

Agensis of Isthmus of Thyroid Gland, its Developmental Basis: A Case Report

Bhavana Tirumala¹, Anil Kumar Reddy Y^{2*}, Joy A Ghoshal³, Hemanth K⁴

¹Tutor, Department of Anatomy, All India Institute of Medical Sciences, Mangalagiri, Andhra Pradesh

²Assistant Professor, Department of Anatomy, All India Institute of Medical Sciences, Mangalagiri, Andhra Pradesh

³Professor and Head, Department of Anatomy, All India Institute of Medical Sciences, Mangalagiri, Andhra Pradesh

⁴Senior Demonstrator, Department of Anatomy, All India Institute of Medical Sciences, Mangalagiri, Andhra Pradesh

DOI: <https://doi.org/10.36347/sjmcr.2024.v12i12.049>

| Received: 20.11.2024 | Accepted: 24.12.2024 | Published: 30.12.2024

*Corresponding author: Anil Kumar Reddy Y

Assistant Professor, Department of Anatomy, All India Institute of Medical Sciences, Mangalagiri, Andhra Pradesh

Abstract

Case Report

The thyroid gland is made up of two conical-shaped lateral lobes connected by a middle, narrower isthmus. It is initially recognised in embryos with around 20 somites as a median thickening of endoderm located in the pharynx's floor, dorsal to the aortic sac and between the first and second pharyngeal pouches. The thyroid gland isthmus and lateral lobes are formed by the bifurcation of the thyroglossal duct tip and subsequent division of the tissue mass. Out of 23 cadavers dissected for routine undergraduate teaching, 1 cadaver with agensis of thyroid isthmus was observed. The thyroid gland consisted of two lateral lobes, namely right and left, with no isthmus. The presence of a pyramidal lobe from the left lobe of the thyroid gland was noted, with the levator glandulae thyroidea connected to the pyramidal lobe of the thyroid gland. The presence of a facial sheath was observed in place of the isthmus of the thyroid gland, exposing the second and third tracheal rings underlying it. When making a diagnosis, it's critical to take into account the potential for ectopic thyroid tissue or the relationship between isthmus agensis and thyroid lobe agensis.

Keywords: Agensis, Thyroid gland, Isthmus, Development, Cadaver.

Copyright © 2024 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC 4.0) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

INTRODUCTION

The term thyroid gland is derived from the Greek word, "thyreoeidos" in which the terms thyreos means shield and eidos means form (Mohebbati A *et al.*, 2012). The thyroid gland consists of 2 lateral lobes, which are conical in shape and contain a median narrower isthmus connecting the two lateral lobes (Mohebbati A *et al.*, 2012; Standring S 2005). Each lobe length measures 5cm with transverse and anteroposterior measurements of 3 cm and 2cm, respectively (Mohebbati A *et al.*, 2012; Standring S 2005).

The pyramidal lobe represents the lower inferior portion of the thyroglossal duct and may be attached to hyoid bone by a fibromuscular band called levator glandulae thyroidea (Mohebbati A *et al.*, 2012). The pyramidal lobe often ascends towards the hyoid bone from the isthmus or from the adjacent lobe, predominantly from the left lobe of the thyroid gland (Dixit D *et al.*, 2009). Isthmus typically measured about 1.25cm transversely and vertically lying anterior to the second and third tracheal cartilaginous rings. Agensis is often associated with the absence of a lobe or ectopic

thyroid tissue and hence in clinical practices such cases should be diagnosed against thyroid nodule, thyroiditis. Incidence of absence of thyroid isthmus was about 5%-10% which can be explained as an anomaly of embryological development (Kaur HS *et al.*, 2013; Pastor VJ *et al.*, 2006).

The isthmus may be missing in amphibians, birds and among mammals- monotremes, certain marsupials, cetaceans, carnivores, and rodents. In rhesus monkey (macacus rhesus), the thyroid glands are in normal position but there was no isthmus (Pastor VJ *et al.*, 2006; Susan PJ 2009). Thyroid isthmus agensis is a developmental aberration that has been described in a few surgical case reports as an uncommon congenital defect. On the other hand, cadaver investigations have shown that the incidence of thyroid isthmus agensis varies from 3 to 33% (Dixit D *et al.*, 2009; Kaur HS *et al.*, 2013; Pastor VJ *et al.*, 2006; Anil Kumar Reddy *et al.*, 2015).

