Austin Journal of Emergency and Critical Care Medicine

Open Access

Austin Publishing Group

Research Article

Home Oxygen Therapy Related Burns: An Outcome Comparison based on Location of Intubation

Meyerson J[1], Coffey RA[2] and Jones LM[2]*

[1]Department of Plastic Surgery, The Ohio State University Wexner Medical Center, Columbus, OH, USA

[2]Department of Surgery, The Ohio State University Wexner Medical Center, Columbus, OH, USA

***Corresponding author:** Jones LM, Department of Surgery, The Ohio State University Wexner Medical Center, 410 W. 10th Avenue, N744 Doan Hall, Columbus, OH 43210, USA

Received: April 04, 2017; **Accepted:** May 05, 2017; **Published:** May 12, 2017

Abstract

Introduction: Burns resulting from home oxygen therapy often result in the patient being intubated without clear indications of airway injury or compromise. This study compares two groups of patients with home oxygen therapy related burns based upon the location of intubation: at a verified burn center and prior to admission to the burn center.

Methods: A retrospective study of all patients admitted with home oxygen burns to our burn center from 2006-2015 was performed. Data collected included intubation status, intubation location, indications for intubation, and bronchoscopy findings. Outcomes included ICU length of stay, hospital length of stay, ventilator days and cost.

Results: A total of 78 patients were divided into intubated and non-intubated: 37% of patients were intubated with 69% intubated prior to transfer to the burn center. The intubated group had significantly longer lengths of hospital stay ($p<0.0001$), longer ICU stays ($p<0.0001$), more ventilator days ($p<0.001$) and higher costs ($p<0.0001$). No patient in either group demonstrated inhalation injury on bronchoscopy. The location of intubation demonstrated an increase of 8% per year toward intubation prior to admission to the burn center ($p<0.05$) with the largest increase from 2010-2015 ($p<0.05$).

Conclusion: In the last decade, there has been an increasing number of home oxygen burn patients being intubated at outside hospitals or by EMS prior to arrival at the burn center. Indications and algorithms for intubation of these patients need to be developed. Community education for non-burn center personnel should be implemented to provide best practices for this patient population.

Keywords: Home Oxygen Therapy; Burn Injury; Intubation

Introduction

Long term oxygen therapy has become an integral part of the treatment of hypoxemia related to chronic obstructive pulmonary disease. Home oxygen therapy (HOT) use has increased greatly over the past10 years with approximately 1.5 million people in the United States currently receiving home oxygen therapy [1]. When combined with fuel and an ignition source, home oxygen therapy can lead to fires and cause severe burns and even death. HOT-related burns have been increasing at 14% per year from 2002-2011 [2]. While the total body surface area (TBSA) of these injuries may be small and involve only the face, patients with these types of injuries are often assumed to have concomitant inhalation injuries. Thus, patients may be intubated as a precaution which itself may lead to unintended consequences. Several studies have documented the hospital courses of patients with HOT-related injuries noting increased length of stay, complications, and cost [3-10]. Previous research has not solely focused on the trends and outcomes of HOT-related burn patients based upon the location of intubation. The purpose of this study is to compare two groups of patients with HOT-related injuries based upon the location of intubation: those patients intubated at our verified burn center and those intubated prior to admission to the burn center. Outcomes to be investigated included total length of stay, intensive care unit (ICU) length of stay, number of ventilator days, hospital costs, complications, indications for intubation and if bronchoscopy was used in the management of these patients.

Materials and Methods

A retrospective chart review was performed of all HOT-related burns admitted to our verified burn center from 2006-2015. Eligible hospitalized adult patients were identified using the burn quality database. Data elements included place of intubation: at our burn center, at an outside hospital or by emergency medical services; evidence of inhalation injury; method of inhalation injury diagnosis; mortality; TBSA burned; complications during hospital stay; sex; age; hospital charges; length of stay; ventilator days until extubation and length of ICU stay. Data was obtained through medical chart review. All hospital charges were adjusted for inflation to 2015 United States (U.S.) Dollars.

Patients were divided into two groups for analysis, those patients with HOT-related burns that were either intubated versus not intubated. Patients who were intubated were further stratified into patients that underwent intubation at our burn center and those who were intubated at an outside hospital or by emergency medical services. Data was analyzed with the *SPSS* statistical program (IBM

Jones et al. © All rights are reserved

Citation: Meyerson J, Coffey RA and Jones LM. Home Oxygen Therapy Related Burns: An Outcome Comparison based on Location of Intubation. Austin J Emergency & Crit Care Med. 2017; 4(2): 1057.

