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Original Article

Anatomy Section

Possible Variations of Thyroid Gland: A Detailed Cadaveric Study

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ABSTRACT

Introduction: The knowledge regarding the identification of anatomical variations of thyroid gland is very important in formulating planned surgical approaches to the thyroid gland and in alerting the surgeons to prevent accidental injuries to the vital anatomical structures in this area.

Aim: To find out the possible anatomical variations and morphometric parameters of the entire thyroid gland.

Materials and Methods: A total of 60 thyroid glands were studied in the cadavers by routine neck dissection method. The morphological variations, arterial supply variations and the morphometric parameters of length, breadth, and thickness were observed.

Results: Out of 60 thyroid glands we observed one thyrotrachealis biceps muscle. Isthmus was absent in 5 (8.3%) of cases, pyramidal lobe was present in 8 (13.3%) of cases, levator glandulae thyroidae was in 3 (5%) of cases , the left STA from LCC in 3 (5%) of cases, left STA bifurcation level in 2 (3.3%) of cases, right STA from right ECA lateral side in 1 (1.6%) of cases, arteria thyroidae ima from arch of aorta was in 1 (1.6%) of cases, the minimum and maximum length of the right lobe was 1.9 cm, 6.9 cm and for the left lobe was 2.1 cm, 5.8 cm, the minimum and maximum breadth of the right lobe was 0.94 cm, 3.72 cm and for the left lobe was 1.2 cm, 3.5 cm, the minimum and maximum thickness of the right lobe was 0.87cm,2.9cm and for the left lobe was 0.7 cm, 2.5 cm, the average weight of the thyroid gland was 14.4 gm.

Conclusion: Thyroid gland in a cadaver caught our attention as it had multiple variations. The implications of such variations are relevant for academic and clinical purposes.

Keywords: Isthmus, Morphology, Morphometry, Superior thyroid artery

INTRODUCTION

Thyroid gland lies against vertebrae C5, C6, C7 and T1, covering the upper part of the trachea. It consists of two symmetrical lobes united by an isthmus. The gland is covered by a fibrous true capsule and false capsule. A small portion of the gland substance often projects upwards from the isthmus, generally to the left of the midline as the pyramidal lobe [1]. The gland is supplied by the Superior Thyroid Artery (STA), Inferior Thyroid Artery (ITA), and sometimes the thyroidae ima artery (a branch from brachiocephalic trunk or arch of aorta) [2]. Cadavers are still the best means to study all the domains of anatomy. Hence, this study will assertively help the surgeons.

MATERIALS AND METHODS

In this observational study total of 60 thyroid glands were studied in the cadavers by routine neck dissection method from August 2013 to January 2017 in Malla Reddy Medical College for women and Malla Reddy Institute of Medical Sciences, in the Department of Anatomy, Hyderabad, India. The cadaver's age limit was 40-65 years of both sexes are included and excluded foetal study and also specimens utilised for teaching of 1st MBBS students. We used scalpel, forceps, scissors, cotton, try, gauze, blotting paper, weighing machine, scale and thread for measurements of morphological features. Finally, the gland was dissected out from its attachments and taken along with pyramidal lobe and levator glandulae thyroidae. The dissected gland was placed in a tray and dried by using cotton, blotting paper and gauze piece. The length of the lobes was measured in centimeters and noted down by using scale from apex to base of the gland. The breadth of the lobes was measured transversely from beginning of the isthmus to posterior border of the thyroid gland. Thickness of the gland was measured by using scalpel incised vertically

and measured from apex to base and the readings were noted down as the thickness in centimeters and gland was placed in a digital balance and weight was noted down in grams.

The results were analysed by descriptive statistics.

RESULTS

A total of 60 thyroid glands (33 male and 27 female) were observed in the present study. At the time of neck dissection very carefully we observed thyroid gland attachments. Traced above, the pretracheal fascia after enclosing the gland is attached to the hyoid bone in the middle line and to the oblique line of the thyroid cartilage on each side. Apart from this we observed accessory muscle thyrotrachealis biceps (cruciform fibers) [Table/Fig-1].

