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EMBRYOLOGY, HISTOGENESIS AND ANATOMY OF THYROID GLAND – A REVIEW ARTICLE

Anatomy

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ABSTRACT

Thyroid gland is an important endocrine organ. Its hormone thyroxine is essential for life. The structure and function of thyroid gland were discovered during 17th to 20th centuries. Thyroid surgery is being done since early 19th century, perfected by Theodre Kocher in early 20th century. Thyroid is the first endocrine gland to develop in embryo and is endodermal origin. The surgically important anatomical relations of thyroid are recurrent laryngeal nerve, parathyroid glands and external laryngeal nerve with variations. Present article throws light on some embryology, Histogenesis and anatomy of thyroid gland based on relevant articles and textbooks. The article was done for one year i.e., March 2020 to February 2021 in the Department of Anatomy, Govt Medical College and Hospital, Ongole

KEYWORDS

Inferior thyroid artery, Recurrent laryngeal nerve, Thyroid follicle, Thyroxine.

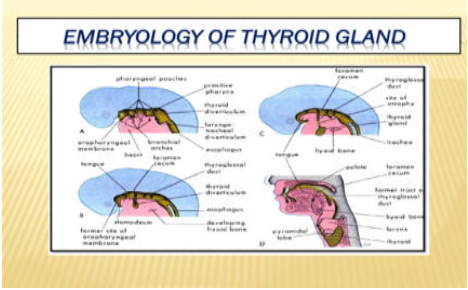
INTRODUCTION

Thyroid is an important endocrine organ in human body. Its enlargement or goiter has been observed by ancient Greeks understanding of its anatomy diseases are due to researchers of 17 centuries to 20th centuries. The understanding of thyroid gland relations and functional status are of importance to thyroid surgeon. Rapid advancement in thyroid surgery of an understanding of its anatomy and physiology is a must for all medical personnel. Present article intends to meet this requirement by review of selected articles and chapters on thyroid gland in standard texts.

Embryology of thyroid gland (Fig:1)

The thyroid is the first endocrine gland to develop in the embryo. It begins to form about 24 days after fertilization from a median endodermal thickening in the floor of the primordial pharynx. This thickening soon forms a small out-pouching – 'the thyroid primordium'. As the embryo and tongue grow, the developing thyroid gland descends in the neck, passing ventral to the developing hyoid bone and laryngeal cartilages. For a short time the thyroid gland is connected to the tongue by a narrow tube, the thyroglossal duct. At first the thyroid primordium is hollow but it soon becomes solid and divides into right and left lobes connected by the isthmus of the thyroid gland which lies anterior to the developing 2nd and 3rd tracheal rings. By seven weeks the thyroid assumes its definitive shape and reaches its final site in the neck. The thyroglossal duct by this time has normally degenerated and disappeared. The proximal opening of the thyroglossal duct persists as a small pit in the tongue-'the foramen cecum'. A pyramidal lobe extends superiorly from the isthmus in about 50% of people. The pyramidal lobe may be attached to the hyoid bone by fibrous tissue and /or smooth muscle- 'the levator of thyroid gland'. A pyramidal lobe and the associated smooth muscle represent a persistent part of the distal end of the thyroglossal duct [1].

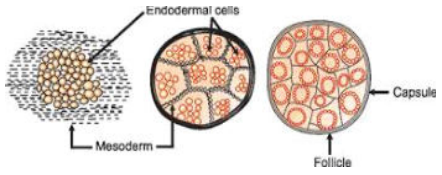
Fig:1 Embryology of Thyroid Gland



Histogenesis of the thyroid gland (Fig 2)

The thyroid primordium consists of a solid mass of endodermal cells which breaks into a network of epithelial cords as it is invaded by the surrounding vascular mesenchyme. By 10th week the cords have divided into small cellular groups. A lumen forms in each cell cluster and cells become arranged in a single layer around a lumen. During 11th week colloid begins to appear in these structures-thyroid follicles – thereafter, iodine concentration and the synthesis of thyroid hormones can be demonstrated [1].

Fig :2 Histogenesis of the thyroid gland



Anatomy of thyroid gland (Fig 3)

The thyroid gland is situated low down at the front of neck weighing about 25 g. The gland has two lobes, each pear shaped hugging anterolateral aspects of cervical trachea from oblique line of thyroid cartilage to 5th or 6th tracheal ring. The right lobe is often larger than left and isthmus joins them anteriorly at the level of 2nd and 3rd tracheal rings. Isthmus is plastered quite firmly to the anterior surface of trachea. A small portion of gland substance, pyramidal lobe often projects upwards from isthmus, generally to the left of midline. The gland has its own capsule and is also enclosed by an envelope of pretracheal fascia which is thickened posteriorly and attached to the cricoid cartilage and upper tracheal rings (suspensory ligament of Berry). This fixation and investment of gland by pretracheal fascia are responsible for the gland moving up and down with larynx during swallowing [2].

Measurements:

Each lobe: Vertical – 5 cm, Anteroposterior – 2 cm, Transverse – 3 cm
Isthmus: Vertical and Transverse – 1.25 cm [3].

Vascular supply:

The thyroid gland has rich blood supply. Each thyroid lobe is supplied by a superior and an inferior thyroid artery and drained by three veins [4].

