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Original Article

Anatomy Section

Morphological Evaluation of the Thyroid Lobes and Isthmus in Asymptomatic Indian Young Adults using Ultrasonography: A Cross-sectional Study

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ABSTRACT

Introduction: Studies on morphological variations of the thyroid gland have been published from various parts of the world. Awareness of these variations becomes critical for diagnosing pathologies involving the gland and for surgeons dealing with head and neck surgery.

Aim: To observe and document asymmetry in thyroid morphology using ultrasonography (visual inspection followed by size estimation) in asymptomatic subjects.

Materials and Methods: It was a descriptive cross-sectional study, conducted in the Department of Anatomy, King George's Medical University, Lucknow, Uttar Pradesh, India, which included 100 volunteer first year students (50 males and 50 females), who attended classes from April 2019-March 2020. Ultrasonography of the thyroid gland was performed and the image showing the thyroid isthmus along with both the lobes at their greatest depth and width was captured. The thickness of isthmus was also observed at this stage. Any visual asymmetry observed was noted; thereafter, in these subjects displaying asymmetry on close examination, the maximal width (mediolateral), maximal depth (anteroposterior), and greatest length (craniocaudal) of each lobe was taken. The statistical analysis was done using Statistical Package for Social Sciences (SPSS) version 24.0. The values were represented in number (%) and mean±Standard Deviation (SD).

Results: During sonographic assessment of the thyroid gland, visual asymmetry was observed on the coronal scan images in 24 out of 100 individuals (14 females and 10 males). These 24 cases were subjected to assessment of actual size measurements on ultrasound. In 23 of these subjects (13 females, 10 males), this asymmetry on close examination was correctly validated during measurements. However, in one female subject, the apparent asymmetry of lobe visualised via the transverse scan, did not translate into a difference in measurements, i.e., both the lobes measured almost similar. An asymmetry in thickness of isthmus was also uniquely observed in 10 subjects (eight females and two males).

Conclusion: Visual assessment of thyroid lobes using ultrasonographic examination revealed asymmetry in lobe size, which was congruent with the measurement of dimensions of the lobes and also asymmetric isthmus thickness was seen. Hence, ultrasonographic examination proved to be a useful tool in routine diagnosis and treatment planning procedures.

Keywords: Asymmetry, Gland, Imaging, Ultrasound, Visual

INTRODUCTION

Thyroid gland is a ductless gland situated anteriorly in the lower neck. It is situated abutting the side of the trachea opposite the 5th-7th cervical and 1st thoracic vertebrae and is enclosed by pretracheal layer of deep cervical fascia. It comprises of two lobes-right and left, interconnected via narrow central isthmus, forming an H-shaped mass. The lobes of thyroid gland can be described as cone-shaped, each measuring approximately 5 cm in length, 3 cm in its greatest transverse, and 2 cm in its anteroposterior extent. Apices of lobes are directed vertically and extend laterally up to oblique lines on thyroid laminae [1]. Isthmus acts as a connection between the two lobes in the lower part and measures approximately 1.25 cm in width as well as height. It lies anterior to 2nd and 3rd tracheal cartilages; however, can lie higher or lower than usual as it dramatically varies in size and site [1]. It's thickness varies between 3-5 mm, and displays demographic variation [2]. Thyroid gland develops as an endodermal diverticulum (thyroglossal duct), which grows caudally from floor of the pharynx behind the tuberculum impar. Parts of lateral lobes develop from the 4th pharyngeal pouch of caudal pharyngeal complex [3].

Morphological variations of thyroid gland have been outlined from different regions worldwide. A 3rd lobe of the thyroid gland, more widely known as pyramidal lobe, may sometimes exist; it is cone-shaped and has a variable length. It's observed prevalence reported mostly from cadaveric studies varies between 35-65% [4-6]. It is often observed as an extension from the upper surface of isthmus (near the midline) or the adjacent part of either lobe (left being more often). The upper end of this may continue up to the hyoid bone in the form of fibromuscular strand, called as Levator Glandulae Thyroideae (LGT). In absence of pyramidal lobe, LGT is found adhered to the upper surface of isthmus [7]. The isthmus has also been reported to be completely absent, with an incidence of 5-10% [8-10]. A higher than normal division of thyroglossal duct may be associated with the formation of two separate individual thyroid lobes due to the absence of isthmus [11]. It has been reported that the right lobe of thyroid gland is generally larger than the left lobe, and is also more likely to be affected by thyroid nodules and tends to enlarge more in diffuse thyroid goiter [12]. Prior knowledge of these variations and asymmetry plays an essential role in achieving earlier and better diagnosis and better surgical outcomes.

