

Original Research Article

A study of Anatomical and Morphological variations of the Thyroid gland

C Kishan Reddy¹, M Panchakshari²

^{1,2} Department of Anatomy, Prathima Institute of Medical Sciences, Nagunur, Karimnagar, Telangana

*Corresponding author

Dr C Kishan Reddy

Email: kishanreddy132@gmail.com

Abstract: It is not uncommon to encounter variations in the Thyroid gland during surgeries. Complete detailed anatomical variations in arterial and venous supply including the presence of ectopic glands is useful for diagnosis and prognosis of patients involved with thyroid disorders. With these facts we tried to evaluate the Anatomical and Morphological variations of the thyroid gland. The study was conducted in Department of Radiology, Prathima Institute of Medical sciences Nagunur, Karimnagar. The patients were examined with ultrasound machine and linear probe 7.5 MHz and Convex probe 3.0 MHz frequency. The details of the thyroid gland including the neck vessels and other adjoining structures were studied and any abnormality was recorded. A total of 143 patients were selected as per inclusion and exclusion criteria out of which 80 were females and 63 were males. Normal thyroid structures were found in 103 (72.1%) and Thyroid gland accessory tissue (pyramidal lobe) was found in 31 (21.68%) of patients. Thyroid gland with ectopic thyroid tissue (lingual Thyroid) was found in 3 (2.1%) of patients and Patient thyroglossal duct cyst was found in 4 (2.7%). The sub lingual thyroid and Absence of thyroid or Hemegenesis of thyroid lobe was found in 1 patient each (0.7%). Thyroid gland variations are common presentation in clinical practice due to deviations in the embryological developmental processes. Most of the variations of the thyroid gland can be very well studied by the Ultrasonography. Such studies must be done by anatomists, clinicians and Radiologists in order to treat patients involved in thyroid gland and related disorders. Surgeons attempting thyroidectomy need to have a thorough knowledge of embryology, surgical anatomy and variations of the thyroid gland in order to prevent inadvertent surgical complications.

Keywords: Thyroid Gland, Variations, Ultrasonography [USG].

INTRODUCTION

The Thyroid gland is largest of endocrine glands and is situated in front and sides of trachea opposite 5-7th cervical and 1st thoracic vertebrae. It is invested by two layers or capsules the inner is false capsule and the outer true capsule. The thyroid gland consists of two lobes and a bridging isthmus. Thyroid size, shape and volume varies with age and sex, Normal thyroid lobe dimensions are 18-20 mm longitudinal and 8-9 mm antero-posterior diameter in newborn; 25 mm longitudinal and 12-15 mm AP diameter at one year age and 40-60 mm longitudinal and 13-18 mm AP diameter in adult population [1]. The limits of normal thyroid volume (excluding isthmus, unless its thickness is >3 mm) are 10-15 ml for females and 12-18 ml for males. The relationships with surrounding structures are sternocleidomastoid and strap muscles anteriorly; trachea/esophagus and Longus colli muscle posteriorly; and common carotid arteries and jugular veins bilaterally [2]. The thyroid gland develops from the median eminence of the floor of primitive pharynx during 4th week of gestation. The primitive primordium from the

foramen cecum descends in the anterior midline of the neck to reach its position below the thyroid cartilage by 7th week of gestation.

At first the thyroid diverticulum is hollow but it soon becomes solid and divides into right and left lobes which are connected by the isthmus of thyroid gland which lies anterior to the developing second and third tracheal rings. At the end of seven weeks the thyroid glands will assume its definitive shape. During the developmental process the thyroid gland retains an attachment to the pharynx by a narrow epithelial stalk known as thyroglossal duct. The duct becomes obliterated by 8th to 10th week of gestation. The thyroid hormone synthesis begin to occur at about 11th week of gestation [3-5]. Occasionally remnants of thyroid tissue may remain along the course of thyroglossal duct giving rise to an additional thyroid lobe called the pyramidal lobe attached at the distal end of Thyroglossal duct and left side of the isthmus in 50% of population [4]. Persistence of Thyroglossal duct results in formation of thyroglossal cyst, which is clinically seen as midline

