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## Full Outline of Unresponsiveness Score and Brainstem Sign Score Application to Predict Mortality of Patients with Severe Head Injuries at Gambiran Public Hospital of Kediri



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### Abstract

There are many factors and variables that influence the prognosis in patients with severe head injuries make determining the prognosis for patients with severe head injuries become difficult. There are two parameters that can predict the prognosis of severe head injury patients with optimal full outline of unresponsiveness score (FOUR score) and brainstem sign score (BSS). FOUR scores can provide a wealth of information about the scale of neurological signs that are quick and easy used for unconscious patients. BSS is an assessment to predict the death of a person permanently to determine whether there is a physiological function that is not function normally. The aimed of this study was to determine ratio of FOUR score and BSS in determining the prognosis of patients with severe head injury at RSUD Gambiran Kediri. The type of study was cross sectional approach. The sampling technique used consecutive sampling technique and obtained a sample of 60 people. The data was analyzed by using chi-square test for comparison of FOUR score and BSS in determining the prognosis of severe head injury patient at RSUD Gambiran Kediri. Based on the results of study by chi-square test showed that  $p \text{ FOUR score} = p \text{ BSS} = 0,004$ , which meant the FOUR score and BSS was determined the prognosis of patients with severe traumatic head injury at RSUD Gambiran Kediri. The study showed that there was no difference between the FOUR score and BSS in determining the prognosis of severe head injury patient at RSUD Gambiran Kediri but FOUR score could be used in incubated or ventilated patients. Based on the results of this study, it is advisable to use scoring method more easily and according to the condition of the patient is with the installed ventilator or non ventilator.

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## INTRODUCTION

One of the neurological emergencies which is the main cause of death and disability in children and young adults is a head injury so that an accurate prognosis is very important (Tarwoto and Wartonah, 2007 in Nurhayati, 2013). Assessment of the neurological prognosis of patients with severe head injury presents its own difficulties (Turgeon, AF, et al, 2017).

Based on data, in the United States and New Zealand there are about 500-800 cases per 100,000 people who experience traumatic head injuries each year (Dewan et al, 2018). The incidence of severe head injuries at the Gambiran Kediri Regional Hospital from January to December 2018 was 261 patients and 27 people died. While the incidence rate for the last 3 months from January to March 2019 there were 68 patients and 17 people died.

The high mortality rate in severe head injury patients requires an effort to help reduce the mortality rate, namely by determining an accurate prognosis so that the treatment given to severe head injury patients is optimal and maximal (Ozoilo, 2012)

Two recognized measures can predict the prognosis of severe head injury patients with precise and accurate results. According to Bordini et al (2010), a rating scale using the full outline of unresponsiveness score (FOUR) is useful for knowing neurological signs in severe head injury patients. The FOUR score can be used to evaluate the level of consciousness in patients with severe head injuries. The advantages of the FOUR score can be used to assess nonverbal responses in patients who are intubated, sedated or in delirium (Nair et al, 2017).

There are four components that become an assessment of the FOUR score, namely eye response, motor response, brain stem reflex and respiration, where each component has a score between 0 - 4 (Bordini et al, 2010).

According to Okasha et al (2014), the FOUR score has advantages compared to GCS because it provides more detailed neurological status information in patients with decreased consciousness or in patients with a vegetative status.

In addition to the FOUR score, there is also a Brainstem Sign Score (BSS) which is used to assess head-trunk reflexes in patients with decreased consciousness. The brainstem sign score is a neurological status assessment tool that can be used in patients with impaired consciousness. The

assessment component in the BSS is more complete than the FOUR. BSS assessment can be seen from pupil size, pupil response to light, corneal reflex, oculosephallic reflex, eye movement, motor attitudes to pain stimuli and breathing patterns. Each component in the BSS has a different range with a total score of 25 (Reginald & Adesola, 2010).

Based on the description above, the studyer is interested in conducting study, namely comparing the full outline of unresponsiveness score and brainstem sign score in predicting mortality in severe head injury patients at Gambiran Kediri Hospital.

## METHODS

This study used a cross sectional design. The sampling technique used consecutive sampling. The respondents were 60 people.

The subjects in this study were patients with severe head injury (GCS 3-8) without accompanying other diseases (stroke, infection and brain tumor) or non-traumatic injury.

All study subjects were assessed FOUR score and BSS at the time of admission to the hospital, then the patient was followed up to 7 days of hospitalization whether there was an outcome in the form of death or moving rooms.

