https://doi.org/10.3329/cbmj.v14i1.79265

Position of the Anterior Commissure in Relation to the Anterior Height of the Thyroid Cartilage: A Cadaver Based Study

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Abstract

A cross-sectional, descriptive type study was done in the Department of Anatomy, Mymensingh Medical College, Bangladesh, between October 2008 and March 2009, to determine the position of the anterior commissure in relation to the anterior height of the thyroid cartilage in cadavers and observe gender difference, if any. A total of 29 postmortem human larynges (male 17 and female 12) were collected from dead bodies (aged between 17 to 60 years) from the mortuary of the Department of Forensic Medicine of the same institution. In the present study, the mean value of the ratio of the distances between the superior thyroid notch and anterior commissure and the midline height from thyroid notch to the inferior border of thyroid cartilage was found 0.23 in females and 0.26 in males. No statistical differences were observed between these two groups (p>0.05). It was also found that anterior commissure lies at the junction of upper one fourth and lower three fourth of the anterior height of thyroid cartilage.

CBMJ 2025 January: Vol. 14 No. 01 P: 22-27

Keywords: Larynx, laryngeal cartilage, thyroid cartilage

Introduction

The larynx is essentially an organ of respiration and phonation, set in the respiratory tract between the pharynx and trachea. Although phonation is important in man, the main function of the larynx is to provide a protective sphincter at the inlet of the air passages to prevent entry of any materials other than air.[1-3] Larynx or voice box is well developed in humans. The larynx lies below the hyoid bone in the anterior midline of the neck, extends from the upper border of the epiglottis to the lower border of the cricoid cartilage.[1,3,4] It projects ventrally between the great vessels of the neck and is covered anteriorly by skin, fascia and the hyoid depressor muscles. Above, it opens into the laryngopharynx through the laryngeal inlet and forms its anterior wall while below, it continues into the trachea. It lies opposite the 3rd to 6th cervical vertebrae in adult males, although it is somewhat higher in adult females. The larynx is made up of skeletal framework of cartilages, which are connected by synovial joints, ligaments and fibrous membranes (cricovocal and quadrate) and are moved by a number of intrinsic muscles. The cavity of the larynx is lined by mucous membrane.[2,3,5] The larynx is composed of nine cartilages – three unpaired cartilages are: thyroid, cricoid, and epiglottic and three paired cartilages are: arytenoids, corniculate, cuneiform.[4,5]

The larynx is divided into 3 main areas as supraglottic, glottic, and subglottic spaces. The paired vocal folds reside at glottis, which is also

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called transglottic space.[6] Right and left vocal cords unite to form the anterior commissure at the front and it adheres to the inner surface of the thyroid cartilage. They are attached to the vocal process of the arytenoid cartilage posteriorly. As an important component of the larynx, the vocal fold is active during voice production, respiration, and airway protection.[7] Precise knowledge of the laryngeal dimensions is necessary for treatment and surgical procedures of laryngeal and voice diseases.[8] Thyroplasty type I was first proposed by Isshiki *et al* in 1974, which is also described as lateral compression. Thyroplasty type I aims to shift the vocal cord medially through deformation of the thyroid cartilage. This method was indicated for laryngeal diseases resulting from imperfect closure of the glottis during phonation without swelling or tumor of the vocal fold. More commonly, thyroplasty type I is also indicated for unilateral vocal cord paralysis.[9] Surgery aims to medialize and augment the paralyzed vocal fold and the underlying soft tissue by pushing cartilage inward through a window dissected on the thyroid cartilage. Previous research reports that the most common reason for failure in thyroplasty type I is window misplacement (too high posteriorly).[10] Also, during laryngeal framework surgery, an overly high implant position might harm the false vocal cord or end in the Morgagni's ventricle.[10] An accurate estimation of the level of the vocal fold relative to the thyroid cartilage is important here. Hence, we proposed this study to determine the level of the anterior commissure and compare our data with available reports in the literature.

