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**Original Research Article**

# Early tracheostomy in patient with severe traumatic brain injury clinical experiences in rural and remote areas

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## ABSTRACT

**Background:** Brain injury accounts for most of the causes of death from trauma. Brain injury is defined as a change in brain function, or brain pathology, caused by external forces. Patients with severe brain injury usually required rapid evacuation and special care in the Intensive Care Unit (ICU) room for respiratory control, mechanical ventilation, neurosurgical evaluation, and intracranial pressure monitoring (ICP). During admission to ICU, patients using tracheostomy, because it requires analgesia, sedation, and prolonged ventilation.
**Methods:** Descriptive retrospective study conducted in February and March 2018 at Medical Record Installation of General Hospital Province of West Nusa Tenggara. The sample size is determined by consecutive sampling method.
**Results:** Sample size were 60 people from medical record. Male patient more common than female (90 %). Based on Age more patients are 40 years old (43.3%). More Patient with early tracheostomy was survived (68,33%), and the rest died (31,67%).
**Conclusions:** Severe head injury patients with tracheostomy are common at <18 years and >40 years. Patients with Severe brain injury who get early tracheostomy have more good outcomes, and have relatively short duration of ICU care.

**Keywords:** Tracheostomy, Severe traumatic brain injury

## INTRODUCTION

Brain injury is defined as "a change in brain function, or brain pathology, caused by external forces." There are several symptoms of brain injury, such as disorientation, confusion, headache, nausea and vomiting, drowsiness, loss. memory, decreased level or loss of consciousness, and neurological deficits such as weakness, loss of balance, vision changes, sensory loss, paresis or paralysis.[1-5]

Patients with severe brain injury usually require rapid evacuation and special care in the Intensive Care Unit (ICU) room for respiratory control, mechanical ventilation, neurosurgical evaluation, and intracranial pressure monitoring (ICP).[5,6] During admission to the ICU, these patients need tracheostomy because they required analgesia, sedation, and prolonged ventilation. Early oxygenation and ventilation administration aims to maintain adequate oxygenation, avoid extreme hypoxemia or hyperoxemia and reduce incident of mortality caused by brain injury. Patients with severe brain injury or those with GCS scores less than 8 is one of the indications of tracheostomy due to the risk of decreased ability of the patient to ventilate and to protect the patient's airway. A study showed that tracheostomy can improve good outcomes in patients with brain injury and may decrease mortality.[5-7] The high number of brain

injury cases in many countries including Indonesia, coupled with the fact that this case remains one of the health problems encourages authors to perform a study about the profile of patients with severe brain injury with early tracheotomy at West Nusa Tenggara Provincial General Hospital.

Brain injury is often referred to as 'silent epidemic'. In Europe, an estimated 2.5 million people suffer from some form of brain injury each year, causing about 75,000 deaths. In addition, the incidence of brain injury in Europe reached 235 per 100,000 population, 103/100,000 in the US, 226/100,000 in Australia, 344/100,000 in Asia, and 160/100,000 in India. The most common mechanisms that cause brain injury are falls (single accident), traffic accidents, and attack-related accidents. In low- and middle-income countries, traffic accidents dominate the cause of brain injury, while developed countries show an increase in the frequency of trauma from falling. The World Health Organization (WHO) estimates that by 2030, brain injury will be a major cause of disability and death globally. This increasing number is primarily due to the increasing frequency of traffic accidents in developing countries, but also triggered by the growing elderly population in the world and as a result of increased vulnerability to trauma.[5,6]

Pathological mechanism of brain injury is generally divided into two phases, namely: primary brain injury and secondary brain injury. Primary brain injury is a mechanical damage that occurs in the brain's parenchyma and occurs during trauma (cortical contusions, laceration, bone fragmentation, diffuse axonal injury, and brainstem contusion). Secondary brain injury originally triggered by primary injury, occurs within hours and days after primary brain injury. Secondary brain injury processes include: hypoxic-ischemic injury (mainly due to high intracranial pressure (ICP) and/or shock), cerebral edema, metabolic dysfunction, changes in blood vessel permeability, reduced blood flow, diffuse axonal injury (DAI), vasospasm, hydrocephalus , and the consequences of intracranial hypertension. Secondary injuries are exacerbated by systemic abnormalities, such as: coagulopathy, hypoxemia, hypotension, hypertension, hyperthermia, hypoglycaemia, hyperglycemia, hypokapnia, hypercapnia, anemia, hypernatremia, and acid-base disorders. Therefore, the treatment of brain injury focuses on inhibiting the development of primary brain injury and preventing secondary brain injury.[5,8]

