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MORPHOMETRIC DIMENSIONS OF FETAL LARYNX

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ABSTRACT

Introduction: The laryngeal cavity space extends from the laryngeal inlet down to the lower border of the cricoid cartilage, where it continues as the trachea. The skeletal framework is formed by a series of cartilages interconnected by ligaments and fibrous membranes. The vocal cords are the primary source of phonation. The larynx contributes for indispensable significance from embryologic, anatomic, physiologic and surgical standpoints.

Aim: The aim of the present study was to investigate morphometric growth patterns of the cartilaginous components and vocal cords in fetal larynx.

Materials and methods: The study was done on 25 spontaneously aborted (13 males and 12 females) fetuses from second to eighth month, in the Department of Anatomy, Kasturba Medical College, Manipal. The fetuses were obtained from the Department of Gynecology, Kasturba Medical Hospital, and Manipal. **Results**: The dimensions of the larynx and its cartilaginous components were measured and the relationship between the obtained data was statistically assessed**. Conclusion**: Correlations were found between the cartilaginous components, size of the larynx, and gestational age. Advances in neonatal medicine have resulted in increased care of fetal and neonatal airways, which requires an exhaustive knowledge of fetal airway anatomy and development .This study results are useful in the prenatal analysis, during treatment planning of airway emergencies and while designing supra glottis devices.

INTRODUCTION

The laryngeal cavity space extends from the laryngeal inlet down to the lower border of the cricoid cartilage, where it continues as the trachea. The skeletal framework is formed by a series of cartilages interconnected by ligaments and fibrous membranes. The vocal cords are the primary source of phonation. The larynx contributes for indispensable significance from embryologic, anatomic, physiologic and surgical standpoints. (1)

The laryngeal cartilages and muscles form from the mesenchyme of the fourth and sixth pharyngeal arches. Cartilaginous tissues from the fourth and sixth pharyngeal arches fuse and form the arytenoid, thyroid, cricoid, corniculate and cuneiform cartilages. The laryngeal cartilages, including the epiglottis, originate from the mesenchymal tissue adjacent to both ectoderm and endoderm (1,2)

Although thyroid, cricoid and arytenoid cartilages consist of hyaline cartilage, the other cartilages consist of elastic cartilage. Hyaline cartilages tend to ossify after the age of 18 years; this occurs earlier in men than in women. In contrast to hyaline cartilages, ossification does not occur in elastic cartilages. (1,2)

AIM

The aim of the present study was to investigate morphometric growth patterns of the cartilaginous components and vocal cords in fetal larynx.

MATERIALS AND METHODS

The study was done on 25 spontaneously aborted (13 males and 12 females) fetuses from second to eighth month, in the Department of Anatomy, Kasturba Medical College, Manipal.

The fetuses were obtained from the Department of Gynecology, Kasturba Medical Hospital, and Manipal.

THYROID CARTILAGE

- Distance between greater and lesser cornua (TY4)
- (right side—left side),
- Height of thyroid notch (TY5),
- Distance between thyroid notch and incisura thyroidea inferior (TY6),
- Height of greater cornua (TC1) (right side—left
- side),
- Height of thyroid ala between base of greater
- cornu and base of lesser cornu (TC2) (right
- side—left side),
- Height of lesser cornua (TC3) (right side—left
- side),
- Distance between greater cornua of thyroid
- (TC7),
- Distance between lesser cornua of thyroid (TC8),

CRICOID CARTILAGE (CR)

- Height of cricoid arch (CR1),
- Height of cricoid lamina (CR2),

EPIGLOTTIS CARTILAGE (EP)

- Length of epiglottis (EP1),
- Width of epiglottis (EP2).

RESULTS

- The measurements of the human fetal larynx dimensions as seen in PICTURE 1,2,3 were done.
- The Diagrammatic representations of the human fetal larynx were depicted in FIGURE 1,2,3
- The relationship between the obtained data was statistically assessed.
- The tabulations of the mean and the standard deviation are done. and represented in TABLE 1,2,3.

