More Than One Third of Intubations in Patients Transferred to Burn Centers are Unnecessary: Proposed Guidelines for Appropriate Intubation of the Burn Patient

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Advanced Burn Life Support emphasizes endotracheal intubation for patients with facial burns before transfer to a burn center to prevent airway obstruction. Many patients are intubated before transport and are often extubated shortly after burn center arrival. We hypothesize that many intubations performed before burn center transport are unnecessary. We conducted a retrospective review of all adults who were intubated before burn transfer and survived to discharge from August 2003 to June 2013. Intubations that had 2 or fewer ventilator days (i.e., potentially unnecessary intubations) were compared with those lasting longer than 2 days. Data collected included age, ventilator days, length of stay, % TBSA burn, % second degree, % third degree, % second degree face burn, % third degree face burn, and origin of burns. A total of 416 patient met inclusion criteria. Of these, 129 patients (31.0%) were intubated less than or equal to 1 day, and a total of 171 (40.1%) patients remained intubated for less than or equal to 2 days. Patients who were intubated less than or equal to 2 days differed from those intubated more than 2 days with respect to % TBSA burn (10.2 ± 8.1 vs 30.8 ± 19.7, $P < .001$), % third degree burn (2.84 ± 5.6 vs 22.5 ± 19.6, $P < .001$), % third degree face burn (0.14 ± 0.7 vs 0.94 ± 1.9, $P < .001$), and hospital days (11.7 ± 10.6 vs 50.7 ± 43.7, $P < .001$). Additionally, patients who were intubated less than or equal to 2 days were more likely to have been intubated in the pre–burn center setting (74.9% vs 51.8%, $P < .001$) and to have been burned outdoors (42.1% vs 24.9%; $P < .001$) than those who were intubated more than 2 days. Multivariate analysis revealed that intubation longer than 2 days was independently associated with older age and larger % TBSA burn. There were no reintubations in patients who were intubated 2 days or less. As a burn community, we have emphasized early intubation before transfer for those who have sustained significant burns, inhalational injury, or facial burns. Unfortunately, this has led to many potentially unnecessary intubations that expose patients to unnecessary complications. Although early intubation is a lifesaving intervention for many burn patients, criteria should be developed to determine when intubation is not needed. (J Burn Care Res 2015;XXX:00–00)

Currently, the American Burn Association suggests in its Advanced Burn Life Support course that when there is any question about the security of the airway then the patient should be intubated before transfer to a burn center.[1] With the emphasis on the ABC in Advanced Trauma Life Support and the Advanced Burn Life Support recommendation to have a low threshold for intubation of patients with facial burns, there has been an increase in the number of patients arriving to burn units intubated. In contrast, previously patients had a lower rate of intubation: in a study of 740 patients admitted to a single burn unit between 1972 and 1975, no patient arrived intubated.[2] Thirty-six patients in this study required intubation on arrival at the burn center. In contrast,

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a study conducted at a regional burn center between 2000 and 2003 revealed that 26% arrived intubated.[3]

Although the concerns about airway edema and losing the ability to intubate a patient with burns are real, intubation is not a risk-free procedure. Risks of intubation include difficulty or inability to intubate, accidental extubation, atelectasis, pneumothorax, nosocomial infection, tracheal injury, and death. In fact, in intubations in nonburn patients, two thirds of complications occur at induction.[4] The risks of these complications are higher when intubation occurs in the emergency department (ED) or in the intensive care unit (ICU) when compared with the operating room (OR). Failed intubation occurred 1 in 50 to 100 intubations in the ED and ICU compared with 1 in 2000 in the elective OR setting. The incidence of death or brain damage from an airway event was 38-fold higher in the ED and 58-fold higher in the ICU compared with the OR.

