

The thyroid gland and its variations: a cadaveric study

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The size and shape of the thyroid gland is subject to much variation, as stated by Wood Jones. Literature is replete with a large number of variations of the gland. By utilizing various techniques like gross dissection, histology, developmental anatomy, and recently thyroid scans and scintigraphy, some common and certain rare anomalies of the thyroid with their possible developmental bases are described in the literature.

An attempt has been made to study the thyroid glands in 90 male cadavers available in our department, with ages ranging from 60 to 75 years with mean height of 5'4". The parameters that were observed included the length and width of lobes, presence or absence of pyramidal lobe, levator glandulae thyroideae, and isthmus with its relation to the tracheal rings.

The average length of the right lobe was 4.32 cm, and the left lobe was 4.22 cm. The thickness of the right lobe was 1.13 cm, and the left lobe was 1.18 cm. Pyramidal lobe was present in 34 (37.77%) cases, frequently arising from the left lobe, while the levator glandulae thyroideae was present in 27 (30%) instances, mostly attached superiorly to the body of the hyoid bone. The isthmus was absent in 15 (16.66%) cases; its relation with the tracheal rings greatly varied from the cricoid cartilage to the fourth tracheal ring.

Knowledge of variations of the thyroid assumes significance as this has relevance in the resection of thyroid, tumours, and tracheostomy. (Folia Morphol 2010; 69, 1: 47–50)

Key words: thyroid gland, pyramidal lobe, levator glandulae thyroideae, and isthmus

INTRODUCTION

According to Wood [12], the size of the thyroid gland is subject to great variation. Seeing the extreme variations in the gross anatomy of the gland, Marshall [6] stated that it was difficult to speak of a normal thyroid gland. The thyroid gland in man is located in the lower half of the front of the neck. It consists of two lateral lobes connected by an isthmus. In some cases, an additional lobe is present, known as the pyramidal lobe (PL). It forms a long pyramid which is attached by its base to the superi-

or border of the isthmus, usually at its junction with the left lobe. Its apex is attached to the body of the hyoid bone by a fibrous band which sometimes contains muscular fibres, known as the levator glandulae thyroideae (LGT). It is seldom in midline in position [1, 11–13].

The developmental anomalies of the thyroid gland are: partial and total agenesis of the gland, various ectopic tissues, accessory thyroid, and absence of isthmus. This distorts the morphology of the gland and causes clinical and functional disorders.

The thyroid gland appears as an epithelial proliferation in the floor of the pharynx between the tuberculum impar and the copula. The thyroid diverticulum grows in allometric proliferation becoming a solid cellular cord called the thyroglossal duct; its caudal end bifurcates and gives origin to the thyroid lobe and the isthmus [13].

Hegedus et al. [4] stated that the difference in thyroid gland volume between males and females was solely down to the difference in body weight. The influence of body weight on the thyroid volume was about three times that of the age.

Sgalitzer [9] stated that the pyramidal process develops out of the lower part of the thyroglossal duct by differentiation of the duct tissue into glandular tissue. The length of the pyramidal process depends on the position at which fragmentation of the thyroglossal duct first occurs.

Keeping these variations in mind, a detailed study was carried out in the cadavers available in this department to record the variations in shape and size of the lobes and the presence of the pyramidal lobe and the relation of the isthmus with the tracheal rings.

MATERIAL AND METHODS

This study was conducted on 90 male cadavers available in the department over a period of 3 years, with ages ranging from 60–75 years and mean height 5'4". Clearance was obtained from the Institutional Ethical Committee before starting the work. The cadavers were fixed in 10% formalin. After the fixation, a midline incision of the neck was made to expose the thyroid gland. All the samples included in the study were normal and free from any gross pathology. The shape of the gland was observed and photographed. The length and thickness of the lateral lobes were measured with the help of digital vernier callipers. The presence or absence of PL and LGT was noted. The length and height of the isthmus was measured and its relation to the tracheal rings was noted.

RESULTS AND OBSERVATIONS

The lobes were found to be asymmetrical. The mean height of the right lobe was 4.32 cm and that of the left lobe was 4.22 cm. The thickness of the right lobe was 1.13 cm and the left lobe was 1.18 cm (Table 1).