## RESULTS

**Table 1** Frequency distribution of severe head injury patients at RSUD Gambiran Kediri

Information	F	Perct (%)
<b>Age</b>		
a) 1 - 5	3	5
b) 6 - 12	3	5
c) 13-17	9	15
d) 18 - 45	18	30
e) 46 - 55	15	25
f) 56 - 65	6	10
g) > 66	6	10
<b>Total</b>	<b>60</b>	<b>100</b>
<b>Gender</b>		
a) Male	42	70
b) Women	18	30
<b>Total</b>	<b>60</b>	<b>100</b>
<b>Profession</b>		
a) Student/student	21	35
b) Civil servants	6	10
c) Private	33	55
<b>Total</b>	<b>60</b>	<b>100</b>

From the study conducted, it was found that 60 study subjects met the inclusion criteria.

Based on Table 1, it can be seen that the frequency of severe head injury patients at the Gambiran Kediri Regional Hospital in 2019 based on age is the majority aged 18-45 years, namely 18 respondents (30%). The highest frequency of severe head injury patients based on gender was the majority of men, namely 42 respondents (70%). Meanwhile, based on occupation, the majority are

private workers, namely 33 respondents (55%).

Table 2 illustrates the bivariate analysis between the FOUR score and BSS variables with the respondent's output by using the chi square test. Grouping the FOUR score was less than and more than equal to 9, while for BSS it is less than and more than equal to 13. From the chi square test results, the p value is 0.004 for the FOUR score and BSS.

**Table 2 Bivariate Analysis Between The Variable Score and Mortality Outcome in RSUD Gambiran Kediri**

Score	Output		f	p	OR	IK95%	Total
	Die	Life					
<b>FOUR score</b>							
High risk of death ( $\leq 9$ )	9	9	18	0.004	0.500	0.225-1,113	60
Low risk of death ( $> 9$ )	0	42	42				
<b>BSS</b>							
Risk of brain stem death ( $\leq 13$ )	9	9	18	0.004	0.500	0.225-1,113	60
No brain stem death ( $> 13$ )	0	42	42				

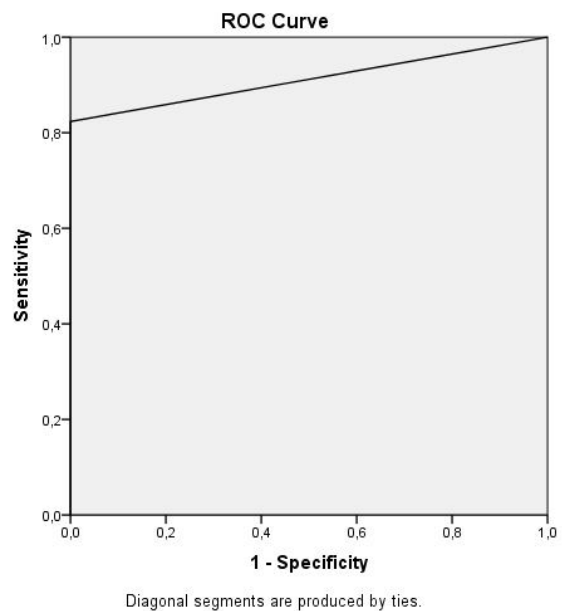
FOUR = Full Outline of Unresponsiveness;  
 BSS = Brainstem Sign Score;  
 OR = odd ratio;  
 IK = Confidence interval.

**Table 3 Diagnostic test between the FOUR score and BSS**

FOUR score	BSS		Total
	$\leq 13$	$> 13$	
$\leq 9$	18	0	18
$> 9$	0	42	42
<b>Total</b>	<b>18</b>	<b>42</b>	<b>60</b>

FOUR = Full Outline of Unresponsiveness Score;  
 BSS = Brainstem Sign Score.

From the diagnostic test, it was found between the FOUR score and BSS, the sensitivity was 100%; specificity 82%. An overview of the ROC (receiver operating curve) is shown in Figure 1.



**Figure 1 Receiver Operating Curve for the probability of mortality against the total FOUR score (A) and BSS (B). AUC FOUR 0.912 and BSS 0.912.**

## DISCUSSION

In the study, it was found that the FOUR score with a value of  $\leq 9$  had a high risk of death, there were 18 respondents (30%) of whom 9 respondents died and 9 respondents lived with a high risk of death. FOUR score  $> 9$  low risk of death, there were 14 respondents alive (70%). This is consistent with Wijdick et al. (2005) which states that the FOUR score can determine the outcome of death in hospital with a p value of 0.004.

While the BSS results showed that BSS with a value of  $\leq 13$  stated that there was a risk of brain stem death, there were 18 respondents (30%) with 9 respondents who died and 9 respondents were alive, while there were 42 respondents (70%) who did not have brain stem death. The p value = 0.004 so the Brainstem Sign Score were used in determining the prognosis of severe head injury patients at Gambiran Kediri Regional Hospital.