neck swelling or lump at the level of hyoid bone or thyroid cartilage. On ultrasound the cyst appears as well-defined anechoic to Hypoechoic lesion with posterior acoustic enhancement. Internal echoes may be seen with the cyst due to hemorrhage or infection. An ectopic thyroid gland is a congenital anomaly and is usually located along the normal route of its descent from the tongue. Lingual thyroid tissue is most common of ectopic thyroid tissues. Ultrasonography will show presence of ectopic thyroid tissue and normal thyroid gland which may or may not be at normal position. Intralingual masses are found in 10% of autopsies although they are clinically relevant only in 1 in 4000 individuals. It is clinically important to differentiate an ectopic thyroid gland from a Thyroglossal duct cyst or an accessory thyroid gland in order to prevent inadvertent surgical removal of the thyroid gland [6]. Agenesis or hypoplasia (unilobular or isthmus) of thyroid gland may occur due to developmental failure of all or part of thyroid gland. On USG the agenesis of isthmus is characterized by absence of isthmus with lateral lobes positioned independently on either side of trachea [5].

MATERIALS AND METHODS

The present study was carried out in Department of Radiology and partially in Department of Anatomy, Prathima Institute of Medical Sciences (PIMS), Nagunur, Karimnagar. In this study 143 patients were selected from the outpatient Department reporting with thyroid related problems. The age group included was 20 to 60 years. Exclusion criteria were patients undergone thyroid surgeries, and on thyroid medications and those with confirmed thyroid malignancies. All the patients were informed about the procedure in their local language and written consent was obtained. Institutional Ethical Committee permission was obtained for the study.

The ultrasound machine used was Model No. EKO7 manufactured by Samsung Medison co Ltd Seoul Korea. The patient was allowed to lie down on his or her back with hyperextended neck by keeping pillows under the neck. The gel was placed on the surface of the neck thyroid areas and linear probe of 7.5 MHz frequency was placed on the gland. The scan was carried on in both longitudinal and transverse planes and with oblique projection also. A thorough examination of the thyroid gland, neck vessels, other adjoining structures including lymph nodes were made. In each section, margins and parenchyma of the gland were observed and measurements were recorded and if any anatomical and morphological variations were also recorded.

The normal thyroid gland has characteristic appearance on USG scan; the gland shows homogenous texture with medium level echoes. The echogenicity is more than that of the surrounding strap muscles. The gland is entrapped in thin highly reflective capsule. Vascular structures are seen piercing the glandular tissue mainly in the upper parts. The strap muscles are seen as Sonolucent bands along the anterior surface of the thyroid gland. The air filled in the midline gives a characteristic curvilinear reflecting with associated reverberation artifacts. At times echo free areas 2-3 mm in size are also seen in the gland substance suggestive of colloid collections. In elderly people, nodular calcifications or linear bands of fibrous tissue may be seen.

RESULTS

The table 1 shows the sex and age group distribution of the patients selected for the study. Most of the patients were belonging to the 31-40 age group followed by 41-50 age groups as shown in the table-1 given below

Table 1: Age and Sex distribution of patients

Age Group	Female	Male	Total	Percentage
20 – 30	15	7	22	15.39
31 – 40	35	14	49	34.26
41 – 50	13	29	41	28.67
51 – 60	17	13	31	21.68
Total	80	63	143	100

The measurements of thyroid gland were taken and averaged for length, width and thickness of Right lobe, Left Lobe and Isthmus. There was a slight variation found in the right lobe and left lobe measurements. In most of the individuals the left lobe tend to be of larger

length on average as compared to the left lobe both in male and female. However the width and mean thickness including the Isthmus were almost similar in both male and female group given in the table 2.

Table 2: Measurements of Thyroid Gland

Sl. No.	Part of Thyroid Gland	Length in cms Mean \pm SD		Width in cms Mean \pm SD		Thickness in cms Mean \pm SD	
		Females	Males	Females	Males	Females	Males
1	Right Lobe	3.99 \pm 0.74	3.94 \pm 0.67	2.43 \pm 0.22	2.43 \pm 0.20	1.19 \pm 0.15	1.12 \pm 0.15
2	Left Lobe	4.06 \pm 0.60	4.18 \pm 1.03	2.39 \pm 0.19	2.39 \pm 0.22	1.17 \pm 0.15	1.16 \pm 0.16
3	Isthmus	0.97 \pm 0.06	0.97 \pm 0.06			0.53 \pm 0.09	0.52 \pm 0.07

The types of variations found in the thyroid gland were recorded. Out of 143 patients 103 (72.1%) had normal appearance. The most common abnormality found was Pyramidal lobe which was present in 21.7% of

the patients and ectopic thyroid tissue including lingual and sublingual thyroid was found in 2.8 % of the patients and Patient thyroglossal duct cyst was found in 2.7% of the patients given in table 3.

