Mortality of brain injury patients undergoing early and late tracheostomy at Dr. Soetomo General Hospital, Surabaya

Hanindyo Riezky Beksono, Marjono Dwi Wibowo, Edwin Danardono

ABSTRACT

Introduction: Opinions regarding the best time to perform a tracheostomy are still being debated. In contrast, the outcomes regarding the installation of an early and late tracheostomy in patients with brain injury still require further study. This study aims to determine the prevalence of mortality in brain injury patients who underwent early tracheostomy and late tracheostomy at Dr. Soetomo General Hospital, Surabaya, in 2022-2023.

Method: This research is an observational descriptive study with a cross-sectional design using medical record data. The study sample included all patients with brain injuries who had undergone tracheostomy installation at Dr. Soetomo General Hospital, Surabaya, from January 2022–May 2023.

Results: In this study, 159 patients underwent tracheostomy surgery at Dr. Soetomo General Hospital, Surabaya, from January 2022 to May 2023, with a mean patient age of 32.6 (±18.6) years. It was found that the majority of patients with brain injuries who underwent tracheostomy had a severe degree of brain injury 26 (86.7%). In comparison, only 4 patients (13.3%) met the criteria for moderate brain injury. The outcome for most patients was death (63.3%), and only 11 patients (36.7%) were alive. Multiple Organ Dysfunction Syndrome (MODS) and septic shock are the most common causes of mortality (31.6%). In addition, mortality in brain injury patients who underwent late tracheostomy was higher than early tracheostomy. Conclusion: The prevalence of mortality in brain injury patients undergoing late tracheostomy is higher than early tracheostomy, with the most common causes of mortality being MODS and septic shock.

Keywords: brain injury, early tracheostomy, late tracheostomy, mortality rate.

INTRODUCTION

Tracheostomy is the procedure of opening the trachea surgically. This procedure creates an opening in the anterior trachea to facilitate breathing. Several conditions have been shown, in studies, to be indicative of tracheostomy insertion, such as neuromuscular diseases, trauma, high-severity injuries, elderly patients, and others. Some researchers have proposed that the decision to perform a tracheostomy should be based on objective measures obtained from a spontaneous breathing trial or a weaning trial from mechanical ventilation. Brain injury is a pathological process of brain tissue that is neither degenerative or congenital but rather the result of external mechanical forces, leading to impaired physical, cognitive, and psychosocial functioning. Severe brain injury results in brain hypoxia, which has the greatest contribution to mortality. As mentioned by Goettler et al., to ensure a free airway and adequate oxygenation and prevent hypercapnia, severe brain injury patients require endotracheal intubation, ventilator machines, and tracheostomy.

The best time to perform tracheostomy is still under debate in the literature. To homogenize the terminology, literature offers two categories, namely ‘early’ and ‘late’ for the timing of tracheostomy. A recent meta-analysis study by Chorath et al. states that ‘early’ tracheostomy is defined as intervention no more than 7 days after initiation of mechanical ventilation and ‘late’ tracheostomy as placement of tracheostomy after 7 days or without tracheostomy. Outcomes related to the placement of ‘early’ tracheostomy and ‘late’ tracheostomy in patients with brain injury are also still debated. Based on this, we conducted a study on the prevalence of mortality of brain injury patients who underwent early tracheostomy and late tracheostomy.

METHODS

This study is an observational descriptive study. Data were collected using a cross sectional method. Data were taken from the medical records of brain injury patients who underwent tracheostomy insertion surgery at Dr. Soetomo General Hospital, Surabaya, from January 2022 - May 2023. The inclusion criteria were brain injury patients who had undergone tracheostomy insertion by surgeons or surgical residents. Incomplete patient medical record data were excluded. Analysis was done descriptively to see the frequency and percentage of each research variable. This analysis used Microsoft Excel software and IBM Statistics Desktop (SPSS) version 26.

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RESULTS
This study obtained 159 tracheostomy surgery patients at Dr. Soetomo General Hospital, Surabaya, from January 2022 - May 2023. Of this population, 30 samples (18.8%) of tracheostomy insertion surgery activities were explicitly performed on patients with brain injury. The mean age of patients with brain injury who underwent tracheostomy insertion was 32.6 (±18.6) years old, with the youngest age being 1 year old and the oldest age being 68 years old. Most of the patients with brain injury who underwent tracheostomy insertion were male. Only 4 patients (13.3%) were female (Table 1).

Most of the patients with brain injury cases who underwent tracheostomy insertion had a fatal outcome (63.3%), and only 11 patients (36.7%) were alive. There were five types of causes of mortality in patients with brain injury who underwent tracheostomy insertion. Multiple Organ Dysfunction Syndrome (MODS) and septic shock were the most common causes of mortality, with a prevalence of 31.6% of the total mortality recorded in this study (n=19) (Table 2).

