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Technical notes & surgical techniques

Subdural drainage of liquor cerebrospinal and early tracheostomy: Alternative management of severe traumatic brain injury with minimal lesion in limited facility and rural area

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ABSTRACT

Background: Patients with severe traumatic brain injury (TBI) usually required rapid evacuation and special care in the Intensive Care Unit for respiratory control, mechanical ventilation, neurosurgical evaluation, and intracranial pressure monitoring (ICP), but in areas with limited facilities not all of these are exist, so it is necessary to provide a novel protocol for it especially in the modest neurosurgical settings.
Method: The study sample was a severe TBI which classified from initial glasgow coma scale (GCS) score ≤ 8 in the West Nusa Tenggara General Hospital, who met the inclusion criteria in between 2016 and 2018 time periode. All samples underwent urgent subdural drainage management and also tracheostomy. Clinical outcome were assesed by the glasgow outcome scale (GOS). All analyses determined by the Medical Record data.
Result: 62 severe TBI patients who underwent subdural drainage and early tracheostomy procedures consisting of 53 (85.5%) men and 9 (14.5%) women. The average age of the study subjects was 30.47 years old with the youngest age of 3 years old and the oldest was 77 years old. The outcome of the study subjects consisted of 48 patients survived (77.4%) and 14 patients died (22.6%).
Conclusion: Subdural drainage and early tracheostomy are recommended novel to perform on severe TBI patient in the area with the modest neurosurgical settings, due to lower mortality rate and better end result.

1. Introduction

Traffic accidents have been identified as a major health problem and need attention. According to the World Health Organization (WHO), traffic accidents are the leading cause of death in children and young adults aged 5–29 years, which causes around 1.35 million people to die each year and is the eighth as the cause of death in all groups age. The risk of death from traffic accidents in low-income countries (27.5 deaths per 100,000 populations) is 3 times greater than in high-income countries (8 deaths per 100,000 populations) [1]. WHO predicts that traumatic brain injury (TBI) and traffic accidents will be the third largest cause of illness and injury in the world in 2020. Although most of the TBI experienced are considered as minor injuries, around 10.9% of the cases are classified as moderate to severe injuries which cause victims to experience significant disabilities [2].

Treatment in TBI patients must be started at the scene of the injury in order to secure the patient's airway and maintain adequate ventilation and circulation. Patients with moderate or severe brain injury should be transferred immediately to a health facility that has a neurosurgical facility as soon as possible. Severe TBI patients with GCS values < 8 and intracranial pressure > 22 mmHg are recommended to be released from the airway and given adequate ventilation, given sedation and analgesics after intubation, and given neuromuscular drugs if needed. The patient's intracranial pressure must be monitored continuously because patients with increased intracranial pressure have a worse end result and have a greater risk of mortality [2–4].

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Fig. 1. High Care Unit: one patients bed, one patients monitor.