Most of the decisions on whether burn patient should be intubated are often made before the patient arrives at the burn center and in some cases before the patient arrives at a nonburn center hospital. Often the people making these decisions have little training in burns and limited experience in making critical airway decisions in burn patients.[5] The removal of mandatory burn training from surgery residency programs only serves to compound the problem. We as a burn community need to provide guidance to these pre–burn center caregivers to minimize unnecessary intubations while protecting patients who legitimately need early intubation to protect their airway. Given the complex issues surrounding burn wounds and intubation and the lack of experience by those making the decision to intubate, we sought to examine the appropriateness of patient intubation admitted/transferred to our burn unit. Additionally, we sought to develop specific guidelines for intubation that can be safely applied to the prehospital setting.

METHODS

We performed a retrospective chart review of 416 adult patients (age 18–91 years) who were intubated either in our emergency room or at an outside facility before burn transfer and survived to discharge from August 2003 to June 2013. Patients with any size burn injury and etiology were included. Intubations that had 2 or fewer ventilator days (i.e., potentially unnecessary intubations) were compared with those lasting longer than 2 days. The retrospective review was approved by the institutional review board of the University of California, Davis. Charts were reviewed for age, gender, race, % TBSA of burn injury, % second degree, % third degree, % second degree face burn, % third degree face burn, length of stay, ventilator days, distance transferred, cause of burns, location of intubation, profession of practitioner intubating, location where burn occurred (indoors vs outdoors), and if the patient was smoking on home oxygen. Values are expressed as mean ± SD.

R statistical package (www.r-project.org) was used to analyze the data. Continuous variable comparisons between two groups was performed using the two-sample student's *t*-test for continuous data such as age, hospital length of stay, burn size, face burn size, and distance. The χ^2 test was used to assess association between discrete categorical variables. Least squares regression and multivariate linear regression were used to identify predictors of a continuous outcome. Multivariate logistic regression analysis was used to determine independent predictors of outcome.

RESULTS

A total of 416 patients met inclusion criteria. Of these, 129 patients (31.0%) were intubated less than or equal to 1 day, and a total of 171 (40.1%) patients remained intubated for less than or equal to 2 days. There were no reintubations in patients who were intubated 2 days or less. Patients who were intubated more than 2 days had a range of 3 to 320 ventilator days. There was no significant difference between the groups with respect to age (43.6 ± 16.2 vs 46.2 ± 17.4 years; Table 1). Patients who were intubated 2 days or fewer had a significantly smaller % TBSA burn than those who were intubated longer (10.2 ± 8.1% [range 0–37%] vs 30.8 ± 19.7% [range 0–95%], $P < .001$). Although there was no difference in the amount of second degree burn sustained (7.4 ± 6.8% vs 8.4 ± 9.4%, not significant [NS]), those who were intubated 2 days or less had smaller amounts of third degree burn (2.8 ± 5.6% vs 22.5 ± 19.6%, $P < .001$). This same pattern is observed looking at the % face burn. The overall percentage of patients who sustained face burns was not statistically different in the two groups with 70.8% of patients intubated 2 days or less sustaining face burns and 71.8% of patients intubated more than 2 days sustaining them. Patients who were intubated 2 days or less had significantly smaller face burns than those who were intubated longer (2.2 ± 1.6% vs 3.0 ± 2.3%, $P < .001$). There was no difference in the amount of second degree burn to the face (1.9 ± 1.6% vs 2.1 ± 2.1%, NS). Patients who were intubated 2 days or less had significantly smaller amounts of third degree burns to

Table 1. Demographics for patients intubated 2 days or less vs those intubated more than 2 days

	≤2 d (171 patients)	>2 d (245 patients)	*P*
Age	43.6 ± 16.2	46.2 ± 17.4	NS
% TBSA burn	10.2 ± 8.1	30.8 ± 19.7	<.001
% Second degree	7.38 ± 6.8	8.39 ± 9.4	NS
% Third degree	2.84 ± 5.6	22.5 ± 19.6	<.001
Face burned (%)	70.8	71.8	NS
% Face burned	2.15 ± 1.59	3.02 ± 2.25	<.001
% Second degree face burn	1.93 ± 1.6	2.07 ± 2.1	NS
% Third degree face burn	0.14 ± 0.7	0.94 ± 1.9	<.001
Hospital days	11.7 ± 10.6	50.7 ± 43.7	<.001
Distance to hospital	102.7 ± 77.1	104.7 ± 103.6	NS

