KREP 2025

KARNATAKA RADIOLOGY EDUCATION PROGRAM

Anatomy and Applied Radiology Thyroid – 1

Thyroid

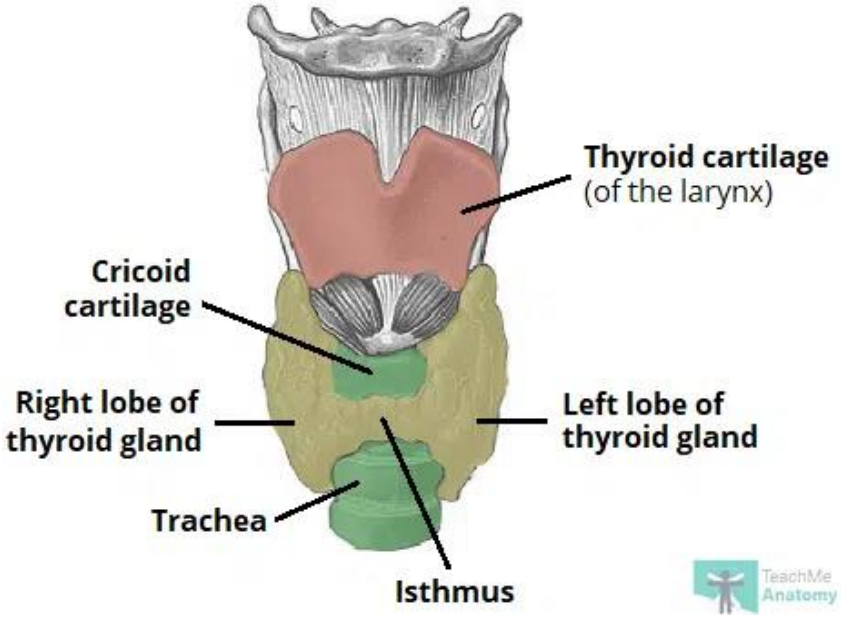
The thyroid gland, a butterfly-shaped organ in the anterior neck, is a vital endocrine gland that produces hormones, primarily T3 and T4, regulating metabolism, growth, and development, and also secretes calcitonin for calcium homeostasis.

Anatomy:

Location:

The thyroid gland is located in the anterior neck and spans the C5-T1 vertebrae. It consists of two lobes (left and right), which are connected by a central isthmus anteriorly – this produces a butterfly-shape appearance.

The lobes of the thyroid gland are wrapped around the cricoid cartilage and superior rings of the trachea. The gland is located within the visceral compartment of the neck (along with the trachea, oesophagus and pharynx). This compartment is bound by the pretracheal fascia.



Follicles:

The thyroid gland is made up of thyroid follicles, which are small, globular sacs lined with follicular cells and filled with a sticky fluid called colloid.

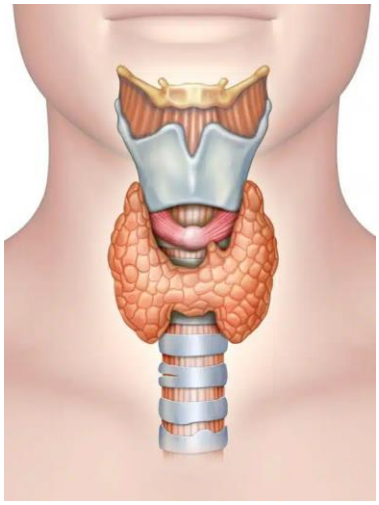
Parathyroid Glands:

The parathyroid glands are located on the posterior surfaces of the thyroid lobes.

Hormones:

The thyroid gland produces triiodothyronine (T3) and thyroxine (T4), which regulate metabolism and calcitonin, which helps regulate blood calcium levels.

The thyroid gland is an endocrine structure located in the neck. It plays a key role in regulating the metabolic rate of the body.