Table 3: Showing the percentage and frequency of thyroid gland anatomical variants

Sl. No	Type of Thyroid Gland variant	Frequency	Percentage
1	Normal	103	72.1
2	Thyroid with Accessory tissue-pyramidal lobe	31	21.7
3	Thyroid with ectopic thyroid tissue- Lingual thyroid	3	2.1
4	Thyroid with ectopic thyroid tissue- Sublingual thyroid	1	0.7
5	Hemiagenesis of thyroid lobe	1	0.7
6	Patient Thyroglossal duct cyst	4	2.7
Total		143	100

DISCUSSION

The thyroid gland is most commonly variable in size and structure this is because of its typical embryological origin. It has dual origin that is from endoderm and ectoderm. The endodermal component is from the floor or primitive pharynx originating at the junction of the first and second pharyngeal pouches. This site is the future of foramen caecum at the junction of the ventral two thirds and dorsal one third of tongue [7]. The endodermal components form the thyroglossal tract and thyroid parenchyma. The ectodermal component arises with calcitonin producing c cells from the neuroectodermal ultimobranchial body and forms the future posterolateral aspect of the parenchyma. [7] The thyroid Developmental Abnormalities [TDA] has been studied by many Ranade *et al.*; [8] found that presence of pyramidal lobe is in 58% of male cadavers and 49.5% showed the presence of Levator Glandulae Thyroidae [LGT]. In our study we found 31 (21.7%) of the patients having pyramidal lobe. The presence of pyramidal lobes could be a source of pitfalls during thyroidectomy due to its unreliable preoperative diagnosis on scintigraphic images. A study by Melnick JC *et al.*; [9] has shown that the frequency of existence of pyramidal lobe in Koreans was up to 76.8%. Similarly a study by Sultana *et al.*; studying 60 specimens found incidence of pyramidal lobe in 52.1% in male and 41.7% in female [10]. Left lobe was the most common site of origin of pyramidal lobe. Ramesh RT *et al.*; in 2007 observed the median thyroid tissue in elderly male cadaver at a site other than in its usual pretracheal region [11]. It was situated in the medial plane extending from hyoid bone to the front of cricoids cartilage. Normal thyroid gland in the pretracheal region was absent. Other researchers have reported of ectopic thyroid tissue which may be asymptomatic or may be with obstruction and other

complications [12, 13]. In the present we found the incidence of lingual and sublingual thyroid in 4 (2.8%) of cases. There are reports of presence of ectopic thyroid tissue in different regions of the body other than abnormal migration of thyroid gland such as in submandibular region [14] lateral aspect of the neck [15], Heart [16] gall bladder [17]. Another thyroid variant called Tubercle of Zuckerkandl was studied by Page C *et al.*; [18] they found 7% of cases related with Thyroid tubercle of Zuckerkandl. Emin Gurleyik reported two cases of enlarged tubercle of Zuckerkandl displacing the recurrent laryngeal nerve laterally [19]. In this study we did not find any case related with Tubercle of Zuckerkandl. Agenesis of thyroid lobe was found in 1 (0.7%) in our study. Zacharian SK *et al* found hemiagenesis commonly involving the left lobe and rarely the right lobe. It has been considered as one of the rare abnormality of the thyroid gland. The exact incidence of hemiagenesis is still unknown as most patients tend to remain a symptomatic. Agenesis of isthmus of thyroid gland was reported by Dixit D *et al.*; [21] they found 14.63% of dissected thyroid gland with absence of Isthmus. In this study we did not find any case of agenesis of isthmus.

CONCLUSIONS:

Thyroid gland variations are common presentation in clinical practice due to deviations in the embryological developmental processes. Most of the variations of the thyroid gland can be very well studied by the Ultrasonography. Such studies must be done by anatomists, clinicians and Radiologists in order to treat patients involved in thyroid gland and related disorders. Surgeons attempting thyroidectomy need to have a thorough knowledge of embryology, surgical anatomy

and variations of the thyroid gland in order to prevent inadvertent surgical complications.

