Early Tracheostomy versus Prolonged Endotracheal Intubation in Severe Head Injury

Moulay Ahmed Bouderka, Bouchra Fakhir, Abderrahmane Bouaggad, Badreddine Hmoumouchi, Driss Hamoudi, and Abdeslam Harti

**Background:** To see if early tracheostomy (fifth day) reduces duration of mechanical ventilation, ICU stay, incidence of pneumonia and mortality in comparison with prolonged intubation (PI) in patients with head injury.

**Methods:** Patients were prospectively included in this study if they met the following criteria: isolated head injury, Glasgow coma scale (GCS) score ≤8 on first and fifth day, with cerebral contusion on CT scan. On the fifth day, randomization was done in two groups: early tracheostomy group (T group, n = 31) and prolonged endotracheal intubation group (I group, n = 31). We evaluated total time of mechanical ventilation, ICU stay, pneumonia incidence and mortality. Complications related to each technique were noted. Analysis of data were performed using Yates and Kruskall Wallis tests, \( p < 0.05 \) was considered significant.

**Results:** The two groups were comparable in term of age, sex, and Simplified Acute Physiologic Score (SAPS). The mean time of mechanical ventilatory support was shorter in T group (14.5 ± 7.3) versus I group (17.5 ± 10.6) (\( p = 0.02 \)). After pneumonia was diagnosed, mechanical ventilatory time was 6 ± 4.7 days for ET group versus 11.7 ± 6.7 days for PEI group (\( p = 0.01 \)). There was no difference in frequency of pneumonia or mortality between the two groups.

**Conclusion:** In severe head injury early tracheostomy decreases total days of mechanical ventilation or mechanical ventilation time after development of pneumonia.

**Key words:** Tracheostomy, Head injury, Intubation, Nosocomial pneumonia, Intensive care unit.


Tracheostomy is frequently done in ICU. Many authors recommend it to avoid serious oropharyngeal and larynx injury occurring from prolonged translaryngeal intubation.\(^1\)\(^-\)\(^7\) However, the benefit of tracheostomy in the ICU is not clearly defined. Despite the long history of tracheostomy few data are available to define the impact of early tracheostomy on duration of mechanical ventilation and ICU stay. In patients receiving mechanical ventilation, tracheostomy has the following benefits: easier nursing care became easier, improved comfort, more secure tube with increased patient mobility, allowance of speech, oral nutrition and in some studies early weaning from mechanical ventilation.\(^8\)\(^,\)\(^9\) Conversely, some studies have suggested that tracheostomy is associated with an increased risk of nosocomial pneumonia.\(^10\)\(^-\)\(^12\)

In 1989 the American consensus conference on artificial airways issued the statement that tracheostomy is preferred if the need for an artificial airway is anticipated to be greater than 21 days.\(^4\) In 1998 the European consensus arrived at the same conclusion.\(^13\)

This study was conducted to further define the impact of early tracheostomy (T) on duration of mechanical ventilation, ICU stay, nosocomial pneumonia and mortality in comparison with prolonged endotracheal intubation (I) in patients with isolated severe head injury.

**MATERIALS AND METHODS**

This is a prospective randomized study conducted 2 years after local CRB committee approval. Patients were included in the study if they met the following criteria: Isolated severe head injury (admission Glasgow coma scale (GCS) score ≤8).

- Cerebral contusion on CT scan
- GCS score <8 on the fifth day without any sedation.

On the fifth day of hospitalization if these criteria were present, patients were randomized to: early tracheostomy (T) or prolonged endotracheal intubation (I). In the T Group, tracheostomy was performed on the 5th or 6th day after admission using a standard technique in the ICU by a critical care physician with low pressure Tracheostomy tube cuffs.

