ORIGINAL RESEARCH

Anatomical Variations of the Thyroid Gland: A Cadaveric Study

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Abstract

Objective: This study aimed to determine the prevalence and morphological characteristics of the variations in the and around the thyroid gland in Sri Lankan cadavers.

Methods: A descriptive cross-sectional study was conducted on 28 embalmed cadavers (17 males, 11 females; mean age 80 years, range 65–94 years) dissected at the Faculty of Dental Sciences, University of Peradeniya (2024–2025). Presence, origin, attachment, and morphological features of PL, LGT, ATG, and TIA were recorded. All measurements were performed by a single investigator.

Results: Pyramidal lobe was identified in 9 cadavers (32.1%). In three cases, PL originated from the medial half or medial two-thirds of the left lobe. LGT was present in 3 cadavers (10.7%), all extending from the PL to the hyoid bone. Two accessory thyroid glands (7.1%) were observed at the hyoid level, both associated with PL and LGT; in these cases, PL measured <1 cm. One cadaver (3.5%) demonstrated a thyroid ima artery arising from the brachiocephalic trunk with bilateral absence of inferior thyroid arteries.

Conclusion: Thyroid variations reflecting incomplete regression of thyroglossal duct remnants are relatively common in the Sri Lankan population. Recognition of these variations is essential for complete thyroidectomy and safe anterior neck surgery.

Keywords: pyramidal lobe; levator glandulae thyroideae; accessory thyroid gland; thyroid ima artery; thyroglossal duct; cadaveric study

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Introduction

The thyroid gland is a highly vascular, reddish-brown endocrine organ situated in the anterior aspect of the lower neck, approximately spanning from the level of the fifth cervical to the first thoracic vertebrae. It lies within the pretracheal layer of the deep cervical fascia and is composed of two lateral lobes joined in the midline by a narrow isthmus (Standring 2016).

The thyroid gland is one of the earliest endocrine organs to develop during embryogenesis. Its descent from the foramen caecum to the anterior neck predisposes it to developmental anomalies related to the thyroglossal duct (Singh 2022).

The pyramidal lobe (PL) represents persistence of the distal thyroglossal duct and most commonly arises from the isthmus, usually near its junction with the left lobe (Maria *et al.,* 2007). Its prevalence varies widely, ranging from 10–30% depending on population and methodology (Sultana *et al.,* 2008).

The levator glandulae thyroideae (LGT) is a fibromuscular or fibrous band extending from the PL or isthmus to the hyoid bone and is also considered a thyroglossal duct remnant (Chaudhary *et al.,* 2013; Natalia *et al.,* 2020).

Ectopic thyroid tissue, although uncommon, may occur anywhere along the embryological course of the thyroglossal duct. The most frequent site is at the base of the tongue near the foramen caecum, where it may represent the only functioning thyroid tissue. Additional ectopic locations include the lateral neck, mediastinum and even subdiaphragmatic regions. Small, separate nodules of thyroid tissue may also be present superior to the lobes or isthmus and are referred to as accessory thyroid glands (Standring 2016). Accessory thyroid tissue may arise from aberrant differentiation of thyroglossal duct remnants and may coexist with PL or LGT (Manisha *et al.,* 2014).

The thyroid ima artery (TIA), when present, may arise from the brachiocephalic trunk or other major vessels and ascends anterior to the trachea. Its presence carries significant surgical risk during tracheostomy and thyroidectomy (Singh 2022; Totlis *et al.,* 2023).

Despite numerous international reports, data from the Sri Lankan population remain limited. Therefore, this study aimed to evaluate the prevalence and morphological characteristics of PL, LGT, accessory thyroid glands and TIA in Sri Lankan cadavers.

