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Morphology of Human Larynx: an Anatomical Study

İnsan Larinks Morfolojisi: Anatomik Bir Çalışma

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ABSTRACT

Purpose: The anatomy of the larynx and the knowledge of the possible variations in the laryngeal cartilages is important while interpreting head and neck radiographs of patients who exhibit anatomical or functional deviations. Morphometric data of the larynx may be useful in various otorhinolaryngology procedures and may also help in selecting the right dimensions of operational tools. Various studied have focused on the measurements of individual laryngeal cartilages. Very few authors have provided a holistic approach to the larynx and their values vary considerably. Therefore this study aims at providing appropriate information regarding the various laryngeal measurements thereby contributing to the field of advanced medicine.

Methods: The study was performed on 25 sagittal sections of adult larynges (14 males, 11 females) in the department of Anatomy, Kasturba Medical College, Manipal. The different parameters of the larynx were measured using digital calipers. Appropriate statistical tests were applied.

Results: The morphometric measurements of the larynx were more in males as compared to females. However females had a larger cricoid diameter.

Conclusion: The study therefore opines that there is a significant difference in dimensions of larynges in males and females. The dimensions of larynx and internal cricoid diameter may act as a reliable guide for various interventions involving the upper respiratory passages.

Key Words: larynx, morphometry, cricoid, cartilages

ÖZET

Amaç: Yapısal veya fonksiyonel deviyasyon gösteren hastaların baş ve boyun radyograflarını değerlendirirken, larinksin anatomik yapısı ve laringeal kıkırdakların muhtemel çeşitlerinin bilinmesi önemlidir. Larinksin morfometrik bilgisinin bilinmesi, çeşitli otorinolaringoloji prosedürlerinde faydalı olabilir ve operasyonda kullanılacak araçların boyutunun doğru seçimine de yardım edebilir. Çeşitli çalışmalar bireysel laringeal kıkırdak ölçümüne odaklanmıştır. Çok az yazar larinkse bütünsel bir yaklaşım göstermektedir ve değerleri önemli ölçüde farklılık göstermektedir. Bu yüzden bu çalışma, çeşitli laringeal ölçümlere ilişkin uygun bilgi sağlamayı böylece ileri tıp alanına katkı sağlamayı amaçlamaktadır.

Materyal ve Metod: Bu çalışma Manipal, Kasturba Tıp Fakültesi, Anatomi Bölümünde yetişkin (14 erkek 11 kadın) larinkslerinde 25 sagital bölme üzerinde uygulandı. Larinkste farklı parametreler dijital kumpas kullanılarak ölçüldü. Uygun istatistiksel testler yapıldı.

Bulgular: Kadınlara nazaran erkeklerde larinksin morfometrik ölçümleri daha fazlaydı. Ancak kadınlar daha geniş bir krikoid çapına sahiplerdi.

Sonuç: Dolayısıyla bu çalışmaya göre kadınlar ve erkekler arasında larinks boyutu bakımından anlamlı bir farklılık vardır. Larinksin ve iç krikoid çapının boyutları, üst solunum yollarınıda içeren müdahaleler için güvenilir bir rehber olarak kullanılabilir.

Anahtar Kelimeler: Larinks, morfometre, krikoid, kıkırdak

INTRODUCTION

The anatomy of the larynx is characterized by considerable complexity of structure and functions that may be affected by various diseases. Lesions in these regions can also cause extrinsic compression resulting in a compromised airway[1]. Precise knowledge of the anatomy of the larynx is essential for various interventions involving bronchoscopes and endoscopes in the respiratory passages. A thorough understanding of the anatomy and the knowledge of variations in the laryngeal cartilages is therefore important, especially while interpreting head and neck radiographs of patients who exhibit anatomical or functional deviations[2].

Morphometric data of the larynx may be useful in otorhinolaryngology procedures such as total and partial laryngectomies, laryngeal microsurgery, in cases of subglottic stenosis and post-intubational stenosis[3,4]. These measurements would be useful in procedures such as endoscopy, surgical manipulations and in endotracheal intubation to prevent unnecessary injuries to the larynx[5]. Most of the studies have focused on the morphometry of individual laryngeal cartilages but the entire laryngeal framework was not considered in majority of the studies[2,3,5]. Therefore this study aims at providing appropriate information about the laryngeal morphometry which is essential in the field of advanced medicine.

MATERIAL and METHODS

The study was carried out using 25 sagittal sections of adult larynges (14 males, 11 females) preserved in 10% formalin in the department of Anatomy, Kasturba Medical College, Manipal. The specimens were obtained from the cadavers donated to our department.

The laryngeal cartilages were identified (figure 1a) and the following parameters of larynx were measured using digital calipers. The parameters measured are shown in figure 1b.

1. Total height (distance between the superior margin of the epiglottis and the inferior margin of the cricoid cartilage)
2. Anterior wall (distance between the highest point of the lamina of thyroid cartilage and the inferior margin of cricoid cartilage)
3. Posterior wall (distance between the interarytenoid notch and the inferior margin of the cricoid cartilage)
4. Internal diameter of cricoid cartilage

Appropriate statistical tests were applied.