We compared demographic data, admission scores and outcome, specifically evaluation the time of mechanical ventilation, Simplified Acute Physiologic Score (SAPS), ICU stay, frequency of pneumonia and mortality.\(^14\) Clinical but not endoscopic complications related to tracheostomy and to prolonged endotracheal intubation (PEI) were noted. The diagnosis of pneumonia was by CDC criteria.\(^15\)

**Statistics**

All data were recorded in a PC and analyzed by Epi info 6.01. Our hypothesis was that early tracheostomy could re-
duce the mechanical ventilation time by 25%. We fixed risk \( \alpha \) at 5% and risk \( \beta \) at 20%. So the minimal number for our population study was 34. Randomization was done with hazard table permutation.

The characteristics of patients in each groups were compared using Chi 2 test with Fischer’s exact test and Yates test correction when necessary for qualitative variables. We compared continuous variables using Student’s \( t \) test. \( p < 0.05 \) was considered significant.

RESULTS

A total of 150 patients with severe head injury had been admitted to our ICU during the study period. Among these patients, six were excluded for the following reasons: 1) improvement of GCS score \( \geq 8 \) on the fifth day \( n = 2 \); 2) death during the first week of hospitalization \( n = 4 \).

The two groups were comparable in terms of age, sex, and SAPS (Table 1). The mean time of mechanical ventilatory support was shorter in T group than in PEI group (Table 2). Nosocomial pneumonia was not more frequent in ET group than in I group (Table 3). However the day pneumonia was diagnosed was later for T group than for PEI group. After nosocomial pneumonia has been acquired, the number of mechanically ventilated days was greater in I group than in T group. Gram-negative bacilli, especially Acinetobacter and Pseudomonas, were the most frequent bacteria isolated in nosocomial pneumonia (Fig. 1). There were two non-lethal stomal bleeds and five stomal infections in T group. Inspiratory dyspnea was present in one patient in T group and three patients in I group. Laryngotracheal endoscopic examination found one tracheal stenosis in the T group that required surgical treatment and five inflammatory granuloma in I group with good recovery after treatment with corticosteroids. There was no difference in mortality between the two groups (Table 4). Intracranial hypertension, acute respiratory distress syndrome (ARDS) and sepsis were the major causes of death for the two groups (Table 5).

DISCUSSION

It is a paradox that although tracheostomy is frequently recommended in head injury patients, there are few studies strictly related to this group. There has been a little agreement

Table 1 Demographic Data

<table>
<thead>
<tr>
<th></th>
<th>T Group ( n = 31 )</th>
<th>I Group ( n = 31 )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>41.1 ± 17.5</td>
<td>40 ± 19</td>
<td>0.53</td>
</tr>
<tr>
<td>Sex: M/F</td>
<td>18/9</td>
<td>20/11</td>
<td></td>
</tr>
<tr>
<td>SAPS</td>
<td>5.4 ± 1.5</td>
<td>6 ± 3.8</td>
<td>0.52</td>
</tr>
</tbody>
</table>

F, female; M, male; SAPS, simplified acute physiological score.

Table 2 Ventilatory Data

<table>
<thead>
<tr>
<th></th>
<th>T Group ( n = 31 )</th>
<th>I Group ( n = 31 )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of weaning attempts</td>
<td>1.6 ± 0.7</td>
<td>1.5 ± 0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>Total ventilation days</td>
<td>14.5 ± 7.3</td>
<td>17.5 ± 10.6</td>
<td>0.02</td>
</tr>
<tr>
<td>Day of extubation or tracheostomy off</td>
<td>26.3 ± 13.7</td>
<td>19.4 ± 10.4</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Table 3 Frequency of Nosocomial Pneumonia and Sinusitis