Materials and Methods

A descriptive cross-sectional cadaveric study was conducted on 28 embalmed cadavers used for routine dissection at the Faculty of Dental Sciences, University of Peradeniya during the years 2024-2025. The cadavers were of the generous donors who had given consent to use their bodies for teaching and research purposes. Standard anterior neck dissection was performed according to the Dissection manual of Department of Basic Sciences. Anatomical variations of the thyroid glands were observed and recorded. Presence of pyramidal lobe, levator glandulae thyroideae, thyroid Ima artery and accessory thyroid glands were observed. All measurements were performed by a single investigator to minimize observer bias.

Results

Demographic Characteristics

Out of the 28 cadavers 17 were male and 11 were female with a mean age of 80 years (65-94 yrs). Details of the observations are as mentioned in Figure 1 and Table 1.

1. Pyramidal Lobe (PL)

Pyramidal lobes were identified in 9 out of 28 cadavers (32.1%). Most PLs originated from

the isthmus. However, in three cases it originated from the medial half or medial two-thirds of the left lobe. Out of those three cases two were associated with LGT.

PL Alone

Among the nine PL cases, three were also attached to the LGT whereas the other six were PL-alone (67%). Five out of those PL-alone cases extended superiorly to the level of the hyoid bone and one extended to the level of the cricoid cartilage (Figure 2).

2. Levator Glandulae Thyroideae (LGT)

LGT was present in 3 cadavers (10.7% overall; 33% of PL cases). Two of them were more fibrous in nature and one was muscular. All LGTs extended from the pyramidal lobe to the hyoid bone (Figure 3).

3. Accessory Thyroid Glands (ATG)

Two accessory thyroid glands (7.1%) were identified one in 86yr old female and the other in 78-year-old male cadaver. Both were present at the level of the hyoid bone, and both were associated with PL and LGT. In both, pyramidal lobe was less than 1cm in length. ATG appeared as nodular glandular masses of less than 1cm in diameter (Figure 4).

4. Thyroid Ima Artery

One male cadaver of 79 years of age (3.5 %) demonstrated a thyroid Ima artery arising from the brachiocephalic trunk, with bilateral absence of inferior thyroid arteries. This case was also associated with a PL (Figure 5).

Discussion

The thyroid gland develops early in embryogenesis as a median endodermal proliferation in the floor of the primitive pharynx and descends from the foramen caecum to its definitive pretracheal position via the thyroglossal duct (Standring 2016). Normally, the thyroglossal duct degenerates by the seventh week of development; however, incomplete regression may result in persistent remnants such as the pyramidal lobe (PL), levator glandulae thyroideae (LGT), accessory thyroid tissue and vascular variations including the thyroid ima artery (TIA).

In the present study, the prevalence of PL was 32.1%. This falls slightly above the commonly reported range of 10–30% described in cadaveric studies (Sultana *et al.,* 2008), yet remains within the broader spectrum reported in anatomical literature. Maria *et al.,* (2007) emphasized that PL frequently arises from the isthmus or adjacent left lobe and may vary considerably in length and morphology.

Three cases in our series demonstrated origin of PL from the medial half or medial two-thirds of the left lobe rather than strictly from the isthmus. Such lateralized origin reflects variability in the descent and differentiation of thyroid tissue during embryogenesis. Since the PL consists of functional thyroid tissue, it may undergo the same pathological processes as the main gland, including hyperthyroidism and malignancy (Wahl *et al.,* 1997). Failure to identify and remove PL during total thyroidectomy may therefore contribute to recurrence or persistent disease (Maria *et al.,* 2007).

LGT was identified in 10.7% of cadavers in this study. Embryologically, LGT represents a persistent fibromuscular segment of the thyroglossal duct extending from the PL or isthmus to the hyoid bone (Chaudhary *et al.,* 2013). It may vary in composition from predominantly fibrous to muscular tissue, and in some cases may contain glandular elements (Manisha *et al.,* 2014).

