressive disease.
- A total thyroidectomy and level 6 neck dissection is usually recommended for most patients, and the presence of clinically positive neck disease indicates the need for selective neck dissection removing nodes from at least levels IIa to Vb.
- Lifelong follow-up is advised.

**RADIOACTIVE IODINE**

- The rationale for using postoperative radioiodine ablation is that it destroys both normal tissue, as well as microscopic foci of carcinoma cells within the thyroid remnant, which thereby reduces the risk of local recurrence and prolongs survival.
- In addition, it can aid the interpretation of serum thyroglobulin measurements during the follow-up period and it also facilitates detection and early treatment of persistent or metastatic disease in the absence of remaining normal tissue.

**RADIO IODINE TREATMENT**

- The usual ablation dose is approximately 3 GBq.
- A post ablation scan should be performed three to five days following the treatment dose.
- A diagnostic radioiodine scan is usually performed 6 months following ablation. In selected cases with aggressive disease, this may be performed sooner.
- If clear, no further scans required and follow-up is with serial thyroglobulin measurements and suppressive thyroxine replacement therapy.
- Before the diagnostic scan, patients should switch from T4 to T3 replacement which is stopped two weeks before imaging. Alternatively, the scan may be carried out using recombinant TSH.
- Women should not become pregnant for a minimum period of four months after treatment and pregnancy should be deferred for at least six months after high-dose I\textsubscript{131} therapy.
- In men, the four-month period is also applicable since this allows for the life span of a sperm cell and pretreatment sperm banking should be considered in men likely to have more than two doses of radioiodine therapy.
- Radiation fibrosis can occur in patients who have had diffuse pulmonary metastatic disease treated with repeated therapy doses of radioiodine.
- T3 is given as 20µg TDS (min 2 weeks before I\textsubscript{131} treatment)
- Normal means Thyroglobulin < 15 µg
Dose of T4 thyroxine, which is adequate to suppress TSH levels (usually 200-250 µg daily).

**SERUM THYROGLOBULIN MEASUREMENTS**

- Serum thyroglobulin is a useful and specific tumour marker which is produced by normal and neoplastic thyroid tissue and which is, in part, dependent on TSH.
- Its diagnostic sensitivity is enhanced by an elevated serum TSH.
- Recombinant human TSH has been recently introduced and approved for use in the USA and Europe as an alternative to thyroid hormone withdrawal when performing diagnostic whole body I\(^{131}\) scans.
- In those patients known to have antithyroglobulin antibodies which interfere with the thyroglobulin assay, it may be preferable to perform a diagnostic whole body radioiodine scan after thyroid hormone withdrawal rather than use recombinant TSH.
- Absolute indications for recombinant TSH include:
  - Hypopituitarism
  - Severe ischemic heart disease
  - Previous history of a psychiatric disturbance
  - Advanced disease or frailty
  - Functional metastases with suppression of the TSH.
- There is no maximum limit to the cumulative dose of I\(^{131}\) that can be given to patients who have persistent disease. Solitary bone metastases should be treated with a combination of orthopaedic intervention, I\(^{131}\) and external beam radiotherapy.