The timing of tracheostomy insertion in patients with brain injury was calculated from the initial hospital admission. The duration was then divided into early tracheostomy (≤7 days) and late tracheostomy if the insertion time was >7 days. Our study showed the distribution of tracheostomy insertion time in patients with brain injury, with the mean insertion time being 2.53 (±2.8) days and the longest insertion time being 11 days. It was found that most of the patients with brain injury cases who had tracheostomy insertion were mostly early tracheostomy (≤7 days), which was 90%. Only 3 patients (10%) had a late tracheostomy (>7 days). It was found that the prevalence of mortality of brain injury patients who underwent late tracheostomy was higher (66.7% of the total who underwent late tracheostomy) than early tracheostomy (63%).

DISCUSSION
In this study, most patients with brain injury who had a tracheostomy inserted had a degree/grade of brain injury of 26 (86.7%). This is following the research proposed by Ludin & Mahmud et al. Patients with brain injury, especially severe brain injury with GCS ≤ 8, often require mechanical ventilation to prevent hypoxemia and hypercapnia conditions that will cause further secondary damage to the brain. Airway management and oxygenation are believed to be the most important treatments to maintain brain oxygenation in patients with severe brain injury and prevent brain tissue ischemia.6,7

The mortality prevalence of brain injury patients who underwent late tracheostomy was higher (66.7% of the total who underwent late tracheostomy) than early tracheostomy (63%). It is also supported that the prevalence of survival (life outcome) of patients who underwent early tracheostomy was higher (37%) than those who underwent late tracheostomy (33.3%). The results of this study are in line with previous studies. A meta-analysis conducted by Lu et al. found that severe brain injury patients who underwent early tracheostomy had a shorter duration of mechanical ventilation, ICU care, and a lower incidence of pneumonia.8 Another study conducted by Chorath et al., with 17 RCTs, showed that early tracheotomy was associated with improved 3 major clinical outcomes: Ventilator Associated Pneumonia (VAP), ventilator-free days, and ICU hospitalization. The findings of the above meta-analysis suggest that early tracheostomy (≤7 days) may reduce the incidence of VAP. This result is clinically crucial as VAP is the most common nosocomial infection in the ICU.9

In addition, a meta-analysis study conducted by Andriolo et al. showed inconsistency between the mortality association at 30 days follow-up with an early or late tracheotomy.9 Rumbak et al. was the only study to show a significant difference between groups, with lower mortality in the early tracheostomy group.10 However, at 180 days follow-up, Bösel et al.11 reported a lower mortality rate in the early tracheostomy group, but Young et al. found no significant difference between groups.12

There were five types of causes of mortality in patients with brain injury who underwent tracheostomy insertion. Multiple Organ Dysfunction Syndrome (MODS) and septic shock were the most common causes of mortality, with a prevalence of 31.6% of the total mortality recorded in this study. These results are in line with Chorath et al., who stated that patients diagnosed with Ventilator-Associated Pneumonia (VAP) have longer ICU and hospital stays, higher hospital costs, and an increased risk of death.9 Also, lower hospitalization costs were found in patients who underwent early tracheostomy compared to late tracheostomy. In this study, septic shock may be caused by pneumonia caused by late tracheostomy. The limitation of this study is the relatively small number of samples and relatively short study time. Further research is needed to examine the relationship between late tracheostomy and early tracheostomy and its relationship with mortality rates in patients with brain injury.

CONCLUSION
The mortality prevalence of brain injury patients who underwent late tracheostomy was higher than early tracheostomy. The survival (life outcome) prevalence of patients who underwent early tracheostomy was higher than those who

Table 1. Characteristics of study subjects.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Frequency (N=30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>&lt; 10 years</td>
<td>2 (6.7%)</td>
</tr>
<tr>
<td>11-20 years</td>
<td>8 (26.7%)</td>
</tr>
<tr>
<td>21-30 years</td>
<td>6 (20.0%)</td>
</tr>
<tr>
<td>31-40 years</td>
<td>2 (6.7%)</td>
</tr>
<tr>
<td>41-50 years</td>
<td>7 (23.3%)</td>
</tr>
<tr>
<td>&gt;50 years</td>
<td>5</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>24</td>
</tr>
<tr>
<td>Female</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 2. Causes of death distribution

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>Frequency (N=30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple Organ Dysfunction Syndrome</td>
<td>6 (31.6%)</td>
</tr>
<tr>
<td>Shock Septic</td>
<td>6 (31.6%)</td>
</tr>
<tr>
<td>Respiratory Failure</td>
<td>2 (10.5%)</td>
</tr>
<tr>
<td>Increase intracranial pressure</td>
<td>4 (21.1%)</td>
</tr>
<tr>
<td>Cardiac Arrest</td>
<td>1 (5.3%)</td>
</tr>
</tbody>
</table>
underwent late tracheostomy. Multiple Organ Dysfunction Syndrome (MODS) and septic shock were the most common causes of mortality out of the total mortality recorded in this study.

**ETHICAL CLEARANCE**

Patient approval has been obtained in this study, and ethics approval was fulfilled from the Ethics Committee of RSUD Dr. Soetomo No. 1562/LOE/301.4.2/I/2024.

**CONFLICT OF INTEREST**

All authors disclosed no conflict of interest.

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**AUTHOR CONTRIBUTION**

All authors contributed equally to the study.

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**REFERENCES**


