Bronchoscopy and Laryngoscopy Findings as Indications for Tracheotomy in the Burned Child

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Objective: To determine possible indications for tracheotomy in the burned child based on bronchoscopic and laryngoscopic findings.

Design and Setting: A retrospective case study of all patients admitted to a tertiary children’s burn center.

Participants: All children admitted with burn inhalation injury between 1990 and 1995 (n = 211).

Intervention: All patients underwent laryngoscopy and bronchoscopy and 19 underwent tracheotomy, with 5 tracheotomy tubes placed emergently.

Main Outcome Measures: Observations during laryngoscopy and bronchoscopy included erythema, edema, carbonaceous material, ulcerations, and bronchial mucous casts. The supraglottis, glottis, and subglottis were analyzed separately, when possible. Any sepsis resulting from tracheotomy was determined. Complications, such as glottic webs, subglottic stenosis, and tracheomalacia, were noted.

Results: Indications for tracheotomy included 6 for airway obstruction, 6 for prolonged intubation, 6 for pulmonary cleansing, and 1 for endotracheal tube complications (subglottic stenosis). When examined by bronchoscopy and laryngoscopy, 17 of 19 children had significant airway edema, 10 had carbonaceous material in the airway, and 3 had ulcerations in the airway.

Conclusions: Tracheotomy is indicated in the burned child when significant airway edema is present. Failure to place a tracheotomy tube in these cases leads to a high incidence of immediate tracheotomies (26%). There was no evidence of clinically significant infection attributable to tracheotomy. The number of airway complications due to tracheotomy was no higher than from endotracheal intubation.


There remains controversy in the literature regarding the timing and necessity of tracheotomy in the burned child. Miller and Gray advocate serial bronchoscopies and early tracheotomy (within 6-8 days) in the presence of persistent airway problems. Calhoun and Deskin report that no variables relating to the initial airway care in burned children were associated with the need for tracheotomy, and they suggest tracheotomy be reserved for patients who cannot be intubated or who fail extubation. Herndon opines that there are no specific rules governing the necessity of a tracheotomy in pediatric burn patients and suggests each patient be judged individually. In clinical practice, the airway in burned children is primarily managed with endotracheal intubation, with tracheotomy reserved for airway obstruction or pulmonary cleansing.

Several studies have long been quoted as reasons to avoid tracheotomy in the burned child. In separate studies in the early 1980s, Moylan and Lund and colleagues both recommended avoiding a tracheotomy, claiming an increase in long-term sequelae, including tracheal stenosis, laryngeal stenosis, tracheomalacia, and the formation of granulation tissue. Gianoli and Miller reported a 13% incidence of early complications and a 38% incidence of late complications in children younger than 1 year undergoing tracheotomy. Eckhauser and colleagues found increased mortality from sepsis in those who underwent tracheotomy, possibly due to seeding of the trachea with bacteria.

Endotracheal intubation, however, is not without controversy. In a prospective study of 200 patients who were intubated for between 2 and 24 days, Whited divided intubated patients into 3 categories: those intubated for 2 to 5 days, those intubated for 6 to 10 days, and those intubated for 11 to 14 days.
SUBJECTS AND METHODS

The records of all children admitted between 1990 and 1995 to the Shriners Burns Institute were reviewed, and those with inhalation injury were examined. All patients who had a tracheotomy tube placed were studied. Data recorded included name, age, percentage of total body surface area burned, percentage area of third-degree burns, whether the patient was intubated, length of intubation, whether tracheotomy was performed, length of tracheotomy intubation, whether the patient underwent decannulation, complications due to tracheotomy, complications due to endotracheal intubation, infection resulting from tracheotomy, bronchoscopic findings of edema, ulceration, and carbon in the supraglottic, glottic, and subglottic areas (performed by various clinicians, including anesthesiologists and otolaryngologists), the indication for tracheotomy, and whether the patient died.

