PRE-BURN CENTRE MANAGEMENT OF THE AIRWAY IN PATIENTS WITH FACE BURNS

PRISE EN CHARGE PRÉHOSPITALIÈRE DES VOIES AÉRIENNES CHEZ LE BRÛLÉ DE LA FACE

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SUMMARY: Face burns expose patients to a higher respiratory risk, and early prophylactic intubation before they enter the burn unit might be life-saving. However, unnecessary intubation may compromise their clinical evolution. Hence, the decision to perform pre-burn centre endotracheal intubation remains a clinical challenge. A retrospective study was developed to characterize the experience of the tertiary burn unit of the Hospital da Prelada with face burn patients arriving endotracheally-intubated between January 2009 and September 2013. Specific goals included assessment of whether these intubations were clinically appropriate and if these procedures determined significant changes in clinical course and outcome. A total of 136 patients were admitted to our burn centre with facial burns. 38.2% (n=52) of them arrived endotracheally-intubated, with 75% (n=39) intubated at the scene of the burn injury and 25% (n=13) in the emergency room because of the suspicion of smoke inhalation injury. In only 23% of the cases (n=12) was the lesion confirmed by bronchoscopy. The overall mortality rate was 12.5% (n=17): 3.6% (n=3) were patients who had not been subjected to pre-burn centre intubation, and 27% (n=14) were in the group of patients arriving intubated. A face burn is a warning sign of a possible upper airway injury, and pre-burn centre prophylactic intubation might be life-saving. However, unnecessary intubation may impair clinical evolution. Therefore, it is imperative that updated practice guidelines for pre-burn centre airway management are adhered to, and that these guidelines are subject to revision in order to improve airway management in burn patients.

Keywords: burns, facial burns, inhalation burns, endotracheal intubation

RÉSUMÉ. Les brûlures de la face exposent le patient à un risque respiratoire important et l’intubation « prophylactique », avant l’hospitalisation en CTB, peut lui sauver la vie. Cependant, une intubation inutile peut retarder défavorablement l’évolution. De ce fait, la décision de réaliser ou non une intubation en préhospitalier reste un défi pour le clinicien. Une étude rétrospective a été conduite, afin de caractériser les patients brûlés de la face arrivant intubés dans le CTB de l’hôpital da Prelada, entre janvier 2009 et septembre 2013. Il s’agissait de définir si l’intubation était nécessaire et si elle impactait l’évolution du patient. Cent trente six patients ont été admis avec une brûlure faciale. Cinquante deux (38,2%) étaient intubés, dont 39 (75%) sur site et 13 (25%) aux urgences, en raison de la suspicion de lésions d’inhalation, qui n’a été confirmée (par bronchoscopie) que 12 fois (23%). La mortalité globale a été de 12,5% (n=17). Elle était de 3,6% chez les patients non intubés (n=3) et de 27% (n=14) chez ceux arrivant intubés. Une brûlure de la face est un signe d’alerte de lésion des voies aériennes supérieures, et une intubation préhospitalière peut être vitale. Cependant, une intubation inutile peut obérer l’évolution. De ce fait, il est impératif de rédiger et maintenir à jour des protocoles de gestion préhospitalière des voies aériennes chez les patients brûlés, afin d’optimiser la prise en charge des brûlés de la face.

Mots clés: Brûlure faciale, inhalation, intubation trachéale

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Introduction

About 47% of patients admitted to burn units have burns on the face and/or neck. These burns expose patients to a double respiratory risk resulting from potential upper airway edema and smoke inhalation injury.

Indications for endotracheal intubation (ETI) in trauma patients, which include burn patients, are airway obstruction, hypoventilation, persistent hypoxemia (SaO2 ≤ 90%) despite supplemental oxygen, severe cognitive impairment (Glasgow Coma Scale ≤ 8), cardiac arrest, severe hemorrhagic shock and smoke inhalation. ETI is indicated for patients experiencing smoke inhalation with any of the following traits: airway obstruction, severe cognitive impairment (Glasgow Coma Scale ≤ 8), major cutaneous burn (≥40%), major burns and/or smoke inhalation where prolonged transport time to a definitive care facility is expected and there is evidence of impending airway obstruction (such as moderate-to-severe facial burn; moderate-to-severe oropharyngeal burn, and moderate-to-severe airway injury seen on endoscopy).