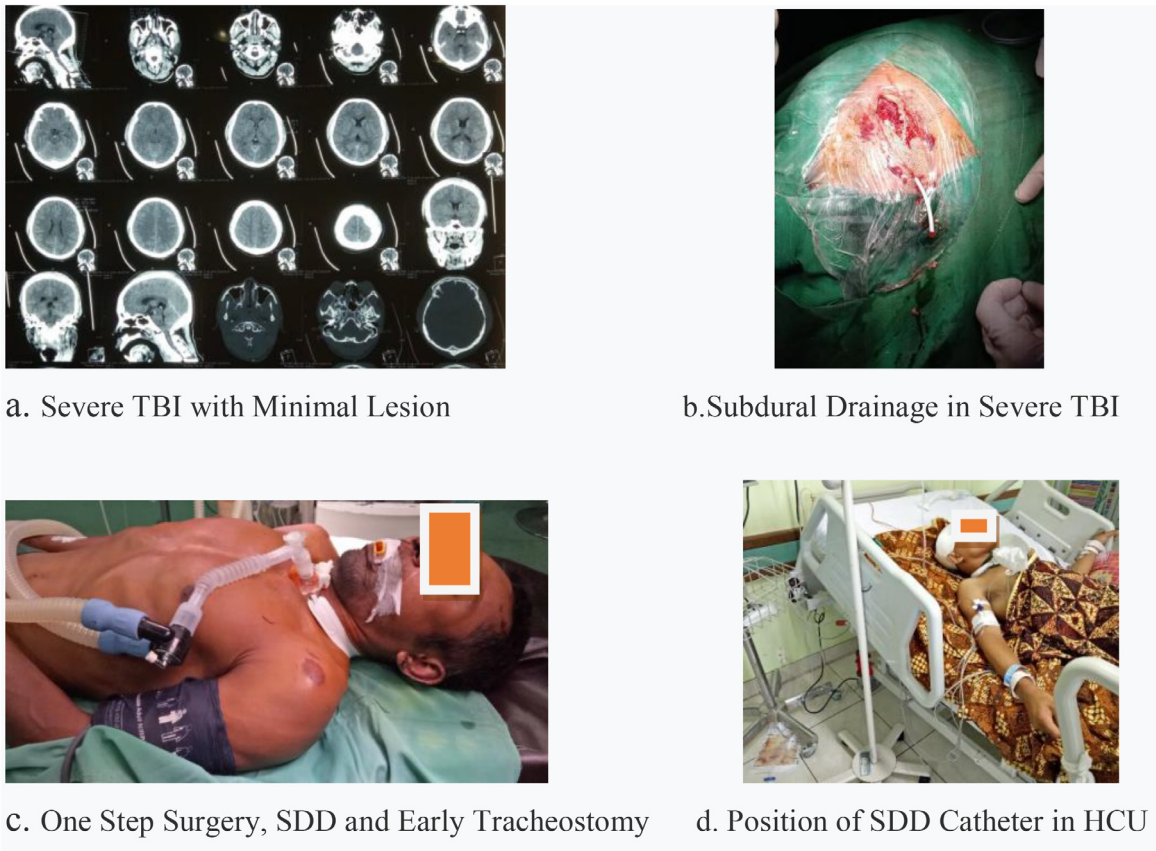

Fig. 2. Alternative Management of Severe Traumatic Brain Injury with Minimal Lesion; SDD and Early Tracheostomy.

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), but in areas with limited facilities not all of these equipment exist, where space capacity is limited and ICP Monitoring is not available, so it is necessary to provide a High Care Unit (Fig. 1) and a simple way to treat patients with severe traumatic brain injury with minimal lesions [5].

Table 1
Characteristics of TBI Patient with Subdural Drainage and Early Tracheostomy.

Characteristics		Numbers	(%)
Gender			
Male		53	85,5
Female		9	14,5
Age			
–	< 40 years	48	77,4
–	> 40 years	14	22,6
Age group			
–	< 10	4	6,5
–	> 10	21	33,9
–	> 20	12	19,4
–	> 30	12	19,4
–	> 40	4	6,5
–	> 50	4	6,5
–	> 60	5	8,1
Average		30.47	
Mechanism of injury			
–	Fall	9	14,5
–	Traffic Accidents	53	85,5
Length of stay (day)			
–	< 3	1	1,6
–	3–7	12	19,4
–	8–14	26	41,9
–	> 15	23	37,1
Average		12.32	
GOS			
–	1	14	22,6
–	2	0	0
–	3	13	21
–	4	16	25,8
–	5	19	30,6
Outcome			
–	died	14	22,6
–	alive	48	77,4

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 and to reduce laryngeal ulcer. Patients with severe brain injury or those with GCS scores < 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 [6].

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 (2004) 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 < 14 days after trauma, because intracranial pressure will be increased 7 days after trauma. 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 [6,7].

The gold standard action to monitor intracranial pressure is by performing an external ventricular drainage technique, which is using a catheter in the ventricle which can also drain the cerebrospinal fluid and insert the drug intrathecally [3,8]. However, this action is inseparable from the risk of infection and bleeding. There are other procedures that have a low risk for infection and bleeding, namely monitoring and subdural drainage [8].

