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Risk factors associated with post-extubation stridor in the trauma intensive care unit

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Abstract

BACKGROUND: Post-extubation stridor is an uncommon complication in medical intensive care units (ICUs) but has not been well studied in trauma patients. We sought to determine the incidence of reintubation due to stridor in trauma patients and describe associated risk factors.

METHODS: A retrospective review of all intubated trauma patients was performed. Data collected included presence of stridor, demographic data, and details of intubation and extubation.

RESULTS: Of all trauma patients reintubated, 31% were for stridor. Although female gender, age less than 18, blunt mechanism, and duration of intubation 5 days or more were associated with reintubation for stridor, endotracheal tube diameter was not. Mortality was not increased with reintubation.

CONCLUSIONS: Trauma ICU patients are reintubated for stridor at a higher rate than medical ICU patients. Age, gender, blunt mechanism, and duration of intubation are risk factors for this complication.

Stridor is an accepted clinical manifestation of laryngeal edema[1] and can herald loss of airway. When stridor is noted after extubation, it is often an acute, precipitous, and stressful event. The complication can develop quickly and may require immediate intervention to prevent reintubation. If supportive measures fail, it may be difficult to re-establish an airway because of the underlying edema. In addition to these immediate concerns, extubation failure typically leads to longer intensive care unit (ICU) stays and more days on the ventilator and has been associated with increased morbidity and mortality in medical populations.[2,3] Although relatively well studied in the medical ICU literature, there is limited research examining reintubation, particularly reintubation due to stridor, in the trauma population.

Most stridor studies have been conducted in medical or mixed medical–surgical ICUs,[1,4–10] where post-extubation stridor (PES) has been identified as an infrequent cause of reintubation, making up approximately 1% to 15% of all reintubations.[1,4,11] Among the risk factors cited for reintubation due to stridor are female gender, longer duration of intubation, and absence of a cuff leak.[1] Another possible risk factor is a larger endotracheal tube (ETT) relative to a patient's laryngeal diameter,[6,9] although this finding has not been universally supported.[12,13]

The pathophysiology of medical ICU patients can differ greatly from trauma patients, making it difficult to extrapolate data from one population to another. A review of the limited trauma literature shows that many risk factors for reintubation are unique and distinct from medical patients.[14,15] Furthermore, in a mixed medical and trauma

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ICU, it was found that admission for trauma was associated with an increased rate of reintubation due to stridor.[9] In the only study to our knowledge examining PES and extubation failure specifically in a trauma population, there was a 33% incidence of stridor leading to reintubation[12]—a rate much higher than in medical ICU studies.

Because of previous medical ICU literature describing trauma as a risk factor for stridor,[9] a higher reported rate of stridor in trauma patients,[12] and from anecdotal observations by the trauma intensive care staff, we hypothesized that in a trauma population, PES is a more frequent cause of extubation failure than previously described in the medical literature. The purpose of this study was to evaluate the incidence of PES as the cause of extubation failure in a trauma population and identify associated risk factors.

Methods

A retrospective study of all intubated patients admitted to the trauma service was conducted at the Community Regional Medical Center, a 650-bed American College of Surgeons–verified level 1 trauma center in Fresno, CA, from May 2007 to May 2014. Patients were excluded from the study if they underwent tracheostomy, were transferred or died before their first extubation attempt, or were successfully extubated but remained intubated after a subsequent surgical procedure.

A patient was considered to have failed extubation due to laryngeal edema if they were reintubated within 48 hours of extubation, and if clinical charting by the nurse, respiratory therapist or physician reported laryngeal edema, upper airway obstruction or, most commonly, stridor, as the direct cause of, or being temporally related to, the patient's reintubation.

Patients in the study were divided into 2 groups: failed extubation with stridor (FES) and successful extubation (SE). A patient was placed in the SE group if they remained off the ventilator for greater than 48 hours. Patients with documented stridor who did not require intubation were also included in the SE group. These 2 groups were compared by the following variables obtained from the trauma database: age, gender, injury type, ISS, Glasgow Coma Scale on arrival to the emergency department, Abbreviated Injury Score of the head and neck, and chest, presence of chest tube, total ventilator days, ICU length of stay, hospital length of stay, placement of tracheostomy, and mortality.

A matched cohort analysis was done to evaluate the importance of the relationship of tracheal and ETT size. In this additional analysis, each FES patient was then matched for age, gender, and ISS, with 2 patients from the SE group. Matching was limited to these demographics to avoid overmatching. FES patients were excluded from further analysis if they could not be matched with patients in the SE group in an attempt to limit potential bias. Comparisons between these 2 groups included weight, laryngeal diameter, and ETT size. Patient weight was measured at admission and within 2 days of extubation in lieu of recorded fluid balance, which often had wide variation.

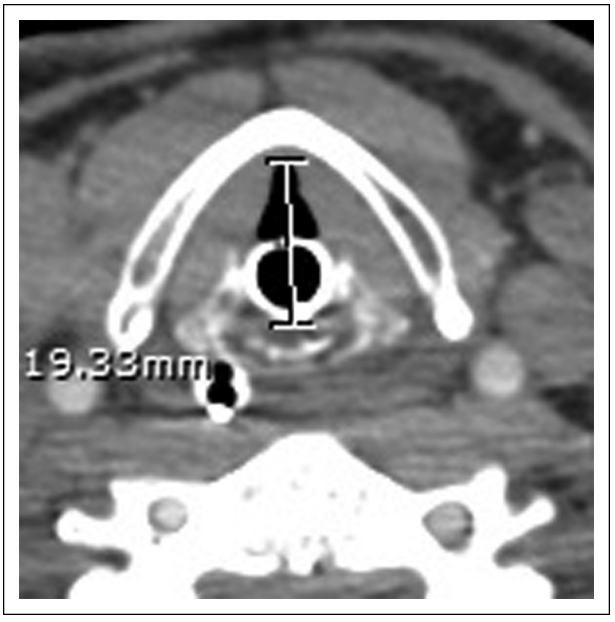

Figure 1 Example of measurement of laryngeal diameter.

The anterior–posterior axial laryngeal diameter was measured at the mid-point between the notch and inferior edge of the thyroid cartilage in the FES group and matched groups (Fig. 1). This location was chosen as it most consistently approximated the location of the patient's vocal cords, the narrowest and most dependent part of the larynx, and where Colice et al[16] most commonly found laryngeal injuries in intubated patients. These data were combined with the external diameter of the patient's ETT to calculate an ETT to laryngeal diameter ratio for each patient. Patients in the matched cohorts without computed tomographic scans were excluded from laryngeal diameter and ETT to laryngeal diameter ratio analysis but were included in comparison with weight and weight change.

Additional comparisons between mortality and tracheostomy rates between FES, SE, and patients failing extubation for reasons other than PES were also performed.

Statistical analysis was performed using paired *t* tests for matched data, 2-tailed independent *t* tests for unmatched data, and chi-square analysis. Statistics were performed using the Statistical Package for Social Sciences (IBM SPSS Statistics for Windows, Version 23.0. IBM Corp, Armonk, NY), and significance was attributed to a *P* value less than .05. This study was approved by the institutional review board of the University of California San Francisco, Fresno, and Community (Regional) Medical Centers.

Results

In the 7-year time period, there were 2,880 intubated trauma patients admitted to Community Regional Medical