Patients with face/neck burns seem to be at higher risk of having a difficult intubation, estimated to be from 5% to 11%. Therefore early prophylactic intubation before they enter the burn unit might be appropriate. Direct thermal injury to the upper airway causes edema formation, which may progress to complete airway obstruction within minutes or hours.

However, airway management in the thermally-injured patient remains a clinical challenge. Even when performed by trained physicians in the controlled environment of a burn unit, the potential for airway catastrophe is well-documented in this population. Pre-hospital and pre-burn centre hospital providers with insufficient training are usually the first to tend to the burn victim, and they are often forced to make critical airway management decisions. Moreover, initial treatment of the patient is usually in a less controlled environment, such as at the scene of the burn injury or in the non-burn centre emergency room, which significantly increases the difficulty and complexity of airway management.

The decision to perform early pre-burn centre endotracheal intubation in a patient with face and/or neck burns is a difficult one. Despite a growing interest in the literature, a great deal of controversy remains. The purpose of this paper is to characterize the experience of the burn unit of the Hospital da Prelada with face and neck burn patients arriving endotracheally-intubated (ETI).

Material and Methods

A retrospective study was carried out including all the patients admitted to the burn unit of the Hospital da Prelada with facial burns between January 2009 and September 2013. Based on these inclusion criteria, 136 patients were selected. Computerized and paper clinical files were consulted to obtain clinical information. This information included different parameters:

- characterization of the sample: gender, age, co-morbidities;
- characterization of the injury mechanism: etiology of the burn (thermal, chemical, electrical), location of the injury (indoors or outdoors);
- characterization of the burn lesion: anatomical areas, total body surface area (TBSA) burned, depth, evolution;
- characterization of the endotracheal intubation process: environment (pre-hospital, emergency room, operating room, burn unit), motive, extubation time, re-intubation time, pre- and intra-burn unit laryngoscopy/bronchofiberscopy results, description of hospitalization evolution; time of hospitalization, treatment (conservative, surgical), complications, sequelae, mortality.

Statistical analysis was performed using Excel and SPSS 20.0 for all statistical analysis.

Results

During the 57-month period, between January 2009 and September 2013, a total of 284 patients were admitted to our burn centre and 47.9% of them (n=136) presented with facial burns. 38.2% (n=52) of them arrived endotracheally-intubated (ETI). The demographics of the sample are shown in Table I. In particular, 73% of the ETI patients were male with a mean age of 49.8 years and average total burn surface area (TBSA) of 26%. TBSA was less than 10% in 44% of these patients (n=23), 11-40% in 31% of patients (n=16) and more than 40% in 25% of patients (n=13). The difference between the ETI and nETI groups regarding TBSA was statistically significant (p=0.0019).

<table>
<thead>
<tr>
<th>Table I - Demographics of patients arriving at the burn centre endotracheally-intubated (ETI) or not endotracheally-intubated (nETI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ETI</strong></td>
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<tr>
<td>Sex (Male)</td>
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</tr>
<tr>
<td>73%</td>
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<td>48</td>
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</table>
As shown in Fig. 1, 37% of the victims (n=19) had full thickness burns (3rd degree), and the others had more superficial burns (1st and 2nd degree). In almost all patients the mechanism of injury was flash/flame burn (n=51), with 11 cases due to an explosion. In only 1 case was the mechanism chemical (with hydrochloric acid). Of the total number of cases, 5 (9.6%) were suicide attempts. Furthermore, 75% (n=39) were intubated at the burn injury scene and 25% (n=13) in the emergency room because of the suspicion of smoke inhalation injury. The final diagnosis of inhalation injury was made by bronchoscopy, performed by an intensive care physician of the burn unit, based on a visualization of thermal airway injury. The lesion suspicion was confirmed by bronchoscopy in 23% of the cases (n=12). In these patients, the most frequently reported reasons for pre-burn centre intubation were “positive laryngoscopy”, “airway edema” and “soot in the naso/oropharynx”.