DISCUSSION

When the embryo is approximately 4 weeks old, the primordium of the respiratory system appears as an outgrowth from the ventral wall of the foregut. The internal lining of the larynx is developed from endoderm, but the cartilages and muscles originate from mesenchyme of the fourth and sixth branchial arches.(1,2)

Examination in children by means of ultrasonography, which represented a new method for researching normal and pathologic states, particularly functional disorders of the larynx Phonosurgical laryngoplastics is a relatively new branch in surgical laryngology .(3)

In the present study, the length and breadth of epiglottis showed a positive correlation with CRL. Cicekcibasi et al in their study on 40 spontaneously aborted fetuses evaluated the measurements of cartilaginous components of larynx with gestational age. In their study, the length and breadth of epiglottis increased from 5.62 mm (§1.13) and

4.06 mm (§0.76), respectively, in second trimester to9.35 mm (§1.52) and 5.63 mm (§0.72), respectively in the third trimester. Our study is similar to Cicekcibasi et al in evaluation of the measurements of the cartilaginous components of the fetal larynx.(4)

Different methods have been described to illustrate observations of fetal measurements and to estimate age-specific reference intervals for these measurements. The simplified method proposed by Royston and Wright (2000) appears to be usable to our study, regrouping a limited population. Few studies have been published on

the anatomical measurements of the airway in paediatric populations or premature populations

Ultrasound measurements in fetuses (Kalache et al.1999) reported a smaller tracheal diameter and higher laryngeal diameter than our results. An experimental study by Kalache et al. (2001) demonstrated that tracheal measurements obtained by ultrasound are smaller than those from anatomical measurements. According to their methods section, the laryngeal diameter measured in this study corresponded to the external cricoid diameter andnot to the endoluminal diameter(5,6)

The measurements were slightly smaller when compared with the corrected gestational age of fetuses in the current study, which may be due to the small sample size and methodological divergences in measure (7)

Clinical importance of the investigation

Laryngotomy in little children is connected to a high risk and followed by many complications. Therefore, findings of anatomical investigations on the larynx size (laryngometry) that are the basis for cannula size determination, as well as the cannulation timing and complications,are of great importance (7,8).

Fracture of the laryngeal cartilage has a special forensic- medical importance, as it is associated to the neck trauma (hanging, strangling – infanticide), because it happens most frequently on the cornua superiora of thethyroid cartilage (7, 8, 9)

. The data on laryngeal angles, air – lumen and thickness of the laryngeal skeletal parts can significantly help in planning endolaryngeal surgeries, or during transcutaneous insertion of electrodes for laryngeal electromiography.

Kaufman (2001) described the problems and complications that occur when performing laryngoplastics, because of the anatomical variations in larynx and unexpected events in surgery connected to this procedure, such as: variable size of the lower thyroid incisure, or its lack, which can cause thyroid cartilage fracture; ossification of thyroid cartilage in the early childhood; tubercules occurring in the region of cricoarytenoid joint which, if large, represents a good orientation in searching this joint; occuring ankylosis and pseudoankylosis.(10,11,12)

If a surgeon has not learned about existence of this type of variations, he/she may cause ankylosis of thelarynx joint.

The reasons for evaluating the dimensions of the fetal larynx are to provide a reliable data for surgical procedures in premature infants, like transplantation, stenting, intubations, cricothyroidotomy, and endoscopic procedures etc,.(12,3,14)

It is suggested that thyroid alar cartilage graft could be used for anterior grafting in laryngotracheoplasty.

This study reports the anatomical development of normal laryngotracheal structures during the fetal period. Laryngotracheal structures present a linear growth proportional to the fetal growth. Inequity in the size of endotracheal tube and the airway are the usual consequences to be blamed for the kind of improper instrumental injuries in the larynx. Using suitable endotracheal tubes especially for premature infants is important for effective airway management and for protecting larynx.

CONCLUSION

Correlations were found between the cartilaginous components, size of the larynx, and gestational age.

Advances in neonatal medicine have resulted in increased care of fetal and neonatal airways, which requires an exhaustive knowledge of fetal airway anatomy and development .This study results are useful in the prenatal analysis, during treatment planning of airway emergencies and while designing supra glottis devices.