The isthmus was absent in 15 (16.66%) cases (Figs. 1B, 2A, B). Its mean height was 1.1 cm and its

Table 1. Mean height and thickness of lobes and isthmus (in cm)

| | Height (\pm SD) | Thickness (\pm SD) | Width |
|------------|--------------------|-----------------------|-------|
| Right lobe | 4.32 \pm 0.69 | 1.13 \pm 0.39 | – |
| Left lobe | 4.22 \pm 0.62 | 1.18 \pm 0.33 | – |
| Isthmus | 1.1 | – | 1.85 |

SD — standard deviation

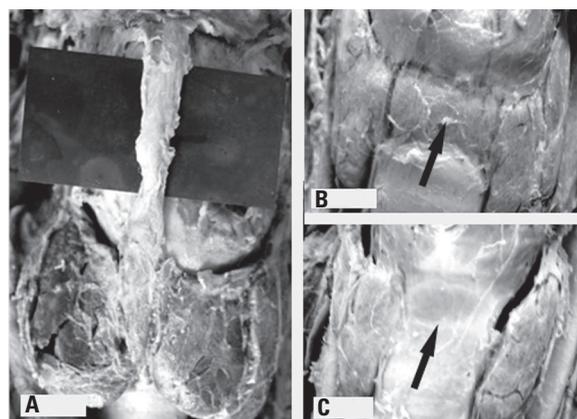


Figure 1. A. Pyramidal lobe arising from the isthmus and levator glandulae thyroideae is attached to the hyoid bone; B. Narrow isthmus related to the 1st tracheal ring as indicated by black arrow; C. Two lobes with complete absence of isthmus indicated by a black arrow.

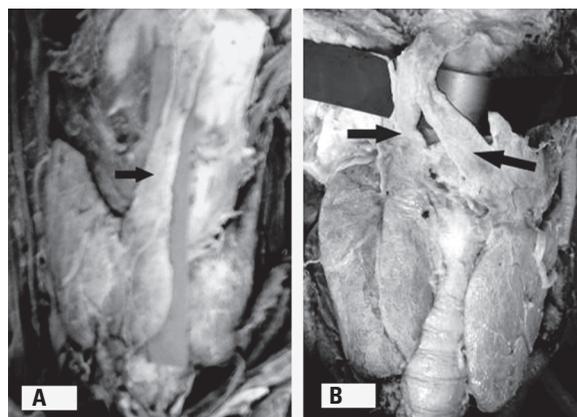


Figure 2. A. Two lobes separated by a cleft (a strip of paper is occupying this cleft) and pyramidal lobe arising from right lobe shown by an arrow; B. Two pyramidal processes arising from the lateral lobes attached by single levator glandulae thyroideae and complete absence of an isthmus.

width was 1.85 cm. The relation of the isthmus to the tracheal rings was variable. In 19 instances, it was related to the 2nd–3rd tracheal rings. In 14 cases, it was anterior to the 1st–2nd tracheal rings. In 12 ca-

Table 2. Incidence of absence (%) of isthmus and relation of isthmus to tracheal rings

| | Absent | Relation to tracheal rings | | | | | | | | |
|---------|-------------|----------------------------|--------|--------|----------|---------|---------|-----------|----------|----------|
| | | Cricoid I & II | Only I | I & II | I to III | I to IV | Only II | II to III | II to IV | III to V |
| Isthmus | 15 (16.66%) | 3 | 2 | 14 | 19 | 4 | 3 | 19 | 10 | 1 |

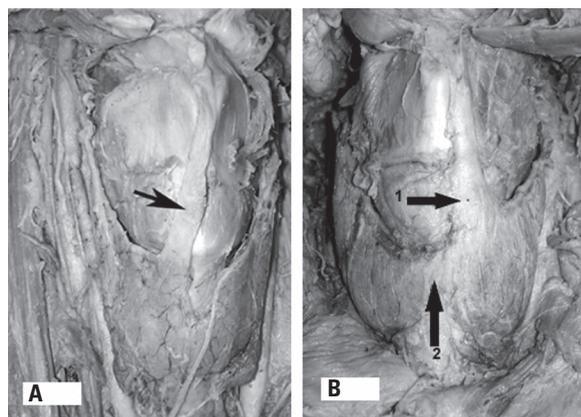


Figure 3. **A.** Pyramidal lobe arising from the right lobe indicated by a black arrow, and levator glandulae thyroideae is attached to the upper border of the hyoid bone; **B.** Pyramidal lobe arising from the left lobe indicated by arrow 1, and levator glandulae thyroideae is attached to the thyroid cartilage. Arrow 2 indicates a narrow isthmus.

ses, it was related to the 1st and 2nd–3rd trachea rings. In 4 cases, it was broad and related to the 1st–4th tracheal rings (Table 2).

