Laryngeal ultrasound versus cuff leak test in prediction of post extubation laryngeal edema

Thesis
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By

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Mostafa Aboelyazeed Kassem

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List of Abbreviations

ACW	:	Air column width
ACWD	:	Air column width difference
CLT	:	Cuff leak test
CN X	:	Cranial nerve 10 the vagus nerve
COPD	:	Chronic obstructive pulmonary disease
DCL	:	Disturbed conscious level
DM	:	Diabetes mellitus
ETT	:	Endotracheal tube
HTN	:	Hypertensive
ICH	:	Intrcerebral hemorrhage
ICU	:	Intensive care unit
LE	:	Laryngeal edema
MI	:	Myocardial infarction
NPV	:	Negative predictive value
PES	:	Post extubation stridor
PLE	:	Post extubation laryngeal edema
PPV	:	Positive predictive value
PRF	:	Postextubation respiratory failure
R.F. I	:	Respiratory failure type I
R.F. II	:	Respiratory failure type II
R.O.C	:	Receiver operating characteristic
RD	:	Respiratory distress
RLN	:	Recurrent laryngeal nerve
RTA	:	Road traffic accident
SD	:	Stander deviation
SLN	:	Superior laryngeal nerve
US	:	Ultra sound
VC	:	Vocal cord

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Introduction

Endotracheal intubation is indicated in several clinical situations in ICU patients including acute respiratory failure, impending respiratory failure, air way protection in upper airway obstruction or patients at risk for aspiration, most commonly due to altered mental status. In addition, elective intubation is performed for many operative procedures **(Griesdale et al., 2008).**

However, intubation/extubation may lead to the development of complications such as post-extubation stridor laryngeal edema, one of the most frequent causes of reintubation, prolonged mechanical ventilation and increased morbidity in the ICU patients, especially those who are intubated for more than 24 h **(Hashemzadeh et al., 2012), (Jaber et al., 2003)**

Factors associated with the development of post-extubation stridor laryngeal edema include older age, female gender, size of endotracheal tube, presence of cuffed tube, prolonged intubation period, presence of an underlying airway disease, traumatic intubation, tracheal aspiration, tube mobility and patient fighting against the endotracheal tube **(Jaber et al., 2003), (Miller and Cole, 1996).**

Cuff leak test illustrating a leak around the endotracheal tube with the cuff deflated, has been proposed as a simple method of predicting the occurrence of post extubation laryngeal edema. Cuff leak test is measured when the patient presumed ready for extubation, it consists of

deflating the balloon cuff of the endotracheal tube in order to assess the air leak around the tube, permitting an indirect evaluation of upper airway patency. A reduced cuff-leak volume identifies a population at increased risk for the development of post extubation laryngeal edema **(Engoren, 1999), (Miller and Cole, 1996).**

However, **Engoren** (1999) reported a high negative predictive value, but a low positive predictive value, for the cuff-leaktest. Although the cuff-leak test is safe and simple, the controversial results may cause physicians to make difficult decisions regarding extubation if the cuff-leak test is positive.

Ultrasound has emerged as a potentially useful bed side non invasive tool in assisting and visualization of the upper air way In addition, laryngeal ultrasonography including measurement of air column width during balloon inflation and deflation and detecting air column width difference could predict post extubation laryngeal edema **(Hertz et al., 1970), (Shih et al., 1997).**

Aim of the Work

The aim of this prospective study is to evaluate diagnostic accuracy of ultrasound in measuring air way column difference (ACWD) versus cuff leak test in predicting post extubation laryngeal edema.

Chapter I

Basic Anatomy of the larynx

A: Gross Anatomy:

Relation and boundaries of the larynx :

The larynx is located within the anterior aspect of the neck, corresponds to the fourth, fifth and sixth cervical vertebrae. Anterior to the inferior portion of the pharynx and superior to the trachea, situated between the trachea and the root of the tongue. It forms the lower part of the anterior wall of the pharynx and is covered behind by the mucous lining of that cavity. Where the mucous membrane of the larynx continuous above with that of the pharynx and below with that of the trachea (**Standring, 2015) .**