Development of Thyroid Gland:

The first endocrine gland to develop in an embryo is the thyroid gland. The thyroid gland is a

Citation: Bhavana Tirumala, Anil Kumar Reddy Y, Joy A Ghoshal, Hemanth K. Agensis of Isthmus of Thyroid Gland, its Developmental Basis: A Case Report. Sch J Med Case Rep, 2024 Dec 12(12): 2209-2212.

midline derivative of the pharynx. It is first identifiable in embryos of approximately 20 somites as a median thickening of endoderm lying in the floor of the pharynx between the first and second pharyngeal pouches and immediately dorsal to the aortic sac (Harjeet A *et al.*, 2004).

The foramen caecum is the site of a median diverticulum that appears early in the fifth week in the furrow immediately caudal to the median tongue bud. It extends caudally as the thyroglossal duct, passing ventral to the primordium of the hyoid bone. The tip of the duct bifurcates and the tissue mass subsequently divides to form the isthmus and lateral lobes of the thyroid gland (GANGBOE *et al.*, 2004; Schanaider A *et al.*, 2008; Sgalitzer KE 1941)

CASE PRESENTATION

As a part of routine undergraduate teaching and training, a deep dissection of head and neck was carried out in 23 cadavers in department of Anatomy, AIIMS Mangalagiri. Out of 23 cadavers in 1 cadaver agenesis of thyroid isthmus was observed.

The thyroid gland consisted of two lateral lobes namely right and left with no isthmus. The measurements and neurovasculature of the thyroid gland were found to be normal.

The presence of pyramidal lobe from the left lobe of the thyroid gland was noted with the levator glandulae thyroidea connected to the pyramidal lobe of thyroid gland. The presence of facial sheath was observed in place of the isthmus of thyroid gland exposing second and third tracheal rings underlying it. The facial sheath is assumed to be pre-tracheal fascia which encloses the gland on either sides and blends in the midline (Figure 1).

The fascia present in place of isthmus was taken and histological sections were prepared to study if there is any presence of ectopic thyroid tissue. As it is a cadaveric specimen the histological section procured weren't satisfactory. The presence of ectopic or accessory thyroid tissue was not found in the procured histological specimens.