Natalia *et al.,* (2020) described LGT as an uncommon but clinically significant structure that may mislead surgeons during thyroid surgery. In our study, all LGTs extended to the

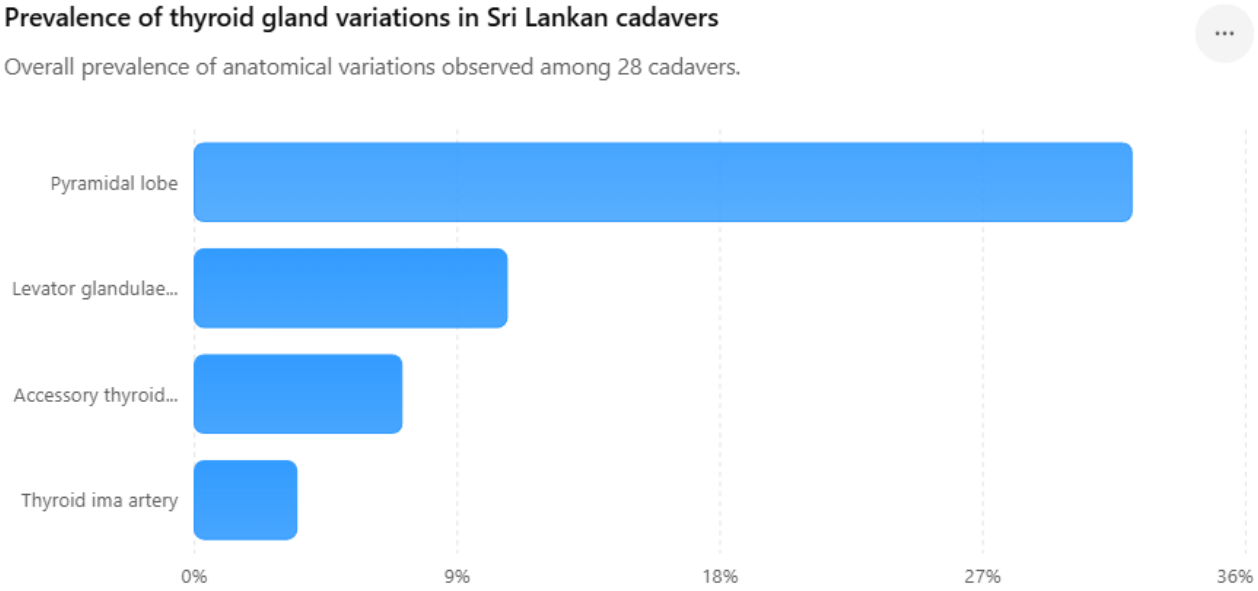


Figure 1: Overall prevalence of thyroid gland variations observed in 28 Sri Lankan cadavers. Pyramidal lobe was the most common variation (32.1%), followed by levator glandulae thyroideae (10.7%), accessory thyroid glands (7.1%), and thyroid ima artery (3.5%).

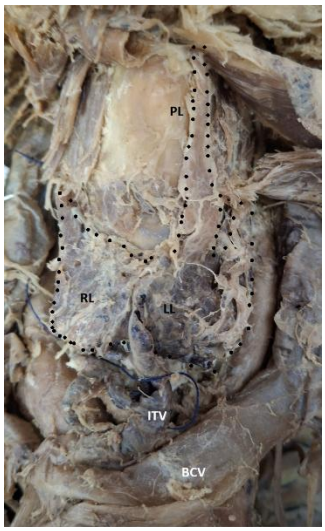


Figure 2: Pyramidal lobe (PL) extending superiorly. RL right lobe; LL left lobe; ITV inferior thyroid vein; BCV brachiocephalic vein.



Figure 3: Levator glandulae thyroideae (LGT) extending from pyramidal lobe (PL) to hyoid bone.



Figure 4: Accessory thyroid gland (ATG) at the level of the hyoid bone associated with pyramidal lobe (PL) and Levator glandulae thyroideae (LGT).