Ultrasound is a safe, reliable, cheap, painless, and non invasive technique to produce images of the internal body structures. The distinctive imaging attributes of ultrasound, make it an essential and versatile imaging modality; thus, leading to wide diagnostic and

therapeutic applications in clinical practice. The superficial location of thyroid gland, makes it ideal for sonographic examination. For superficial organs lying within 1-3 cm of surface, imaging frequencies of 7.5-15 MHz (Megahertz) are used [13].

While conducting an earlier study on the morphometry of thyroid gland using ultrasound, asymmetry in thyroid morphology was additionally observed among the studied asymptomatic population group. Therefore, the authors decided to explore it further and collected the relevant data from the study subjects. Hence, the present study is a part of the study entitled 'Morphometry of the Thyroid Gland and its Correlation to Various Anthropometric Parameters in Asymptomatic Indian Young Adults- A Cross-sectional Study', with the sample population and study duration being similar [14].

The present study aimed to observe and document asymmetry and variations in thyroid morphology in asymptomatic subjects using ultrasonography. Hence, the present study would augment the information reserve regarding morphology of thyroid gland, thereby, forming a cornerstone to safe and successful future surgeries.

MATERIALS AND METHODS

This descriptive cross-sectional study was carried out in the Department of Anatomy in collaboration with the Department of Radiodiagnosis, King George's Medical University (KGMU), Lucknow, Uttar Pradesh, India. The study population included 100 volunteer 1st year students (50 males and 50 females), who attended classes from April 2019-March 2020 in the Department of Anatomy. The study was conducted after obtaining informed consent from subjects and clearance from the Institutional Ethics Committee of the university viz. reference code 96th ECM II B-Thesis/P36.

Inclusion and Exclusion criteria: Subjects willing to participate in the study, after obtaining written and informed consent were included. However, the subjects with symptoms/signs like restlessness, hoarseness of voice, agitation, tremors, rapid significant weight loss despite an increased appetite, excessive sweating, elevated heart rate or intolerance to heat/cold; history of treatment for thyroid disorders; positive family history of thyroid cancer; prior history of radiotherapy/neck surgery; and any visible/palpable mass in the neck, were excluded from the present study.

Sample size calculation: The sample size was calculated using the below formula:

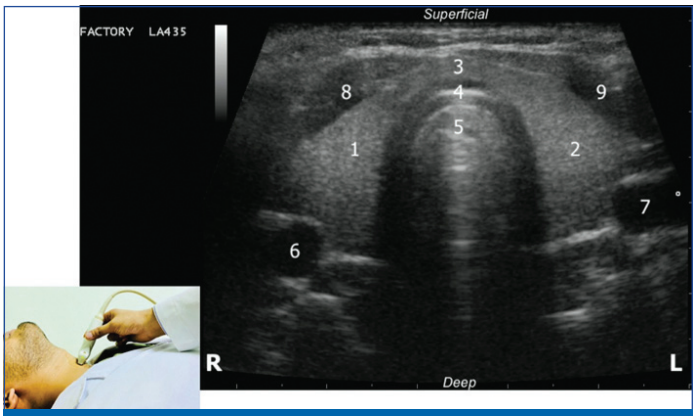
$$N=[Z\alpha/22\times p\times(1-p)]/d2$$

where, $Z\alpha/2$=critical value of the normal distribution at $\alpha/2=1.96\sim2$ for 95% confidence level, power 80% and α is 0.05; p=sample proportion=0.50 i.e. 50% (considered for normative data amongst asymptomatic adults viz. infinite population); d=margin of error= 0.10 i.e. 10%. Hence, sample size (N)=22×0.5×0.5/(0.1)2=4×0.25/ 0.01=1.00/0.01=100.