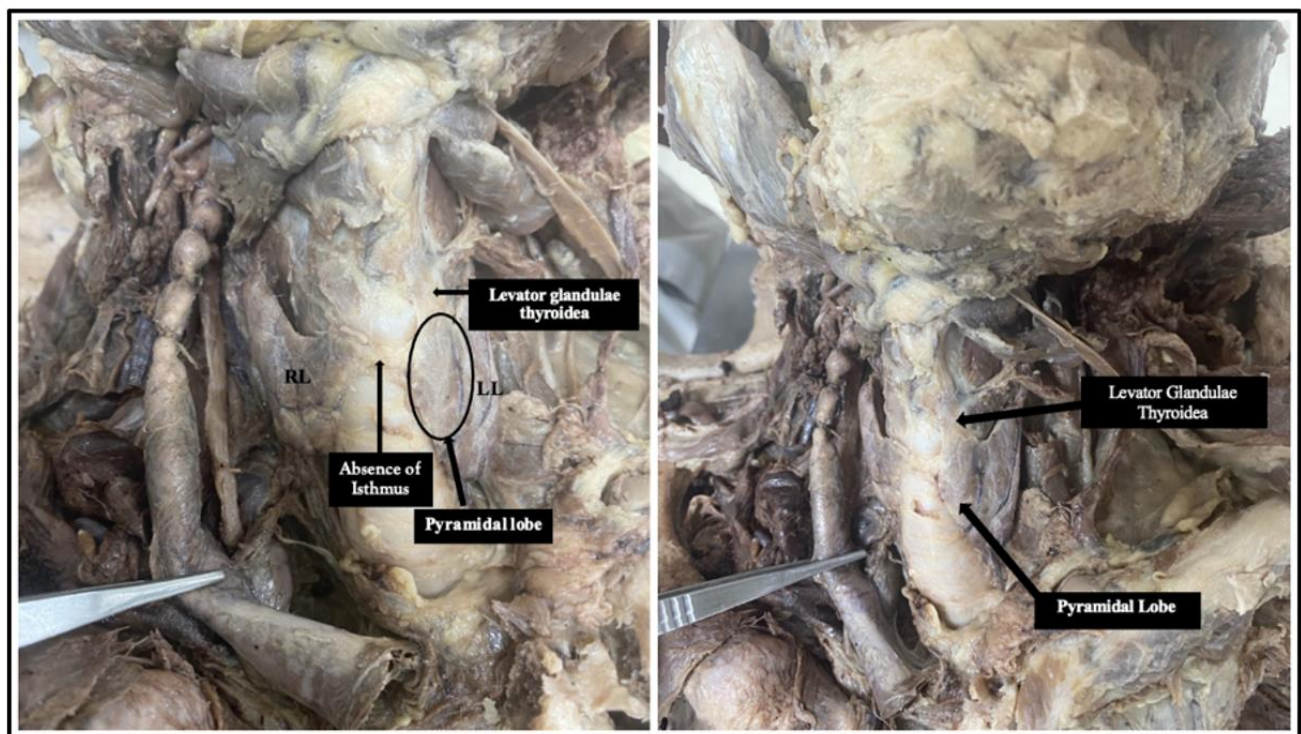


Figure 1: Thyroid gland with absence of isthmus (RL: Right Lateral Lobe; LL: Left Lateral Lobe)

DISCUSSION

The absence of thyroid isthmus is rarely seen in humans. Agenesis of the thyroid isthmus is the complete and congenital absence of the thyroid isthmus (Kaur HS *et al.*, 2013; Pastor VJ *et al.*, 2006). Anomalous embryological development can contribute to the absence of thyroid isthmus. Studies suggest that the

chromosome 22 plays a significant role in the thyroid development (Harjeet A *et al.*, 2004).

The thyroid gland appears as an epithelial proliferation in the floor of pharynx between tuberculum impar and the copula at a point later indicated by foramen caecum (Gangboe *et al.*, 2004). Subsequently the thyroid gland descends in front of the pharyngeal gut as bilobed

diverticulum. During the migration the thyroid remains connected to tongue by thyroglossal duct (Schnaider A *et al.*, 2008; Sgalitzer KE 1941).

The developmental anatomy of the thyroid gland is very important to know the reason behind the anatomical variations of thyroid gland. The anatomical variations of thyroid gland are due to a partial persistence of the median or thyroglossal duct or failure of development of entire gland or part of the gland often results in agenesis (Sgalitzer KE 1941; Ranade AV *et al.*, 2008).

The thyroglossal duct degenerates at its cephalic end. An isthmus may not exist if the thyroglossal duct is highly separated (Schnaider A *et al.*, 2008; Sgalitzer KE 1941). According to literature, the development of the isthmus is an advanced stage during the embryonic period, and any arrest in the process before this point may lead to the absence of the isthmus (Sgalitzer KE 1941; Marshall CF 1895). Rarely, a high separation of thyroglossal duct can lead to two independent thyroid lobes and pyramidal lobe with the absence of isthmus.

The studies conducted by various researchers showed that incidence varied between the ranges of 5% to 33%. Pastor *et al.*, (2006), reported that the incidence was found to be between 5-10%. Other studies conducted by Marshall (1895) and Dixit *et al.*, (2009), were found to be 8-10% and 14.6% respectively. Out of all the references Ranade *et al.*, (2008) documented the highest incidence of agenesis of thyroid isthmus which is 33%.

Patients with isthmus agenesis are generally euthyroid but hypothyroidism or hyperthyroidism may be seen (Vayisoglu Y *et al.*, 2013). If agenesis of the isthmus is found, conditions such as autoimmune thyroid nodule, thyroiditis, primary thyroid cancer, metastasis, and amyloidosis must be considered in the differential diagnosis. Thyroid lobe agenesis, ectopic thyroid tissue, and parathyroid hyperplasia may be associated with isthmus agenesis (Gangboe *et al.*, 2004; Sankar KD *et al.*, 2012). Thus, it is imperative to remember the importance of identifying agenesis of the isthmus and other associated thyroid anomalies in the preoperative screening of patients whose thyroid surgery is planned.

