

RESEARCH ARTICLE

Combination of Glasgow Coma Scale, Age, and Systolic Blood Pressure in Assessing Patients' Outcomes with Decreased Consciousness

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Abstract

Glasgow Coma Scale (GCS) is commonly used to assess outcomes of patients with loss of consciousness, but it is insufficient in predicting the outcome of some cases. This study aimed to assess the combination of GCS, systolic blood pressure and age to predict the outcome of patients with decreased consciousness. This was a retrospective cohort observational study of 76 loss of consciousness patients that comes into the Emergency Department of Dr. Cipto Mangunkusumo General Hospital in June-August 2014. Data was obtained from the medical records. GCS, systolic blood pressure and age were recorded when patients were admitted to the triage. Outcome was assessed two weeks after admission in the emergency department. Bivariate analysis on the GCS and age showed significant different between patients with poor outcome group with good outcome group ($p < 0.05$) and no significant different of the systolic blood pressure between both groups ($p > 0.05$). Multivariate analysis on the GCS and age showed good probability equation based on the calibration test and discrimination. The combination of Glasgow Coma Scale and age was accurate in assessing the outcomes of patients with loss of consciousness.

Keywords. Glasgow Coma Scale, systolic, age, outcomes

Gabungan Glasgow Coma Scale, Umur, dan Tekanan Darah Sistolik Sebagai Penilai Luaran Pasien Penurunan Kesadaran

Abstrak

Glasgow Coma Scale (GCS) telah menjadi salah satu penilaian yang digunakan untuk menilai luaran pasien penurunan kesadaran, tetapi dinilai masih belum mampu memprediksi luaran yang terjadi. Penelitian ini bertujuan untuk menilai gabungan GCS, tekanan darah sistolik dan umur untuk memprediksi luaran pasien dengan penurunan kesadaran. Penelitian ini merupakan studi observasional kohort retrospektif yang melibatkan 76 pasien dengan penurunan kesadaran yang datang ke IGD RSUPN Dr. Cipto Mangunkusumo selama bulan Juni-Agustus 2014. Data diambil dari rekam medik. GCS, tekanan darah sistolik dan umur dicatat saat pasien di triase. Luaran dinilai setelah dua minggu pasca kedatangan di IGD. Hasil analisis bivariat pada GCS dan umur diperoleh hasil berbeda bermakna antara pasien kelompok luaran buruk dengan kelompok luaran baik ($p < 0.05$). Hasil analisis bivariat pada tekanan darah sistolik tidak berbeda bermakna antara pasien kelompok luaran buruk dengan kelompok luaran baik ($p > 0.05$). Hasil analisis multivariat pada GCS dan umur memperoleh hasil persamaan probabilitas yang baik menurut uji kalibrasi dan diskriminasi. Gabungan Glasgow Coma Scale dan umur memiliki ketepatan dalam menilai luaran pasien dengan penurunan kesadaran.

Kata kunci: Glasgow Coma Scale, sistolik, umur, luaran

Introduction

Decreased consciousness is one of the most common cases in the Emergency Room (ER) and its mortality rate is quite high. The most common cause of decreased consciousness is neurological dysfunction (stroke) followed by head trauma. The mortality number of stroke is 140.000 out of 795.000 cases, while for head trauma 521 out of 100.000 cases per year. There were 116 decreased consciousness patients in the ER of Dr. Cipto Mangunkusumo General Hospital (CMGH) in May 2014, with 44% mortality rate.^{1,2}

The causes of decreased consciousness are divided into two, intracranial, such as stroke, head trauma, intracranial infection, tumor, and extracranial such as drugs intoxication, heart failure, renal failure, liver failure, respiratory failure, severe electrolyte imbalance, hypoglycemia, hyperglycemia and systemic infection. Stroke and sepsis were the most common cause of decreased consciousness in the ER of CMGH in May 2014.^{1,2}

Patient's *Glasgow Coma Scale* (GCS) at the time of admission in the ER can predict the outcome of decreased consciousness patients. GCS was established by Jennett and Teasdale³ to assess consciousness level of patients with head trauma. GCS has been used broadly to do an initial assessment of consciousness for all patients admitted to the ER. Wahyu¹ concluded that GCS can predict the outcome of patients with decreased consciousness in CMGH's ER.

