



Research Paper

Laryngotracheal stenosis in burn patients requiring mechanical ventilation

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KEYWORDS

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Abstract *Objective:* To identify the incidence of laryngotracheal stenosis (LTS) in burn patients requiring mechanical ventilation at a regional academic burn center.

Methods: A retrospective review of all burn patients requiring endotracheal intubation or tracheostomy for airway management between 2003 and 2009 was performed. A group of trauma patients requiring similar airway instrumentation during the same period of time was used as a control.

Results: None of the trauma patients and 2 of the burn patients developed LTS. Both presented with stridor and were diagnosed within 2–5 weeks after extubation. One patient underwent successful carbon dioxide laser radial incision and dilation and continues to do well. The other patient failed endoscopic treatment and required T-tube placement. The incidence of LTS in burn patients requiring mechanical ventilation was 2.98% overall and 4.76% among those with inhalational injury.

Conclusions: Patients become symptomatic within weeks of the initial injury. Treatment is challenging and multiple surgical procedures are often required. A larger study is necessary to determine if the incidence is higher among burn patients.

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Introduction

Acquired laryngotracheal stenosis (LTS) continues to be a formidable challenge for the otolaryngologist. Its etiology has changed over the years from infectious and traumatic, to primarily iatrogenic as a result of mechanical ventilation.^{1,2} The incidence of LTS ranges from 1% to 10% after intubation but increases to 19% in critically ill patients requiring mechanical ventilation.^{3–8}

It is generally accepted that iatrogenic LTS begins with mucosal damage by pressure from a translaryngeal or transtracheal tube. This leads to disruption of the microcirculation within the mucosa resulting in ischemia.^{9–11} Superficial injury, in which the integrity of basement membrane is preserved, usually recovers completely in a matter of weeks. Deeper damage, however, takes longer to heal, and the normal respiratory epithelium is often replaced with squamous epithelium which impairs tracheal ciliary transport.¹² A breached mucosal barrier, exposed cartilage and impaired ciliary motility all increase the risk of infection and scar formation.^{3,4}

Inhalational injury accompanies at least one third of all major burn accidents. The thermal injury to the airway is magnified by a chemical burn from the products of incomplete combustion.^{13,14} Together, these two insults cause mucosal sloughing and tracheobronchitis, which in turn results in scarring.

As a large proportion of burn victims require mechanical ventilation at some point during their hospital course, it is often difficult to separate out the two etiologies. Previous reports have suggested that post-intubation LTS tends to be more severe after an inhalation injury.¹⁵ The incidence of LTS in burn patients with inhalational injury requiring endotracheal intubation or tracheostomy has been reported to be between 5% and 24%.^{16–18}

We present a series of 67 consecutive patients admitted to our burn unit who required mechanical ventilation and compare them to a similar group of non-burn patients to determine the incidence of acquired laryngotracheal stenosis in burn patients overall and in those with inhalational injury.

Materials and methods

After institutional review board approval was obtained, a retrospective review of all burn patients requiring endotracheal intubation or tracheostomy for airway management at Temple University Hospital, a Level 1 trauma center and a regional burn center, between 2003 and 2009 was performed. A group of non-burn trauma patients requiring endotracheal intubation or tracheostomy during the same time period was used as a control.

Demographic information, past medical and surgical history, mechanism and extent of burn or trauma injury was collected from the inpatient records. In addition, the method and duration of airway management, bronchoscopic findings, time to decannulation and to diagnosis of LTS was recorded. The incidence of LTS was calculated and compared for both groups. Statistical analysis to compare the difference between the two groups was performed using a Student *t*-test.

For patients diagnosed with LTS, the time to presentation, presenting signs and symptoms, management, and follow-up were compiled from the inpatient and outpatient record.

Results

Demographics

One hundred-fourteen burn patients who required mechanical ventilation between 2003 and 2009 were identified. Of these, 47 expired and were excluded. The remaining 67 patients were included in the analysis. In addition, 72 mechanically ventilated non-burn trauma patients were used as a control group.

The mean age was 50 years (range 14–90 years) for the burn patients and 38 years (range 14–87 years) years for the trauma group. Males dominated both groups comprising 58.2% of the burn patients and 86.1% of the trauma patients [Table 1]. The groups were not significantly different in terms of their past medical, surgical, or social history.

Injury

The mechanisms of burn were house fire (60%), gasoline explosion (14%), oxygen explosion (10%), motor vehicle accidents (10%), and electrical burn (6%) [Fig. 1]. The average body surface area burned was 17% (1%–68%). Eleven patients (16%) exhibited inhalation injury only. Of those who suffered cutaneous burns, 28 (49%) had face involvement. The mechanisms of trauma were multiple with motor vehicle accidents, gunshot wounds and falls comprising the majority [Fig. 2].

Airway management

The vast majority of patients in both groups were intubated before arrival to the hospital with 19 patients (28.4%) intubated in the field and an additional 24 patients (35.8%) intubated at an outside institution. The remaining patients were successfully intubated in the Emergency Department, except for one burn victim who required an emergency cricothyrotomy. The mean duration of intubation was 8.8 days (range 1–13 days) for the burn group, and 5.8 days (range 1–16 days) for the trauma group. Twenty-one (31.3%) burn patients underwent bronchoscopy within 10 days of admission and were found to have bronchoscopic findings of inhalational injury.

Forty-six (68.6%) burn victims and 22 (30.6%) trauma patients required tracheotomy. The pre-tracheotomy intubation period was 11.4 days (range 1–19 days) for the burn group and 13.5 days (range 1–23 days) for the trauma group. After tracheotomy, 56.7% of burn patients and 66.7% of trauma patients were decannulated prior to discharge or during outpatient follow-up. The mean time to

Table 1 Demographics of burn and trauma groups.

Group	Mean age, years (range)	Males	Females
Burn	50 (14–90)	39	28
Trauma	38 (14–87)	62	10

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