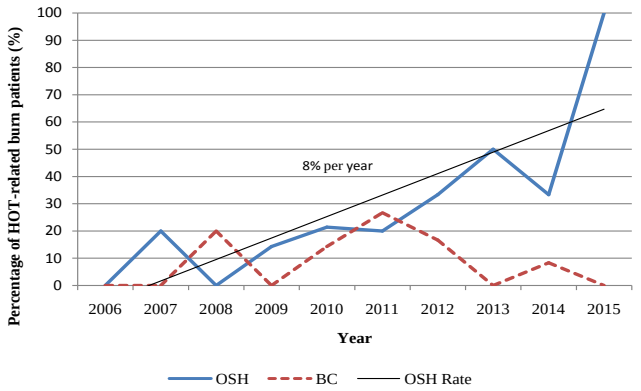

Figure 1: Rate per year in percentage of HOT-related burn patients based upon location of intubation at a burn center (BC) versus outside hospitals and emergency medical services (OSH) from 2006 to 2015.

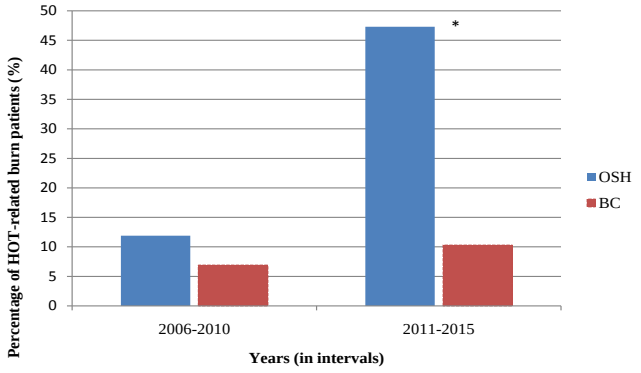

Figure 2: Percentage of HOT-related burn patients based upon location of intubation at a burn center (BC) versus outside hospitals and emergency medical services (OSH) in five year intervals from 2006 to 2015. Asterisk (*) represents p-value of <0.05.

Inc. Armonk, NY). Categorical data were compared using Chi squared test and continuous data were compared using student's t-test. A p-value of less than 0.05 was considered statistically significance.

Results

A total of 78 patients were eligible for inclusion into the study. All patients had ignition from cigarette smoking. Subjects were grouped into intubated and non-intubated patients. There were no statistical differences in patient demographics based upon intubation status. In total, 29 patients (37.0%) presenting with HOT-related burn injuries were intubated. Of those that underwent intubation, 20 patients (69.0%) were intubated prior to transfer to our burn center by either an outside hospital or emergency medical services (OSH) with the remaining 9 patients (31.0%) intubated at our institution (BC). The mean TBSA for intubated patients was 3.3% (range 0.5-20%) and for non-intubated patients was 1.7% (range 0.5-10%) ($p<0.05$).

Comparing patients undergoing intubation versus non-intubation, the intubation group had on average a longer hospital length of stay of 9.4 days versus 2.6 days ($p<0.0001$), longer ICU length of stay of 6.1 days versus 0.5 days ($p<0.0001$) and a greater number of days on a ventilator 5 days versus 0.0 days ($p<0.001$) (Table 1). Outcome measures did not significantly differ between

Table 1: Table of outcome measures of HOT-related burn patients based upon intubation versus non-intubation.

Outcomes	Intubated	Not Intubated	p-value
Average TSBA (%)	3.3%	1.7%	0.0384
LOS-Hospital	9.4 days	2.6 days	<0.0001
LOS-ICU	6.1 days	0.5 days	<0.0001
Ventilator dependent	5 days	0.0 days	<0.001
Hospital charges (USD, adjusted 2015)	$110,110	$14,400	<0.0001

initial location of intubation (BC versus OSH). Six of the 29 (20.7%) intubated patients had bronchoscopy performed, and no patient in our study demonstrated inhalation injury on exam. The most common complications from intubation resulted in ventilator acquired pneumonia (n=4) and tracheostomy (n=2). No airway complications were noted for patients that were not intubated. There was one patient mortality; however, this subject sustained a TBSA of 80% with ignition of clothing after the HOT-related burn. This patient was excluded from statistical analysis.