<table>
<thead>
<tr>
<th></th>
<th>T Group ( n = 31 )</th>
<th>I Group ( n = 31 )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nosocomial pneumonia n (%)</td>
<td>18 (58)</td>
<td>19 (61.3)</td>
<td>0.79</td>
</tr>
<tr>
<td>Day NP diagnosed</td>
<td>6.7 ± 1.8</td>
<td>9.2 ± 2.3</td>
<td>0.95</td>
</tr>
<tr>
<td>Mechanically ventilated days after pneumonia diagnosed</td>
<td>6 ± 4.7</td>
<td>11.7 ± 6.7</td>
<td>0.01</td>
</tr>
<tr>
<td>Bacteria</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NGB/PGC</td>
<td>13/5</td>
<td>15/4</td>
<td>0.92</td>
</tr>
<tr>
<td>Sinusitis n (%)</td>
<td>3 (9.6)</td>
<td>5 (16.1)</td>
<td>0.7</td>
</tr>
</tbody>
</table>

NP, nosocomial pneumonia; NGB, negatives gram bacilli; PGC, positives gram cocci.

Table 4 Outcome and Mortality

<table>
<thead>
<tr>
<th></th>
<th>T Group ( n = 31 )</th>
<th>I Group ( n = 31 )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovery n (%)</td>
<td>19 (61.3)</td>
<td>23 (74.2)</td>
<td>0.41</td>
</tr>
<tr>
<td>Bleeding n (%)</td>
<td>2 (6.4)</td>
<td>0 (0)</td>
<td>0.47</td>
</tr>
<tr>
<td>Death n (%)</td>
<td>12 (38.7)</td>
<td>7 (22.5)</td>
<td>0.27</td>
</tr>
<tr>
<td>Day of death</td>
<td>30.6 ± 20.1</td>
<td>27.7 ± 14.6</td>
<td>0.72</td>
</tr>
</tbody>
</table>

Table 5 Etiology of Death

<table>
<thead>
<tr>
<th></th>
<th>T Group ( n = 31 )</th>
<th>I Group ( n = 31 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intracranial hypertension</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Sepsis</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>ARDS</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Cardiovascular dysfunction</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

ARDS, acute respiratory distress syndrome.
on the optimal timing of the procedure in mechanically ventilated patients.\textsuperscript{16-18} The consensus conference of 1989 recommended conversion to tracheotomy if the anticipated need for mechanical ventilation is \(>21\) days.\textsuperscript{5} Few studies have tried to resolve this question: is there any benefit to practice tracheotomy? If yes, at what time?

Few studies methodologically acceptable tried to answer these questions.\textsuperscript{8,9,19–22} Rodriguez\textsuperscript{8} et al. suggested that there was a reduction in the duration of mechanical ventilation, ICU and hospital stay. He did not comment on sequellea of prolonged intubation versus early tracheostomy. Dunham et al.\textsuperscript{19} found no difference with respect to important clinical outcomes. However, they noted that the frequency of major laryngotracheal damage was similar for early and late tracheostomy. El-Naggard et al.\textsuperscript{20} found a higher percentage of extubation and lower frequency of airway lesions in the late tracheostomy groups. Two retrospective studies were conducted by Lesnik et al.\textsuperscript{8} and Blot et al.\textsuperscript{21} Lesnik reviewed 101 adult patients who were admitted after blunt injuries, 32 had tracheostomy within the first 4 days and 69 underwent tracheostomy after 4 days. The author found that the mean duration of ventilatory support was 6.0 days in early tracheostomy group versus 20.6 days in the late tracheostomy group (\(p < 0.001\)). Blot et al.\textsuperscript{21} in their retrospective study compared early (with in 48 h) versus late (\(>7\) days) tracheostomy in 53 neutropenic patients. The frequency of nosocomial pneumonia, death in ICU and hospital were not significantly different but the length of hospital stay and of the mechanical ventilation were significantly longer in early tracheostomy group (\(p < 0.05\)).