CT-Scan was used as radiologic examination to confirm brain injury. The most intracranial pathologic finding identified by CT-Scan was subdural hematoma (SDH), Epidural Hematoma (EDH), Intracerebral Hematoma (ICH), subarachnoid hematoma (SAH), intraventricular haemorrhage (IVH), and diffuse axonal injury. Patient prognose was mostly predicted from; type of bleeding, cistern basalis status, midline shift, and SAH, with SAH and complete obliteration of cistern basalis.[5,8]

***Tracheostomy in severe brain injury***

Generally, patients with severe brain injury generally were required a tracheostomy procedure to maintain respiration in longer period. There were some benefits compared to endotracheal tube in the ICU; to reduce laryngeal ulcer, for better airway clearing, to decrease the use of analgetic drugs, to decrease airway resistance, and to maintain airway. Tracheostomy was best used if the patient was going to maintain mechanic ventilation for longer than 21 days, but there was no evidence for the best use of tracheostomy. Some studies said that early tracheostomy in severe brain injury associated with some benefits; shorten usage of mechanic ventilation and shorten hospitalization time. The study that conducted by Boerderka et al, reported that early tracheostomy on fifth or sixth day after trauma, associated with shorten the usage of mechanic ventilation without increasing mortality and morbidity if compared to late tracheostomy. Despite of that, the duration of using mechanic ventilation was never less than 14 days after trauma, because intracranial pressure will be increased 7 days after trauma.[9]

The expected benefits of using mechanical ventilation in shorter duration and length of care in the ICU include: more efficient health care allocation, reduced medical costs, reduced morbidity, and improved long-term functional outcomes. Although ICU costs tend to be lower in the initial group, we didn't find any significant differences in other measurable parameters. To evaluate early tracheostomy, we also need to consider the negative impacts that will be occur. In the literature, some possible losses that could make outcomes to be worse have been reported. For example, the effect of early tracheostomy on mortality remains controversial.[9] Another disadvantages of early tracheostomy are the effect of tracheostomy in intracranial pressure (ICP) and brain perfusion pressure (BPP). A study reported that there is an increase of ICP after early tracheostomy in severe brain injury patients, therefore the patients required close monitoring. Shibahashi et al, found that tracheostomy in the early stages did not need to be inhibited, but not recommended when there is intracranial hypertension. In order to reduce the side effects, it is necessary to monitor and manage ICP.[9] The disadvantages of tracheostomy should also be considered because the inflammatory response is caused by local damage to the tissues that can lead to systemic responses such as fever, leukocytosis and increased plasma protein concentration. Excessive inflammatory responses lead to poor outcome and clinical conditions. The tracheostomy procedure itself can cause local damage, however, it also has some potential advantages over endotracheal intubation.[9]

## METHODS

This study was a retrospective descriptive study using medical record data of neurosurgery patients who met inclusion and exclusion criteria in General Hospital

Province of West Nusa Tenggara in 2016 and 2017. The sample size was determined by consecutive sampling method, all subjects who met the inclusion criteria were included into the sample research. The sample was severe brain injury patients with tracheotomy fulfilling inclusion criteria in Medical Record data for the period of January-December 2016 and 2017. The inclusion criteria in this study were: traffic accident patients with diagnosis of severe brain injury (GCS score ≤8) with tracheostomy, men and women of all ages. Meanwhile, exclusion criteria in this study were patients with brain injury who were not caused traffic accident, traffic accident patients with a diagnosis of severe brain injury (GCS score ≤8) who died prior to tracheostomy. The samples of this research were 60 samples based on inclusion and exclusion criteria.