Methods

The present study was performed on 29 human larynges at the Department of Anatomy of Mymensingh Medical College, Mymensingh, Bangladesh. Larynges were collected from the mortuary of the Department of Forensic Medicine of the same institution. All the specimens were obtained from Bangladeshi cadavers of both sexes – all from medico-legal cases (unnatural death). However, only fresh specimens were taken for this study from the cadavers approximately within the preceding 12 to 24 hours of death.

The age range of persons whose larynx was collected varies from 17 to 60 years. From each cadaver, thyroid cartilages were collected through "Block Dissection", during routine postmortem examination. Then the tissue block was washed gently with running tap water to remove the blood and blood clots as far as possible.

Each specimen was duly tagged by a piece of waxed cloth, which bore an identifying number representing individual serial number. Then the specimen was fixed and preserved in 10% formol-saline solution. For the location of the exact position of the anterior commisure, the larynges were divided in the midline posteriorly with a vertical incision of the cricoid lamina and the adjacent soft tissue. One needle was inserted at the position of the anterior commissure and passed from the endolarynx to the thyroid ala externally.

Measurements were made of the position of the needle in relation to the thyroid notch and the inferior border of the thyroid cartilage by calculating the mean value of the ratio of the distances between the superior thyroid notch and anterior commissure and the midline height from thyroid notch to the inferior border of thyroid cartilage (Fig. 1).[10,11]

Fig. 1: Photograph of interior of the larynx showing anterior commissure (indicated as 'A' mark)

All the data were compiled, sorted properly, and analyzed statistically using Statistical Package for Social Sciences (SPSS) version 11.0. Comparison between sexes was done by unpaired Student's 't' test. P value <0.05 was considered as significant. This study was approved by the Ethical Review Committee of Mymensingh Medical College, Mymensingh, Bangladesh.

Results

In the present study, the mean value of the ratio of the distance between the superior thyroid notch and anterior commissure and the midline height from superior thyroid notch to the inferior border of thyroid cartilage was found 0.23 in females and 0.26 in males. No statistical differences were observed between two groups (p=0.330) (Table-I).

Table-I: Sex differences in the position of the anterior commissure in relation to the anterior height of thyroid cartilage in different sex of adult age group.

Sex	Number of specimen	A) Length between Anterior commissure and superior thyroid notch (in mm)	B) Anterior height of thyroid cartilage (in mm)	Ratio between A and B	p-value
Male	17	5.11	19.52	0.26	0.330
Female	12	3.91	16.83	0.23	

Discussion

In cases of vocal cord paralysis, treatment is planned according to the cause of paralysis and the resulting functional failure from it.[11] Treatment aims to improve sound quality and prevent aspiration. In the treatment of unilateral palsy, medialization by injection or thyroplasty type 1 (medialization laryngoplasty) is applied. Medialization laryngoplasty is a laryngeal framework surgery method that was first proposed by Isshiki *et al*. in 1974.[12] In the procedure, a cartilage window at the level of the vocal cord is opened on the thyroid cartilage, and with the help of an implant placed inside it, paraglottic area tissues on the paralytic side are brought to the midline to obtain a stable vocal cord surface, where the opposite vocal cord can make contact.[13]

In the present study, the mean value of the distance from the thyroid notch to the anterior commissure was 5.11 mm in male and 3.91 mm in female. Ortug *et al.* studied the mean value of the distance from the thyroid notch to the anterior

commissure was 9.15±1.99 mm in men and 9.38±3.43 mm in woman, which were statistically similar.[14] Cinar *et al.* reported the same distance as 8.12±1.73 mm and 5.04±0.86 mm in males and females respectively,[10] while Enver *et al.* reported 8.6±2.13 mm and 7.14±1.4 mm in males and females respectively.[15] Interestingly, the research of Ortag *et al.,* Cinar *et al*. and Enver *et al.* addressed the same population with subjects of a similar age; however, they reported different values. All of those studies conducted on cadavers under autopsies.