NS, not significant.
Face burned refers to whether or not there was any burn present on the face (yes or no). % Face burned refers to the percentage of the face that was burned.

their face than did those who were intubated longer than 2 days (0.1 ± 0.7% vs 0.9 ± 1.9%, $P < .001$). As expected, patients who were intubated greater than 2 days stayed in the hospital more days (11.7 ± 10.6 vs 50.7 ± 43.7 days, $P < .001$). There was no difference in the distance traveled to the burn center.

The circumstances surrounding how the burn was sustained and the patient's intubation were examined. There was no significant difference between the two groups in terms of cause of the burns. The majority of burns in both groups were fire or flame (92.4% vs 89.4%; Figure 1). This was followed by scald (5.3% vs 4.5%). Because of the fact that there is often more concern for the airway of those who sustain their burns while smoking on home oxygen, this group was investigated separately. There was a slightly higher percentage of patients who were smoking on home oxygen that were intubated 2 days or less (9.9% vs 5.7%, NS; Table 2), but this was not a statistically significant difference. There was a significant difference in the location where the burn occurred (i.e., inside vs outside) between the two groups. In the patients who were intubated 2 days or less, we found that 42.1% of them were burned outside, whereas only 24.9% of those who were intubated more than 2 days were burned outside ($P < .001$). Additionally, patients who were intubated more than 2 days were more likely to be burned indoors (67.3% vs 53.2%, $P < .001$). Most patients were intubated by emergency room physicians, irrespective of how long they remained intubated (68.4% vs 65.7%, NS). The next most common profession to intubate patients was the paramedics (20.5% vs 17.5%, NS). When the circumstances surrounding the actual intubation were examined there were significant differences between those who were intubated less than or equal to 2 days and those who were intubated for longer periods of time. Those intubated less than or equal to 2 days were significantly more likely to have been intubated before arrival at the burn center (74.9% vs 51.8%, $P < .001$), and those who were intubated more than 2 days were more likely to have been intubated at the burn center (41.6% vs 21.6%, $P < .001$).

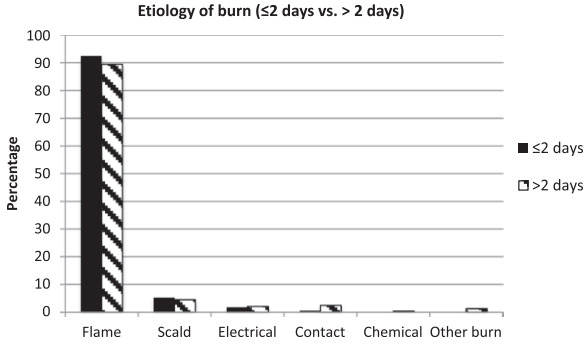

Figure 1. Causes of burn injury in patients intubated 2 days or less vs more than 2 days. Flame burn is the most common in each group.

A multivariate logistic analysis was done adjusting for age, % TBSA burn, % TBSA of face burn, and distance to burn center (Table 3). In this analysis, only age and % TBSA burn were risk factors for intubation longer than 2 days. The odds ratio for age was 1.04 with a 95% confidence interval of 1.02 to 1.07, and for % TBSA burn, it was 1.16 with a 95% confidence interval of 1.12 to 1.21. With linear multivariate analysis, % TBSA burn, age, and intubation status were all significantly associated with an independent increase in length of hospital stay.