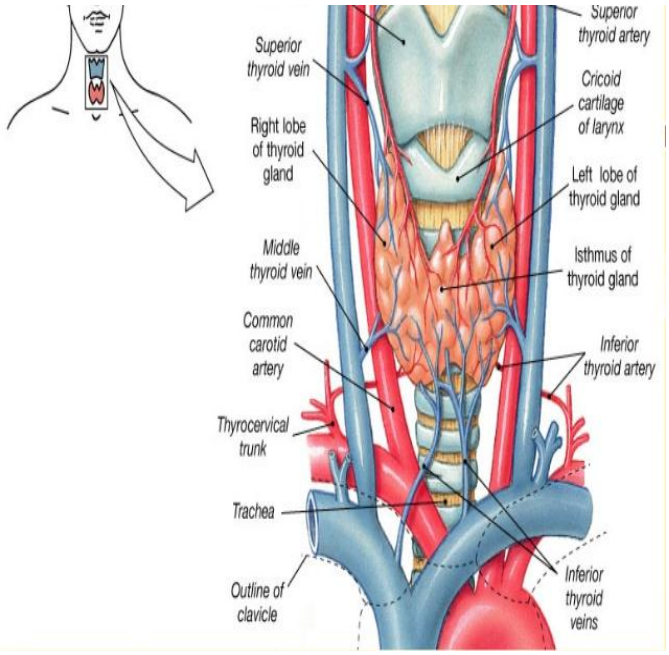

Fig. (1): Relation and boundaries of the larynx (Merati et al., 2006)

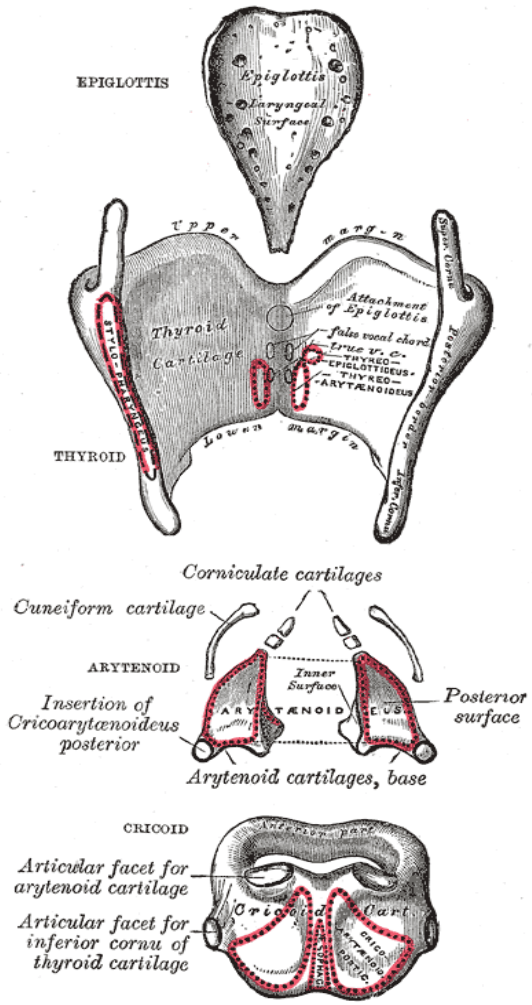

Fig. (2): Cartilage of the larynx. (Standring, 2015).

Component of the larynx :

The larynx is composed of 3 large, unpaired cartilages (cricoid, thyroid, epiglottis); 3 pairs of smaller cartilages (arytenoids, corniculate, cuneiform); and a number of intrinsic muscles. The hyoid bone, while technically not part of the larynx, provides muscular attachments from above that aid in laryngeal motion **(Standring, 2015).**

A:Cartilages of the larynx

❖ Unpaired cartilage:

1- Epiglottis:

The Epiglottis (cartilago epiglottica) is a thin lamella of fibrocartilage of a yellowish color, shaped like a leaf, The depressions between it and the root of the tongue, on either side of the median fold, are named the valleculae (**Sinnatamby, 2011)**.

2- The Thyroid Cartilage

The Thyroid Cartilage is the largest cartilage of the larynx. It consists of two laminae the anterior borders of which are fused with each other at an acute angle in the middle line of the neck, forming a subcutaneous projection named the laryngeal prominence (pomum Adami). This prominence is most distinct at its upper part and is larger in the male than in the female (**Sinnatamby, 2011)**.