Data were collected by recording important information in the patient's medical record. Data recorded include: name, medical record number, age, gender, traffic accident mechanism, diagnosis, CT-scan results, length of treatment, outcome, duration of care, initial GCS, last recorded GCS before patient heal/die, and complications during treatment. Data is processed by using Microsoft Excel.

## RESULTS

During January-December 2016 and 2017, based on medical record data there were 60 patients with severe head injury with tracheostomy and then treated in ICU at NTB Provincial General Hospital. Based on the results of the study, the number of samples of patients with severe brain injury with tracheotomy were 60 people. Table 1 shows the number of patients with severe brain injury and tracheostomy based on gender. Of the 60 samples, there were 54 male patients (90%) and 6 (10%) female patients.

**Table 1: Number of patients with severe brain injury and tracheostomy based on gender.**

| Gender | Total | |
|---|---|---|
| | N (people) | % |
| Male | 54 | 90 |
| Female | 6 | 10 |
| Total | 60 | 100 % |

In Table 2, the number of severe brain injury patients with tracheostomy in the age group of less than 18 years was 14 (23.3%); the age group of 18-25 years was found as many as 9 people (15%), age group 26-32 years as many as 5 people (8.3%), age group 33-39 years as many as 6 people (10%), and age group> 40 year as many as 26 people (43.3%).

Table 3 shows the outcomes of severe brain injury patients with tracheostomy, in which the number of living patients was 41 (68.33%) and the number of patients died was 19 (31.67%).

**Table 2: Number of patients with severe brain injury and tracheostomy based on age.**

| Age (year) | Total | |
|---|---|---|
| | N (people) | % |
| <18 | 14 | 23.3 |
| 18-25 | 9 | 15 |
| 26-32 | 5 | 8.3 |
| 33-39 | 8 | 13.4 |
| ≥40 | 24 | 40 |
| Total | 60 | 100 % |

**Table 3: Outcome in severe brain injury patients with tracheostomy.**

| Outcome | Total | |
|---|---|---|
| | n (people) | % |
| Survive | 41 | 68.33 |
| Died | 19 | 31.67 |
| Total | 60 | 100% |

**Table 4: Duration of treatment of severe brain injury patients with tracheostomy.**

| Duration of treatment (days) | Total | |
|---|---|---|
| | n (people) | % |
| < 3 | 4 | 6.67 |
| 3-7 | 13 | 21.67 |
| 8-14 | 19 | 31.67 |
| ≥ 15 | 24 | 40 |
| Total | 60 | 100% |

**Table 5: CT scans of patients with severe brain injury with tracheostomy.**

| CT-Scan | Total | |
|---|---|---|
| | N (people) | % |
| Cerebral edema | 40 | 66.67 |
| Epidural hematoma (EDH) | 11 | 18.33 |
| Intracranial hemorrhage (ICH) | 17 | 28.33 |
| Subarachnoid hematoma (SAH) | 10 | 16.67 |
| Subdural hematoma (SDH) | 20 | 33.33 |
| Intraventricular hemorrhage (IVH) | 5 | 31.67 |
| Diffuse axonal injury (DAI) | 19 | 31.67 |
| Cerebral contusion | 6 | 10 |
| Total | 60 | 100% |

Table 4 shows the duration of treatment of severe brain injury patients with tracheostomy. In the group with the duration of treatment <3 days found as many as 3 people (5%); in the group with 3-7 days treatment duration found 13 people (21.67%); length of treatment 8-14 days as many as 19 people (31.67%); and in the old group treatment ≥ 15 days as many as 24 people (40%).

Table 5 shows the CT scans of severe brain injury patients with tracheostomy. Number of patients with cerebral edema were 40 people (66.7%), epidural hematoma (EDH) 11 people (18.33%), intracranial hematoma (ICH) 17 people (28.33%), subarachnoid hematoma (SAH) 10 (16.67%), subdural hematoma (SDH) 20 people (33.33%), intraventricular hematoma 5 people (8.33%), diffuse axonal injury (DAI) 19 people (31.67%), and cerebral contusion as much as 6 people (10%). From the data obtained, the most common CT-Scan head findings were cerebral edema.