A cost comparison demonstrated that the average amount charged (adjusted to 2015 U.S. dollars) during each hospital admission were significantly higher in patients intubated ($110,110) than non-intubated patients ($14,400) ($p<0.0001$). There was no significant difference in amount charged based upon the initial location of intubation (Table 1).

Two cohorts were compared dependant on patient location of intubation: those intubated at our burn centerand those intubated prior to transfer to our center by either an outside hospital or emergency medical service team. This comparison between patients being intubated at our BC versus an OSH demonstrated an increasing rate of 8% per year during the course of our study from 2006 to 2015 (Figure 1). The average percentage of patients being intubated over this total 10 year time period was calculated.The difference between these two cohorts in the first 5 years of the study was 4.3% of patients being intubated at an OSH versus our BC (11.9% vs. 6.9%, p=NS, 2006 to 2010). In the most recent 5 years the difference between patients being intubated at an OSH versus our BC expanded to a statistically significant difference of 37% (47.3% vs. 10.3%, $p<0.05$, 2010 to 2015) (Figure 2).

Discussion

In recent years, there have been significant increases in the number of patients who have HOT-related burns. Reports of a total of 1190 HOT-related burns from 2003 to 2006 and rates of HOT-related burns increasing 14% a year since 2001 have placed this specific population at the center of discussion in recent years [2,4]. As increasing numbers of patients with chronic lung disease are being placed on home oxygen therapy the chance of a patient sustaining a HOT-related burn increases. Several studies have demonstrated that patients with HOT-related burns differ from patients with other types of burn injuries, noting increased length of stay (LOS), mortality and costs associated with HOT-related burns. Length of stay ranges from 2-48 days in the hospital and costs vary widely from $8,000-$200,000 [3,4-9]. A recognizable reason for the array of outcomes in HOT-related burn patients revolves around the distinction of intubation versus non-intubation. Recently, Assimacopulous using the American Burn Association National Burn Repository

compared HOT-related burn patients based upon intubation and non-intubation. Similar to our findings, HOT-related burn patients that were intubated had significantly increased length of stay in the hospital and ICU, increased number of ventilator days, larger TBSA and increased hospital charges [2].

Clearly, intubation of patients with chronic lung disease results in negative influences on many different outcomes. Several studies have investigated the use of bronchoscopy and grading systems in evaluation of thermal injury after the fact [11-14]. Yet indications for intubation are a continued topic of debate and often are a result of expert opinion. Based upon the Advanced Trauma Life Support (ATLS) protocol, identification of a patient with inhalation injury has the following findings: singeing of the hair, eyebrows or eyelashes; carbonaceous sputum; hoarseness or stridor; inflamed oropharynx; hypoxemia; and a history of closed space injury [15]. Airway management in ATLS recommends early consideration of intubation in all cases concerning for inhalation injury. The Advanced Burn Life Support (ABLS) protocol notes similar physical exam findings that may indicate inhalation injury, but are less vague on determining indications for intubation. ABLS airway management recommends intubation with stridor, retractions, respiratory distress or obstruction and deep or full thickness facial burns. If these symptoms are not present then 100% humidified supplemental oxygenation by mask and close monitoring is preferred [16].

The indications reported for intubation in our study included singed hair, burns or blistering to lips and mouth, carbonaceous sputum, and hoarseness. It should be noted that these are all findings indicating inhalation injury, but do not necessary warrant intubation based upon ABLS protocol. Based upon our study and others mentioned in this article, it is evident that patients admitted with HOT-related facial burns may be prematurely intubated resulting in severe repercussions. The consequences of placing this population with chronic lung disease on a ventilator are clear. What is not obvious is when and where it is appropriate for these patients to be intubated.