The result between FOUR score and BSS, sensitivity 100%; specificity 82%. The results of this study has the same sensitivity level, meaning that there was no difference between the FOUR score and BSS in determining the prognosis of patients with severe brain injury (p FOUR score = p BSS = 0.004), AUC FOUR score = BSS = 0.912).

According to Stead (2009), the FOUR score is a neurological signs rating scale that provides a good assessment of eye movement, motor response, brain stem reflexes, and breath effort in patients on ventilators and patients who experience decreased consciousness. This was supported by the results of the study by Matoha (2016) that based on the FOUR score there was high risk of death for 3 people (5.2%) and a low risk of death for 33 people (56.9%). In general, a high FOUR score will produce a good outcome.

This scale ignores verbal assessments so that it can still be applied to patients who have experienced verbal injury (Dewi, 2011). Severe head injury patients out of 60 respondents at the time of examination using the FOUR score showed signs of abnormalities in the pupils. Some showed different reactions in both eyes. According to Andrews (1991 cited in Sastrodiningrat (2006) states that anisochores, dissimilar pupil reflexes or unresponsive pupils are caused by compression of the third brain nerve or an injury to the upper brainstem. In motor, an abnormal motor response is found. such as flexor and extensor postures. This is according to the study

of Jennet & Teasdale (1979). This motor response can predict a poor prognosis outcome after severe head injury.

The FOUR score can be used to predict mortality or functional outcome after discharge in severe head injury patients. In addition, the FOUR score can be used quickly and easily to assess neurological signs in patients with decreased consciousness.

The results of this study are supported by Gorji (2016) that in predicting mortality in hospitals with a FOUR score, the receiver operating curve (ROC) value is 0.92 (95%, CI. 0.81-0.97) and BSS can be used to predict mortality as done by Pamungkas (2015).

Pamungkas (2015) states that the assessment of brain stem death using BSS to measure mortality states that respondents with brain stem death ( $< 13$ ) are 66.7% and there is no risk of brain stem death ( $> 13$ ) of 33.3%.

According to study by Obiako and Ogunniyi (2010) on BSS in predicting the final outcome of the prognosis of stroke patients, the BSS results were obtained with a value of p =  $< 0.0001$ . In addition, it is supported by study by Obiako & Ogunniyi (2010) which states that the accuracy level of the brainstem sign's score in the calculation of negative predictive value (NPV) is 100% in a period of 1 to 28 days, while positive predictive value (PPV) is 90-100% in a period of 7 days. So that the brainstem sign's score is a score for assessing the mortality of a person with a period of 7 days with a risk of brainstem death with a value of less than 13.

According to the researchers, no difference occurred because the components of the FOUR score and BSS were the same, namely motor response, brain stem reflexes including pupillary and corneal reflexes and breathing patterns. The advantage of the FOUR score is that it can be used as a measuring tool in determining prognosis in patients who are intubated or on a ventilator (Stead and Murthy, 2009). The FOUR score component has a score or a value that states the breath at the speed above the ventilator, which is given a score of 1 (one), but the researchers found 9 respondents who were installed on a ventilator, this will give a minimal result score and it is difficult to use in knowing the difference. FOUR score is faster and easier to use than BSS. BSS can be used in the ER or can be used in patients without a ventilator.

## CONCLUSION

After conducting a study on the comparison of the full outline of unresponsiveness score and brainstem sign score in determining the prognosis of severe head injury patients, it was known that the FOUR score and BSS examination of 60 respondents showed a high risk of death for FOUR score and BSS  $\leq 13$ , there was a risk of brain stem death. There were 9 people died and 9 people lived with a total of 18 people (30%). FOUR score  $> 9$  low risk of death and BSS  $> 13$  there was no brain stem death, there were 42 people alive (70%) so there was no comparison seen from the diagnostic test between FOUR score and BSS, sensitivity 100%; specificity 82%; AUC FOUR score for the likelihood of death in hospital 0.912 and AUC BSS 0,

## SUGGESTION

1. Nursing agencies  
It is hoped that nursing agencies will further develop study and disseminate the latest methods in carrying out examinations to determine the prognosis of severe head injury patients.
2. Gambiran Kediri Regional Hospital  
It is hoped that the FOUR score measuring instrument can be applied in the ICU room because it can be used for assessment in patients with a ventilator installed and BSS is applied in the ER or in patients without a ventilator.
3. Further researchers  
In this study, the number of respondents greatly influenced the results of the study. Therefore, it is hoped that it can motivate researchers to further develop study, namely adding longer study time with the aim of getting more respondents.

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