Age is an unmodified factor in the patient. As the patient grows old, the organ systems decrease in function, especially vital organs such as heart, lungs, kidneys, liver which affected the whole body function, thus worsen the prognosis. Increasing age was a strong predictor for both one-day and 30-day mortality in the ER.⁴

Blood pressure also affects mortality rate. A change in the blood pressure affects organs' perfusion that leads to permanent damage and death. Taylor stated that mortality risk is associated with systolic blood pressure. In the ER and prehospital setting, hypotension in non-trauma patient is a strong predictor of in-hospital mortality.⁵⁻⁷

Glasgow Coma Scale-Age-Systolic Blood Pressure (GAP) is simple scoring system to predict

mortality for trauma patients.^{7,8} The addition of age and systolic blood pressure to GCS score is expected to increase the accuracy in predicting decreased consciousness patients' outcome. This assessment can be done by all medical staffs, in the field or in the ER without any help of monitor or laboratory support, which makes it applicable to decreased consciousness patients. The result of the assessment shows patient's condition to the medical staffs and gives early information to patient's family.^{3,9}

GCS, age, and systolic blood pressure are closely related to each other, as well as patients' outcome. Thus, those three variables are adequate and proper as an outcome predictor. This study aimed to assess the combination of GCS, systolic blood pressure and age to predict the outcome of patients with decrease of consciousness in the ER of CMGH.

Methods

This is a retrospective cohort study in CMGH ER in June-August 2014. Data was obtained from the medical records. The inclusion criteria are adult (≥ 18 years old) with GCS less than 15 at the admission time. Exclusion criteria were patients with decreased consciousness history, patients receiving sedatives before ER admission, patients with long term hospitalization outside CMGH. Drop out criteria were referred patients to the other hospital after CMGH ER admission.

Minimum sample count was 70. Data recorded were name, medical record number, sex, GCS score, systolic blood pressure and outcome. Outcome was assessed two weeks after admission in the ER department. Outcome was divided into good outcome (GCS 4-5) and poor outcome (GCS 1-3). Data analysis was done using SPSS 20 with unpaired T-Test or Mann-Whitney-U test, depended on the distribution. Multivariate analysis with logistic regression was done to components with $p > 0.25$.

Result

There were 76 subjects (Table 1) who came to ER with decrease of consciousness in June-August 2014. Most of subject with poor outcome and the mean age was 51.13 ± 15.77 years old.

Table 1. Subjects' Characteristics

Characteristics	n (%)
Sex	
Male	25 (32.89)
Female	51 (67.11)
Age (years)*	51.13 ± 15.77
GCS**	9 (3-14)
Systolic blood pressure (mmHg)**	126.5 (60-240)
Outcome	
Good outcome	27 (35.5)
Poor outcome	49 (64.5)
Diagnosis intracranial	
Head trauma	14 (18.4)
Intracranial space occupying lesion	4 (5.3)
Hemorrhagic stroke	12 (15.8)
Non hemorrhagic stroke	9 (11.8)
Intracranial infection	11 (14.5)
Metabolic	
Sepsis	17 (22.4)
Uremic Encephalopathy	2 (2.6)
Hepatic Encephalopathy	1 (1.3)
Cardiac	1 (1.3)
Diabetic Ketoacidosis	2 (2.6)
Drug/alcohol intoxication	3 (3.9)

* mean±SD, **Median (min-max)

Bivariate analysis on the GCS and age showed significant different ($p < 0.05$) between patients with poor outcome group with good outcome group and

no significant different ($p > 0.05$) of the systolic blood pressure between both groups (Table 2).

Table 2. Bivariate Analysis of GCS, Systolic Blood Pressure, Age towards Outcome

Variable	Poor Outcome	Good Outcome	p
GCS*	8(3-14)	11(8-14)	0.000
Systolic blood pressure*	120(60-220)	130(80-200)	0.559
Age**	54.11(13.66)	44.84 (17.97)	0,034

*Mann-Whitney-U test, ** Unpaired T-test,

Multivariate analysis was done in two steps, shown in Table 3. In the first step, analysis on

the systolic blood pressure had $p > 0.05$ thus this variable is not analyzed in the second step.

Table 3. Multivariate Analysis of GCS and Age Towards Outcome

Variable	Coefficient	p	OR	CI 95%
Step 1				
Age	0.044	0.024	1.045	1.006-1.087
GCS	-0.422	0.000	0.656	0.519-0.829
Systolic blood pressure	-0.014	0.112	0.986	0.968-1.003
Constant	2.546	0.063	12.757	
Step 2				
Age	0.044	0.024	1.045	1.006-1.087
GCS	-0.422	0.000	0.656	0.519-0.829
Constant	2.546	0.063	12.757	

The accuracy of age and GCS in predicting the outcome of patients with decreased consciousness can be formulated as:

$$\text{Probability (P)} = \frac{1}{1 + \exp(-y)} \frac{1}{1 + \exp(-y)}$$

The equation of y was derived from:

$$y = \text{constant} + a_1x_1 + a_2x_2 + \dots + a_nx_n$$

$$y = 2,546 + [(0,04) (\text{age})] + [(-0,422) (\text{GCS})]$$

Calibration test of the above equation was done by Hosmer and Lemeshow test (Table 4). Calibration test was done to assess whether there is a difference between observed value and expected value. The test result is deemed fit when $p > 0.05$. The calibration test of GCS and age showed no difference between observed and expected value ($p = 0.499$). Furthermore, calibration test was divided into non-trauma patients and trauma patients, both results were fit ($p = 0.878$ and $p = 0.678$ respectively).

