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Defining the criteria for intubation of the patient with thermal burns

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ARTICLE INFO

Article history:
Accepted 9 February 2018
Available online xxx

Keywords:
Thermal burn
Endotracheal intubation
Inhalational injury
Mechanical ventilation

ABSTRACT

Objectives: Recent studies demonstrate that burn patients are undergoing unnecessary intubations. We sought to determine the clinical criteria that predict intubations with benefit.

Methods: This was a retrospective review of intubated adults admitted to our center with thermal burns 2008-2013. Criteria for intubation were defined as traditional criteria (suspected smoke inhalation, oropharynx soot, hoarseness, dysphagia, singed facial hair, oral edema, oral burn, non-full thickness facial burns), or ABA criteria as defined by the 2011 ABA guidelines (full thickness facial burns, stridor, respiratory distress, swelling on laryngoscopy, upper airway trauma, altered mentation, hypoxia/hypercarbia, hemodynamic instability). Patients with <26 days free from mechanical ventilation (ventilator-free days (VFD)) out of 28, were deemed indicated long-term intubations. Those with ≥26 VFD were deemed unnecessary short-term intubations.

Results: Of 218 patients, 151 had long-term and 67 had short-term intubations. Long-term intubation was strongly associated with ABA criteria (77.5%) compared to traditional criteria (22.5%) ($p < 0.001$). Sensitivity of ABA criteria for long-term intubation was 77% and specificity 46%. Traditional criteria associated with long-term intubation included suspected smoke inhalation (OR 2.45 [95% CI, 1.18-5.11]), and singed facial hair (OR 2.53 [95% CI, 1.25-5.09]). The addition of these to ABA criteria created the Denver criteria, which exhibited an increased sensitivity for long-term intubations (95%), but decreased specificity (24%).

Conclusions: Intubation should be considered for patients displaying the Denver criteria, which includes full thickness facial burns, stridor, respiratory distress, swelling on laryngoscopy, upper airway trauma, altered mentation, hypoxia/hypercarbia, hemodynamic instability, suspected smoke inhalation, and singed facial hair. Patients lacking these criteria should not be intubated.

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https://doi.org/10.1016/j.burns.2018.02.016
0305-4179/

1. Introduction

Inhalational injuries occur in approximately one-third of major burn injuries and cause significant morbidity and mortality [1,2]. Thermal burns can lead to inhalational injuries that cause respiratory failure and necessitate intubation by two mechanisms: upper or lower airway injury [3]. Upper airway injuries result from direct thermal exposure to the mucosa leading to swelling and upper airway obstruction [4]. These burns can result in early airway loss, and need for intubation, within the first 12 h after injury [5]. Lower airway injury results from exposure to smoke and chemical by-products of combustion leading to pneumonitis, and also from systemic asphyxia from carbon monoxide, cyanide and methemoglobinemia [6]. These burns result in delayed respiratory failure (24–48 h after injury) and often require prolonged ventilatory support. Due to the delayed onset of respiratory failure in inhalational injury, it is difficult to predict which patients should be intubated and when.

The ability to predict need for early intubation in upper airway burns is critical because intubation after the onset of obstruction can be difficult. This led to the traditional prophylactic practice of early intubation of burn patients with any physical exam findings associated with increased risk of airway swelling [7,8]. Currently, evidence-based guidelines outlining criteria for intubation of patients with inhalational injuries are lacking [9–11]. Due to the absence of consensus criteria for intubation, determining which patients with thermal burns require intubation can be very challenging for the EMS provider, emergency physician, or critical care provider [10,12]. This is well recognized and outlined as the number one priority for inhalational injury research: to create a universally accepted clinical definition and/or diagnostic criteria for inhalational injury [11].

Recent literature suggests that many patients are being needlessly intubated for prophylactic reasons [13,14]. Intubation and mechanical ventilation are associated with complications including pneumonia, which carries significant morbidity and mortality for burn patients [15–17]. The American Burn Association (ABA) revised the intubation guidelines in 2011 to address this issue with the goal of decreasing unnecessary intubations [18]. Adherence to these guidelines and their ability to predict necessary and unnecessary intubations has not yet been evaluated.

Table 1 – ABA and traditional indications for intubation of the patient with thermal burns.

Indications for intubation	
2011 ABA guidelines	Traditional
• Full thickness facial burns	• Suspected smoke inhalation
• Stridor	• Oropharynx soot
• Respiratory distress	• Hoarseness
• Swelling on laryngoscopy	• Dysphagia
• Upper airway trauma	• Singed facial hair
• Altered mentation	• Oral edema
• Hypoxia/hypercarbia	• Oral burn
• Hemodynamic instability	• Non-full thickness facial burn

We reviewed the treatment and outcomes of intubated burn patients cared for at our ABA verified burn center to determine the sensitivity and specificity of the 2011 ABA guidelines to reliably predict useful intubations. We hypothesized that patients intubated using ABA criteria would remain intubated for a significant period of time, indicating that a necessary intubation was performed; additionally, patients intubated for traditional reasons (not following ABA guidelines), would be intubated for a short period of time, signifying an unnecessary intubation.

2. Materials and methods

2.1. Study population and design

This study was a retrospective review of patients admitted to a tertiary care ABA verified burn center from January 2008 to July 2013. All adult (≥18 years old) patients acutely intubated (within 3 days of injury) with suspected thermal (flame, smoke, scald) inhalational burn injury were included. Patients were excluded for non-burn injuries (necrotizing fasciitis, Steven's Johnson syndrome/toxic epidermal necrolysis), non-thermal burns (electricity, lightening, frostbite, chemical), intubation performed solely for a procedure in the operating room, and intubation ≥3 days from burn injury.

Criteria for intubation were divided into traditional prophylactic and ABA criteria. Intubations were categorized as ABA intubations if at least one ABA criterion was met. Intubations were categorized as traditional if none of the ABA criteria were met. The 2011 ABA guidelines included full thickness facial burns, stridor, respiratory distress, swelling on laryngoscopy, and other standard criteria for intubation including upper airway trauma, altered mentation, hypoxia/hypercarbia, and hemodynamic instability. Traditional criteria included suspected smoke inhalation, oropharynx soot, hoarseness, dysphagia, singed facial hair, oral edema, oral burn, and non-full thickness facial burns (Table 1). The 2011 ABA guidelines were presented in the 2011 American Burn Life Support (ABLS) course [18].

Protocolized daily assessments for extubation readiness were made of all patients. This included daily morning spontaneous awakening trials (SAT) for all patients without severe hemodynamic instability, severe derangements in gas exchange, or elevated intracranial pressure. A spontaneous breathing trial (SBT) was performed if the conditions requiring intubation had been reversed/controlled, neuromuscular function was adequate to cough, able to perform purposeful movements and spontaneously breathe, secretions were thin and minimal, hemodynamics were stable, ventilator requirements were minimal including positive end-expiratory pressure (PEEP) <8 cm H_2O, fraction of inspired oxygen percentage (F_iO_2) <50%, arterial partial pressure of carbon dioxide (P_aCO_2) 35–45 mmHg or baseline if chronically hypercarbic, and minute ventilation <12 L/min, and presence of a cuff leak was optional. An SBT was performed in pressure support mode using 5 cm H_2O of pressure support with 5 cm H_2O of positive end-expiratory pressure (PEEP). A patient passed an SBT and was considered for extubation if he/she maintained a rapid shallow breathing index <105 without desaturation, tachycardia, significant

Please cite this article in press as: J.H. Badulak, et al., Defining the criteria for intubation of the patient with thermal burns, Burns (2018), https://doi.org/10.1016/j.burns.2018.02.016