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ACCURACY OF GLASGOW COMA SCALE (GCS) COMPONENTS AS PREDICTORS OF MORTALITY OF MODERATE AND SEVERE HEAD INJURY CLIENTS

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ABSTRACT

In moderate and severe head injury clients with multiple traumas, there may be difficulty calculating GCS scores due to facial trauma to the eyes and mouth. This condition makes it difficult for nurses and emergency room doctors to calculate client prognosis using GCS. This study aims to analyze the ability of GCS components as a predictor of mortality for moderate and severe head injury clients. This study is an *observational* study with a *retrospective cohort* design. The population is the medical record data of head injury patients admitted in the period January to December 2020 at Dr. Iskak Tulungagung Hospital. A sample of 115 medical records was obtained through purposive sampling method. The variables were GCS score in emergency department *triage data* and *mortality* data of head injury clients within seven days of treatment. *The* results were analyzed by *Mann Whitney Test*, logistic regression and ROC *Curve* comparison. *The* logistic regression result of GCS score has *sensitivity* = 0.904, *specificity = 0*.809, PPV = 0.955, NPV = 0.654; *GCS-Eyes* has sensitivity = *0*.938, specificity = 0.617, PPV = 0.854, NPV = 0.807; *GCS-Verbal* has a *sensitivity* = 0.929, specificity = 0.667, PPV = 0.887, NPV = 0.769; *GCS-Motor* has a sensitivity = 0.833, specificity = 0.692, PPV = 0.955, NPV = 0.346. ROC *Curve* comparison results show ROC GCS = 0.952, *GCS-Eyes* = 0.870, *GCS-Verbal = 0*.885, *GCS-Motor = 0*.903. The conclusion is that the *GCS-Motoric* component is the GCS component that has the best accuracy after GCS.

Keywords: Head Injury, GCS Components, Mortality Prognosis.

INTRODUCTION

Glasgow Coma Score (GCS) is a diagnostic tool that has long been a tool for evaluating the level of client awareness, assessing the client's clinical status, and being a prognosis tool for clients who have head injuries (Kung et al, 2011; Rapsang & Shyam, 2015; Tjahjadi. et al, 2013). The GCS score is obtained from the results of additional assessments of three components, namely eye (E), motor (M), and verbal (V) (Rapsang & Shyam, 2015; Tjahjadi et al, 2013). In clients with multiple trauma conditions, especially in cases of moderate and severe head injury, it is possible to calculate a GCS score because of the trauma to the face that affects the eyes and mouth. This condition can make it difficult for nurses and emergency room doctors who use GCS as a parameter to

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evaluate the level of client awareness and the prognosis of head trauma clients.

According to the results of Ristanto's (2017) study, there was a significant relationship between GCS scores of client head injury and mortality incidence of head injury clients within 7 days of treatment. Based on the results of multivariate logistic regression analysis, GCS has a negative correlation with head injury client mortality within 7 days of treatment, so it can be interpreted that the lower the GCS value, the more likely the head injury client mortality will increase within 7 days of treatment. The logistic regression test results show that the GCS equation has a p value of the Hosmer and Lamesho test = 0.146, a sensitivity value of 0.84, a specificity of 0.74, a Positive Predictive Value (PPV) of 0.892, a Negative Predictive Value (NPV) of 0.645, and with an AUC of 0.853 (CI95% 0.767-0.938).

Glasgow Coma Score is an important factor that must be measured in clients with head injuries (Jennet, 2005). Glasgow Coma Score is a diagnostic tool that has long been a tool for evaluating the level of client awareness, assessing the client's clinical status, and being a prognosis tool for clients who have suffered head injuries (Kung et al., 2011). The Glasgow Coma Score is also used to quantitatively assess neurological disorders and is used generally in the description of the severity of head injury patients (Ting et al., 2010). The GCS score is the standard measurement of neurological function in clients with changes in mental status due to any cause, including head injuries (Lingsma, 2014). The assessment of GCS depends on the response of the cerebrum to afferent stimuli. Variations in the value of GCS are caused by impaired cerebral function or disorders in the brain stem that affect the passage of stimuli to the cerebral hemisphere (Irawan et al., 2010; Wilkinson & Lennox, 2005).