Study Procedure

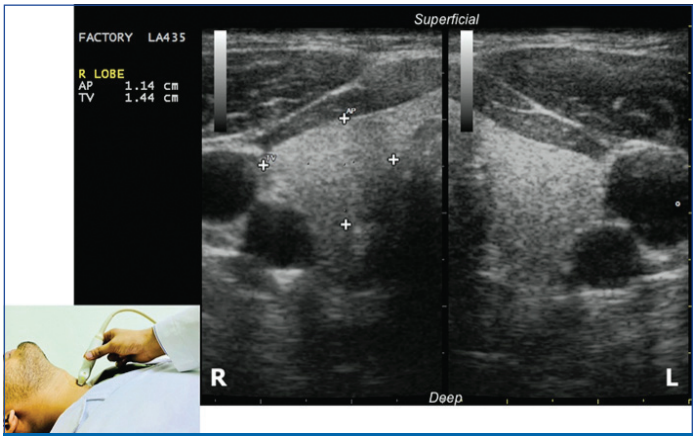
The B-mode ultrasonography was performed using MyLab™40 - Esaote ultrasound machine, with linear probe frequency 6-13 MHz.

Scanning protocol [15]: Sonography was performed in supine position, with hyperextended neck (using a pillow under shoulders to maintain the same). The thyroid gland was observed in the lower neck. Water-soluble ultrasound gel was applied to the skin over the neck area to be scanned. Scanning was conducted, holding the transducer perpendicular to skin using minimal pressure, anterior and anterolateral areas of the neck were screened in a sweeping motion to rule out any obvious abnormalities. Thyroid gland was identified on sonography due to it's distinct echogenicity as compared to the neighbouring structures [16]. The thyroid gland appeared mid-grey with even homogeneous texture with medium-level echoes. Anteriorly strap muscles were observed as hypoechoic structures, the trachea was visible posterior to medial portion of thyroid, with its echogenic cartilage rings and air shadows; while posterior to lateral portion of thyroid, common carotid artery and internal jugular vein were visualised with their echo-free lumina. Entire gland was observed from inferior to superior aspect. Both lobes appeared hyperechoic in comparison to adjacent muscles, while the capsule was observed as a thin line, hyperechoic to parenchyma of gland [Table/Fig-1].

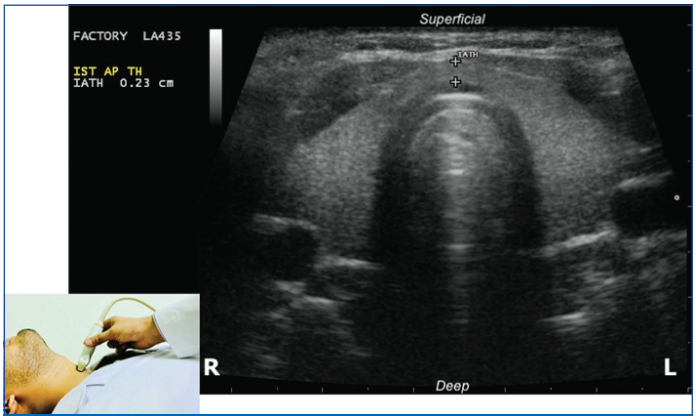


[Table/Fig-1]: Ultrasound image showing the thyroid gland in a transverse view. (1-right lobe, 2-left lobe, 3-isthmus, 4-white line represents cartilaginous rings of trachea, 5-trachea, 6-right common carotid artery, 7-left common carotid artery, 8-right sternothyroid and sternohyoid muscles, 9-left sternothyroid and sternohyoid muscles)