The superior vascular pedicle:

This contains superior thyroid artery, which is the 1st branch of the external carotid, and its accompanying vein, which drains into the internal jugular vein. These enter upper pole of gland at its apex and branches to the front and back of the gland. These vessels are easily dealt with surgically, because the loose space between the two capsules is developed at the upper pole of the thyroid lobe and a ligature is placed close to the upper pole, to include both vessels and exclude the external laryngeal nerves.

The inferior thyroid artery:

Arises from thyrocervical trunk, passes behind the carotid sheath and then runs transversly across the space between this and the thyroid gland to enter the deep surface of the gland as several separate branches close to tracheothyroid groove. These are close to recurrent laryngeal nerve and inferior parathyroid gland and hence inferior thyroid artery should be ligated in its transverse portion medial to the carotid sheath.

The inferior thyroid veins:
These leave lower border of gland and pass through the loose fascial space to join the left brachiocephalic vein. They are fragile and require to be ligated singly. The middle thyroid vein: It is short, thin walled vessel, leaving the middle of the gland and directly courses laterally to pass in front of or behind the carotid artery and enter the internal jugular vein. It is the 1st vessel encountered in thyroidectomy.

The thyroidea ima artery:
Runs from brachiocephalic trunk in front of trachea and it is small and surgically irrelevant. Blood supply of retrosternal extension comes from neck and hence its operative removal can always be conducted by cervical approach.

Innervation:
The thyroid gland receives its innervation from the superior, middle and inferior cervical sympathetic ganglia. They are vasomotor in function [3].

Lymphatic drainage:
Major: Middle and Lower jugular, Posterior triangle nodes. Lesser: Pretracheal and para tracheal, Superior mediastinal nodes. Because of wide distribution of nodes, standard radical neck dissection has been abandoned in favor of 'regional' node removal in cases of management of thyroid neoplasms [4,5].

The important close surgical relations of the thyroid gland:
These are the recurrent laryngeal nerves, the external laryngeal nerves and the parathyroid glands. These should be recognized and cared for during thyroid surgery [4].

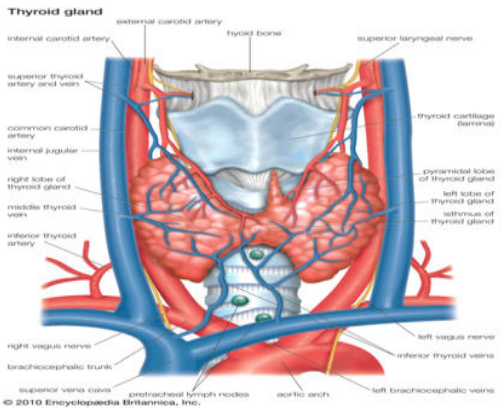
The External laryngeal nerve:
A branch of superior laryngeal nerve, descends on the fascia of the inferior pharyngeal constrictor is closely related to superior vascular pedicle of thyroid and leaves this at a variable height above the gland to travel medially to cricothyroid muscle. It is important for pitch of voice and its damage alters the voice.

The Recurrent laryngeal nerve:
This innervates laryngeal musculature and provides sensory innervation to the glottic larynx. The RLN arises from the vagus at the level of subclavian artery on the right and at the level of aortic arch on the left. They are taken caudally during embryonal growth and thus run an upward course to reach vocal cords. They lie in TE groove and then bear a variable relationship to the branches of inferior thyroid artery before entering the larynx. In majority, the nerve is found easily in TE groove just below thyroid gland but its course may vary and it may be much more lateral. In 0.3% to 0.8% of cases, a non recurrent nerve has been reported, which arises from cervical portion of vagus at the level of larynx or thyroid gland. Vast majority of these occur on right side in conjunction with an anomalous retroesophageal subclavian artery Rare cases of left non recurrent laryngeal nerve have been reported [6].

Parathyroid glands:
The parathyroid glands, most commonly 4 in number arise from 3rd branchial pouch (Inferior parathyroids) and 4th branchial pouch (Superior parathyroids). The superior parathyroids most consistently located (80%) within 1 cm superior to the intersection of the RLN and the ITA near the crico thyroid joint. Inferior parathyroids are more variable in the location due to their longer migration with inferior thyroid and thymus. 45%-60% located inferior, lateral or posterior to inferior thyroid pole below the level of ITA. 26%-35% located immediately inferior to the inferior thyroid pole in association with cervical thymus. < 1% located in anterior mediastinum. The blood supply to the parathyroids is predominantly by way of ITA. To preserve parathyroids along with blood supply, a medial to lateral dissection along the thyroid capsule plane is utilized. Parathyroids are small bean shaped structures with a yellow tan to caramel color [6].

Structure:
The thyroid consists of large number of closed follicles (200-300 microm in diameter) lined by a single layer of epithelial cells. The follicles contain colloid. Colloid is made up of proteins, especially the iodinated glycoprotein, thyroglobulin, a 19S protein to which tyrosine residues is bound and in which thyroid hormone synthesis and storage takes place. The follicles are bound together in groups to form lobules each supplied by an end artery [7]. There are para follicular cells constituting < 2% of total cells which are scattered on outer aspects of the follicles and secrete calcitonin [2]. The thyroid gland is highly vascular and is the only endocrine gland to store its secretion outside the cells [2].

Fig :3 Gross Anatomy of Thyroid Gland



Conclusion
Thyroid is an important endocrine organ. The knowledge of embryology, anatomy especially relations to parathyroids and recurrent laryngeal nerve and their variations are important to thyroid surgeon.

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