The Role of laryngeal ultrasound in comparison with cuff leak test in prediction of post extubation stridor

Thesis

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Presented by

Sara Mohamed Eltaher
M.B., B.Ch Misr University for Science and Technology

Supervised by

Prof. Dr. Sherif Wadie Nashed
Professor of Anesthesia, Intensive Care Medicine and Pain Management, Faculty of Medicine, Ain Shams University

Prof. Dr. Noha Mohamed Elsharnouby
Professor of Anesthesia, Intensive Care Medicine and Pain Management Faculty of Medicine, Ain Shams University

Dr. Mohamed Abdul Mohsen Abdul Naiem
Lecturer of Anesthesia, Intensive Care Medicine and Pain Management Faculty of Medicine, Ain Shams University

Faculty of Medicine
Ain Shams University
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دور الموجات الصوتية علي الحنجرة مقارنة باختبار تسريب الهواء في تنبؤ حدوث الاختناق بالمجرى الهوائى بعد رفع الانبوبة الحنجرية

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توطئة للحصول علي درجة الماجستير في الرعاية المركزة

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☐ سارة محمد الطاهر/الطبيب

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تحت إشراف

☐أ.د/ شريف وديع ناشد

أستاذ التخدير والرعاية المركزة وعلاج الآلم

كلية الطب- جامعة عين شمس

أ.د/ نهي محمد الشرنوبي

استاذ التخدير و الرعاية المركزة وعلاج الألم

كلية الطب- جامعة عين شمس

☐د/ محمد عبد المحسن عبد النعيم

مدرس التخدير والرعاية المركزة وعلاج الآلم

كلية الطب- جامعة عين شمس

كلية الطب

جامعة عين شمس

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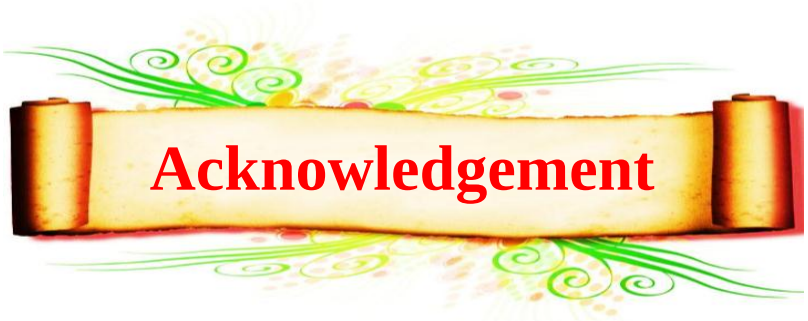

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Last but not least, I dedicate this work to my family, whom with out their sincere emotional support, pushing me for ward this work would not have ever been completed.

Contents

List of Abbreviations

ACWD	:	Air column width difference
AUC	:	Area under the curve
BD	:	Ballon deflation
BI	:	Ballon inflation
BP	:	Blood pressure
CLT	:	Cuff leak test
CO_2	:	Carbon dioxide
COPD	:	Chronic obstructive pulmonary disease
CPAP	:	Continuous positive airway pressure
CT	:	Computed tomography
DCL	:	Disturbed concious level
DM	:	Diabetes mellitus
ETT	:	Endotracheal tube
EI	:	Endotracheal intubation
GCS	:	Glasgow coma scale
HAP	:	Hospital-acquired pneumonia
HTN	:	Hypertension
HR	:	Heart rate
HVLP	:	High volume low-pressure
ICU	:	Intensive care unit
LRTI	:	Lower respiratory tract infection
LVLP	:	Low volume low pressure
PES	:	Post extubation stridor
ROC	:	Receiver-operating characteristic curve
RR	:	Respiratory rate
SPSS	:	Statistical package for the social science
UAO	:	Upper airway obstruction
US	:	Ultrasound
T5	:	Thoracic vertebra no.5
TLC	:	Total leuko cytic count
VC	:	Vocal cords
VAP	:	Ventilator associated pneumonia
VAT	:	Ventilator associated tracheobronchitis

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ABSTRACT

Background: Endotracheal intubation is commonly used in (ICU) for different causes. However, intubation/extubation may lead to the development of complications such as post-extubation stridor (PES), one of the most frequent causes of reintubation, prolonged mechanical ventilation, and increased morbidity in the ICU patients. PES and upper-airway obstruction are multifactorial in etiology and can occur as a result of laryngotracheal edema, intubation trauma, excessive cuff pressure with mucosal ulceration, and prolonged intubation with secondary inflammation and granuloma formation.