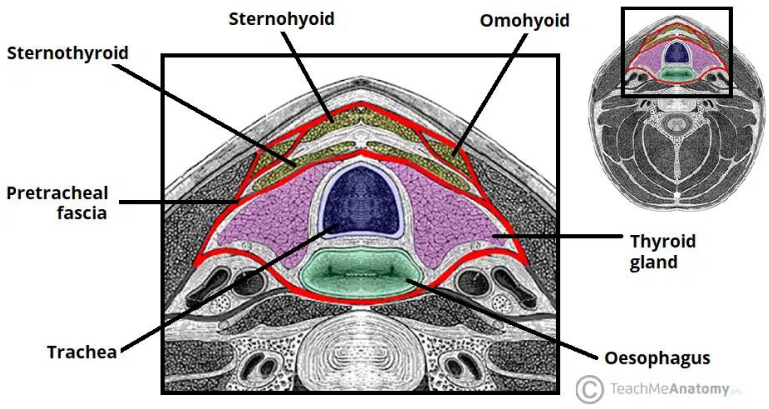
Anatomical Relations

The thyroid gland is closely associated with numerous other structures in the anterior neck:

Anterior – infrahyoid muscles, namely the sternothyroid, superior belly of the omohyoid and sternohyoid.

Lateral – carotid sheath, containing the common carotid artey, internal jugular vein and vagus nerve

Medial:
Organs – larynx, pharynx, trachea and oesophagus
Nerves – external laryngeal and recurrent laryngeal



Transverse section of the neck, showing the pre-tracheal fascia in red

Arterial Supply

The arterial supply to the thyroid gland is via two main arteries:

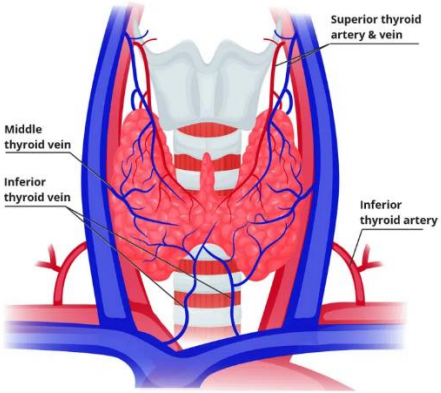
Superior thyroid artery – arises as the first branch of the external carotid artery. It lies in close proximity to the external branch of the superior laryngeal nerve (innervates the larynx).

Inferior thyroid artery – arises from the thyrocervical trunk (a branch of the subclavian artery). It lies in close proximity to the recurrent laryngeal nerve (innervates the larynx).

In a small proportion of people (around 10%) there is an additional artery present – the thyroid ima artery. It arises from the brachiocephalic trunk and supplies the anterior surface and isthmus of the thyroid gland.

Venous Drainage

Venous drainage is carried by the superior, middle, and inferior thyroid veins, which form a venous plexus around the thyroid gland.
The superior and middle veins drain into the internal jugular vein and the inferior empties into the brachiocephalic vein.



Innervation

The thyroid gland is innervated by branches derived from the sympathetic trunk.

These nerves do not control the secretory function of the gland – the release of thyroid hormones is regulated by the pituitary gland.

Lymphatic Drainage

The lymphatic drainage of the thyroid is to the paratracheal and deep cervical nodes.

CLINICAL RELEVANCE

Recurrent Laryngeal Nerve

The left and right recurrent laryngeal nerves lie in close proximity to the thyroid gland. Care must be taken not to damage them during thyroid surgery.

They branch from their respective vagus nerve within the chest and hook around the right subclavian artery (right recurrent laryngeal nerve), or the arch of aorta (left recurrent laryngeal nerve).

Each nerve then travels back up the neck, running between the trachea and oesophagus in the tracheoesophageal groove. It then passes underneath the thyroid gland to innervate the larynx

Physiology:

Thyroid gland produces three hormones:

- **Triiodothyronine, also known as T3**
- **Tetraiodothyronine, also called thyroxine or T4**
- **Calcitonin**

Physiology of thyroid hormones:

T3 and T4 are the only proper thyroid hormones, they are made in follicular epithelial cells of the thyroid gland.

The third hormone produced by thyroid gland calcitonin is made by c-cells.

Iodine is the building block of both T3 and T4. Hence, dietary intake of this trace mineral iodine is vital.

Amount of thyroid hormone required by the human body at a particular time varies; and to make the perfect quantity of thyroid hormone at any given time, the human body needs help from the pituitary gland.