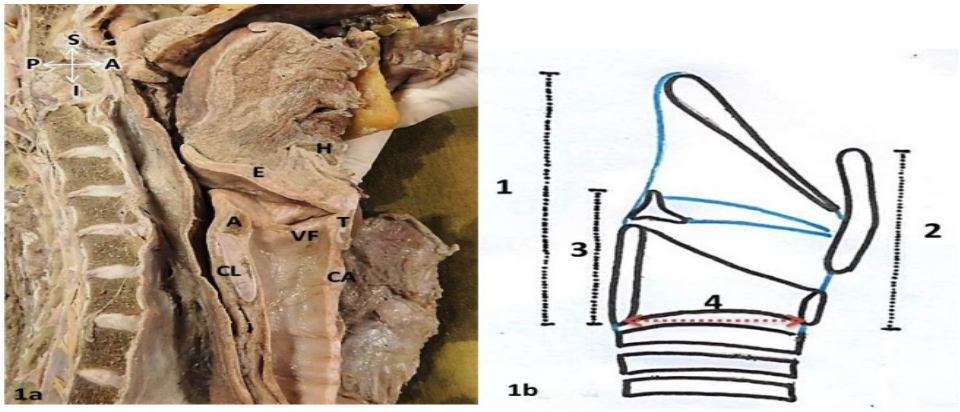

Figure 1. Sagittal section of the larynx and its schematic representation

1a: E- epiglottis, H- hyoid bone, T- thyroid cartilage, CA- cricoid arch, A- arytenoid cartilage, CL- cricoid lamina, VF- vocal fold

1b: 1- Total height of the larynx, 2- Anterior wall, 3- Posterior wall, 4- Antero-posterior diameter of cricoid

RESULTS

The study on 25 sagittal sections of adult larynges showing the mean and standard deviations of the parameters measured is represented in table 1. Paired t test was used to compare the parameters in males and females.

The morphometric measurements of the larynx were more in males as compared to females with statistical significance ($p<0.05$). On the contrary the cricoid diameter when observed was larger in females when compared to males. However the difference was statistically not significant.

Table 1: Laryngeal morphometry showing mean and standard deviation.

Parameters in cm	Males (N=14)	Females (N=11)	P value
Total height	6.53±0.38	5.72±0.41	<0.001*
Anterior wall	4.23±0.66	3.91±0.44	<0.001*
Posterior wall	3.85±0.47	3.75±0.39	0.05*
Diameter of cricoid	1.55±0.25	1.57±0.23	0.2

*p values with statistical significance

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DISCUSSION

Larynx is one of the most complex organs of the human body and has a great importance in Embryologic, anatomic, physiological and surgical point of view. Morphometric evaluation of the larynx has always been interesting to both morphologists and physicians. There has been an increased application of sophisticated electrophysiological and radiological methods for the diagnosis and treatment of laryngeal disorders. This requires an extensive knowledge of the size and proportions of the human larynx and its cartilaginous components[2].

Precise knowledge on the morphometry of the human larynx is essential in the interventions involving the upper respiratory passages. Even though the literature reveals number of studies on the laryngeal morphometry, the values vary considerably[4,6,7]. Most of the studies in the literature have focused on the individual cartilages of the larynx[2,5,8]. Very few studies have concentrated on the laryngeal morphometry as a whole. In a study by Miklaszewska and his coworkers, the larynx was approached holistically in fetuses where measurements like the total height, anterior and posterior walls were considered[9]. In the present study the similar parameters were adapted in adult larynges.

The different dimensions of the laryngeal cartilages vary considerably in males and females and are highly significant. All the major measurements of the larynx, i.e. length, transverse diameter and anteroposterior diameter are greater in the male than in the female. Zrunek and his co-workers had stated that the dimensions of male human larynges are 10-30% greater than in females[6]. However no significant differences were observed between different populations. In the present study the parameters measured were significantly higher in males than in females which are in general agreement with the previous studies[7].

Until puberty, the male and female larynges are similar in size but, afterwards, the male larynx enlarges considerably in comparison to the female: all the cartilages increase in size and the thyroid cartilage projects anteriorly in the midline of the neck, while its sagittal diameter nearly doubles

during this process. In a study by Miklaszewska and his coworkers there was a proportional increase in the laryngeal parameters with respect to the crown-rump length. It was also noted that the mean length of different laryngeal measurements were 0.5 mm larger in males than in females[9].

Various studies have been conducted to study the morphometry of the individual laryngeal cartilages, cricoid being the most important among them. In a study by Joshi et al the mean transverse diameter was found to be 18.33±2.26mm while the anteroposterior (AP) diameter was 19.29±2.47 mm^2. Harjeet et al in his study on North West Indian population measured the AP diameter of cricoid to be 20.22±4.07 mm[10]. Many authors have supported the same[7,8,11]. However the gender differences in the AP diameter of the cricoid were not considered the previous studies. In the present study the AP diameter of the cricoid was 15.5±0.25 and 15.7±0.23 mm in males and females respectively. The mean diameter of the cricoid was more in females than in males although these findings were however not statistically significant.

A thorough understanding of the anatomy and the knowledge of variations in the laryngeal cartilages is therefore important, especially while interpreting head and neck radiographs of patients who exhibit anatomical or functional deviations. It may also help in selecting the right dimensions of operational tools. These measurements would be useful in procedures such as endoscopy, surgical manipulations and in endotracheal intubation to prevent unnecessary injuries to the larynx. Therefore this study aims at providing appropriate information to the field of advanced medicine.

CONCLUSION

The study opines that there is a significant difference in the dimensions of larynges in males and females. The cricoid diameter although was greater in females than in males did not vary significantly. The dimensions of larynx and internal cricoid diameter and their gender differences may act as a reliable guide for various interventions involving the upper respiratory passages.

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