

A rare case of agenesis of isthmus with the presence of levator glandule thyroideae in anterior lobulated thyroid gland

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ABSTRACT

Introduction: The carcinoma of thyroid incidences is increasing rapidly in men and women. Thyroidectomy is the ultimate treatment plan for the majority of cases. The lack of knowledge about embryological and anatomical variations can cause iatrogenic injuries and leads into mortality.

Aims and Objectives: The aim was to carry out a descriptive observational study on embryological and anatomical variations in the thyroid gland through cadaver.

Materials and Methods: The present study comprises an adult male human cadaver, Scalpel, forceps, scissors, and probe. The blunt dissection was carried out to clear the fat and fascia in the midline of neck region to expose the sternothyroid muscle. Loosened and transected the muscle, then examined the thyroid gland carefully.

Results: The current study has shown that the agenesis of isthmus, lobes of thyroid gland positioned more anteriorly, and the presence of levator glandulae thyroideae.

Conclusion: The lack of knowledge of embryological and anatomical anomalies in the thyroid gland can cause major complications during surgery and also post operatively. The complete awareness of these various anomalies helps in the accurate diagnosis and better outcomes.

Keywords: agenesis, anomalies, thyroidectomy, carcinoma, variations

INTRODUCTION

The thyroid cancers incidences are rapidly increasing worldwide as 10.1 in women and 3.1 in men per 100000 [1]. When comes to India incidences rate is 5.4 per 100000 [2]. Thyroid cancer is divided into subtypes as phenotypical and heterogeneous. Phenotypical again subdivided into papillary, follicular, hurthle cell, medullar, poorly differentiated and anaplastic thyroid carcinoma. When comes to heterogeneous classified into genetic heterogeneity and non-genetic heterogeneity thyroid carcinoma with various subtypes [3]. However, thyroidectomy (the removal of thyroid gland) is the most effective treatment for the majority of carcinomas nonetheless [4].

In the 18th century the mortality rate because of thyroidectomy was approximately 40% due to poor anti septic surgical procedure and knowledge of thyroid gland anatomical variations. The advancement in anti-septic surgical techniques and anesthetic facilities tremendously decreased the mortality and morbidity rate in modern days. However, the potential complications such as hemorrhage, injury to recurrent and superior laryngeal nerve, hypoparathyroidism, hypothyroidism and infections still exist due to the lack of complete knowledge of various anatomical and embryological variations [5-6]. There are very rare variations like agenesis of isthmus, Levator Glandule Thyroideae (LGT) and malposition of thyroid lobes interrupt the surgical procedure and causes lethal complications. Hence, we want to discuss anatomical and embryological basis for these variations through our study.

The thyroid gland is a vital, butterfly shaped, largest endocrine gland. It is located in the lower part of neck inferior to the larynx and wrapped front and sides of the trachea at the level of the 5th cervical to 1st thoracic vertebrae. Usually it is brownish-red in color and 25 gm in weight. It is composed with the two symmetrical lateral lobes, which are connected anteriorly by the narrow median isthmus. Each lobe measured with 5 cm long, 3 cm transverse and 2 cm in antero-posterior in width. The isthmus lies at the level of 2nd to 3rd tracheal rings and measured with 1.25 cm transversely and vertically. It is a highly vascular gland supplied by Superior and inferior thyroidal artery, with the surgical significant relationship of superior and recurrent laryngeal nerves respectively [7-9].

When comes to embryology, the thyroid gland is the first endocrine. The thyroid gland developed from the endoderm and parafollicular cells are developed from the caudal-pharyngeal

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complex (derived from 4th and 5th pharyngeal pouch) infused neural crest cells. After the formation of pharyngeal arches, the medial ends of two mandibular arches (1st arch) are separated by midline swelling called as tuberculum impar. Immediately behind the impar the epithelium becomes thick and sinks form foramen caecum. From the foramen caecum a diverticulum grows down in the midline into the neck is called as thyroglossal duct. Its caudal end bifurcates and proliferates into two lateral lobes and its midline connector isthmus of thyroid gland later it ceased from the foramen caecum. While developing the thyroid gland it comes close to caudal-pharyngeal complex (ultimobranchial body) and fuses with it. Cells proliferate from this complex developed as a parfollicular cells [10-12].