Objective: The aim of this study was to evaluate the value of laryngeal ultrasonography versus cuff leak test in predicting post-extubation stridor.

Patients and Methods: Our study included fifty patients admitted to the critical care department, Misr University for Science and Technology Hospitals from the period of November 2017 to July 2018 intubated for different causes for a minimum of 24 h. excluded patients primarily intubated for the upper airway obstruction ,patients with laryngeal carcinoma, Previous tracheostomy, neck radiotherapy. All patients will undergo for laryngeal ultrasonography versus cuff leak test to predict post-extubation stridor.

Results: In our study CLT identified PES patients with a sensitivity of 75%. But with low PPV of 50% for leakage volume of (132.5 mm). Laryngeal ultrasound showed a sensitivity of 50% for those patients with air column width before deflation less than 10.955 mm and ACWD 0.905 mm with PPV of 11.8% and 14.3% for air column width and ACWD respectively

Conclusion: Both CLT (Cuff leak test) and laryngeal US (ultrasound) might have sensitivity in predicting PES and should be used with caution in this regard.

Keywords: Post extubation stridor, laryngeal ultrasound versus cuff leak test, post extubation stridor

INTRODUCTION

Endotracheal intubation is indicated in several clinical situations in ICU patients including acute hypoxemic or hypercapnic respiratory failure, or impending respiratory failure, air way protection in upper airway obstruction, Patients at risk for aspiration, most commonly from central nervous system derangements may benefit from elective intubation.

In addition, elective endotracheal intubation (EI) is performed for many operative procedures; at times to facilitate certain diagnostic procedures (ex. Computed tomography scan, bronchoscope and (broncho alveolar lavage); and to aid in respiratory hygiene. Another potential indication for EI includes the need to hyperventilate by mechanical ventilation, attempting to reduce intracranial pressure in patients with acute intracranial hypertension [(1)].

However, intubation/extubation may lead to the development of complications such as postextubation stridor (PES), one of the most frequent causes of reintubation, prolonged mechanical ventilation, and increased morbidity in the ICU patients, especially those who are endotracheally intubated for more than 24 hours[(2,3)].

Factors associated with the development of PES 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[3,4].

Diagnosis of PES is of significant clinical importance as these patients can benefit from close monitoring and Endotracheal intubation is commonly used for respiratory support in intensive care unit (ICU) [4,5,6,7].

Cuff leak test (CLT), illustrating a leak around the endotracheal tube with the cuff deflated, has been proposed as a simple method of predicting the occurrence of PES. CLT 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 PES[4,8].

Although cuff leak test has been proposed as a simple method of predicting the occurrence of postextubation stridor, cut- off point of cuff-leak volume substantially differs between previous studies; making decision of extubation difficult with positive test [5,9].

In addition, laryngeal ultrasonography including measurement of air column width could predict post extubation stridor[10]

Aim of the work

The aim of this study was to evaluate the value of laryngeal ultrasonography versus cuff leak test in predicting post-extubation stridor.

AIRWAY AND INTUBATION

Indications for endotracheal intubation:

Endotracheal intubation is indicated in several clinical situations including acute hypoxemic or hypercapnic respiratory failure, or impending respiratory failure[11-14]. This procedure is also used to protect the airway in conditions of upper airway obstruction, either mechanical or from airway pathology[11-14] Patients at risk for aspiration, most commonly from central nervous system derangements may benefit from elective intubation[12-15].

In addition, elective EI is performed for many operative procedures; at times to facilitate certain diagnostic procedures (ex. computed tomographic scan); and to aid in respiratory hygiene.[11-14] Another potential indication for EI includes the need to hyperventilate by mechanical ventilation, attempting to reduce intracranial pressure in patients with acute intracranial hypertension [16].

Airway Anatomy

Endotracheal intubation can be performed either orally or nasally, although oral intubation is the more commonly used technique[15].The nasopharynx and oropharynx lead to the laryngopharynx (hypo pharynx). At the base of the tongue, the epiglottis separates the larynx from the laryngopharynx. The epiglottis serves as a protective

mechanism for preventing aspiration by covering the opening of the larynx (i.e. the glottis) during swallowing.

The larynx, composed of cartilages, connecting ligaments and muscles, establishes the boundary of the upper and lower airway. The glottis divides the larynx into a superior compartment (from the laryngeal outlet to the vocal cords) and an inferior compartment (from the vocal cords to the lower border of the cricoid cartilage), which leads to the trachea. In the adult, the airway is narrowest at the vocal cords and in small children at the cricoid cartilage ring (fig.1).