The morphological features observed in the present study are summarised below [Table/Fig-2-6].

1. Absence of isthmus in 8.3% of cases [Table/Fig-3].

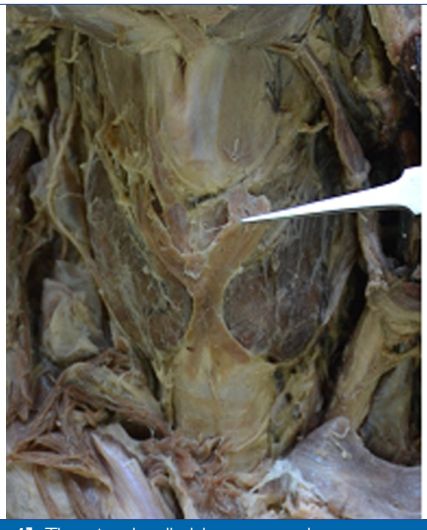
2. Presence of pyramidal lobe in 13.3% of cases

a) Presence of pyramidal lobe from left lobe in 4 cadavers [Table/Fig-3].

b) Pyramidal lobe arising from the right lobe in 3 cadavers [Table/Fig-4].

c) Present above the isthmus in one cadaver [Table/Fig-5].

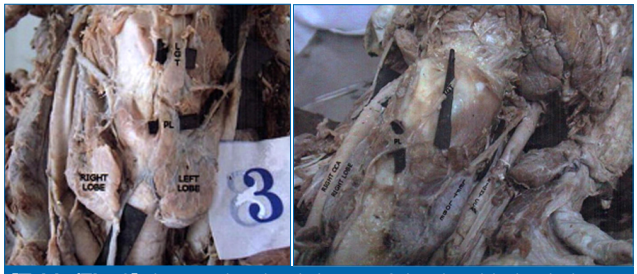
3. Presence of levator glandulae thyroidae in 5% of cases



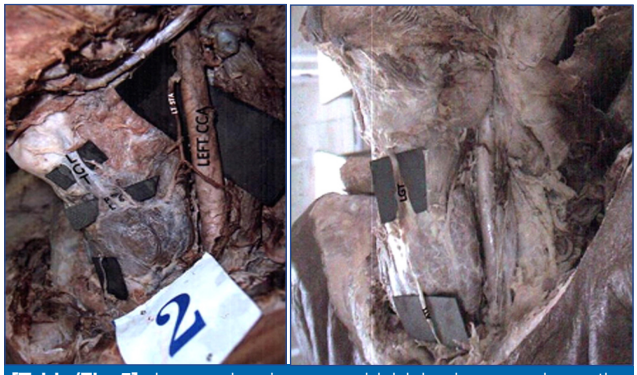
[Table/Fig-1]: Thyrotrachealis biceps muscle.

S.no	Type of Variation	Percentage (%)	n value
1	Absence of Isthmus	8.3%	5
2	Pyramidal lobe	13.3%	8
3	LGT	5%	3

[Table/Fig-2]: Morphological features of thyroid gland.
*LGT: levator glandulae thyroidae



[Table/Fig-3]: Image showing isthmus of the thyroid gland absent, pyramidal lobe arising from the left lobe and Levator glandulae thyroidae extending upwards from the pyramidal lobe.
[Table/Fig-4]: Pyramidal lobe arising from the right lobe.