An analysis of complications that occurred as a result of intubation was conducted. A total of 10 complications were identified. Two of these were in the group intubated more than 2 days (cricothyroidotomy 2×), and both of these occurred in the pre–burn center setting. Eight complications occurred in the patients who were intubated 2 days or less. These

Table 2. Physical factors surrounding burn and intubation

	≤2 d (171 patients)	>2 d (245 patients)	*P*
Intubated at pre–burn center (%)	74.9	51.8	<.001
Intubated at burn center (%)	21.6	41.6	<.001
Intubated at unknown location (%)	3.5	6.5	NS
Intubated by emergency room physician (%)	68.4	65.7	NS
Intubated by paramedic (%)	20.5	17.6	NS
Intubated by anesthesia (%)	7.0	10.2	NS
Intubated by unknown caregiver (%)	4.1	6.5	NS
Burn sustained outdoors (%)	42.1	24.9	<.001
Burn sustained indoors (%)	53.2	67.3	<.001
Burn sustained at unknown location (%)	4.7	7.6	NS
Smoking on home O_2 (%)	9.9	5.7	NS

NS, not significant.

Patients who were intubated in the pre–burn center setting and who sustained their burns while outdoors were more likely to be intubated less than or equal to 2 days.

included a patient who woke up during intubation with recollection of the event, coded during intubation, aspiration, hypotension, seizure on induction, and two patients with multiple failed intubation attempts. Examining the issue of complications from another perspective, it appears that six patients (five in those intubated >2 days and one in the group intubated ≤2 days) who arrived at the burn center not intubated had to be intubated emergently. None of these patients suffered complications from the delay in their intubations, and none of them required surgical airways. This represents 1.4% of patients who were intubated during their stay at our burn center.

DISCUSSION

Our study again brings to light the issue of unnecessary intubations in the burn population. This issue is not a new one and has been explored by other centers with similar results. A study of 111 patients who were intubated and transported more than 90 miles to a regional burn center found that 53.1% of patients were able to be extubated in the first 24 hours and 64.8% were extubated by hospital day 2.[3]

Table 3. Multivariate analysis

	Odds Ratio	95% Confidence Interval	*P*
Age	1.04	1.02–1.06	<.001
TBSA	1.16	1.12–1.21	<.001
% face burned	0.96	0.80–1.15	NS
Distance to hospital	1.00	0.99–1.01	NS

NS, not significant.

Odds ratio of being intubated greater than 2 days is independently associated with age and % TBSA.

Our results were not quite as dramatic with 40.1% of patients extubated by hospital day 2. This trend is seen again in another study that examined the intubations of patients in the pre–burn center/prehospital setting in 2010. In that study, 41.4% of patients were extubated within 2 days of admission.[5] Despite the fact that there have been multiple studies that examine time to extubation, our study is unique in that it examines the differences between those who are extubated early and those who remain intubated.

Examining the difference between those who are intubated unnecessarily and those who were appropriately intubated has prompted us to develop specific guidelines for intubation that can be safely applied to the pre–burn center setting. The ability to predict which patients with burn injuries require intubation and which do not has plagued physicians since the beginning of modern burn surgery. In 1962, Phillips and Cope[6] examined the factors that were predictive of respiratory tract damage. They found that 40% of patients with a flame burn developed respiratory difficulties, whereas only 3% of scald burns did. We also found that the majority of patients who were intubated sustained flame burns. A similar percentage of patients with scald burns were present in the unnecessary and appropriately intubated groups in our study, but these were far outnumbered by those with flame burns. Additionally, they noted that patients who were burned in nonenclosed spaces only developed respiratory distress 10% of the time, whereas those in enclosed spaces did 47% of the time. We also found that patients who were intubated for less than or equal to 2 days were more likely to have been burned outside than patients who were intubated longer. Finally, Phillips and Cope[6] found that the location of the burn was important in determining need for intubation. Their study found that superficial burns

and burns to the periphery of the face are less likely to cause respiratory distress. In our patient population, we found that smaller burns, smaller amounts of third degree burn, and smaller amounts of third degree burns to the face were associated shorter intubations and therefore might be useful in predicting patients who do not need intubation.