The developmental anomalies of thyroid gland vary, the thyroid tissue may form anywhere along the course of thyroglossal duct such as lingual thyroid—under the tongue, intra-lingual thyroid embedded in the substance of tongue, supra hyoid- above hyoid bone, infra hyoid- below the hyoid, intra thoracic inside the thoracic region. Sometimes due to abruptly division of thyroglossal duct, one of the lateral lobe may be missed is called as hemiagenesis, isthmus may be missed very rarely is called as agenesis of isthmus, presence of pyramidal lobe (extra lobe) may arise from the upper part of isthmus or lateral lobes or may be detached from thyroid. The anomalous position of thyroid lobes also occurs due to shorter or longer division of thyroglossal duct. Sometimes the thyroglossal duct may persist and form sacthyroglossal sac, or may acquire secondary openings-thyroglossal fistula, persistent duct may prone to develop carcinoma. Very less time a fibro muscular band, musculus levator glandulae thyroideae develop and stretched from the pyramidal lobe or upper part of isthmus on the left side to the body of hyoid bone above [13-15].

Hence the complete knowledge of developmental variations of thyroid gland plays significant role in accurate diagnosis, planning of treatment and surgical interventions of thyroidectomy surgeries and better outcomes during radiotherapy management.

MATERIALS AND METHODS

Materials

- Scalpel- With blade
- Forceps- Small pointed, tooth forceps, non-toothed forceps
- Scissors
- Probe

Methods

The present study was conducted in the department of anatomy, Sree Balaji Medical College, Chennai. During routine cadveric dissection on 60 years male embalmed body. The dissection was carried according to guidelines of manuals of practical anatomy. Identified the infra-hyoid group of muscles after clearing of fat and fascia in the midline of neck region through blunt dissection. Loosen the sternothyroid muscles from its deeper structures with the help of probe. Transected and reflected the same muscle with the help of scissors then carefully examined the thyroid gland and its arteries, veins, other deep related structures and noted the findings [16-17].

RESULTS

Findings

The author observed the following findings

- The lobes of thyroid gland located more anteriorly as a right lobe and left lobe rather than laterally.
- The right and left lobes are not connected by isthmus.
- There is agenesis of isthmus.
- Levator glandulae thyroideae stretched from the upper border of left lobe to the lower border of body of hyoid bone above.
- Thyroidal arteries are normal in course but terminated very closely near the medial side and upper border of the lobes in figure 1.

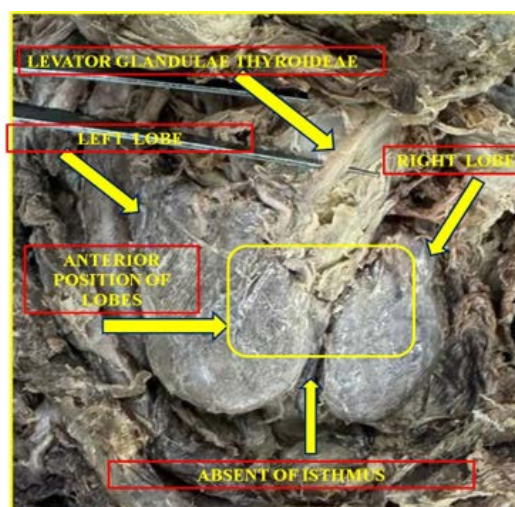


Fig. 1. The thyroid gland showing right and left anterior lobes with the absence of isthmus and levator glandulae thyroideae stretched from the upper border of left lobe to the lower border of hyoid bone above

DISCUSSION

Agenesis of isthmus of thyroid gland is congenital anomaly due to the abnormal development of the gland. It was first reported by the allan in 1952 in 2% to 4% cases [18]. Anson et al. in 6%-8% cases [19]. Marshal et al. reported 10% in the study of variations in the gross structure of thyroid gland in the children with the sample size of 60 [20]. Gruber et al. in 5% [21]. Pastor et al. in 5%-10% [22]. Ranade et al. in 33% [23]. Joshi SD et al. in 16.66% [24]. Daksha dixit et al. in 14.60% [25]. Harjeet et al. in 7.90% [26]. Archana Belavadi Jagadish et al in 10% [27]. In our study also there is a complete absent of isthmus and thyroid lobes are not connected but which are cited very closely each other. The cause for agenesis of isthmus idiopathic, may be genetic predisposition that is mutations in the chromosome 22 and genes TITF1, PAX8, FOXE1, and TITF2, because these are plays very important role in the development of thyroid gland. In animals such as amphibians, birds the isthmus not present, when comes to mammals in marsupials, carnivores and rodent's isthmus may missed [27-28]. The agenesis of isthmus is rare anomaly, and most of the time asymptomatic. During clinical practice when such condition diagnosed, it should be anticipate other embryological anomalies in thyroid gland and its surrounding structures. It may associate with the autonomus thyroid nodule, thyroiditis, primary carcinoma, neoplastic metastasis, amyloidosis, should be ruled out. When surgeons planned for thyroidectomy surgery, they should have complete preoperative knowledge about these anomalies for which differential diagnosis is necessary such as scintigraphy, ultrasonography, computerized tomography, magnetic resonance imaging, and in nodular goiters fine needle aspiration biopsies followed by immuno-histochemistry tests to evaluate the embryological anomalies in and around the thyroid gland and also differentiation between benign and malignant lesions. Accurate diagnosis always helps in proper conduction of surgery and better outcomes [18-28].