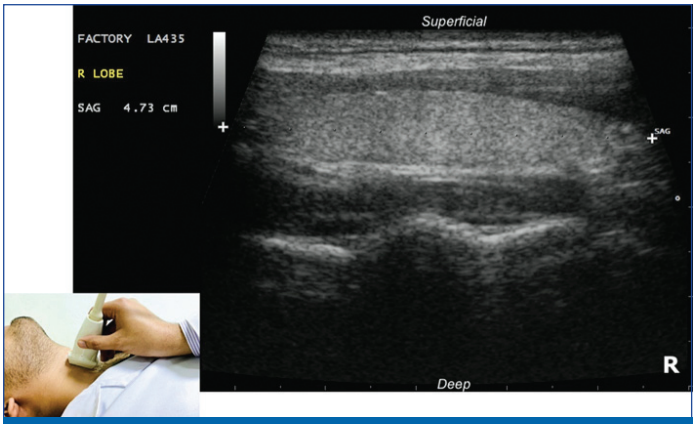
Any visual asymmetry of the thyroid lobes and isthmus as observed via ultrasound scan was noted. Thereafter, in these subjects, the maximal width (mediolateral), maximal depth (anteroposterior) and greatest length (craniocaudal) of each lobe was taken. Hence, the image showing the thyroid isthmus along with both the lobes in the transverse section at their greatest depth and width was captured and measurements were taken for both the lobes [Table/Fig-2]. The thickness of isthmus was also measured at this stage [Table/ Fig-3]. The gland, was then scanned longitudinally (from medial to lateral aspect) beginning at the sagittal plane holding the transducer perpendicular above the sternal notch. The image, which showed the lobe at its greatest length (craniocaudal), was frozen and measurements were taken for both the lobes [Table/Fig-4].



[Table/Fig-2]: Ultrasound image showing depth (anterior-posterior) and width (medial-lateral) measurements for the right lobe of thyroid gland. (Images from left to right)



[Table/Fig-3]: Ultrasound image showing thickness measurement for the isthmus of thyroid gland.



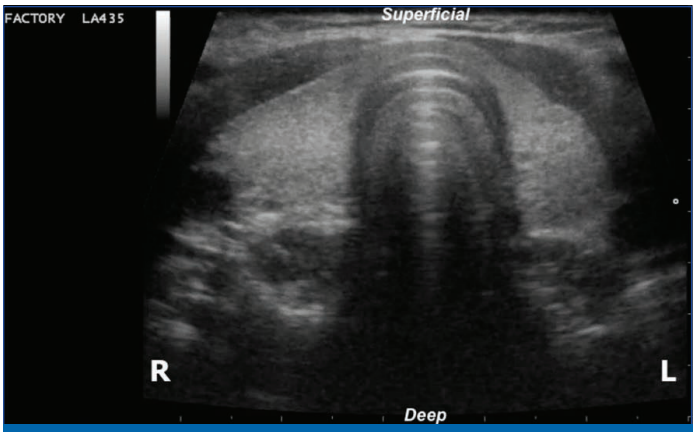
[Table/Fig-4]: Ultrasound image showing length (craniocaudal) measurement for the right lobe of thyroid gland. (Images from left to right)

STATISTICAL ANALYSIS

The statistical analysis was performed using SPSS version 24.0 (Chicago, Inc., USA). The values were represented in number (%) and mean±SD. Independent sample t-test was used to compare the means of thyroid lobe dimensions and isthmus thickness across gender. The p-value <0.05 was considered statistically significant.

RESULTS

During an overall sonographic assessment of the thyroid gland, an apparent asymmetry in lobes as well as isthmus was observed on a transverse scan during visual assessment even before measurements were taken [Table/Fig-5]. Asymmetry was observed in 24 out of 100 subjects (14 females and 10 males). Amongst these, it was observed that the left lobe appeared smaller as compared to the right lobe in 14 subjects (seven females and seven males), whereas right lobe was apparently smaller in 10 subjects (seven females and seven males).



[Table/Fig-5]: Ultrasound image showing isolated asymmetry of lobes (smaller left lobe) with uniform isthmus thickness.

Amongst 23 subjects (13 females, 10 males), this visual asymmetry in size on validation (by measuring the dimensions of lobes), revealed that lobe which looked small, also measured smaller in it's dimensions as compared to the other side. However, in remaining one female subject, the apparent asymmetry of lobe observed on the transverse scan, did not translate into a difference in measurements; both lobes measured almost similar.

Among females, the mean right lobe length was 4.85±0.35 cm, width was 1.23±0.30 cm, depth was 1.33±0.20 cm; while mean left lobe length was 4.63±0.48 cm, width was 1.22±0.25 cm and depth was 1.23±0.15 cm. Among males, the mean right lobe length was 5.09±0.20 cm, width was 1.41±0.22 cm, depth was 1.40±0.20 cm; while mean left lobe length was 5.06±0.28 cm, width was 1.29±0.18 cm and depth was 1.19±0.13 cm [Table/Fig-6]. There was no statistical difference across gender with respect to the dimensions of right and left thyroid lobes as well as bilateral differences in measurements, which is shown in [Table/Fig-7].