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Table No. 1

	THYROID CARTILAGE	MEAN RIGHT	S D	MEAN LEFT	S D
TY 1	HEIGHT OF SUPERIOR HORN	4.2	O.84	4.2	0.74
TY 2	HEIGHT OF THYROID ALA	5.0	0.019	5.02	0.018
TY 3	HEIGHT OF INFERIOR HORN	2.4	0.84	2.3	0.018
TY 4	DISTANCE BETWEEN 1-3	11.6	0.39	11.5	0.37
TY 5	HEIGHT OF THYROID NOTCH	2.3	0.026	2.2	0.022

TY 6	DISTANCE BETWEEN TY 5-ITI	5.5	0.87
TY 7	RSH-LSH	10.5	0.53
TY 8	RSH-LSH	8.1	0.62

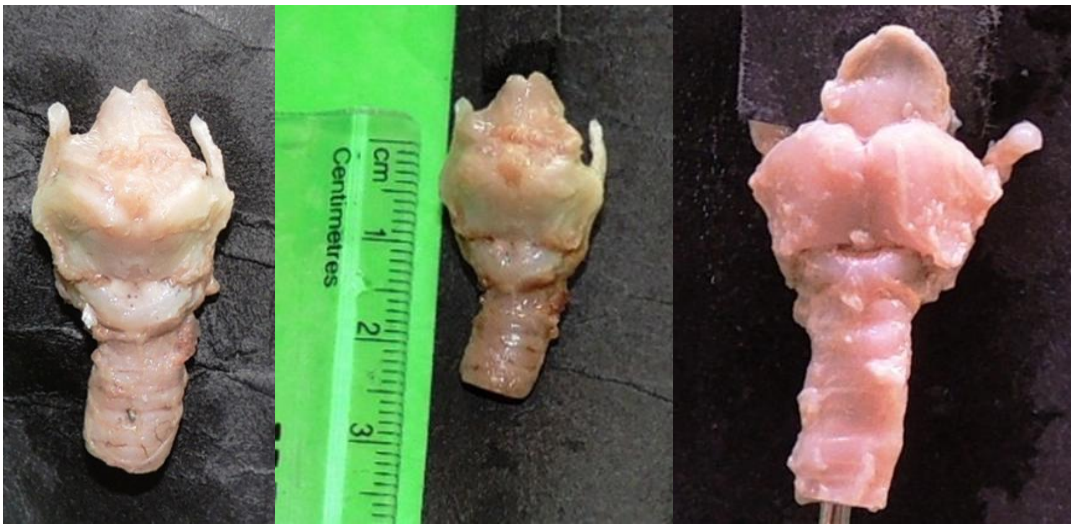
Table No. 2

CRICOID CARTILAGE-CR	MEAN	SD
HEIGHT OF THE ARCH [CR 1]	2.7	0.39
HEIGHT OF THE LAMINA [CR 2]	7.1	0.62

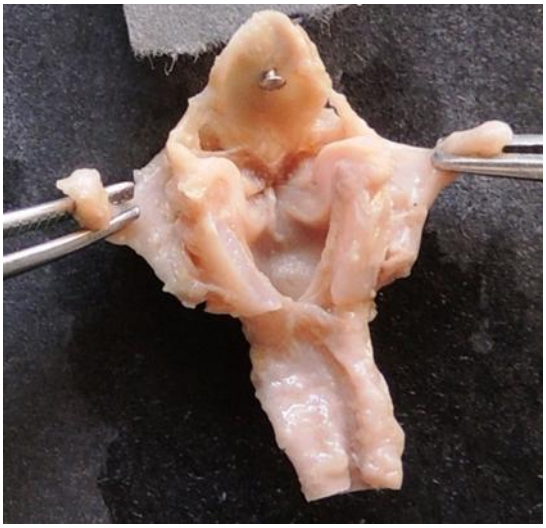
Table No. 3

EPIGLOTTIS- EP	MEAN	S.D
LENGTH [EP 1]	7.8	0.59
WIDTH [EP 2]	5.2	0.35

Picture 1: Showing the framrwork of fetal larynx



Picture 2: Showing the interior of the fetal larynx



Picture 3: Showing the method of measurement of fetal larynx.