The isthmus was very narrow and related to just the 1st tracheal ring in 2 cases (Fig. 1B) and related to the 2nd tracheal ring in 3 cases. The position of the isthmus was found to be higher to the cricoid cartilage in 3 cases, and lower up to the 5th tracheal ring in 1 instance (Table 2).

The pyramidal lobe was present in 34 (37.77%) instances; out of these, in 16 (47.05%) it was arising from the left lobe (Fig. 3B). In 11 (32.55%) cases, it was attached to the right lobe (Fig. 3A) and in 7 (20.58%) cases from the isthmus (Fig. 1A). In two cases, two pyramidal lobes were seen arising from the lateral lobes and were united cranially in the median plane with the complete absence of an isthmus (Fig. 2B).

The levator glandulae thyroideae was present in 27 (30%) cases. LGT was attached to hyoid bone in 18 (66.66%) instances (Figs. 1A, 2B, 3A). It was attached to the upper border of thyroid cartilage in 14 (14.81%) and to the lower border of the thyroid cartilage in 5 (18.51%) cases.

DISCUSSION

A number of variations in the shape and size of the gland were observed. The mean length of the lateral lobes is described as 5 cm in most of the Anatomical texts [1, 11–13]. Hegedus et al. [4], by ultrasonic scanning technique, in 271 healthy subjects (13–91 years old) measured the mean volume of the thyroid gland as 18.6 ± 4.5 mL. A significant difference between males (19.6 ± 4.7 mL) and females (17.5 ± 4.2 mL) was found ($p < 0.001$). They stated that influence of body weight on the thyroid volume was about three times that of age and the difference in the volume of the gland between males and females depended upon body weight. Harjeet et al. [3] described it as 4.04 cm for the right lobe and 3.82 cm for the left lobe for Northwest Indians. In our study, the mean length of the right lobe was 4.32 cm and the left lobe was 4.22 cm. The left lobe was smaller than the right lobe. In India, as the stature of individuals is comparatively shorter than that of westerners, this might account for the shortness of lateral lobes.

Pyramidal lobe was present in 37.77% in the present study, and it was attached either to the isthmus or the lateral lobes. It was observed that the maximum number of pyramidal lobes was attached to the left lobe (47.05%), as compare to the right lobe or the isthmus. In 32.55% and 20.58% of cases, it was attached to right lobe and isthmus, respectively. Marshall [6] described the presence of PL in 43% of cases. Harjeet et al. [3] observed it in 28.9% of specimens. Levy et al. [5] found that PL was arising from the left side in 63% of cases. They described the presence of PL by radioiodine thyroid scan in 17% of normal cases and 43% of PL in patients with diffuse toxic goiter. Using thyroid scintigraphy, Siraj et al. [10] visualized PL in 41% of patients, and they found a greater incidence among females. The presence of two pyramidal lobes attached by a single LGT has been described by some workers [3, 6, 8]. In the present study, this was seen in two cases only. This rare anomaly of double pyramidal process is generally explained by assuming a high bi-

furcation of the thyroid anlage, the growing thyroglossal duct split at its apex, and each branch giving origin to a lobe of the gland [9].

We found LGT in 27 (30%) specimens, which was attached to the hyoid in 18 (66.66%), the upper border of the thyroid cartilage in 4 (14.81%), and the lower border of the thyroid cartilage in 5 (18.51%) cases. Harjeet et al. [3] described it in 94 (22.9%) cases in males and 17 (10.6%) cases in females. They described it as extending caudally from the body of the hyoid in 53.2% of males and in 52.9% of females, in 10.8% from the median thyroid ligament, and from the lower border of the lamina of the thyroid in 34.04%. Marshall [6] found LGT attached to the hyoid bone in 17 (28.3%) cases, and in 9 cases it merged with the fascia covering the thyroid cartilage. Faysal et al. [2] observed an unusual case in which LGT extended from the apex of the mastoid process. Our findings are similar to those of Marshall [6].