The measurements of isthmus revealed that the central antero-posterior measurement for thickness of thyroid isthmus ranged from 1.4-4.2 mm. Asymmetry in thickness of isthmus was found in 10% participants (two males and eight females) [Table/Fig-8]. Variations in thickness of isthmus through its length ranged from 0.60-2.6 mm. Isthmus thickness was found reduced on left side in seven participants (two males and five females), as compared to reduced isthmus thickness in three subjects (three females) on right side [Table/Fig-9]. Differences in isthmus thickness on left ranged from 2.43±0.78 mm as compared to 3.65±1.51 mm on the right. There was no statistical difference across gender with respect to the asymmetry in isthmus thickness on right and left sides from midline as well as the differences in dimensions between right and left side, which is shown in [Table/Fig-10].

On comparing the unequal lobes with unequal thickness of isthmus, it was found that in 10 subjects there was a coexistent reduction in isthmus thickness and the corresponding thyroid lobe size ipsilaterally, while in the remaining 14 subjects, only the lobe was small, whereas isthmus was of uniform thickness.

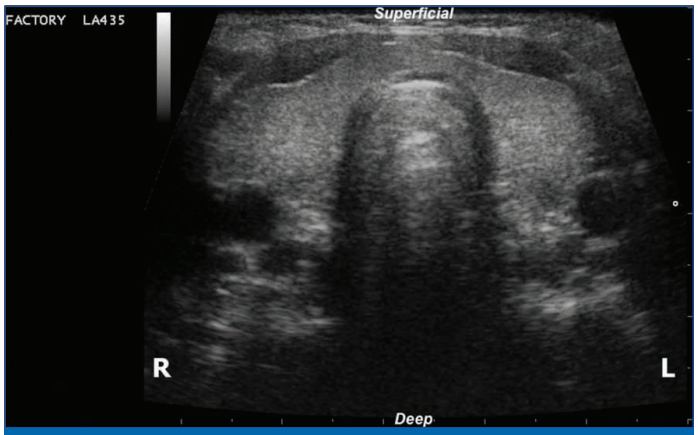
Any other variation in morphology like the presence of pyramidal lobe, levator glandulae thyroidae, accessory thyroid tissue or the absence of isthmus could not be observed amongst the present study subjects.

Variables		Right lobe			Left lobe			Difference in measurements between lobes		
		Length (cm)	Width (cm)	Depth (cm)	Length (cm)	Width (cm)	Depth (cm)	Length (cm)	Width (cm)	Depth (cm)
Female	Mean	4.85	1.23	1.33	4.63	1.22	1.23	0.30	0.18	0.16
	SD	0.35	0.30	0.20	0.48	0.25	0.15	0.30	0.12	0.13
	Minimum	4.24	0.74	0.99	3.61	0.78	1.02	0.05	0.04	0.01
	Maximum	5.41	1.91	1.60	5.19	1.79	1.49	1.13	0.40	0.46
	N	14	14	14	14	14	14	14	14	14
Male	Mean	5.09	1.41	1.40	5.06	1.29	1.19	0.32	0.19	0.24
	SD	0.20	0.22	0.20	0.28	0.18	0.13	0.21	0.10	0.11
	Minimum	4.73	0.95	1.00	4.50	1.07	1.02	0.04	0.08	0.12
	Maximum	5.34	1.65	1.65	5.34	1.66	1.41	0.64	0.38	0.51
	N	10	10	10	10	10	10	10	10	10
Total	Mean	4.95	1.31	1.36	4.81	1.25	1.22	0.31	0.19	0.19
	SD	0.31	0.28	0.20	0.46	0.22	0.14	0.26	0.11	0.13
	Minimum	4.24	0.74	0.99	3.61	0.78	1.02	0.04	0.04	0.01
	Maximum	5.41	1.91	1.65	5.34	1.79	1.49	1.13	0.40	0.51
	N	24	24	24	24	24	24	24	24	24

[Table/Fig-6]: Descriptive statistics for dimensions of the right and left thyroid lobes as well as bilateral differences in measurements in patients with observed asymmetry.