3- The Cricoid Cartilage:

The Cricoid Cartilage is smaller, but thicker and stronger than the thyroid and forms the lower and posterior parts of the wall of the larynx. It consists of two parts: a posterior quadrate lamina and a narrow anterior arch. Cricoid is the only complete tracheal ring so in emergency intubation pressure can be applied to the cricoid cartilage to occlude the oesophagus and thus prevent regurgitation of gastric contents (**Sinnatamby, 2011).**

Paired cartilage :

1- The Arytenoid Cartilages :

The arytenoid cartilages form the part of the larynx to which the vocal ligaments and vocal folds attach. They are pyramidal in shape. The anterior angle of the base of it is elongated to form a vocal process for attachment of the vocal ligament, while The anterolateral surface has 2 depressions for attachment to the false vocal cord (vestibular ligament) and the vocalis muscle **(Standring, 2015)**.

2- The Corniculate Cartilages

The Corniculate Cartilages are two small conical nodules consisting of yellow elastic cartilage, which articulate with the summits of the arytenoid cartilages and serve to prolong them backward and medial ward. They are situated in the posterior parts of the aryepiglottic folds of mucous membrane and are sometimes fused with the arytenoid cartilages **(Merati and Steven, 2006.)**

3- The Cuneiform Cartilages:

The Cuneiform Cartilages are two small, elongated pieces of yellow elastic cartilage, placed one on either side, in the aryepiglottic fold, where they give rise to small whitish elevations on the surface of the mucous membrane, just in front of the arytenoid cartilages (**Merati and Steven, 2006).**

B:Ligaments of the larynx

The ligaments of the larynx are:

- Extrinsic ligament which are (the Hyothyroid Membrane, the Lateral Hyothyroid Ligament, the hyoepiglottic ligament and the cricotracheal Ligament)

those ligament connecting the thyroid cartilage and epiglottis with the hyoid bone and the cricoid cartilage with the trachea.

- Intrinsic ligament which are (the conus elasticus, the quadrangular membrane and the thyroepiglottic ligament) those ligament connect the several cartilages of the larynx to each other (**Standring, 2015)**.

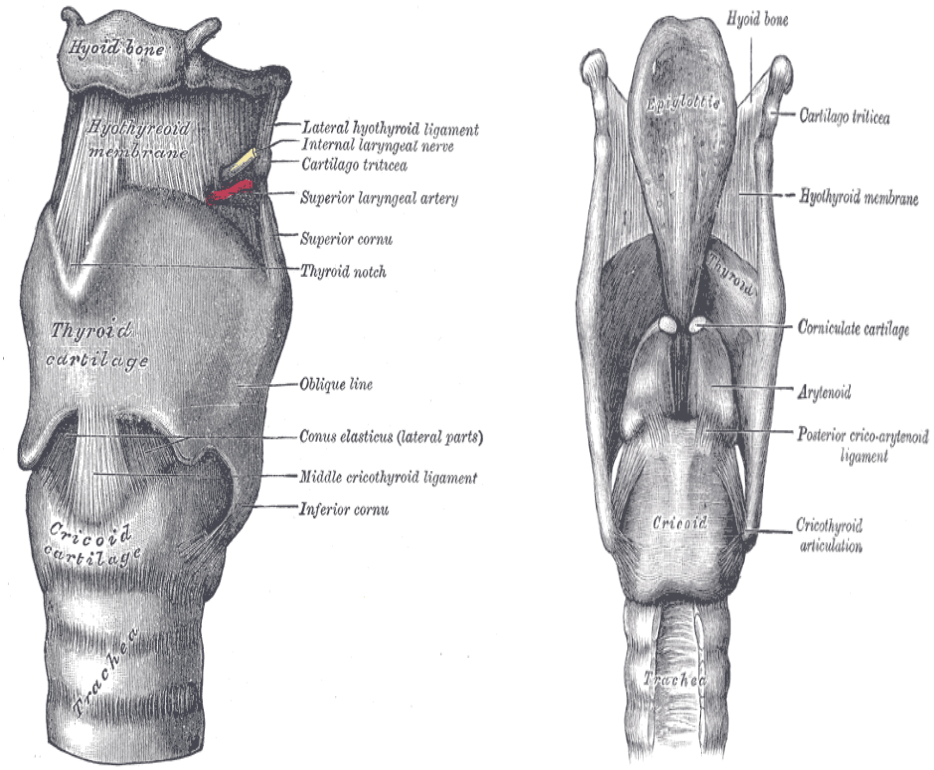

Fig. (3):Ligament of the larynx. (Standring, 2015).

C:The muscle of the larynx

The muscles of the larynx are

- ✓ Extrinsic muscle which consist of the suprahyoid group (Digastricus, Mylohyoideus, Stylohyoideus and Geniohyoideus), the infrahyoid group (Sterno-hyoideus, Thyreohyoideus, Sternothyreoideus and