

A Cadaveric Study of Anatomical Variations in the Thyroid Gland

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Abstract

The thyroid gland is the first endocrine gland to develop in the embryo. Developmental anomalies of thyroid gland are quite commonly seen. Most of the variations are due to the partial persistence of the median or thyroglossal duct. Persistence of pyramidal lobe, thyroglossal cysts, agenesis of the thyroid gland and aberrant thyroid are the major developmental anomalies of the thyroid gland. We conducted a study in about 40 formalin fixed cadavers to look for any morphological variations of thyroid gland including pyramidal lobe and levator glandular thyroidae. All the anomalies detected were documented and compared with previous studies. The complete knowledge about thyroid anatomy, its variation and its associated anomalies is very important for surgeons for surgical interventions. It is also important for physicians and radiologists so that these variations are not overlooked in the differential diagnosis.

Keywords: Thyroid Gland; Anatomy; Anomalies; Agenesis; Thyroid Cartilage; Surgeons.

Introduction

The thyroid gland, brownish-red and highly vascular, thoracic vertebral is placed anteriorly in the lower neck, level with the fifth cervical to first, thoracic vertebrae. Ensheathed by the pretracheal layer of deep cervical fascia, it has right and left lobes connected by a narrow, median isthmus [1].

The thyroid gland is the first endocrine gland to develop in the embryo. It begins to form approximately 24 days after fertilization [2] and appears as an epithelial proliferation in the floor of the pharynx between the tuberculum impar and the copula at a point later indicated by the foramen cecum. Subsequently, the thyroid descends in front of pharyngeal gut as a bilobed diverticulum. During this migration, the thyroid remains connected to the tongue by a narrow canal, the thyroglossal duct which later disappears [3].

A conical pyramidal lobe often ascends towards

the hyoid bone from the isthmus or the adjacent part of either lobe (more often the left). It is occasionally detached or in two or more parts. A fibrous or fibromuscular band, the levator of thyroid gland (*musculus levator glandulae thyroideae*) sometimes descends from the hyoid body to the isthmus or pyramidal lobe [1]. It is seen in approximately 50% of people [2]. The pyramidal lobe may be the source of recurrent disease when it is not removed during indicated total thyroidectomy. The identification and removal of the pyramidal lobe are also of great importance for successful postoperative radioactive iodine treatment in patients with differentiated thyroid carcinoma [4].

Small detached masses of thyroid tissue may occur above the lobes or isthmus as accessory thyroid glands [1]. The anomalies of thyroid gland distort the morphology of the gland and may cause functional disorders and various thyroid illnesses.

Materials and Methods

A detailed cadaveric dissection of anterior midline neck region was carried out in about 40 formalin fixed cadavers which were provided for medical students in Department of Anatomy, Navodaya Medical College, Raichur over the period of 4 years. The thyroid gland was looked for any morphological variation including pyramidal lobe and levator glandular thyroidae.

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Results and Observations

The following anatomical variations were observed (Table I):

1. Agenesis of isthmus was observed in one specimen which also showed pyramidal lobe arising from right lobe (Fig. 1).
2. 6 specimens showed partial agenesis of thyroid isthmus (Fig. 2 and Fig. 3).

3. Pyramidal lobe was observed in 7 specimens out of which 4 were seen to be arising from left lobe. One specimen showed pyramidal lobe on right side associated with agenesis of isthmus (Fig.1). Pyramidal lobe was attached to isthmus in two of the specimens (Fig. 4).
4. Levator glandular thyroidae was present in 3 cases out of which two extended from left lobe to cricoid cartilage (Fig. 5) and third from right pyramidal lobe to thyroid cartilage.

Table 1: Showing incidence of thyroid gland variations in the present study

Sl. No	Anomaly	Incidence (Total= 40 Cadavers)	Percentage
1	Agenesis of Isthmus	1	2.5%
2	Partial Agenesis of Isthmus	6	15%
3	Pyramidal Lobe	7	17.5%
4	Levator Glandular Thyroidae	3	7.5%



Fig. 1: Agenesis of isthmus in a specimen which also showed pyramidal lobe arising from right lobe of thyroid gland



Fig. 2: Partial agenesis of thyroid isthmus in a specimen



Fig. 3: Another specimen with Partial agenesis of thyroid isthmus



Fig. 4: Specimen showing pyramidal lobe attachment to isthmus



Fig. 5: Specimen showing levator glandular thyroidei extending from left lobe of thyroid to cricoid cartilage

Discussion

Developmental anomalies of thyroid gland are quite commonly seen. Most of the variations are due to the partial persistence of the median or thyroglossal duct [5]. Persistence of pyramidal lobe, thyroglossal cysts, agenesis of the thyroid gland and aberrant thyroid are the major developmental anomalies of the thyroid gland [6,7].