Parameters		t-test for equality of means				
		t	df	Sig. (2-tailed)	Mean difference	Std. error difference
Right lobe	Length (cm)	-1.906	22	0.070	-0.23286	0.12219
	Width (cm)	-1.627	22	0.118	-0.18000	0.11063
	Depth (cm)	-0.832	22	0.414	-0.06943	0.08345
Left lobe	Length (cm)	-2.583	22	0.017	-0.43586	0.16877
	Width (cm)	-0.797	22	0.434	-0.07471	0.09374
	Depth (cm)	0.688	22	0.499	0.03986	0.05793
Difference in measurements between lobes	Length (cm)	-0.228	22	0.822	-0.02500	0.10978
	Width (cm)	-0.186	22	0.854	-0.00843	0.04524
	Depth (cm)	-1.548	22	0.136	-0.07786	0.05030

[Table/Fig-7]: Comparison of the means of thyroid lobe dimensions across gender. Independent t-test was used



[Table/Fig-8]: Ultrasound image showing asymmetrical isthmus thickness.

Variables		Isthmus thickness-Right side (mm)	Isthmus thickness-Left side (mm)	Difference between right and and left side dimensions (mm)
Female	Mean	3.61	2.61	1.88
	SD	1.58	0.64	0.68
	Minimum	1.70	1.70	0.60
	Maximum	6.10	3.50	2.60
	N	8	8	8
Male	Mean	3.80	1.70	2.10
	SD	1.70	1.13	0.57
	Minimum	2.60	0.90	1.70
	Maximum	5.00	2.50	2.50
	N	2	2	2
Total	Mean	3.65	2.43	1.92
	SD	1.51	0.78	0.63
	Minimum	1.70	0.90	0.60
	Maximum	6.10	3.50	2.60
	Range	4.40	2.60	2.00
	N	10	10	10

[Table/Fig-9]: Descriptive statistics for asymmetry in isthmus thickness on right and left sides from midline as well as the differences in dimensions between right and left side.

Parameters	t-test for equality of means				
	t	df	Sig. (2-tailed)	Mean difference	Std. error difference
Isthmus thickness-Right side (mm)	-0.148	8	0.886	-0.18750	1.26271
Isthmus thickness-Left side (mm)	1.603	8	0.148	0.91250	0.56932
Difference between right and left side dimensions (mm)	-0.429	8	0.679	-0.22500	0.52403

[Table/Fig-10]: Comparison of the means of isthmus thickness across gender. Independent t-test was used

DISCUSSION

Thyroid ultrasound has become the mainstay for clinical diagnostic as well as therapeutic interventional procedures in many thyroid disorders. Asymmetry of the size of the thyroid lobes is common in healthy individuals. The 3-dimensional ultrasound is valuable for the assessment of thyroid size because of its high measurement precision and reliability [17].

Visual asymmetry was observed in the size of lobes amongst 24 subjects (14 females and 10 males). Out of these 24, it was observed that left lobe appeared visually smaller in 14 subjects (seven females and seven males), whereas right lobe was apparently smaller in remainder 10 subjects (seven females and three males). Lobes were smaller on the left side and larger on the right side in majority. In a recent study by Abubakar AA et al., (2021), 400 participants from Kano Metropolis, Nigeria, were assessed using ultrasound, wherein the mean right and left thyroid lobes' volumes were 4.1±0.74 cm and 3.6±0.65 cm, respectively [18]. In another study by Salaam AJ et al., (2020), amongst 400 healthy adults of Nigeria, the right lobe volume (3.2±1.47 cm^3) was greater than the left lobe (2.77±1.35 cm^3) [19]. Hence, the findings of the current study as perceived on visual examination are in line with the volumetric data reported by various other studies where right lobe volume has been reported more as compared to the left side [18-23]. However, this discrepancy in the volumes of the left and right thyroid lobes has neither a socio-cultural nor physiologic explanation [20].