Thyroid hormones affect your:

- **T3 and T4 increase the basal metabolic rate.**
- **T3 and T4 promote physical and mental growth in children.**
- **Calcitonin is involved in calcium and bone metabolism.**
- **Thyroid hormones activate the nervous system which improves concentration.**
- **Thyroid hormone affects your: body temperature and circulation, appetite, energy levels, growth and bone development, muscle tone and suppleness, heart rate, blood sugar levels, central nervous system and bowel function, cholesterol levels, fat, carbohydrate and protein metabolism.**
- **Higher the amount of T3 and T4 in the body, higher is the body metabolism. If the level of T3 and T4 drops in the body, so does the rate of metabolism.**

Iodine for thyroid hormone

Human body need iodine to create the thyroid hormone. As we know iodine is the building block of both T3 and T4.
This trace mineral cannot be produced by the human body.
Hence, dietary intake of iodine is vital.
Iodine is absorbed into the blood stream from food and bowel, from where it is carried to the thyroid gland to be used by the thyroid gland in due course.

Feedback Mechanisms:

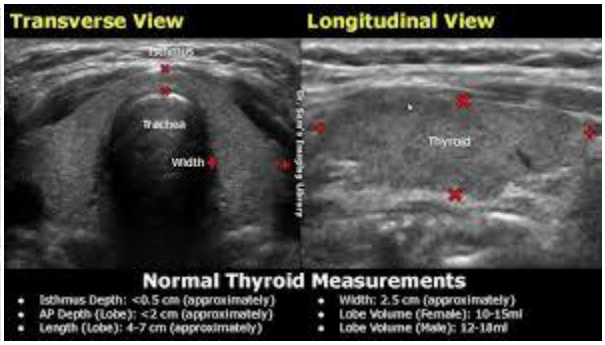
- **The pituitary gland and thyroid hormone**
- **The pituitary is an endocrine gland that is located at the base of your brain.**
- **It controls the endocrine system.**
- **It effects the thyroid by producing a hormone called thyroid stimulating hormone (TSH).**
- **TSH stimulates the thyroid gland to produce right amount T3 and T4.**

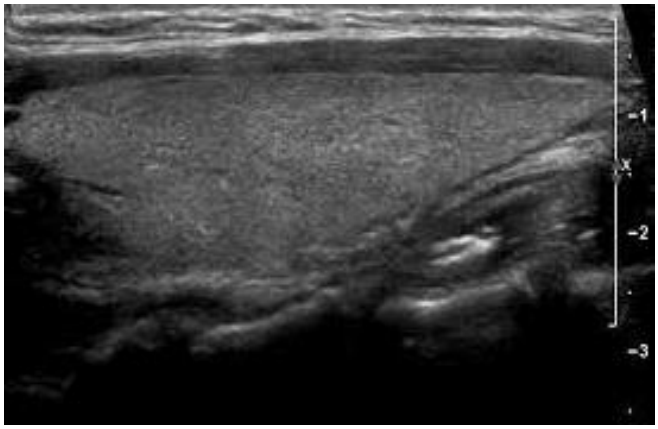
If there is more amount of T4 present in ones blood stream, the pituitary gland will produce less TSH which will slow down the thyroid activity leading to less production of T4. Whereas, if the level of T4 hormone is less then required amount in they body, the pituitary gland will produce higher quantity of TSH to boost the metabolism and production of thyroid hormone.

Age (yr)	Female			Male		
	TGV (mL)	SE	N	TGV (mL)	SE	N
01 - 10	1.53	0.22	8	1.86	0.25	12
11 - 20	4.27	0.43	17	3.88	0.35	21
21 - 30	4.41	0.23	32	5.54	0.52	20
31 - 40	5.31	0.40	31	7.84	0.85	14
41 - 50	5.62	0.48	27	4.74	0.19	7
51 - 60	4.40	0.73	9	4.91	0.41	9
61 - 90	4.09	0.42	7	4.93	0.56	7

Ultrasound

- **the normal thyroid gland has a homogeneous appearance with medium echogenicity**
- **the capsule may appear as a thin hyperechoic line (sometimes called "perithyroid echogenic line")**
- **each lobe normally measures**
    - **length or craniocaudal: 4-6 cm**
    - **depth or anterior-posterior dimension: <2 cm**
    - **isthmus <0.5 cm deep**
- **volume (excluding isthmus, unless its thickness is >3 mm)**
    - **10-15 mL for females**
    - **12-18 mL for males**