Intubated for 11 to 24 days. He found significant short- and long-term sequelae in all 3 groups, but much more pronounced in those intubated longer than 10 days. Common complications included subglottic stenosis, posterior laryngeal stenosis, and granulation tissue formation. Complications ranged from 2% of those intubated for a short period to 14% for those intubated longer than 10 days. In a more recent study, Tom and Miller report complications due to endotracheal intubation, infections resulting from tracheotomy, bronchoscopic findings of edema, ulceration, and carbon in the supraglottic, glottic, and subglottic areas (performed by various clinicians, including anesthesiologists and otolaryngologists), the indication for tracheotomy, and whether the patient died.

RESULTS

OVERALL

Of the 211 patients admitted to the Shriners Burns Institute with inhalation injury, 19 (9%) underwent tracheotomy. The average age was 4.2 years, the average total body surface area burned was 61%, and the average area of third-degree burn was 53%.

<table>
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<tr>
<th>Site and Finding</th>
<th>No. of Patients</th>
<th>No. Who Died</th>
<th>No. of Tubes Placed Emergently</th>
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<td>Supraglottis and glottis</td>
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<td>0</td>
</tr>
<tr>
<td>Supraglottis, glottis, and subglottis</td>
<td>14</td>
<td>4</td>
<td>3</td>
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<tr>
<td>Soot or casts</td>
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<td>0</td>
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<tr>
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<td>0</td>
</tr>
<tr>
<td>Ulcerations</td>
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<td>2</td>
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<tr>
<td>Not found</td>
<td>16</td>
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</tr>
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</table>

AIRWAY MANAGEMENT

Sixteen (84%) of the 19 children requiring tracheotomy were initially endotracheally intubated. Two of the remaining 3 eventually required an immediate tracheotomy due to airway obstruction and an inability to pass an endotracheal tube. The indications for tracheotomy were airway obstruction from edema (6 [32%]; 5 of these were placed emergently); predicted long-term intubation (6 [32%]); pulmonary cleansing (6 [32%]); and complications of intubation (subglottic stenosis, 1 [5%]).

FINDINGS ON DIRECT LARYNGOSCOPY AND BRONCHOSCOPY

Findings on bronchoscopy were divided into 3 anatomical regions: the supraglottis, the glottis, and the subglottis. Bronchoscopic findings were categorized as normal; erythematous and/or edematous; ulcerated and/or necrotic; and carbonaceous and/or with casts. Seventeen (89%) of 19 patients had initial findings of inflammation and edema, 3 (16%) had ulcerations, and 10 (53%) had carbon in the airway. Four died, all with edema and carbonaceous deposits in all 3 regions in the airway (Table).

AIRWAY COMPLICATIONS

There were 7 children with a total of 9 complications secondary to airway management. Six of the complications were due to endotracheal intubation (2 cases of subglottic stenosis and 4 cases of pneumomediastinum or pneumothorax) and 3 to the tracheotomy (2 cases of tracheomalacia and 1 of pneumomediastinum). In no instance was sepsis or infection documented to be caused by the tracheotomy. Both cases of subglottic stenosis required surgical intervention, whereas both cases of tracheomalacia resolved during observation. All instances of pneumothorax and pneumomediastinum were related to high airway pressures. Three children were not decannulated (2 due to anoxic brain injury and 1 due to recurrent aspiration pneumonia).
VOICE ASSESSMENT

All voices and airways were subjectively assessed by the child’s caregiver. All results were described as normal or near normal.

COMMENT

Surgeons generally prefer to manage the airway of burned children with an endotracheal tube and reserve tracheotomy for those who cannot be intubated or who fail extubation. However, this study shows that those children with significant airway edema or carbonaceous deposits seen during bronchoscopy and laryngoscopy and managed with an endotracheal tube are at risk for immediate tracheotomy (26%). The immediate tracheotomy is usually performed due to accidental extubation and an inability to reinsert the endotracheal tube. This finding suggests that tracheotomy is indicated in those children with significant airway edema seen on initial bronchoscopy and laryngoscopy. Bacterial inoculation of the trachea due to the tracheotomy did not lead to clinically significant infection in this population. The number of cases of tracheomalacia due to tracheotomy and the number of cases of subglottic stenosis due to the endotracheal tube were identical.

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REFERENCES