Asymmetry of thyroid lobes occurs in normal individuals. Reduced development or agenesis of lobe more commonly affects the left lobe and this is similarly reported in the present study [24]. Reduction in size or even absence of one lobe has no clinical significance or symptoms. There are increased chances of compensatory hypertrophy of the contralateral thyroid tissue and various thyroid pathologies like nodular disease, disturbances in function, morphological abnormalities, and even autoimmune disorders [25,26].

The authors found that 10% of the total subjects displayed an asymmetry in the thickness of isthmus as observed during the ultrasound examination. Isthmus dimension was more commonly reduced on the left side (seven subjects) as compared to right side (three subjects). After thorough literature search, the authors deduce that there was absence of available data regarding asymmetry in the thickness of thyroid isthmus and it's association with lobe size, as visualised on ultrasound examination. Though, studies in the past have reported occurrence of agenesis of isthmus with prevalence ranging from 3-10%, and with greater frequency in males [27,28]. Genetic factors and defects in embryogenesis are the likely factors responsible for asymmetric development [29].

Also, the authors were unable to observe the presence of pyramidal lobe, levator glandulae thyroidae, accessory thyroid tissue or the absence of isthmus amongst the present study subjects. Majority of the available literatures are cadaveric studies, reporting morphological variations in the form of; presence of pyramidal lobe, levator glandulae thyroidae, accessory thyroid tissue or the absence of isthmus [5,28].

The present study reported ultrasound findings are unique and can serve as an aid to the information pool regarding normal morphological variations, which can be encountered during major thyroid surgeries. Hence, it can lead to better and safer surgical outcomes.

Limitation(s)

Only young, asymptomatic student volunteers who were enrolled for classes in the Department of Anatomy, KGMU, Uttar Pradesh, Lucknow, India were included, as study participants. They were within the age range of 17-24 years. Therefore, for a better comparative result, further studies in children as well as older age group, could be conducted. Given the time restrictions and practicality of conducting

this investigation, the authors also recognise that the sample size of 100 is a limitation of the current study. Hence, there is a dire need for future studies on larger samples from our region.

CONCLUSION(S)

Visual assessment of thyroid lobes using ultrasonographic examination revealed asymmetry in lobe size, which was congruent with the measurement of dimensions of the lobes. Also, visual close examination revealed asymmetric isthmus thickness, such that the reduced isthmus thickness was more frequently observed on the left side as compared to right. Hence, a close visual ultrasonographic examination could be useful for routine clinical diagnosis as well as planning of surgical procedures in many thyroid disorders.