Given the importance of measuring GCS in head trauma clients, it is necessary to simplify the GCS score if one component cannot be measured. This simplification can be done using the constituent components of the GCS score itself. So that research is needed to calculate the accuracy of each GCS component. By knowing the accuracy capabilities of each GCS component, the component with the highest accuracy or close to the accuracy of the GCS can be used as a substitute for the GCS score as a parameter to evaluate the client's level of awareness and the prognosis of the client for head trauma, especially in cases of moderate and severe head injury.

METHODS

This study is an *observational analytic correlation* with a *retrospective cohort* approach. *The* population in this study were head injury clients who entered through the emergency room recorded in medical record installation data in the period January - December 2018 at Dr. Iskak Tulungagung Hospital. The sample in this study were head injury clients who met the inclusion and exclusion criteria. The inclusion criteria in this research are: 1) Medical records of head injury clients with ISS value ≥ 15 (Salim, 2015), 2) Medical records that have GCS data, 3) Medical records that have data on client age 20-65 years. Exclusion criteria: Did not use medical record data of clients who: 1) moved the hospital before 7 (seven) days of treatment at RSUD Dr. Iskak Tulungagung, 2) suffered serious burns, 3) intoxication (both drugs and alcohol), 4) suffered other serious injuries that could worsen the client's condition (intra abdominal bleeding, cardiac tamponade, multiple fractures in the pelvis). The sampling technique used *purposive sampling* and obtained a sample of 115 medical record

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data. The results were analyzed using the *Mann Whitney Test*, logistic regression and ROC *Curve* comparison.

METHOD

This study is an observational analytic correlation with a retrospective cohort approach. The population in this study were clients with head injuries who entered through the *ER* who recorded medical record installation data in the period January - December 2018 at Dr. Iskak Tulungagung. The sample in this study were head injury clients who met the inclusion and exclusion criteria. The inclusion criteria in this study were: 1) medical records of head injury clients with an ISS value of ≥ 15 (Salim, 2015), 2) Medical records that had GCS data, 3) Medical records that had data on the client's age of 20-65 years. Exclusion criteria: Do not use medical record data of clients who: 1) moved to the hospital before 7 (seven) days of treatment at RSUD Dr. Iskak Tulungagung, 2) had serious burns, 3) intoxication (both drugs and alcohol), 4) had other serious injuries that could worsen the client's condition (intra-abdominal bleeding, cardiac tamponade, multiple fractures of the pelvis). The sampling technique used purposive sampling and obtained a sample of 115 medical record data. The results were analyzed using the Mann Whitney test, logistic regression and comparison of the ROC Curve.

RESULTS

Table 1. Respondent characteristics data

Characteristics	n	%
Gender		
Male	84	73
Female	31	27
Causes of trauma		
Accident	100	87
Falling from a height	9	7.8
Hit by a blunt object	6	5.2
Client mortality		
Live	89	77.4
Die	26	22.6
Total	115	100

Table 2. data of GCS characteristics

Variables	Average	Median	Minimum	Maximum
Age	39.90	40	19	68
ISS Score	25.23	26	18	38
GCS *Score*	8.48	9	3	12
Score Eyes	2.03	2	1	4
Score Verbal	2.36	2	1	5
Motor *Score*	4.09	5	1	5

Based on the results of the study in Table 1, most of the head injury victims were male (84 or 73%) with the main cause being accidents (100 or 87%) and most of the head injury victims were alive (89 or 77.4%) after treatment for 7 days after head

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injury. Based on the results in Table 2, the average age of head injury victims was young or productive (median 40 with a mean of 39.90 (19-68)). In the ISS *score* data, the average victim had multiple trauma injuries (median 25.55 with a mean of 25.55 (18-38)). In GCS *score* data, the highest level of injury was moderate head injury (median 9 with a mean of 8.53 (3-12)). In the *eyes score data, it* has a median of 2 with a mean of 2.01 (1-4). In the verbal score data, it has a median of 2 with a mean of 2.36 (1-5). In the motor score data, it has a median of 5 with a mean of 4.17 (1-5).