Within the group of patients arriving intubated but without bronchoscopy confirmation of inhalation injury (77%, n=40), the reasons reported for pre-burn centre intubation were miscellaneous. For 72.5% of them (n=29), the reason given was “burn of the face”, “burn of the nasal vibrissae”, “swelling of the lips,” or even “need for transportation”. For 10% (n=4), the reason was “respiratory distress” or “low oxygen saturation”. For 15% (n=6), the motive was “airway edema” (including tongue or pharynx) or “positive laryngoscopy”. In one case (2.5%) pre-burn centre intubation was performed because the patient was found unconscious in a closed space.

It is important to remark that in 11.5% of patients (n=6) the decision to perform or to extend intubation in the burn unit setting was due to a traumatic laryngoscopy or intubation initially executed by pre-hospital or pre-burn centre healthcare providers at the scene of the burn injury or in the non-burn centre emergency room.

Regarding the ETI patients, in 40.3% of cases (n=21, nt=52) the burn injury scene was a closed space. For those with confirmed inhalation injury, 75% (n=9, nt=12) occurred in a confined space. Since our burn centre is a tertiary unit, the patients had been initially observed in the emergency room of another hospital. None of the intubated patients had been transported directly from the injury scene or transferred from another tertiary burn unit.

After admission to our burn unit, average length of hospitalization of ETI patients was 25.8 days, ranging from a minimum of 1 day to a maximum of 195 days. In contrast, the average stay of nETI patients was 21.2 days. The difference between the groups was not statistically significant (p=0.383).

Complications during hospitalization were miscellaneous. The most common complication was respiratory infection (44%, n=23) and the most common isolated agent was Staphylococcus aureus. No major complications were recorded for 15 patients (n=29%). As Table II shows, the development of respiratory infection during hospitalization occurred more frequently in patients with more extensive TBSAs and was associated with more delayed extubation. The data also seem to indicate that extubation on the third day of hospitalization is associated with higher survival rates.

Regarding patients with confirmed inhalation injury, 16.7% (n=2) were extubated on the second day of hospitalization, 58.3% (n=7) were extubated after the second day and 25% (n=3) died before extubation.

Overall mortality was 12.5% (n=17). Mortality rate was 3.6% (n=3) within the group of patients not subjected to pre-burn centre intubation, and 27% (n=14) within the group subjected to pre-burn centre intubation.

### Table II - Comparison of TBSA and extubation timing between the group without major complications, the respiratory infection group and the mortality group

<table>
<thead>
<tr>
<th></th>
<th>TBSA</th>
<th>Extubation</th>
<th>Extubation</th>
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<tr>
<td></td>
<td>&lt;10%</td>
<td>11-40%</td>
<td>≥ 41%</td>
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<tr>
<td></td>
<td>≥ D3</td>
<td>&lt;D3</td>
<td>≥ D4</td>
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<td></td>
<td>(or no</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>extubation)</td>
<td></td>
<td></td>
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<tr>
<td>No major complications</td>
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<td></td>
<td></td>
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<td>n</td>
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<td>%</td>
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<td>Respiratory infection</td>
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<td>n</td>
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<td>%</td>
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<tr>
<td>Mortality</td>
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the group of patients who arrived intubated. The mortality rate for patients with confirmed inhalation injury was 50% (6 cases). TBSA was less than 10% in 14% of these patients (n=2), 11-40% in 36% of patients (n=5) and more than 40% in 50% of patients (n=7).

The timing of extubation is summarized in Table III. In fact, 50% were extubated by the second day of hospitalization and a total of 77% were extubated by the third day. Three patients required re-intubation, as summarized in Table IV.

Table IV - Characterization of the re-intubation process performed in 3 patients. D1 – first day of hospitalization; D2 – second day of hospitalization; D9 – ninth day of hospitalization

<table>
<thead>
<tr>
<th>Extubation</th>
<th>Re-intubation</th>
<th>Reason for re-intubation</th>
<th>2nd extubation</th>
<th>TBSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient 1</td>
<td>D1</td>
<td>6 hours later</td>
<td>hypoventilation</td>
<td>1 day later</td>
</tr>
<tr>
<td>Patient 2</td>
<td>D1</td>
<td>2 days later</td>
<td>nosocomial pneumonia</td>
<td>26 days later</td>
</tr>
<tr>
<td>Patient 3</td>
<td>D9</td>
<td>16 days later</td>
<td>ARDS</td>
<td>Death</td>
</tr>
</tbody>
</table>

Discussion

A burn of the face is a warning sign of a possible inhalation injury. Indeed, smoke inhalation is present in about 22% of all burn presentations and in 60% where there are central facial burns. Patients with face burns are at higher risk of difficult intubation, and early prophylactic intubation before they enter the burn unit might be appropriate. However, unnecessary intubation may pose a risk to the clinical evolution of these patients and also to final outcome.