When comes to the musculus levator glandulae thyroideae, it is an uncommon anatomical variation around the thyroid gland. Surgical operations involving the neck and around thyroid gland may result in iatrogenic injuries because of this anomaly. Usually, it extends from the pyramidal lobe or isthmus on left side to the lower border of hyoid bone. LGT reported by Sultana et al. in 43.33% cases [29]. Begum et al. in 15% [30]. Ranade et al. in 49.5% [31]. Veerahanumaiah et al. in 41% [32]. Joshi et al. in 30% [33], Anjan

et al. in 18.75 cases [34]. However, in present case the LGT arised nor from the isthmus, neither from the pyramidal lobe, since both were absent. It is stretched from the upper border of left lobe to the lower border of body of hyoid bone above. This pattern is very rare and very less reports are present.

Moris (1950) classified LGT into 5 types:

- Hyopyramamidalis muscle (hyoid bone to pyramidal lobe),
- Thyreopyramidalis muscle (thyroid cartilage to pyramidal lobe),
- Thyreoglandularis muscle (thyroid cartilage to the thyroid capsule),
- Hyoglandularis muscle (hyoid bone to the thyroid capsule),
- Tracheoglandularis muscle (proximal trachea to the isthmus of thyroid) based on 210 japanese cadaver study [35]. In present study LGT belongs to hyoglandularis muscle type. The knowledge of LGT and its variant extension is plays significant role in preventing iatrogenic injuries during neck surgeries.

When comes to anomalies position of thyroid gland, usually the lobes lateral in position to the trachea and connected by the isthmus. In present case lobes are positioned more anteriorly as a right lobe and left lobe rather than laterally since absence of isthmus. This is a rare anomaly not reported till now, obviously when position misplaced the relations also change can cause mis diagnosis and wrong approach in conduction of surgery. Hence, the knowledge about position of lobes also very important to prevent unwanted injuries during surgeries around the thyroid gland.

CONCLUSION

Conclusively, the knowledge of the thyroid gland anomalies must be considered with utmost important. Thorough understanding of its embryological and anatomical basis variations helps in prevention of critical intra-operative and postoperative complications. The purpose of this report was to highlight the very rare anomalies in single case that is position of lobes, agenesis of isthmus and LGT variant are may encounter during the surgery. Thereby to form a cornerstone to prevent complications and to conduct effective surgeries.