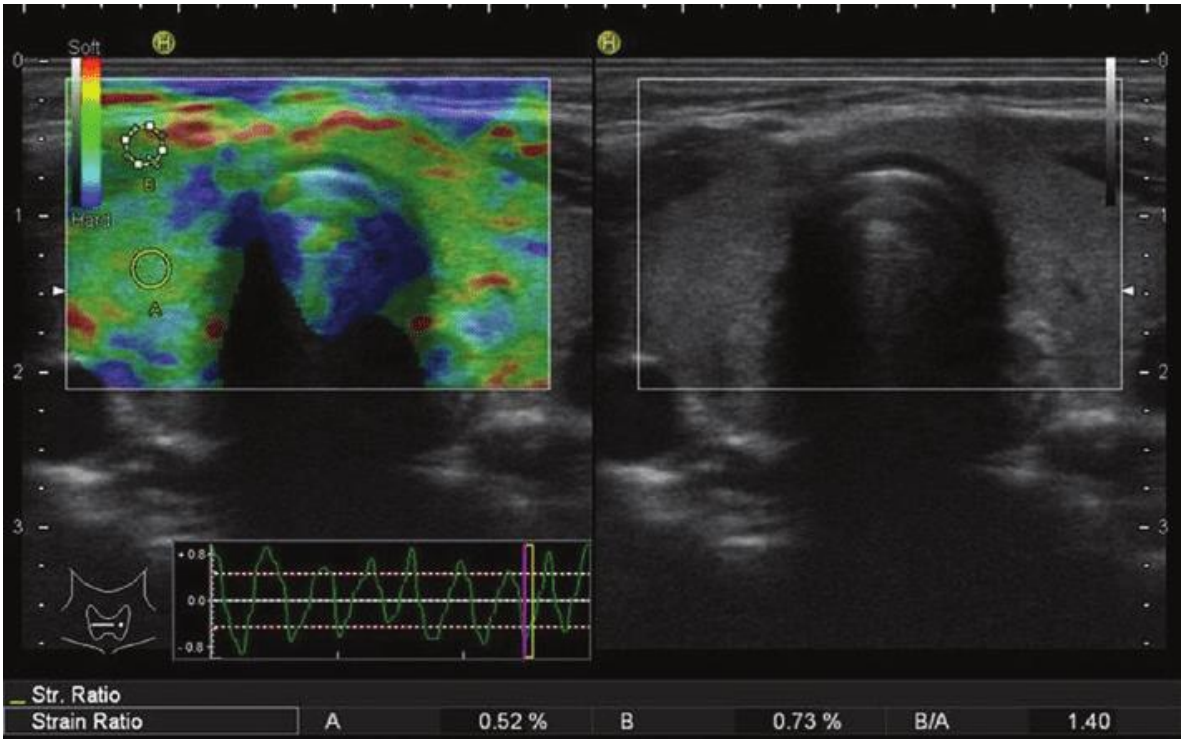
Thyroid elastography is a non-invasive imaging technique that uses ultrasound to assess the stiffness of thyroid tissue, helping differentiate between benign and malignant thyroid nodules.

Normal Findings:

Homogeneous Appearance: In a normal thyroid, the elastogram (the image produced by elastography) should show a uniform color, indicating that the tissue is of similar stiffness throughout.

No Nodules: There should be no visible nodules or areas of increased stiffness (often appearing as blue or red areas) within the thyroid tissue.

Normal Stiffness: The normal thyroid tissue has a relatively soft consistency, and this is reflected in the elastogram as a uniform color coding.



Ultrasound elastography (USE) image of thyroid gland. Upper left panel shows a color-coded USE image, upper right panel illustrates gray-scale ultrasound image, and base panel presents sinusoidal waves of compression and decompression. Lower region of interest (ROI) is positioned on thyroid gland, and upper ROI is on adjacent soft tissue

Compiled by: Dr Pravin G U Principal, Prof.RadioDiagnosis . Sri Chamundeshwari Medical college Hospital & Research Institute,Channapatna,Karnataka.President IRIA Karnataka

https://teachmeanatomy.info/ ,
https://www.researchgate.net/?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6Il9kaXJlY3QiLCJwYWdlIjoiX2RpcmVjdCJ9fQ