Table 3. Logistic Regression Test Results

	Coefficient	S.E	Wald	df	*P-value*	OR	95% IK Min	95% IK Max
GCS	-1.109	0.220	25.499	1	0.000	0.330	0.214	0.507
Eye	-2.709	0.545	24.676	1	0.000	0.067	0.023	0.194
Verbal	-2.592	0.541	22.919	1	0.000	0.075	0.026	0.216
Motoric	-1.453	0.282	26.457	1	0.000	0.234	0.134	0.407

Table 4. Accuracy Comparison

Variables	Predictive Ability: Live	Predictive Ability: Died	%	*Overall Percentage*
GCS	85	4	95.5	88.7
	9	17	65.4	
Eyes	76	13	85.4	84.3
	5	21	80.8	
Verbal	79	10	88.8	86.1
	6	20	76.9	
Motoric	85	4	95.5	81.7
	17	9	34.6	

Based on the test results in Table 4.3, it can be concluded that all variables affect the mortality of head injury clients (*p = 0.000). The* strength of the relationship can be seen from the OR value, the GCS variable has the greatest strength (OR = 0.330), then the motor component (OR = 0.234), and then the eye and verbal components. Based on the results of *the multivariate* logistic regression test analysis in Table 4, the *sensitivity* value of GCS = 0.904 or 90.4% (85/94), eyes component = 0.938 or 93.8% (76/81), verbal component = 0.929 or 92.9% (79/85), motor component = 0.833 or 83.3% (85/102). From the calculation of the *sensitivity* value, it can be concluded that the *eyes* and verbal components have the highest *sensitivity* as *predictors of mortality for* moderate and severe head injury clients. *Specificity* value of GCS = 0.809 or 80.9% (17/21), eyes component = 0.617 or 61.7% (21/34), verbal component = 0.667 or 66.7% (20/30), motor component = 0.692 or 69.2% (9/13). From the calculation of *specificity* values, it can be concluded that GCS and motor components have the highest *specificity* as *predictors of mortality for* moderate and severe head injury clients.

Positive Predictive Value (PPV) of GCS = 0.955 or 95.5% (85/89), eyes component = 0.854 or 85.4% (76/89), verbal component = 0.887 or 88.7% (79/89), motor component = 0.955 or 95.5% (85/89). From the results of the PPV value calculation, it can be concluded that

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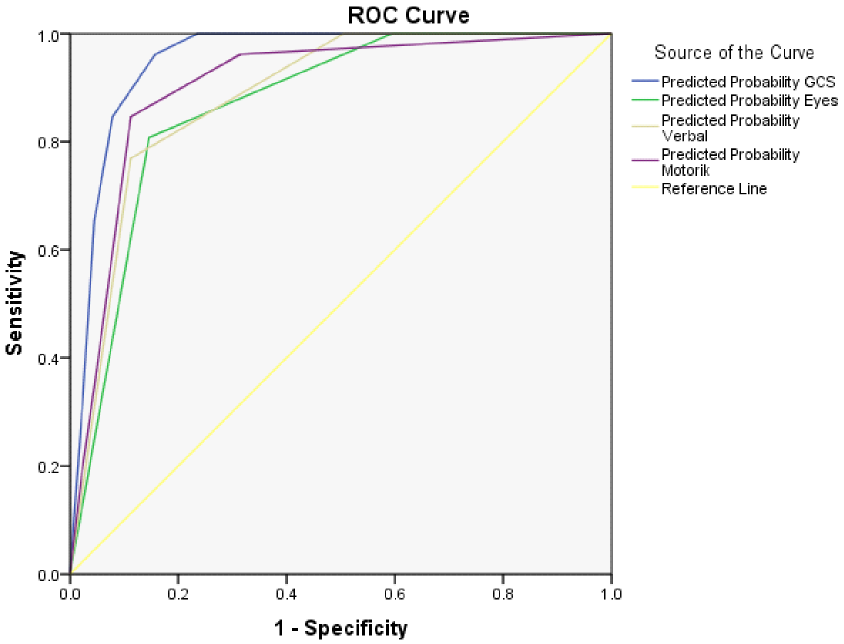
the GCS component and the motor component have the highest PPV value as a *predictor of mortality for* moderate and severe head injury clients. *Negative Predictive Value* (NPV) of GCS = 0.654 or 65.4% (17/26), eyes component = 0.807 or 80.7% (21/26), verbal component = 0.769 or 76.9% (20/26), motor component = 0.346 or 34.6% (9/26). From the calculation of the NPV value, it can be concluded that the *eyes* and verbal components have the highest NPV value as a *predictor of mortality for* moderate and severe head injury clients.