REFERENCES

1. Pizzato M, Li M, Vignat J, Laversanne M, Singh D, et al. The epidemiological landscape of thyroid cancer worldwide: GLOBOCAN estimates for incidence and mortality rates in 2020. *Lancet Diabetes Endocrinol.* 2022;10.
2. Continuing medical education -CME on "Differentiated Thyroid Cancer" organised by AIIMS Nagpur.
3. Hu J, Yuan IJ, Mirshahidi S, Simental A, Lee SC, et al. Thyroid Carcinoma: Phenotypic Features, Underlying Biology and Potential Relevance for Targeting Therapy. *Int J Mol Sci.* 2021;22:1950.
4. Treatment of Thyroid Cancer, by Type and Stage. *Cancer.*
5. Complications of Thyroid Surgery: Practice Essentials, Overview, Bleeding. *EMedicine.* 2023.
6. Bansal C, Bhardwaj A, Rathi S, Agrahari A, Singh VP. Postoperative Complications of Thyroid Surgery: A Corroborative Study with an Overview of Evolution of Thyroid Surgery. *Int J Head Neck Surg.* 2015;6:149-154.
7. Standing S. *Gray's Anatomy: The Anatomical Basis of Clinical Practice.* Elsevier; 2016. 470-471.
8. Snell RS. *Clinical anatomy by regions.* Lippincott Williams Wilkins. 2012:657-658.
9. Datta AK. *Essentials of Human Anatomy Part - II: Head & Neck.* Curr. Books Int. 2017. 160-190.
10. Datta AK. *Essentials of Human Embryology.* 2010.
11. Inderbir Singh. *Human embryology.* Jaypee Brothers Med. Publ. 2014. 112-115.
12. Allen E, Fingeret A. *Anatomy, Head and Neck, Thyroid.* PubMed. 2020.
13. Standing S. *Gray's Anatomy: The Anatomical Basis of Clinical Practice.* Elsevier; 2016. 470-471.
14. Singh V. *Textbook of Clinical Embryology.* Elsevier Health Sci. 2020. 138-139.
15. Chaudhary P. Levator Glandulae Thyroideae, a Fibromusculoglandular Band with Absence of Pyramidal Lobe and Its Innervation: A Case Report. *J Clin Diagn Res.* 2013.
16. Koshi R. *Cunningham's Manual of Practical Anatomy Vol 3 Head and Neck.* Oxford University Press; 2018. 65-66.
17. Tank PW, Grant, Sauerland EK. *Grant's dissector.* Lippincott Williams Wilkins; 2005. 180.
18. Singhal G, Nayak P, Sharma N. A Rare Case of Isolated Agenesis of the Thyroid Isthmus: Surgical Implications. *Int J Recent Surg Med Sci.* 2022.
19. Kumar GP, Satyanarayana N, Vishwakarma N, Guha R, Dutta AK, et al. Agenesis of isthmus of thyroid gland, its embryological basis and clinical significance – A case report. *Nepal Med Coll J.* 2010;12:272-274.
20. Marshall CF. Variations in the Form of the Thyroid Gland in Man. *J Anat Physiol.* 1895;29:234-239.
21. Potaliya P, Choudhary A, Ghatak S. Isthmus agenesis with variant topography of levator glandulae thyroideae: A case report. *Int J Med Res Rev.* 2020;8:273-276.
22. J.f PV, J.a GV, F.j DP, M BC. Agenesis of the thyroid isthmus. *Eur J Anat.* 2024;10:83-84.
23. Ranade AV, Rai R, Pai MM, Nayak SR, Prakash, et al. Anatomical variations of the thyroid gland: possible surgical implications. *Singapore Med J.* 2008;49:831-834.
24. Joshi SD, Joshi SS, Daimi SR, Athavale SA. The thyroid gland and its variations: a cadaveric study. *Folia Morphol.* 2010;69:47-50.
25. Dixit D, Shilpa M, Harsh M, Ravishankar M. Agenesis of isthmus of thyroid gland in adult human cadavers: a case series. *Cases J.* 2009;2.
26. Harjeet A, Sahni D, Jit I, Aggarwal AK. Shape, measurements and weight of the thyroid gland in northwest Indians. *Surg Radiol Anat.* 2004;26:91-95.
27. Jagadish AB, Prabhakar P, Subhash R LP. A cadaveric study of agenesis of isthmus of thyroid gland with embryological, genetic bases and clinical significance. *Int J Anat Res.* 2016;4:2386-2391.
28. Singhal G, Nayak P, Sharma N. A rare case of isolated agenesis of the thyroid isthmus: Surgical implications. *Int J Recent Surg Med Sci.* 2022.
29. Sultana SZ, Khalil M, Khan MK, Shamim R, Parveen S, et al. Morphological study of levator glandulae thyroidea in Bangladeshi cadaver. *Myrmensingh Med J.* 2009;18:179-183.
30. Nurunnabi AS, Alim A, Mahbub S, Kishwara S, Begum M, et al. Morphological and Histological Study of The Pyramidal Lobe of The Thyroid Gland in Bangladeshi People - A Postmortem Study. *Bangladesh J Anat.* 1970;7:94-100.
31. Ranade AV, Rai R, Pai MM, Nayak SR, Prakash, et al. Anatomical variations of the thyroid gland: possible surgical implications. *Singapore Med J.* 2008;49:831-834.
32. Veerahanumaiah S, Dakshayani KR, Menasinkai SB. Morphological variations of the thyroid gland. *Int J Res Med Sci.* 2015;3:53-57.
33. Joshi SD, Joshi SS, Daimi SR, Athavale SA. The thyroid gland and its variations: a cadaveric study. *Folia Morphol.* 2010;69:47-50.
34. Rajkonwar AJ. Morphological Variations of the Thyroid Gland among the People of Upper Assam Region of Northeast India: A Cadaveric Study. *J Clin Diagn Res.* 2016.
35. Bell DJ. Levator glandulae thyroideae muscle. *Radiopaedia.*