

Laryngeal air column width ratio in predicting post extubation stridor

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Abstract

Aim: Correlation of upper air column width ratio in postextubation stridor patients. **Materials and Methods:** A prospective observational study was conducted in a tertiary hospital between January and December 2013. Patients who were admitted in Intensive Care Unit and intubated for >24 h were included (72 patients). The upper airway air column width ratio (air column width before extubation/air column width after intubation) was calculated and compared in patient with or without postextubation stridor. **Results:** The incidence of stridor was 6.9% (5/72). The duration of mechanical ventilation was 5.60 ± 1.14 days and 3.91 ± 1.45 days in stridor and nonstridor group respectively. In all 5 patients who had stridor, the upper airway air column width ratio was 0.8 or less. **Conclusion:** Air column width ratio of 0.8 or less may be helpful in predicting postextubation stridor, which should be confirmed by large observational studies.

Keywords: Air column width, cricothyroid membrane, cuff leak test, postextubation stridor, ultrasound

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Introduction

Endotracheal intubation can cause damage to the oropharynx, larynx, and trachea. Mucosal ulcerations and laryngeal edema occur in almost all patients intubated for 4 days or more.^[1] Postextubation stridor may occur in 2–15% of patients after extubation.^[2,3] Stridor involves a higher degree of morbidity and mortality particularly those who requires re-intubation.^[4] Examination of the vocal cords (VC) is most commonly performed by direct or indirect laryngoscopy, but this may not be readily approached in intubated patients. Postextubation stridor is commonly the result of edema of the subglottic area or the VC.^[5] The cuff-leak test, which has been used widely in the evaluation of upper-airway patency prior to extubation, but its positive predictive value is still low.^[6] There is no single test with high positive predictive

value to identify the patients who are at risk of laryngeal edema and postextubation stridor.

Noninvasive approaches to examine the VC and the larynx would be helpful and there have been many ultra-sonographical methods developed for visualizing this structure.^[7-13]

Materials and Methods

After taking informed consent from patient relatives and approval from hospital scientific review board, patients between age 18 and 75 years who were admitted in Intensive Care Unit during 1-year study period and intubated for >24 h were included (72 patients). All patients were intubated (high-volume, low-pressure) with cuffed endotracheal tube (ETT) (with an internal diameter size of 7.0–7.5 mm for females and 8.0–8.5 mm for males). Laryngeal ultrasound (US) was performed with a 5.0 MHz linear probe to measure air column width (defined as the width of air passed through the VC as determined by US) in all these patients as shown in Figure 1. Air column width was measured with the probe placed on the cricothyroid membrane with a transverse

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view of the larynx and patient positioned supine with a neck extended and ETT cuff deflated which was taken as control [Figure 2]. 3–4 h before planned extubation laryngeal US was repeated, and measurement recorded as test [Figure 3]. We have recorded the air-column width with cuff deflated over the respiratory cycles for three consecutive times, and the average value was considered. The cuff-leak test was performed as described by Miller and Cole.^[14] All of the patients were extubated when the cuff-leak was >100 ml and when they passed weaning trial. Stridor was defined as the presence of a high-pitched inspiratory wheeze localized to the trachea or the larynx and associated with respiratory distress, usually requiring medical intervention.

Statistical analyses were performed using standard statistical software. Categorical variables were summarized through the calculation of frequency and relative frequency. Continuous variables were summarized through the calculation of mean and standard error.

Results

The incidence of stridor in our study was 6.9% (5/72). The duration of mechanical ventilation was 5.60 ± 1.14 days and 3.91 ± 1.45 days in stridor and nonstridor group, respectively [Table 1]. All 72 patients were extubated when cuff leak was >100 ml. The average volume of cuff leak in stridor and nonstridor group was 112.0 ± 10.36 ml and 191.34 ± 54.00 ml respectively. The mean air column width in stridor group after intubation (cuff deflation) was 5.98 ± 0.19 mm and before extubation (cuff deflation) was 4.46 ± 0.20 mm. The mean air column width in nonstridor group after intubation (cuff deflation) was 6.01 ± 0.38 mm and before extubation (cuff deflation) was 5.64 ± 0.38 mm. The air column width ratio (before extubation/after intubation) in stridor and nonstridor groups were 0.74 ± 0.04 mm and 0.93 ± 0.02 mm respectively. In our study 5 patients with an air column width ratio of 0.8 or less had postextubation stridor even with standard cuff leak test volume of >100 ml. Out of 5 patients who had stridor 4 patients were re intubated as they did not respond to steroids, epinephrine nebulisation and bilevel positive airway pressure support.