REFERENCES

[1] Standring S. Gray's anatomy. 42nd ed. Churchill Livingstone: Elsevier. 2021;601-05.
[2] Seker S, Tas I. Determination of thyroid volume and its relation with isthmus thickness. Eur J Gen Med. 2010;7(2):125-29.
[3] Dutta AK. Essentials of Human Anatomy Head and Neck. 6th ed. Current Books International. 2017;134-39.
[4] Joshi SD, Joshi SS, Daimi SR, Athavale SA. The thyroid gland and its variations: A cadaveric study. Folia Morphol (Warsz). 2010;69(1):47-50.
[5] Veerahanumaiah S, Dakshayani KR, Menasinkai, Sharada B. Morphological variations of the thyroid gland. Int J Res Med Sci. 2015;3(1):53-57.
[6] Braun EM, Windisch G, Wolf G, Hausleitner L, Anderhuber F. The pyramidal lobe: Clinical anatomy and its importance in thyroid surgery. Surg Radiol Anat. 2007;29(1):21-27.
[7] Hamilton WJ. Textbook of Human Anatomy. 2nd ed. The McMillan Press Ltd. 1976;488.
[8] Kaur HS, Kumar U, Bajwa SJ, Kalyan GS. Absent thyroid isthmus: Embryological and clinical implications of a rare variation of thyroid gland revisited. Thyroid Res Pract. 2013;10:80-82.
[9] Pastor VJF, Gil VJA, De Paz Fernandez FJ, Cachorro MB. Agenesis of the thyroid isthmus. Eur J Anat. 2006;10:83-84.
[10] Marshall CF. Variation in the form of the thyroid in man. J Anat Physiol. 1895;29:234-39.
[11] Dixit D, Shilpa MB, Harsh MP, Ravishankar MV. Agenesis of isthmus of thyroid gland in adult human cadavers-A case series. Cases J. 2009;2:6640.
[12] Melmed S, Auchus RJ, Goldfine AB, Koenig R, Rosen CJ, Williams RH. Williams Textbook of Endocrinology. 14th Ed. Philadelphia: Elsevier/Saunders; 2020.
[13] Rumack CM, Levine D. Diagnostic Ultrasound. 5th ed. Elsevier. 2018;1:07-12.
[14] Aggarwal N, Sehgal G, Pankaj AK, Verma RK, Parihar A, Manik P, et al. Morphometry of the thyroid gland and its correlation with various anthropometric parameters in asymptomatic Indian young adults- A cross-sectional study. J Clin Diag Res. 2021;15(4):AC04-AC09.
[15] ANNEX 2: Method for determining thyroid size by ultrasonography. Assessment of Iodine Deficiency Disorders and Monitoring Their Elimination: A Guide for Programme Managers. 3rd ed. WHO, UNICEF, ICCIDD. World Health Organisation: Geneva. 2007;ISBN 9789241595827.
[16] Brunn J, Block U, Ruf G, Bos I, Kunze WP, Scriba PC, et al. Volumetric analysis of thyroid lobes by real-time ultrasound. Dtsch Med Wochenschr. 1981;106(41):1338-40.
[17] Lyshchik A, Drozd V, Reiners C. Accuracy of three-dimensional ultrasound for thyroid volume measurement in children and adolescents. Thyroid. 2004;14(2):113-20.
[18] Abubakar AA, Ohagwu CC, Yahuza M, Zira D, Sidi M, Mansur U, et al. Sonographic determination of thyroid gland volume among apparently healthy adults in Kano metropolis. Nig J Med Imaging Rad Ther. 2021;10(1):01-10.
[19] Salaam AJ, Danjem SM, Salaam AA, Angba HA, Abinaiye PO. Determination of normal thyroid gland volume on ultrasound in normal Adults in Jos, North Central Nigeria. Int J Sci Res Pub. 2020;10(1):44-54.
[20] Kayastha P, Paudel S, Shrestha DM, Ghimire RK, Pradhan S. Study of thyroid volume by ultrasonography in clinically euthyroid patients. J Inst Med Nepal. 2010;32(2):36-43.
[21] Ahidjo A, Tahir A, Tukur M. Ultrasound determination of thyroid gland volume among adult Nigerians. Internet J Radiol. 2005;4(2):01-04.
[22] Suwaid MA, Tabari AM, Isyaku K, Idris SK, Saleh MK, Abdulkadir AY, et al. Sonographic measurement of normal thyroid gland volume in school children in Kano, Nigeria. West Afr J Ultras. 2009;8(1):14-22.
[23] Yildirim M, Dane S, Seven B. Morphological asymmetry in thyroid lobes, and sex and handedness differences in healthy young subjects. Int J Neurosci. 2006;116(10):1173-79.
[24] Park IH, Kwon SY, Jung KY, Woo JS. Thyroid hemiagenesis: Clinical significance in the patient with thyroid nodule. J Laryngol Otol. 2006;120:605-07.
[25] Maiorana R, Carta A, Floriddia G, Leonardi D, Buscema M, Sava L, et al. Thyroid hemiagenesis: Prevalence in normal children and effect on thyroid function. J Clin Endocrinol Metab. 2003;88:1534-36.
[26] Ruchala M, Szczepanek E, Szaflarski W, Moczko J, Czarnywojtek A, Pietz L, et al. Increased risk of thyroid pathology in patients with thyroid hemiagenesis: Results of a large cohort case-control study. Eur J Endocrinol. 2010;162:153-60.
[27] Dixit D, Shilpa MB, Harsh MP, Ravishankar MV. Agenesis of isthmus of thyroid gland in adult human cadavers: A case series. Cases J. 2009;2(4):6640.
[28] Ranade AV, Rai R, Pai MM, Nayak SR, Prakash, Krisnamurthy A, et al. Anatomical variations of the thyroid gland: Possible surgical implications. Singapore Med J. 2008;49(10):831-34.
[29] Sankar KD, Bhanu PS, Bapuji P. Agenesis of isthmus of thyroid gland with embryological and clinical basis. Narayana Med J. 2012;1(1):32-34.

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