REFERENCES

1. Chaudhary V, Bano S; Thyroid ultrasound. Indian J Endocrinol Metab 2013; 17(2): 219.
2. Ghervan C; Thyroid and parathyroid ultrasound. Med Ultrason. 2011; 13:80–84.
3. Kaplan EL, Shukla M, Hara H, Ito K; Developmental abnormalities of the thyroid. In: De Groot LJ, editor. Endocrinology. Philadelphia Saunders; 1994:893–99.
4. Larsen WJ; Development of the head and the neck. In: Larsen WJ, editor. Human Embryology. New York: Churchill Livingstone; 1993: 335–39.
5. Léger J, Marinovic D, Garel C, Bonaïti-Pellié C, Polak M, Czernichow P; Thyroid developmental anomalies in first degree relatives of children with congenital hypothyroidism. J Clin Endocrinol Metab 2002; 87:575–80.
6. Leung AK, Wang AL, Robson WL; Ectopic thyroid gland simulating a thyroglossal duct cyst: a case report. Can J Surg 1995; 38(1): 87.
7. Bhargav PRK; Salient Anatomical Landmarks of Thyroid and Their Practical Significance in Thyroid Surgery: a Pictorial Review of Thyroid Surgical Anatomy (Revisited). Indian J Surg 2014; 76(3): 207-11.
8. Ranade AV, Rai R, Pai MM, Nayak SR, Prakash, Krishnamurthy A, *et al.*; Anatomical variation of the thyroid gland: possible surgical implications. Singapore Med J 2008; 49:831-34.
9. Hussein M, Yadav B, Saxena D, Sharma Kr. Arun; Anatomical variations of Thyroid Gland and Its clinical significance in North Indian Population. Global J Biol & Health Sc 2013; 2(2): 12-16.
10. Sultana S, Mannan S, Ahmed M, Rahman M, Khan M, Khalil M; An anatomical study of pyramidal lobe of the thyroid gland in Bangladeshi people. Mymensing Med J 2008; 17: 8-13.
11. Ramesh RT, Balakrishnan R, Prakashchandra S, Suresh R; Ectopic Thyroid tissue with a rare vascular variation. Int J Morphol 2007; 25: 121-27.
12. Walling AD; Ectopic thyroid tissue. Am Fam Physician 1987; 36(3):147-50.
13. Basaria S, Westra W.H, Cooper DS; Ectopic lingual thyroid masquerading as thyroid cancer metastases. J. of Clinical Endocrinology & Metabolism 2001; 86(1):392-95.
14. Sambola-Cabrer I, Fernández-Real J.M, Ricart W, Barbas J.F, Olle M, Teruel J; Ectopic thyroid tissue presenting as a submandibular mass. Head Neck 1996; 18(1):87-90.
15. Caccetta T.P, Kumar A, Ishak H; Lateral aberrant thyroid tissue presenting as a lateral neck mass. ANZ journal of surgery, 2005; 75(12): 1123-1124.
16. Casanova JB, Daly RC, Edwards BS, Tazelaar HD, Thompson GB; Intracardiac ectopic thyroid. Ann Thorac Surg 2000; 70:1694-96.
17. Harach HR; Ectopic thyroid tissue adjacent to the gallbladder. Histopathology 1998; 32:90-1.
18. Page C, Cuvelier P, Biet A, Boute P, Laude M, Strunski V; Thyroid tubercle of Zuckerkandl anatomical and surgical experience from 79 thyroidectomies. J Laryngol Otol 2007; 123(7):768–71.
19. Emin G, Sami D, Omer G, Mevlut P; The Rare Coincidence: Non recurrent Laryngeal Nerve Pointed by a Zuckerkandl's Tubercle. Case Rep Med 2012; 2012:1-3.
20. Zachariah SK, Narayanan P, Mathew NV, Krishnakutty SL; Hemiagenesis of the right Lobe and Isthmus of the thyroid presenting as multinodular goiter. Res Endocrinol 2014; 2014: 5.
21. Dixit D, Shilpa MB, Harsh MP, Ravi Shankar MV; Agenesis of isthmus of thyroid gland in adult human cadaver: a case series. Cases J 2009; 2: 6640.