CONCLUSION

Thyroid gland agenesis in its entirety is uncommon. When making a diagnosis, it's critical to take into account the potential for ectopic thyroid tissue or the relationship between isthmus agenesis and thyroid lobe agenesis. Conditions such as amyloidosis, thyroiditis, primary thyroid cancer, metastases, and autoimmune thyroid nodules must also be considered in the differential diagnosis. Preoperative evaluations could identify patients scheduled for thyroid surgery who have agenesis of the isthmus and other thyroid abnormalities,

which would significantly improve surgical safety and lower the likelihood of postoperative problems.

ACKNOWLEDGEMENT

The authors sincerely thank those who donated their bodies to science so that anatomical research and teaching could be performed. Results from such research can potentially increase scientific knowledge and can improve patient care. Therefore, these donors and their families deserve our highest respect.

REFERENCES

- Anil, K. R., Wanjari, S. P., & Ujwal, G. (2015). Agenesis of Isthmus of the Thyroid Gland in an Adult Male Cadaver: A Case Report. *Sch J Med Case Rep*, 3(5), 433-434.
- Dixit, D., Shilpa, M. B., Harsh, M. P., & Ravishankar, M. V. (2009). Agenesis of isthmus of thyroid gland in adult human cadavers: a case series. *Cases J*, 2, 6640. doi: 10.1186/1757-1626-0002-0000006640. PMID: 20181171; PMCID: PMC2827060.
- Gangbo, E., Lacombe, D., Alberti, E. M., Taine, L., Saura, R., & Carles, D. (2004). Trisomy 22 with thyroid isthmus agenesis and absent gall bladder. *Genetic Counseling (Geneva, Switzerland)*, 15(3), 311-315.
- Harjeet, A., Sahni, D., Jit, I., & Aggarwal, A. K. (2004). Shape, measurements and weight of the thyroid gland in northwest Indians. *Surgical and radiologic anatomy*, 26, 91-95.
- Kaur, H. S., Kumar, U., Bajwa, S. J. S., & Kalyan, G. S. (2013). Absent thyroid isthmus: Embryological and clinical implications of a rare variation of thyroid gland revisited. *Thyroid Research and Practice*, 10(2), 80-82.
- Marshall, C. F. (1895). Variations in the form of the thyroid gland in man. *Journal of anatomy and physiology*, 29(Pt 2), 234.
- Mohebbati, A., & Shaha, A. R. (2012). Anatomy of thyroid and parathyroid glands and neurovascular relations. *Clinical Anatomy*, 25(1), 19-31.
- Ranade, A. V., Rai, R., Pai, M. M., Nayak, S. R., Prakash, K. A., Krisnamurthy, A., & Narayana, S. (2008). Anatomical variations of the thyroid gland: possible surgical implications. *Singapore medical journal*, 49(10), 831.
- Sankar, K. D., Bhanu, P. S., & Bapuji, P. (2012). Agenesis of isthmus of thyroid gland with embryological and clinical basis. *Narayana Medical Journal*, 1(1), 32-34.
- Schnaider, A., & de Oliveira, P. J. (2008). Thyroid isthmus agenesis associated with solitary nodule: A case report. *Cases Journal*, 1, 1-2.
- Sgalitzer, K. E. (1941). Contribution to the study of the morphogenesis of the thyroid gland. *Journal of anatomy*, 75(Pt 4), 389.

- Standring, S., Herold, E., Healy, J. C., Johnson, D., & Williams, A. (2005). Gray's Anatomy. 39th edition, Elsevier, *Churchill Livingstone*, 560–564.
- Susan, P. J., & Gajendra, K. (2009). Agenesis of isthmus of thyroid gland with bilateral levator glandulae thyroideae. *International Journal of Anatomical Variations*, 2, 29-30.
- Vayisoglu, Y., Ozcan, C., Gen, R., Eti, C. M., Sut, H., & Gorur, K. (2013). Thyroid isthmus agenesis associated with thyroid papillary carcinoid isthmus agenesis associated with thyroid papillary carcinoma. *Journal of Craniofacial Surgery*, 24(4), e428-e429.
- Vázquez, J. P., Verona, J. G., De Paz Fernández, F. J., & Cachorro, M. B. (2006). Agenesis of the thyroid isthmus. *European Journal of Anatomy*, 10(2), 83.