However all these studies have some methodological bias:

- Inhomogeneous population\textsuperscript{18–20}
- Retrospective study\textsuperscript{9,20}
- No randomization\textsuperscript{8,18}
- If randomization was present, it was substandard, (alternative allocation, the day of the studies were blinded)\textsuperscript{8,18,19}
- Comparison between early and late tracheotomy not versus prolonged endotracheal intubation\textsuperscript{8,9,17–21}

That’s why specific inclusion and exclusion criteria, homogenous population and standardized weaning practices are necessary. We think that to ovoid all these methodological bias, we have to find first a homogenous population in term of pathology and in terms of gravity. Second, the population chosen must be ventilated for a long time in order not to do tracheostomy abusively (for patients who did not require it). We believe that the ideal population study is patients with isolate severe head injury who met the criteria cited in our methodology.

We had observed that patients with sever head injury who were mechanically ventilated had a high frequency of unsuccessful extubation and required tracheostomies. After the first week, most of these patients didn’t require mechanical ventilatory support but were intubated mainly for airway protection. Early tracheostomy may assist in early termination of mechanical ventilatory support and therefore, reduce the ICU and hospital stay for these patients.

In our experience, two clinical features at the time of intubation aid identification of unlikely to be extubated: patients with a GCS score <8, brain stem deficit and cerebral contusion in CT scan. That is why we chose these conditions as inclusion criteria in our study. The limitation of this approach is the high mortality rate during the first week of hospitalization. In our opinion tracheostomy should depend not only on the probability of successful extubation but also on the probability that a patient had good chance of being discharged alive. That is why we avoided in our protocol tracheostomy in patients who will be potentially extubated early (GCS score >8) and the patient who would die during the first week and would not benefit from the procedure.

Presently, most physicians decide the timing of tracheostomy in patients with neurologic disease based on results derived from observations in patients mechanically ventilated for pulmonary causes.\textsuperscript{3,23} Most of the patients with sever head injury, as seen in our study, required intubation for at least one week but not necessarily mechanically ventilation for a long time. However, airway protection is permanently needed. Tracheostomy provides an early alternative for airway protection and seems to decrease the need for prolonged mechanical ventilation support. Secondly, severe head injury patient requires a long time for recovery and the airways protective reflexes are rarely optimal. This was confirmed by the high frequency of reintubation attributable to poor control over secretions aspiration in intubation groups.\textsuperscript{24,25}

Frequency of nosocomial pneumonia seems to be lower with early tracheostomy. Many studies confirm theses findings.\textsuperscript{9,21,26} Other authors found that tracheostomy increases the frequency of pneumonia.\textsuperscript{27–29} We did not find any statistical difference in term of frequency of pneumonia between the 2 groups.

The association between the risk of laryngotracheal injury and duration of intubation is another important consideration in the timing of tracheostomy. Nowak et al.\textsuperscript{30} reported that the risk of severe tracheal complications was higher in patients with closed head injury who were intubated for >14 days compared with those intubated for <14 days and there was no difference in the risk of laryngotracheal injury between 0–6 days and 7–13 days of intubation. Richard et al.\textsuperscript{31} evaluated the frequency rate of laryngotracheal stenosis in 315 patients with neurologic disease (Head injury, tetraplegia, . . .), the risk of laryngotracheal stenosis was not dependent on the duration of intubation. Our study did not find a difference between the two groups in term of laryngotracheal complications. However, we should remember that only clinical symptoms were recorded and laryngotracheal endoscopy was done only if there was clinical suspicion of laryngotracheal complication. We think that Tracheostomy should be performed before the time period when laryngotracheal injury
becomes a concern, based on experience from other studies\(^2^9–31\) of patients with neurologic diseases.

Koller\(^3^2\) found that patient with respiratory failure who had a tracheostomy had more favorable outcome than patients who did not have a tracheostomy. However, this study population was not homogenous and they included all of their ICU patients. In our study mortality did not differ between the two groups.

In conclusion, early tracheotomy decreases the total days of the ventilator and mechanical ventilatory time after pneumonia in isolated severe head injury. It did not reduce either ICU stay or the frequency of pneumonia or mortality.

**REFERENCES**