## DISCUSSION

Based on Table 1 statistic data, gender did not have significant data, although men were more likely to experience severe brain injury than women. In a study conducted by Grigorakos et al, the majority of patients with severe brain injury were male (70.05%) and only 29.95% were female.[10] The results of this study are the same as Rawis et al, which is the distribution of patients with moderate brain injury and severe brain injury in ICU and HCU is more in male 33 people (83%) compared to female as many as 7 people or 18%.[11]

In a similar study conducted by Simanjuntak et al, in 2013 also found that most of the head injured patients were male, as many as 302 people (71.9%) while females are 118 (28.1%).[12] It may be related to different types of activity in men and women, men tends to have activities and occupations that are more at risk for head injury. Similar results were also obtained by Jasa et al, during 2012 at ICU Dr. Zainoel Abidin General Hospital, the results showed that the number of male patients are 56 patients, it was much more (67%) than in female (33%).[13] This is consistent with the literature which states that traffic accidents as the main cause of head injury in the world occurs 2-3 times more in males than females.[14]

According to the data in Table 2 shown, it can be concluded that severe brain injury patients with tracheostomy most at age ≥40 years as many as 24 people (40%), followed by age <18 years as many as 14 people (23.3%).Similar results were also obtained in various studies, cases of severe head injury mostly occurred at age 15-20 years as many as 22 patients (27%) and age 40 years, more than 29 patients (35%).[13] This is relatively similar to the statistic of traumatic brain injury in the United States, which states the age group at risk is aged 0-14 years, 15-19 years and >75 years as a group of age at risk but age group with the highest risk is group of 15-19 years.[15]

Severe brain injury patients need a patent airway for a long period of time. While intubation cannot be used for a long time. Therefore, tracheostomy is required. Early tracheostomy is thought to have much benefits, including: reduced the risk of pneumonia, the used of ventilation can be faster, reduced laryngeal injury, the increased risk of glottic stenosis due to less endotracheal suppression, easier mouth care.

Based on the data in Table 3, the number of severe brain injury patients with tracheostomy who still survive is higher than the number of patients who died. However, the value cannot be determined because it is not statistically tested. A similar study by Hai-Pengk et al, showed that mortality rates of patients with severe head injury in the study at various hospitals in the world is very varied.[16] This is determined by the standards of therapy performed, the initial clinical conditions in the case as well as the monitoring performed during the ICU treatment.[13]

Based on the data in Table 4, it is known that severe brain injury patients are treated most for ≥15 days in ICU that is 24 people (40%) followed by patients with 8-14 days of treatment of 19 people (31.67%), then 8-14 days as many as 13 people, and <3 days as many as 4 people. This is relatively consistent with the results of studies conducted by Arabi et al. Which shows that the average treatment of severe brain injury patients in ICU is 10-14 days.[17]Bouderka states that there was a reduction in the duration of mechanical ventilation.[18] Rodriguez et al also suggested that there was a reduction in the duration ICU and hospital stay.[19] Araby et al, suggested that the use of tracheostomy can shorten the duration of hospital and ICU stay of severe head injury patients.[17] Fan Hai Peng et al, compared ultra-early and delay tracheostomy with results that duration of ICU stay in patients with an ultra-short tracheostomy was shorter as well as fewer pneumonia events.[16]

Cerebral edema is the most common CT-Scan finding in patients with severe brain injury with tracheostomy (66.67%), followed by epidural hematoma (EDH), diffuse axonal injury, intracranial hematoma, subdural hematoma, cerebral contusions and intraventricular hemorrhage.

## CONCLUSION

Severe brain injury patients with tracheostomy in January-December 2016 and 2017 at General Hospital Province of West Nusa Tenggara were 60 people. 54 of them are male. Severe head injury patients with tracheostomy are common at <18 years and >40 years. Patients with Severe brain injury who get early tracheostomy have more good outcomes, and have relatively short duration of ICU care. Cerebral edema is of most CT-Scan images found in patients with severe brain injury at General Hospital Province of West Nusa Tenggara in January-December 2016 and 2017.

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