Discussion

Endotracheal intubation and mechanical ventilation is commonly performed for hypoxic patients secondary to respiratory or cardiac cause. Mucosal ulcerations and laryngeal edema occur in almost all patients intubated for 4 days or more.^[1] Postextubation stridor may occur



Figure 1: Performing laryngeal ultrasound in intubated patient at the level of cricothyroid

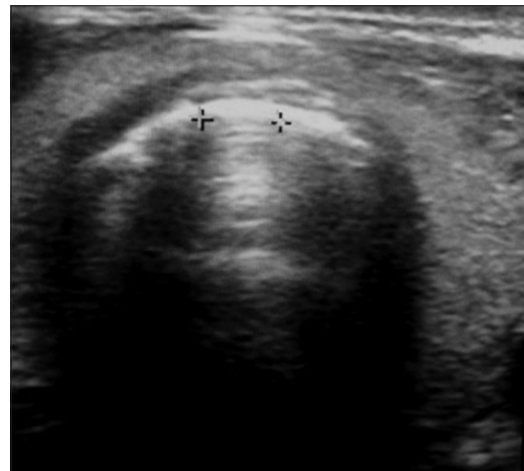


Figure 2: Air column width (0.57 cm) immediately after intubation with cuff deflated

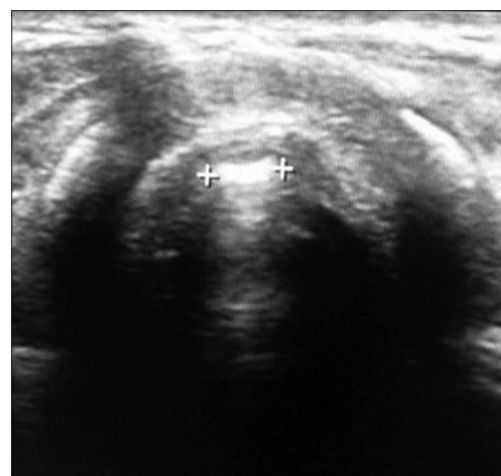


Figure 3: Air column width (0.42 cm) of same patient 3 h before extubation with cuff deflated and the air column width ratio of 0.73. This patient had stridor after extubation

in 2–15% of patients after extubation.^[2,3] Stridor involves a higher degree of morbidity and mortality particularly

Table 1: Characteristics of patients with and without stridor

	Mean±SD	
	Nonstridor (n=67)	Stridor (n=5)
Age (average)	54±years	55±years
Sex		
Males	35	2
Females	32	3
ETT size		
7.0 mm	12	1
7.5 mm	20	2
8.0 mm	14	1
8.5 mm	21	1
Duration of mechanical ventilation (days)	3.91±1.45	5.60±1.14
Cuff leak after intubation (ml)	214.25±44.83	172.0±22.80
Cuff leak before extubation (ml)	191.34±54.0	112.0±10.36
Air column width (after intubation) (mm)	6.01±0.38	5.98±0.19
Air column width (before extubation) (mm)	5.64±0.38	4.46±0.20
Air column width ratio (mm)	0.93±0.02	0.74±0.04

SD: Standard deviation; ETT: Endotracheal tube

those who requires re-intubation.^[4] The cuff-leak test, which has been used widely in the evaluation of upper-airway patency prior to extubation, but its positive predictive value is still low.^[6] Critical care physicians can easily evaluate the weaning potential in intubated patients, but it is difficult to predict the extubation failure due to upper-airway obstruction. Laryngeal US is a new, less invasive and easily reproducible method of examining the larynx. Many ultra-sonographical methods were developed for visualizing this structure^[7-13] in the recent years. Miller and Cole^[14] have shown that patients with reduced cuff leak volume (<110 ml) prior to extubation are at increased risk for postextubation stridor. The air column width measured by US has a potential ability to predict postextubation stridor in intubated patients. This prospective study was carried to correlate upper air column width ratio in postextubation stridor patients.

The standard ETT cuff leak test was performed before extubation and patients were extubated when cuff leak of 100 ml or more and who fulfilled the weaning criteria. Cuff leak test values and upper airway air column width ratio (air column width before extubation/air column width after intubation) were analyzed at the end of the study.

The incidence of stridor in our study was 6.9% (5/72), which is similar to other studies^[2,3] (2–15%). There was a correlation between stridor and number of intubation days (the duration of mechanical ventilation was 5.60 ± 1.14 days and 3.91 ± 1.45 days in stridor and nonstridor group respectively), which has also been shown by Kastanos *et al.*^[15] Ding *et al.*^[16] have shown that laryngeal ultrasonography could be reliable

noninvasive method in identifying laryngeal edema and to predict postextubation stridor. In our study, patients with upper airway air column width ratio of 0.8 or less had postextubation stridor even with standard cuff leak test of >100 ml. Laryngeal US can be used in prediction of postextubation stridor, which has high sensitivity and specificity. In our study, of 72 patients, only 5 patients had stridor which is very low compared with the nonstridor group and to recommend as the definitive test to predict postextubation stridor. Large study populations are required for further correlation of our findings.

Conclusion

Air column width ratio of 0.8 or less may be helpful in predicting postextubation stridor, which should be confirmed by large observational studies.

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