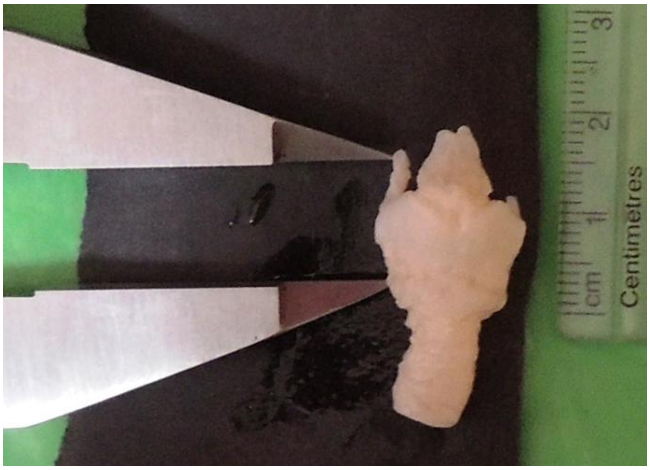


Diagram 1: Diagramatic representations of the measurement of fetal thyroid cartilage

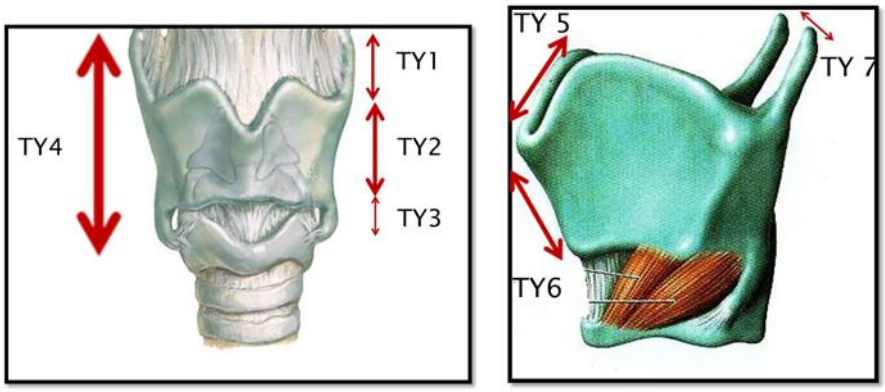


Diagram 2: Diagramatic representations of the measurement of fetal cricoid cartilage

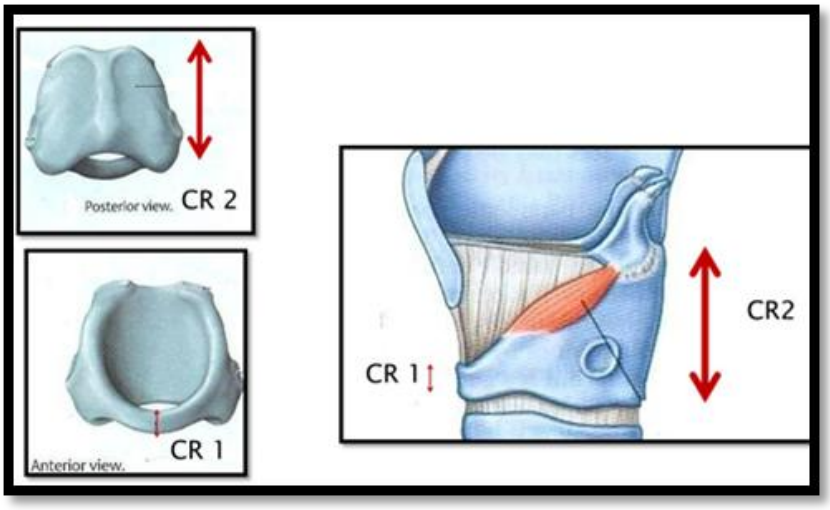


Diagram 3: diagramatic representations of the measurement of fetal epiglottis