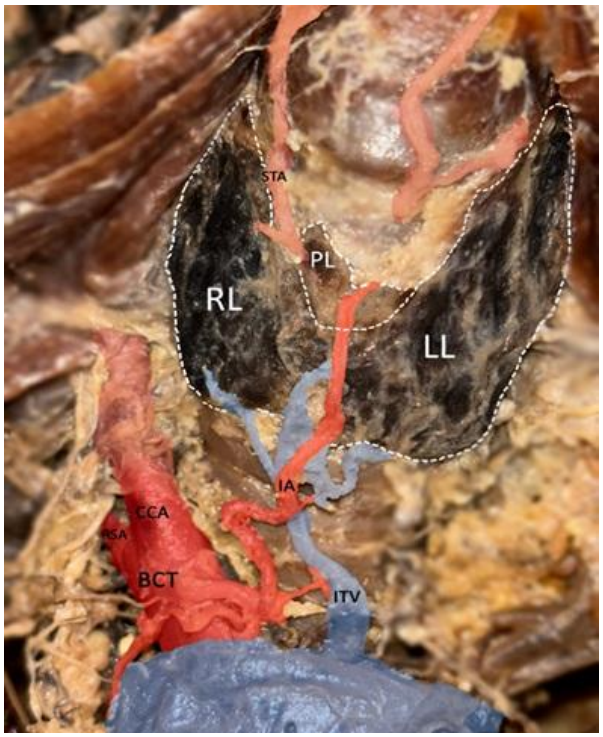


Figure 5: Thyroid Ima artery (IA) arising from brachiocephalic trunk (BCT). CCA: common carotid artery, RSA: right subclavian artery, STA: superior thyroid artery.

hyoid bone, consistent with classical descriptions. Recognition of LGT is important to avoid residual thyroid tissue during surgical procedures.

Accessory thyroid glands (ATG) were observed in 7.1% of specimens and were located at the level of the hyoid bone, associated with both PL and LGT. Embryologically, accessory thyroid tissue arises due to aberrant differentiation or fragmentation of the thyroglossal duct during descent (Standring 2016).

Manisha *et al.,* (2014) reported that LGT may contain glandular tissue and represent a continuum of thyroglossal duct remnants. In the present study, both accessory glands measured less than 1 cm in diameter, which may explain why such structures are often overlooked during surgery. Clinically, persistence of accessory thyroid tissue may contribute to recurrent hyperthyroidism or residual disease following subtotal thyroidectomy (Maria *et al.,* 2007).

The thyroid ima artery was identified in 3.5% of cadavers. This vessel represents persistence of embryonic vascular channels supplying the developing thyroid gland. Singh (2022) described variability in origin of TIA, most commonly from the brachiocephalic trunk, with important implications during anterior neck procedures. Totlis et al. (2023) further emphasized the risk of severe hemorrhage during tracheostomy when TIA is present.

In our case, TIA arose from the brachiocephalic trunk and was associated with bilateral absence of inferior thyroid arteries, suggesting compensatory vascular development. Such vascular variability underscores the importance of careful midline dissection during emergency airway access and thyroid surgery.

The coexistence of PL, LGT, accessory thyroid glands and TIA in certain specimens supports their shared embryological origin. All represent varying degrees of persistence of thyroglossal duct remnants or primitive vascular networks. The spectrum observed in this study reinforces the concept that thyroid anatomical variations are developmental rather than incidental findings.

Given that PL and accessory thyroid tissue may harbor pathological changes (Wahl *et al.,* 1997), thorough exploration of the region between the isthmus and hyoid bone is essential during total thyroidectomy. Similarly, awareness of TIA is critical during tracheostomy and anterior cervical procedures to prevent catastrophic hemorrhage (Totlis *et al.,* 2023).

Conclusion

Anatomical variations of the thyroid gland reflecting persistence of thyroglossal duct remnants are relatively common in Sri Lankan cadavers. Recognition of PL, LGT, accessory thyroid glands, and TIA is essential for

complete thyroidectomy and prevention of surgical complications.

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Conflict of Interest: The authors declare that they have no conflict of interest

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