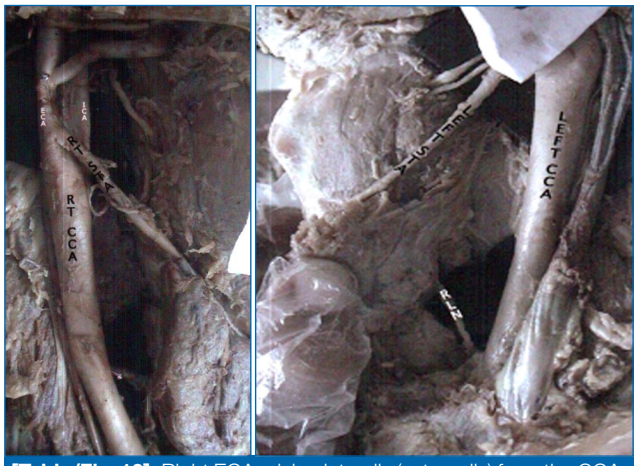


[Table/Fig-5]: Image showing pyramidal lobe is seen above the isthmus and Left STA from left CCA
[Table/Fig-6]: LGT seen extending from isthmus of the thyroid gland.

S.no	Type of Variation	n
1	Left STA from Left CCA	3
2	Left STA at bifurcation of CCA	2
3	Right STA from right ECA lateral	1
4	Absence of left ITA	2
5	Arteria Thyroidae Ima	1

[Table/Fig-7]: Arterial supply of thyroid gland.
*STA: Superior thyroid artery, CCA: Common carotid artery,ECA: External carotid artery,ITA: Inferior thyroid artery

[Table/Fig-8]: Image showing left STA arising directly from the left CCA, left ITA and LRLN are also seen.
[Table/Fig-9]: Left STA arises from Left ECA at bifurcation level.



[Table/Fig-10]: Right ECA arising laterally (externally) from the CCA, right STA arising from laterally positioned right ECA.
[Table/Fig-11]: Left ITA absent LRLN seen in trachea oesophageal groove.
*LRLN: Left recurrent laryngeal nerve

a) Extending upwards from pyramidal lobe of the thyroid gland [Table/Fig-3].

b) Extending upwards from isthmus of the thyroid gland [Table/Fig-6].

The arterial supply variations are studied and tabulated below [Table/Fig-7-11].

All the 60 thyroid glands were separated from neck and placed in a digital balance and the average weight was noted down as 14.4 gm, and the data collected were statistically analysed and results were tabulated as follows [Table/Fig-12].

DISCUSSION

Developmental anatomy of thyroid gland suggests that, positional variation and the ultimate position of the thyroid gland depends on extent of elongation of thyroglossal duct and thyroid gland blood supply cannot have origins other than from the CCA, subclavian artery or arch of aorta. Those variations might be explained by anatomical changes occurring between the 29th day and the 7th week of embryological development of the aortic arches and the synchronous descent of the thyroid gland [3].

In the present study an abnormal muscle thyrotrachealis biceps was found and it is previously reported by Macalister A [4].

In present study, in 8.3% of the cases isthmus was absent. It coincides with most of the authors like Won HS et al., who have reported that in 3% of the cases the isthmus was absent and the lateral lobes of the thyroid were separate from each other [5]. According to Marshall CF, it is about 10% [6]. In the present study the frequency of presence of pyramidal lobe is in 13.3%, whereas Braun E et al., reported that the pyramidal lobe was found to be present in 55% of the cadavers [7]. According to Won HS et al., the frequency of the existence of the pyramidal lobe was 76% [5]. In this study, in 5% of cases levator glandulae thyroidae was observed. According to Gregory JK et al., an accessory muscle LGT from hyoid bone to inserted partly on isthmus and partly on thyroid cartilage [8].

Our present study was unique in respect of origin of left STA from left CCA in about 5% of cases, which is supported by several cadaveric studies including Indian studies by Sanjeev IK et al., and Anitha T et al., [9,10] Ozgur Z et al., however, did not confirm the same [11]. The incidence of origin of the STA from CCA bifurcation in our study is about 3% of cases which coincides with Natsis K et al., [12] and Ongeti KW et al., [13]. They found that carotid bifurcation as the second most common site of origin of STA (21.5% on the right and 18.5% on the left side). In a study by Lucev N et al., the origin of STA from CCA bifurcation was found to 22.5% of cases [14], Vazquez T et al., [15] in their autopsy study of 330 hemi necks reported CCA bifurcation as the most common site of origin of STA (49%). In an Indian study by Anitha T et al., STA origin from carotid bifurcation was 19% on right side, but 22% on left side [10].