Diagonal segments are produced by ties.

Based on the results of the *ROC curve* comparison analysis, *it* was found that GCS ROC = 0.952, *Eyes* component ROC = 0.870, *Verbal* component ROC = 0.885, *Motor* component ROC = 0.903. From these results, it can be concluded that the *motor component* is the GCS component that has the best accuracy after GCS, so that the *motor* component can be used as a substitute for GCS as a *predictor* parameter of *mortality for* moderate and severe head injury clients.

DISCUSSION

The findings indicate that the motor component of GCS has the ability to replace total GCS in predicting *mortality of* moderate and severe head injury clients. In adult or pediatric clients with moderate and severe head injury and there is a complication for total GCS assessment, it can be replaced with GCS motor component assessment. The motor component of GCS has a higher *ROC curve* or *Area Under Curve* (AUC) than the AUC of the *Eyes* GCS and *Verbal GCS* components.

According to (Beskind *et al.*, 2014) *the motor* component of *pre-hospital* GCS has good discriminatory ability equivalent to total GCS in the ability to determine the severity of head injury, whether or not the client needs special measures such as intubation; referral to a trauma center hospital, and client *outcome* after hospitalization. The motor component of GCS is a very useful parameter for *prehospital providers* because it is easy to

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assess and has better reliability than other GCS components. (Reith *et al.*, 2017). The motor component of GCS has been identified to contain almost all the prognostic information in the total GCS score in severe head trauma clients. (Peel, Melnychuk and Young, 2016)..

The dominance of the GCS motor component is caused by one of them, the average GCS score in the study results is 8. According to (Reith *et al.*, 2017)(Reith et al., 2017), in the condition of clients experiencing severe head trauma with a GCS score range of 3 to 7 and 8, a good or bad picture of the client's condition can be reflected most strongly in the GCS motor score (from scores 1 to 5 in six categories). In this condition, the *Eyes* GCS component and *Verbal* GCS component tend to remain low. As a result, in most clients with a total GCS score of 3 to 7, the sum score of all GCS components only reflects changes in the client's motoric component responses. This is supported by the results of a study that showed that the average motor component score was 4 and the average score of the eye and verbal components was 2. Another study in children admitted to the intensive care unit and had a total GCS score of 8 or less, the GCS motor component score alone was anticipated to distinguish between poor and good outcomes. Other studies have suggested that the GCS eye component and GCS verbal component can be omitted without compromising GCS prediction accuracy as the GCS motor score is considered to have accounted for almost all of the predictive power, both in adults and in children.

According to (Reith *et al.*, 2017)In the GCS total score range, the motor component score tends to remain unchanged so that the GCS total score is mainly influenced by changes in the score of the verbal and eye components. However, at a total GCS score of 13, the motor component score again dominates its influence on the GCS summation score. In most clients with mild head trauma cases with a total GCS score ranging from 13 to 15, the GCS motor score does not affect the level of consciousness because it has reached its maximum influence at a total GCS score of 13 in most patients. The lowest and highest effects of eye component responses were achieved at GCS sum scores of 8 and 14 while verbal responses were found at GCS sum scores of 7 and 15. Univariate logistic regression analysis identified a decrease in case fatality rate was depicted by an increase in either component score or GCS sum score across all data sets. This suggests that either component or sum GCS scores have an inverse relationship with the worsening condition of both moderate and severe head injury clients.

Across all GCS data sets, the motor score has the highest prognostic value in clients with severe head trauma compared to the other components. However, in patients with less severe TBI, the prognostic effect is lower. The eye and verbal components have prognostic value at different severities of head injury, the verbal component showing the highest prognostic value of all components in clients with mild head injury. The prognostic value of the three components combined with all GCS components (E + M + V) in the logistic regression model consistently remained higher than the prognostic value of each component across different severities of head injury. However, each different composition of EMV with identical sum GCS scores carries a different risk of mortality (Reith *et al.*, 2017).

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