The isthmus was found to be absent in 16.66% (15) of cases in the present study. Harjeet et al. [3] described that two lobes were separated in 7.9% of thyroids. They quoted the finding of Williams et al. (1982), wherein the isthmus was reported to be absent in 0.024% of cases. Marshall [6] described it as being absent in 10% of cases. Oya [8] observed its absence in 4% of cases. Pastor Vazquez et al. [7] described a case report of a complete absence of the isthmus. He quoted Gruber (1978) who reported an absence of the isthmus in 5% of the cases studied.

Most of the anatomical texts describe the isthmus as being related to the 2nd–3rd tracheal rings. We found this in 19 cases. In 14 instances, it was related to the 1st and 2nd and in 12 cases to the 1st, 2nd, and 3rd tracheal rings. In some it was placed at a higher level, i.e. at the level of the cricoid cartilage, and in some it was placed at a lower level, i.e. at the 5th tracheal ring.

SUMMARY AND CONCLUSIONS

The thyroid gland was studied in 90 male cadavers. The shape and size of the gland, the presence and absence of PL, LGT, and the isthmus and its relation to the tracheal rings was observed. The mean length of the right lobe was slightly greater than that of the left

lobe. The pyramidal lobe was present in 37.7% of cases, more frequently arising from the left lobe. In two cases, two pyramidal lobes arising from both of the lateral lobes were noted. LGT was present in 30% of cases, more frequently attached to the hyoid bone than the upper and lower borders of the thyroid cartilage. The isthmus was absent in 16.66% of cases. Its relation to the tracheal rings varied from the cricoid cartilage to the 5th tracheal rings. Good knowledge of these variations in the lobes of the thyroid gland and the pyramidal lobe, and in the position of the isthmus would be helpful for surgeons in performing tracheostomies and in the evaluation of scintigraphy.

REFERENCES

1. Du Plessis DJ (1975) In synopsis of surgical anatomy. 11th Ed. John Wright & Sons, Bristol.
2. Faysal SA, Sami KH, Fuad HA, Jihad HS (1996) An unusual levator glandulae thyroidea: a case report and literature review. *J Anat Soc India*, 45: 125–128.
3. Harjeet A, Sahni D, Indar J, Aggarwal AK (2004) Shape, measurement and weight of the thyroid gland in northwest Indians. *Surg Radiol Anat*, 26: 91–95.
4. Hegedus L, Perrild H, Poulsen LR, Jesper R, Andersen M, Holm B, Schnohr P, Jensen G, Hansen JM (1983) The determination of thyroid volume by ultrasound and its relationship to body weight, age and sex in normal subjects. *J Clin Endocrinol Metabol*, 56: 260–263.
5. Levy HA, Sziklas JJ, Rosenberg RJ, Spencer RP (1982) Incidence of a pyramidal lobe on thyroid scans. *Clin Nucl Med*, 7: 506–501.
6. Marshall CF (1895) Variations in the form of the thyroid gland in man. *J Anat*, 29: 234–339.
7. Pastor Vazquez JP, Gil Verona JA, De Paz Fernandez FJ, Barbosa Cachorro M (2006) Agenesis of the thyroid isthmus. *Eur J Anat*, 10: 83–84.
8. Oya SA (1997) Gross anatomical study on anomalies of the thyroid gland. *Gazi Medical J*, 8: 33–38.
9. Sgalitzer KE (1941) Contribution to the study of the morphogenesis of the thyroid gland. *J Anat*, 75: 389–405.
10. Siraj QH, Aleem N, Inam Ur-rahman A, Qaisar S, Ahmed M (1989) The pyramidal lobe: a scintigraphic assessment. *Nucl Med Commun*, 10: 685–693.
11. Standring S (2005) *Grays anatomy*. 39th Ed. Elsevier Churchill Livingstone, London, New York.
12. Wood JF (1953) *Buchanan's manual of anatomy*. 8th Ed. Billiere Tendall and Cox, London.
13. Hollinshead WH, Rosse C (1985) *Textbook of anatomy*. 4th Ed. Harper & Row Publishers, Philadelphia, New York, London.