This study was drawn up to characterize our experience with face burn patients arriving at our burn centre endotracheally-intubated, with the specific goals of assessing whether these intubations were clinically appropriate and evaluating whether these procedures determined significant changes in clinical course and outcome.

On this issue, the study of Cupera et al. concluded that the most common mistake in the pre-hospital management of burn patients was inadequate or inappropriate airway management. They emphasized that a high level of theoretical and practical training and experience was mandatory for optimal decision-making and performance. Furthermore, the common indications for intubation in thermally injured patients (i.e. facial burns, singed nasal hairs or soot in the naso/oropharynx) are relatively insensitive and nonspecific in determining which patients need pre-burn centre airway management.

Accordingly, in the 23% of cases of ETI patients with inhalation injury confirmed by bronchoscopy, the most frequently reported reasons for pre-burn centre intubation were “positive laryngoscopy” and “airway edema”. On the contrary, for the 77% of patients without bronchoscopy confirmation of inhalation injury, the reasons were less specific, not clinically alarming and usually not based on a laryngoscopy, such as “burn of the face”, “burn of the nasal vibrissae”, “swelling of the lips,” or even “need for transportation”.

On the other hand, 40.3% of patients arriving at the burn unit already intubated and 75% of patients with an inhalation injury confirmed by bronchoscopy were injured in a closed space, indicating that most inhalation injuries occurred in a closed space. Therefore, a closed space burn injury may be a warning sign of inhalation injury and perhaps lower the threshold for prophylactic intubation.

We have to emphasize that in 11.5% of the ETI patients, the decision to perform or to extend intubation was dictated by an iatrogenic event, i.e. traumatic intubation and traumatic laryngoscopy, which stresses the importance of a trained pre-burn team in airway management.

11.5% of the patients were extubated on the same day they arrived at our burn centre, 38.5% were extubated before the end of their second post-burn day, 27% were extubated after this period and 23% died before extubation. Regarding patients with confirmed inhalation injury, a significantly smaller percentage, namely 16.7%, was extubated by the second day of hospitalization, 58.3% after the second day and 25% died before extubation.

Early extubation, especially at less than 48 hours after admission, as seen in most patients without confirmed inhalation injury, raises the question of whether the intubation was indicated at all. However, the high rate of early extubation may lead some to suggest that these data are simply the result of aggressive attempts to extubate. Were this so, one would expect a multitude of re-intubations relatively soon after extubation. However, in our study population, just 3 patients required re-intubation. One of them was re-intubated on the same day, with final extubation...
the day after. The reason for the other 2 patients being re-intubated was not related to the initial thermal injury, but to the development of associated complications.

The development of respiratory infection during hospitalization, the most common registered complication, was also associated with more delayed extubations. In fact, 90% of patients with no major complications were extubated by the second day of hospitalization, compared to just 31% of patients who developed respiratory infection.

Conclusions

The decision to perform early pre-burn centre endotracheal intubation in a patient with face and/or neck burns is a critical one, and can determine clinical evolution and final outcome. These crucial decisions are usually made by pre-hospital and pre-burn centre hospital providers, occasionally with insufficient training, and in less controlled environments, such as at the scene of the burn injury or in the non-burn centre emergency room, which significantly increases the difficulty and complexity of airway management.

In fact, a burn on the face is a warning sign of a possible inhalation injury and early prophylactic intubation, before the patient enters the burn unit, might be lifesaving. However, unnecessary intubation may pose a risk to the clinical evolution of these patients. It becomes imperative to develop scientific consensus in order to generate recommendations to guide the pre-burn centre airway management of the facial burn patient.

BIBLIOGRAPHY