Indonesia, as a low-income country, has relatively high TBI cases, including in West Nusa Tenggara Province. The authors are encouraged to make a study of the profile of severe TBI patients in rural area with the modest neurosurgical setting facilities, which represented by our center.

2. Methods

This study is a retrospective study using medical record data of neurosurgical patients who meet the inclusion and exclusion criteria in the West Nusa Tenggara General Hospital in between 2016 and 2018 periode. This study aims to determine the outcome patient treated with subdural drainage of liquor cerebrospinal to decrease of intracranial pressure and early tracheostomy as alternative management of severe traumatic brain injury with minimal lesion in Limited Facility and Rural Area (Fig. 2)

This study is a correlative study to look for a relationship between the characteristics of severely managed TBI patients and subdural drainage with patient outcomes assessed by the Glasgow outcome scale (GOS). Inclusion criteria in this study include: patients after experiencing trauma (such as traffic accidents, falls, and other) with a diagnosis of severe TBI (initial glasgow coma scale (GCS) score ≤8) with subdural drainage management, early tracheostomy, all gender and ages.

Table 2
Baseline characteristic according severe traumatic brain injury and its outcome.

	Outcome			GOS						
	Alive	Dead	*P*	1	2	3	4	5	*p*	*r*
Sex										
Male	11(17.74%)	42(67.74%)	0.404	11	0	12	13	17	0.574	0.073
Female	3(4.48%)	6(9.68%)		3	0	13	16	19		
Age										
< 40	8(12.90%)	40(6451%)	0.039	8	0	11	14	15	0.219	−0.158
≥40	6(9.68%)	8(12.90%)		6	0	2	2	4		
MOI										
Fall down	3(4.83%)	6(9.68%)	0.4040	3	0	2	3	1	0.221	0.158
Traffic accident	11(17.74%)	42(67.74%)		11	0	11	13	18		
LOS										
< 3 days	1(1.61%)	0	0.00	1	0	0	0	0	0.019	−0.296
3–7 days	9(14.51%)	3(4.83%)		9	0	0	1	2		
8–14 days	2(3.22%)	24(38.70%)		2	0	5	10	9		
> 14 days	2(3.22%)	21(33.87%)		2	0	8	5	8		

3. Results

In this study, there were 62 severe TBI patients who underwent subdural drainage procedures consisting of 53 (85.5%) men and 9 (14.5%) women. The average age of the study subjects was 30.47 years with the youngest age of 3 years and the oldest was 77 years. Most of the trauma mechanisms of the subject were caused by traffic accidents (85.5%) and the remainder was caused by falls (14.5%). Most patients were hospitalized for 8–14 days (41.9%), followed by consecutive treatments > 14 days (37.1%), 3–7 days (19.4%), and < 3 days (1.6%). Most patients had GOS values of 5 (30.6%), followed by GOS values of 4 (25.8%), GOS values of 1 (22.6%), GOS values of 3 (21%) and then GOS values of 2 (0%). The outcome of the study subjects consisted of 48 patients were alive (77.4%) and 14 patients were died (22.6%) (Table 1).

4. Discussion

Based on gender, it was found that men had worse GOS outcomes compared to women ($r = -0.073$) but were not significant ($p = 0.574$). Result of this study is similar to a study conducted by Simanjuntak *et al* in 2013 which found that men suffered more head injuries compared to women with a ratio of 71.9% to 28.1% [9]. Many studies have stated that young adult men are the highest risk holder for brain injury. However, outome differences related to gender are thought to be strongly influenced by hormonal changes and neuroprotective effects of estrogen, progesterone, and testosterone. Several studies conducted indicate that women have a worse outcome if they have a TBI, and only a few reports have better results in women. Research conducted by Kraus found that injuries to women were 1.75 times greater for death and 1.57 times more at risk for disability after TBI. However, research using data from IMPACT shows that there is no correlation between gender and outcome. The outcome can be affected by age and race, but not influenced by gender [10].