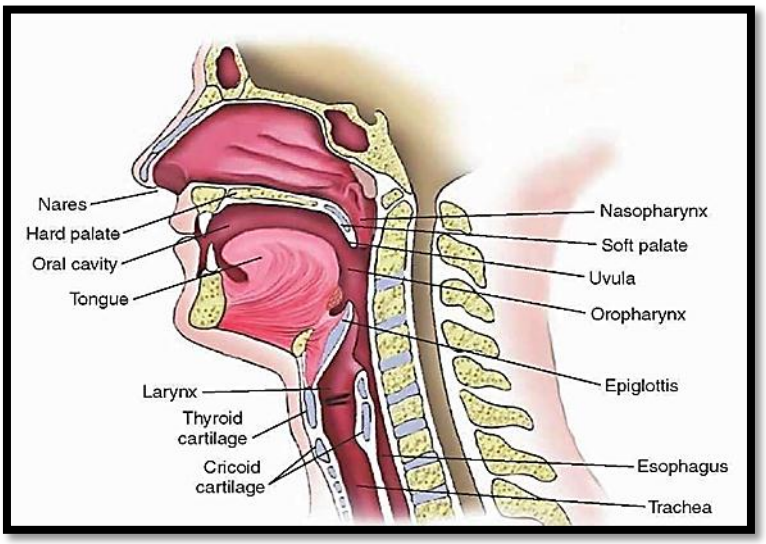

Figure 1. Anatomy of the airway

The trachea begins at the level of the cricoid cartilage and extends to the carina. The carina (at the level of the angle of Louis, about T5)[17] is the point of airway bifurcation, leading to the left and right main stem bronchi.

The right main stem bronchus is less angulated from the trachea than is the left main stem bronchus (25 versus 45 degrees) [17] and therefore is more prone to intubation if an endotracheal tube (ETT) is inserted too far.

Difficult intubation:

Difficult intubation is a potentially serious complication of EI and patients should be examined for signs of a difficult airway [18-20].

Signs of potentially difficult airways. *[12,14]*

- Difficulties with positioning of the neck: arthritis, trauma, or previous surgery
- Anatomical variations: small mouth, large tongue, bull neck, receding lower jaw, high arched palate, marked obesity
- Limitation of mouth opening
- Stridor or other signs of upper airway inflammation from epiglottitis, laryngeal infection or burn
- Trauma to the larynx or trachea
- Congenital malformation of face, head and neck.[21] (fig2).

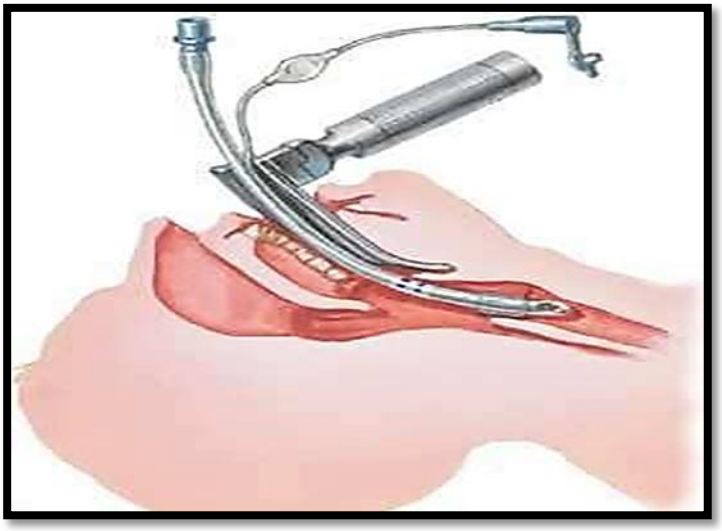

Figure 2. Endotracheal intubation

Complications attributable to the ETT :

1. Swallowing impairment:

Swallowing is abnormal following extubation in approximately half of patients[38-40], although clinically significant aspiration is much less common[38]. This was illustrated by a series of 254 patients who were intubated endotracheally for >48 hours following cardiac surgery[39]. Fifty-one percent of the patients exhibited post-extubation dysphagia. Risk factors for post- extubation dysphagia included a prolonged duration of endotracheal intubation, perioperative cerebrovascular events, and perioperative sepsis. The cause of impaired swallowing following extubation is not well understood, but it usually resolves without intervention.