Our study primarily focuses on location of intubation in HOT-related burn injuries. Although outcomes do not significantly differ between initial location of intubation, they certainly diverge based upon whether the HOT-related burn patient is intubated or not. We found 37% of HOT-related burn patients admitted to our institution were intubated. Of those intubated, 69% were intubated prior to arrival. Our data mirrors that of Amani et al. in which they reported HOT-related burn patients had 37% of all admissions being intubated, notably they had 100% of intubations occur prior to admission [17]. Other reports by Robb et al. and Chang et al. had intubation rates of 30.8% and 21.7% respectively [7,9]. Muelhberger et al. required no intubations in their study of 21 admissions [6]. As reported earlier the number of HOT-related burn injuries are consistently increasing on a yearly basis. It can be presumed that the total number of intubations will rise with these admissions. What is even more striking, as we have demonstrated in this article, is that the number of patients that are being intubated prior to arrival is continuing to increase at a rate of 8% per year, while the number of intubations at our verified burn center remains stable. This begs the question, as the numbers of HOT-related burn admissions continue to rise, how do we actively decrease the number of intubations in this population?

Facial burns, of and by themselves, do not always equate to the presence of inhalation injury. Indications and algorithms for intubation of HOT-related burn patients need to be developed and differentiated from inhalation burns secondary to enclosed spaces or explosion blasts. Of particular interest to this study is the further evaluation of community education for emergency medical services and emergency room physicians that may be more familiar with the protocols of ATLS rather than ABLS. This difference could possibly account for the increasing rate of HOT-related burn patients being intubated by non-burn specialized practitioners as well as concerns for loss of airway in transit and possible liability. Likely, a two pronged approach to this dilemma is required to prevent unnecessary intubations and resultant complications in this population. One arm focused on sustainable patient education and prevention strategies to avoid HOT-related burn injuries and the second arm creating standardized treatment for HOT-related burn patients in regards to intubation.

References

1. Nishi SP, Zhang W, Juo YF, Sharma G. Oxygen therapy use in older adults with chronic obstructive pulmonary disease. Chalmers JD, ed. PLoS ONE. 2015; 10: e0120684.
2. Assimacopoulos EM. The National incidence and resource utilization of burn injuries sustained while smoking on home oxygen therapy. J Burn Care Res. 2016; 37: 25-31.
3. Edelman DA, Maleyko-Jacobs S, White MT, Lucas CE, Ledgerwood AM. Smoking and home oxygen therapy--a preventable public health hazard. J Burn Care Res. 2008; 29: 119-122.
4. Ahrens M. Fire and burns involving home oxygen. National Fire Protection Association. 2008.
5. Murabit A, Tredget EE. Review of burn injuries secondary to home oxygen. J Burn Care Res. 2012; 33: 212-217.
6. Muehlberger T, Smith MA, Wong L. Domiciliary oxygen and smoking: an explosive combination. Burns.1998; 24: 658-660.
7. Robb BW, Hungness ES, Hershko DD, Warden GD, Kagan RJ. Home oxygen therapy: adjunct or risk factor? J Burn Care Rehabil. 2003; 24: 403-406.
8. Barillo DJ, Coffey EC, Shirani KZ, Goodwin CW. Burns caused by medical therapy. J Burn Care Rehabil. 2000; 21: 269-273.
9. Chang TT, Lipinski CA, Sherman HF. A hazard of home oxygen therapy. J Burn Care Rehabil. 2001; 221: 71-74.
10. Baruchin O, Yoffe B, Baruchin AM. Burns in inpatients by simultaneous use of cigarettes and oxygen therapy. Burns. 2004; 308: 836-838.
11. Pruitt BA, Cioffi WG, Shimazu T, Ikeuchi H, Mason AD. Evaluation and management of patients with inhalation injury. J Trauma. 1990; 30: 63-67.
12. Moylan JA, Adib K, Birnbaum M. Fiberoptic bronchoscopy following thermal injury. Surg Gynecol Obstet. 1975; 140: 541-543.
13. Brown DL, Archer SB, Greenhalgh DG, Washam MA, James LE, Warden GD. Inhalation injury severity scoring system: a quantitative method. J Burn Care Rehabil. 1996; 17: 552-557.
14. Hassan Z, Wong JK, Bush J, Bayat A, Dunn KW. Assessing the severity of inhalation injuries in adults. Burns. 2010; 36: 212-226.
15. Advanced trauma life support: Student course manual. Chicago, IL: American College of Surgeons; 2012.
16. Advanced burn life support course: provider's manual. Chicago, IL: American Burn Association. 2007: 26-31.
17. Amani H, Lozano DD, Blome-Eberwein S. Brother, have you got a light? Assessing the need for intubation in patients sustaining burn injury secondary to home oxygen therapy. J Burn Care Res. 2012; 33: 280-285.