Based on age, it was found that the higher the age the worse the outcome of GOS was obtained with a value of $r = 0.215$ but not significantly associated ($p = 0.574$). At the age of < 40 years and ≥ 40 years, 8 patients died and 40 patients lived in the age group < 40 years and 6 patients died and 8 patients lived in the age group ≥ 40 years. There is a relationship between age when divided into < 40 years and ≥ 40 years with patient outcomes. Based on the assessment using GOS it was found that the age group < 40 years had a better GOS outcome compared with patients in the age group ≥ 40 years ($r = -0.158$). However, this was not significantly related ($p = 0.219$) (Table 2). The results of this study are similar to the research conducted by Dhandapani [10], which found that there was a significant relationship between age and deterioration from injury. Outcome was considered to be getting worse with increasing age in every decade. In multivariate analysis, patients aged > 40 years experienced reduced outcomes in various aspects. This was thought to occur due to decreased recovery capacity of the brain due to aging and a decrease in the number of functional neurons [11].

Based on the mechanism of the trauma, patients with traffic accident had better GOS than patients with fall mechanism ($r = 0.158$) but this relationship was not significant ($p = 0.221$). Based on data from centers for disease control and prevention (CDC), traffic accident and falls are the two main mechanisms that cause TBI [12,16,17]. The results of this study are similar to the research conducted by Ziaeirad et al. in 2018 and Rosyidi et al. in 2019 where traffic accident was the biggest caused for mechanism of TBI. WHO has also predicted that traumatic brain injury and traffic accidents will cause the third largest disease and injury in the world by 2020 [1,16,17].

Based on the length of hospital stay, there is a relationship between the length of treatment and the outcome of the patient. The outcome based on GOS shows that the longer the treatment, the better the GOS ($r = -0.296$) and associated significantly ($p = 0.019$). Research on the length of hospital stay has been carried out by Lasprilla et al. in 2010 with similar results that extended treatment at the hospital had a better outcome compared to no climbing treatment. The extended length of stay in hospitals was specifically to be able to improve rehabilitation planning better, improve education for patients and their families, and use better health personnel. However, it did not rule out the possibility of lengthening the hospital stay due to other infections obtained from the hospital as well as complications from the initial illness suffered [13].

Severe brain injury patients need a patent airway for a long period of time. While intubation can not 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 [18–20].

Bouderka states that there was a reduction in the duration of mechanical ventilation. Rodriguez et al also suggested that there was a reduction in the duration ICU and hospital stay. Araby (2004) suggested that the use of tracheostomy can shorten the duration of hospital and ICU stay of severe head injury patients. Hai Peng (2007) 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 [18–20].

Subdural monitoring of intracranial pressure and drainage is considered as a method to manage severe TBI. This procedure did not have complications such as infection or bleeding [8,9]. In addition, the use of subdural drainage is the least invasive method and can be done quickly and easily [14]. Hong (2006) also concluded that the use of subdural drainage in patients with severe brain injury is recommended to monitor intracranial pressure compared to external ventricular drainage [8,9]. A study comparing subdural drainage and subperiosteal drainage concluded that there was no significant differences between both procedure as both have tendency for lower rate of serious complications, a lower rate of mortality, and a lower rate of postoperative epileptic seizures in older patient [14,15].

5. Conclusion

Outcome of severe traumatic brain injury with minimal lesion depends on early diagnostic and prompt treatment, in areas with limited facilities and rural area not all of these equipment exist, where space capacity is limited and ICP Monitoring is not available, so it is necessary to provide a High Care Unit and a simple way to treat patients with subdural drainage of liquor cerebrospinal to decrease of intracranial pressure and early tracheostomy. It can be concluded that subdural drainage and early tracheostomy is a good procedure to perform in severe head injury patient due to lower mortality rate and better end result.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.inat.2019.100614.

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