In the present study, the mean value of anterior height of thyroid cartilage was 19.52 mm in male and 16.83 mm in female. Ortug *et al.* reported the values as 10.54±1.73 mm for males and 8.88±1.81 mm for females.[14] Cinar *et al.* observed 11.5 mm in males and 8.1 mm in females.[10] Enver *et al.* reported the values as 10.27±2.96 and 7.86±1.1 for males and females respectively, and the difference was statistically significant.[15] There have been many different mathematical approximations for the projection of the vocal fold. Although Isshiki suggested that the vocal fold could be found with a line parallel to the midline of the thyroid cartilage,[13] while Koufman & Isaacson and Tucker et al. proposed that this line is at the superior margin of the thyroid cartilage.[16,17] Netterville *et al.* recommended a window of 3 mm superior to the caudal border of the thyroid cartilage.[18] However, Meiteles *et al.* recommended that ‘‘thyroid cartilage incision for supraglottic laryngectomy should be made on a line joining the junction of the upper one third and lower two-thirds of the midline length and the juncture of the upper one third and lower two-thirds of the oblique line. This will ensure a position above the level of the anterior commissure and the true vocal cord.[19] Thus, there seems to be a lack of consensus on the recommendations. To evaluate this, a ratio is being used as distance from superior thyroid notch to the anterior commissure and the midline height from the superior thyroid notch to the inferior thyroid border.[20] Cinar *et al.* reported that the ratio of the distance between the superior thyroid notch and anterior commissure and the midline height from thyroid notch to the inferior border of thyroid cartilage was 0.41 in males and 0.38 in females; no statistical difference was found between two groups ($p>0.05$). They found that the anterior commissure lies approximately at the junction of the upper two fifths and lower three fifths of the midline height of thyroid cartilage in the majority of the larynges of the male and female cadavers.[10] Enver *et al.* reported the ratio as 0.53±0.05 in females and 0.54±0.07 in males.[15]

Again, all of these studies report minimal differences in results concerning the study group of the same population. All studies reported that the anterior commissure is above the midline for both male and female subjects. In the present study, the mean value of the ratio of the distances from the superior thyroid notch to anterior commissure and the midline height from thyroid notch to the inferior border of thyroid cartilage was found to be 0.23 in females and 0.26 in males in adult group. No statistical differences were observed between two groups ($p>0.05$), which corresponds with the previous studies.[10,15] However, it was also found that anterior commissure lies at the junction of upper one fourth and lower three fourth of the anterior height of thyroid cartilage. Ortug *et al.* calculated this ratio as 0.46 for male and 0.51 for female

showing that anterior commissure is above the midline in male and at the level to slightly below in females.[14] Interestingly, Sprinzl *et al*. reported that most of the male samples (19 of 24) reside below the midline and most of the female samples resides at midpoint (17 of 21).[20]

Exact knowledge of the level of the vocal fold as well as anterior commissure as projected on the external thyroid cartilage is of critical importance for the performance of phonosurgery. Sprinzl *et al.* proposes possible ethnological differences for all different evaluations. However, our results show that interpopulational difference may exist, in terms of the projection of anterior commissure. It is also stated that formalin preservation may be attributable to the differences among groups.[19]

Conclusion

Our data suggests that the position of anterior commissure lies approximately at the junction of the upper one fourth and lower three fourth of the midline height of thyroid cartilage in the majority of the larynges of the male and female cadaver in adult age group. Detailed anatomical knowledge is necessary for the diagnosis of these diseases by endoscopic evaluation, laryngoscopy, CT scan and MRI investigations. Laryngeal surgery demands precise method of investigation to provide accurate anatomical details of the laryngeal abnormalities. It is only when such information is available that a precise diagnosis can be made, and surgical treatment can be planned. Therefore, for diagnostic and management in procedures like intubation, tracheotomy, medialization, implant, subluxation, thyroplasty, laryngoplasty, laryngotomy and laryngectomy, minute anatomical knowledge of larynx is essential. This short of information is undoubtedly best gathered through experience in the living subject, second only to that approach and clearly prerequisite to it is the study of representative specimens i.e., anatomical study through autopsy.

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