In our study we found that the right STA arising from lateral aspect of ECA in 1% of cases. It was also reported by Livini the origin of STA from SCA in 7% and 9% of cases respectively [16].

The usual area of distribution of left ITA to the thyroid gland was supplied by the right ITA. Toni R et al., reported that the ITA can originate from the TCT and less frequently from the SCA directly, but origin from the CCA remains extremely rare, no matter the ethnicity of population [17]. Very few cases have been published about this specific type of anatomical abnormality of the ITA. In our present study absence of the left ITA occurred in 3.3% of cases which coincides with the Sherman JH et al., 1-6% of cases [18]. In the present study in one case arteria thyroidea ima was found from arch of aorta. It was previously described by Angel et al., [2].

	Right lobe				Left lobe			
Parameters	Minimum	Maximum	Mean	Std.Deviation	Minimum	Maximum	Mean	Std.Deviation
Length (cm)	1.9	6.9	4.4	0.721	2.1	5.8	4.7	0.892
Breadth (cm)	0.94	3.72	2.25	0.553	1.2	3.5	2.30	0.653
Thickness (cm)	0.87	2.9	1.7	0.687	0.7	2.5	1.5	0.382

[Table/Fig-12]: Morphometric parameters of thyroid gland.

In our present study the length of the thyroid gland right lobe and left lobes was 4.4 cm, 4.7cm, respectively, this value coincided with most of the authors like Monica Diana S et al., [19] 4.05 ± 0.70 cm, length of left lobe was 3.79 ± 0.60 cm. Harjeet A et al., length of right lobe 40.49 ± 6.78 mm, left lobe 38.29 ± 7.94 mm [20], Joshi SD et al., reported that the mean length of right lobe 4.32 cm, length of left lobe 4.32cm, length of left lobe 4.22 cm the average length of right lobe was 4.43 cm, left lobe was 4.21 cm the average length of the right lobe was 4.11 cm, the left lobe was 4.02 cm [21]. Dixit D et al.,[22], Ozgur Z et al., [23], Tanriover O et al., [24], Phukon MJ et al., [25] reported higher values than our study. In the present study breadth of the right and left lobes was 2.25 cm,2.30 cm respectively, these values coincided with the previous authors like Monica Diana S et al., [19] breadth of the right lobe was 2.10 ± 0.60 cm, breadth of left lobe was 2.04 ± 0.52 cm, Harjeet et al., [20].

In the present study the thickness of the right and left lobes was 1.7 cm,1.5 cm respectively, these values coincide with most of the authors like Monica Diana S et al., [19] thickness of the right lobe was1.41 ± 0.35 cm, thickness of left lobe was 1.25 ± 0.23 cm, Harjeet A et al., [20], Joshi SD et al., [21], Tanriover O et al., [24], Phukon MJ et al., [25] reported the thickness of the left lobe as 2.33 ± 0.55 cm, for the right lobe thickness was 2.39 ± 0.54 cm, this value was higher than present study values, as their study was on Turkish population. In the present study weight of the gland was 14.4 gm, the value coincide with the study of Monica Daina S et al., [19], Tanriover et al., [24] reported that the mean thyroid weight was 26.11± 8.18 gm, higher values reported by these authors are due to racial difference.

LIMITATION

This study was done in South Indian population with the available resources.

CONCLUSION

The present observations on a small sample of thyroid gland forms a data base for undertaking studies on large sample for accurate statistical analysis and for better understanding of the variations of morphology and morphometry of thyroid gland. The present study was designed to report the prevalence of anatomical variations and developmental anomalies of the thyroid gland that will hopefully help to minimise the above mentioned complications related to thyroid surgery.

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