We propose guidelines for intubation based on the parameters that were able to distinguish patients requiring intubation in our population and that of Phillips and Cope[6] (Table 4). Obviously in the end, the decision to intubate comes down to the discretion of the prehospital or pre–burn center provider, but it is our job as burn physicians to guide their decision with the goal of keeping patients safe while avoiding unnecessary intubations. In general, intubation should be deferred the burn center physicians when at all possible. As we found, patients who are intubated at the burn center are much more likely to be appropriately intubated and are generally intubated for a more prolonged period of time. Specifically, patients who sustain burns with a mechanism other than flame can generally be observed and transferred without intubation. Additionally, patients who have flame burns that do not occur within enclosed spaces are unlikely to have significant inhalation injury but may still require intubation based on the size and location of their burns. Burn size should remain a critical component of the decision to intubate patients. Patients with large burns should be intubated irrespective of where the burn occurred or the presence or absence of facial burns as the amount of resuscitation that they require may lead to edema, which makes intubation impossible on arrival at the burn center. Patients with burns less than 20% TBSA and that do not involve the face also do not usually require intubation. Patients who have sustained burns to the face pose a difficult decision. In general, based on historical studies, burns that are either in the periphery of the face or are only second degree can often also avoid intubation. Perhaps the most important part of these guidelines is communication between the burn center and the prehospital/pre–burn center practitioners. A conversation should occur between practitioners as soon as is feasible to discuss the transfer of the patient and the possible need for intubation (if it has not had to be emergently addressed as part of the primary survey). As the field of telemedicine improves, our ability to predict who does and does not require intubation will be augmented by the ability of burn center practitioners to see the patients before transfer.

Given that the airways of burn patients are potentially tenuous, it is important to always keep the patient's safety at the forefront of our mind. In our study, there were a small number of patients who required emergent intubation upon arrival at the burn center who may have benefited from earlier intubation. Additionally, there were relatively few complications associated with intubation, but several of these were severe and potentially life threatening. Although using these guidelines will hopefully prevent unnecessary intubations, it should not place patients at too high of a risk. In using these guidelines in practice, one must be cognizant to continually reassess the patient for impending airway compromise. Additionally, if transfer to the burn center is going to be significantly delayed then more thought must be given to the possible need for intubation. Transport times to the burn center were not specifically examined in this study. However, for our burn center our average transfer time was 355.7 minutes with a standard deviation of 158.8 minutes. This study looked at both patients who were transferred to our facility and those who came directly from the scene and over a 10-year period. While the airway

Table 4. Guidelines for intubation in the pre–burn center setting

Guidelines for intubation in the pre–burn center setting:

- Patient safety should not be compromised, and patient status is the ultimate determinant of intubation need
- Standard indications for intubation should be followed including but not limited to shortness of breath, wheezing, stridor, hoarseness, combativeness, or decreased level of consciousness
- Contact should be made with the regional burn center as soon as is safely feasible to discuss the events surrounding the burn and need for intubation
- If patient is clinically stable with no signs or symptoms compromised airway, burns with lower need for intubation before transfer to a burn center are as follows:
  - Burns that occur from causes other than flame injury
  - Burns that do not occur in enclosed spaces
  - Burns that are less than 20% TBSA
  - Burns that have no third degree burns to the face
  - Patient is within a reasonable distance to a burn center (approximately 3 hr transfer time)

of a patient who sustained burns can be daunting, we cannot allow our prehospital and pre–burn center colleagues to continue to intubate patients with little thought to whether this procedure is necessary or not. It is our responsibility as a burn community to work with and educate our colleagues on appropriate management of the burn-injured patient with potential airway compromise. Further research efforts need to be focused on improving communication with pre–burn center providers, providing education for these providers and enhancing the use of telemedicine to involve the burn surgeon in the patient's care before transfer.

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