Bland Sutton describes the processus pyramidalis as part of the original thyroglossal duct, or median thyroid rudiment of His [8]. Pyramidal lobe was seen in 25% cases in the present study. Marshall reported the presence of pyramidal lobe in 43% of the cases [9]. Blumberg stated that 60.65% cases had the pyramidal lobe and in most cases its location was at left side of the gland (left: right = 3:1) [10]. Enayetullah found pyramidal lobe and levator glandulae thyroidei in 50% and 32% of cases respectively [11]. Begum (2004) found pyramidal lobe in 26.7% and most was from the left side [12]. Harjeet et al. observed it in 28.9% of specimens [13]. Study by S.D Joshi et al. described the pyramidal lobe in 37.7% cases and it was also observed the maximum number of pyramidal lobes was attached to left lobe(47.05%) [14]. Levy et al. found that pyramidal lobe was arising from the left lobe in 63% of cases. They described the presence of pyramidal lobe by radioiodine thyroid scan in 17% of normal cases and 43% of pyramidal lobe in patients with diffuse toxic goitre [15]. Using thyroid scintigraphy, Siraj et al. visualized pyramidal lobe in 41% of patients, and they found a greater incidence among females [16]. A much better method for detecting the pyramidal lobe in the living subjects is computed tomography (CT) of the neck. According to

Geraci G et al. the pyramidal lobe was identified in only 50% of cases during preoperative diagnostic treatments using either ultrasonography or Tc-99m pertechnetate scintigraphy [17].

Eisler made an extensive study on the levator glandulae thyroidei and its innervations. He states that the levator of the thyroid gland may be innervated either by ansa cervicalis or through vagus [18]. Renade et al. reported levator glandulae thyroidei in 49.5% [19] and study conducted by Veena Kulkarni et al., found levator glandulae thyroidei in 30% cases [20]. In the present study, it was seen in 7.5% cases which was similar to study done by Marshall who reported levator glandulae thyroidei in 10% cases [9]. According to Gregory and Guse, Soemmerring's levator glandulae thyroidei is an accessory muscle which runs from the hyoid bone to insert partly on the thyroid cartilage and partly on the isthmus of the thyroid gland²¹. Bourgery described and illustrated a muscle which he called as "hypothyroidien", which occupied the place of the pyramidal lobe [22]. Finally, Godart reported a case in which the structure was indeed muscular, on the basis of nitric acid test for the muscle [23]. Soemmerring's muscle is same as the hyo-thyro-glandulaire of Pointe, the levator glandulae thyroidei superficialis medius et longus of Krause and the musculus thyroideus of Merkel, its usual full name in the literature being 'levator glandulae thyroidei of soemmerring' [24].

Failure in the development of thyroid gland lead to various anomalies. Absence of the thyroid gland, or one of its lobes, is a rare anomaly. In thyroid hemi agenesis, the left lobe is more commonly absent. Mutations in the receptor for thyroid-stimulating hormone is probably involved in some cases². In the present study, agenesis of isthmus was observed in one case which was associated with pyramidal lobe on right lobe and its incidence was 2.5%. Marshall described absent isthmus in 10% cases [9]. Oya observed its absence in 4% of cases²⁵. Gruber reported an absence of the isthmus in 5% of the cases [14]. Anson reported absence of isthmus in 6-8% of cases [26]. Deflice M et al. and Dumont JE et al. have reported that genetically developmental agenesis results from mutations in one of these developmental genes (TITF1, PAX8, FOXE1/TITF2), especially TITF2 because, these genes are more essential for normal development of palate and thyroid gland [27,28]. High separation of thyroglossal duct can provoke two independent lateral lobes with or without pyramidal lobes with absence of isthmus. Kumar et al. has reported that due to its rare nature isthmus agenesis should be kept in mind for safe surgery to avoid complications during neck operations [29]. Clinically,

the diagnosis of agenesis of isthmus can be done with scintigraphy. It can also be diagnosed with the aid of USG, CT, MRI or during a surgical procedure. When the image of absent isthmus is observed, a differential diagnosis against autonomous thyroid nodule, thyroiditis, primary carcinoma, neoplastic metastasis and infiltrative diseases like Amyloidosis should be considered [30].

Conclusion

The complete knowledge about thyroid anatomy and its variation is very important for surgeons for surgical interventions. Understanding of anatomical variations and its associated anomalies is also important for physicians and radiologists so that these variations are not overlooked in the differential diagnosis.

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