Table 4. Calibration Test for Combination of Age and GCS

Variables	p
Age and GCS	0.499
Age and GCS, non-trauma cause	0.878
Age and GCS, trauma cause	0.678

Discrimination test was done by Receiver Operating Characteristic (ROC) analysis. ROC is a curve of several intersections between sensitivity (y axis) and 1-specificity (x axis). Figure 1A showed ROC discrimination test result of GCS and age combination, with Area Under Curve (AUC) value of 0,801 and CI 95% (0.697-0.904). AUC value for GCS only is 0.769, CI 95% (0.665-0.874). This means the combination of GCS and age can predict 80 patients with poor outcome out of 100 patients with decreased consciousness. The AUC value of combined GCS and age equation showed a strong interpretation because the AUC value is statistically in 80-90%.

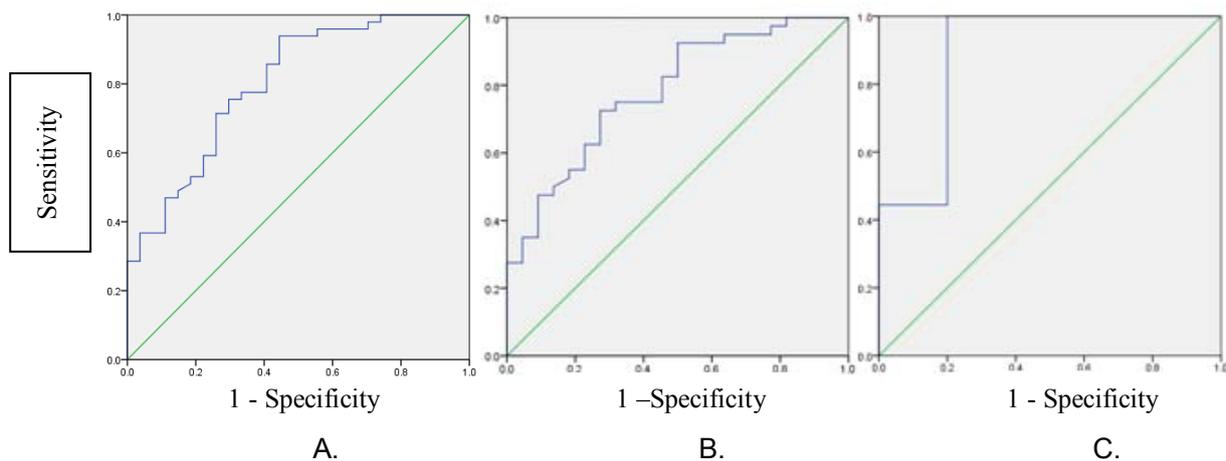


Figure 1. ROC Curve of GCS and Age in Predicting Outcome of Patients with Decreased Consciousness

A. ROC Curve of GCS and Age, AUC value 0.801 (CI 95% 0.697-0.904). B. ROC Curve of GCS and Age in non-trauma patients, AUC value 0,781 (CI 95% 0.664-0.898). C. ROC Curve of GCS and Age in trauma patients, AUC value 0,889 (CI 95% 0.676-1.000).

The AUC value for non-trauma patients was 0.781, in 70-80% area with intermediate interpretation (Figure 1B), while AUC for trauma patients was 0,889, in 80-90% are with strong interpretation (Figure 1C). Patients with decreased consciousness due to trauma has 10.8% higher AUC value compared to patients with non-trauma cause. The higher AUC value for patients with decreased consciousness due to trauma (0.889, strong interpretation) compared to non-trauma cause (0.781, intermediate interpretation) by 0.108 means that the equation has a better prediction value for patients with trauma cause.

Discussion

Patients with decreased consciousness need prompt treatment towards the cause to avoid worsening of condition. Multidisciplinary treatment in CMGH ER is expected to give an optimal treatment to the patients. Wahyu¹ and Eken¹⁰ stated that Glasgow Coma Scale (GCS) can predict the outcome of patient with decreased consciousness, which is in conjunction with this study's result. This study found a significant difference of age as a predictor between good outcome and poor outcome, consistent with studies done by Ljunggren⁴ and Barfod.¹¹ These results might be because of the

mean age of the subjects in this study, which was 51.13 years old. Older age is associated with worse outcomes. In older population, the possibility of having comorbidities such as diabetes mellitus, hypertension, and heart problems is higher. The presence of these comorbidities would surely worsen the outcome in patients with decreased consciousness.

Systolic blood pressure affects mortality patient since blood pressure change perfusion affects vital organs' perfusion. Hao Z et al¹² stated that blood pressure is an independent prognostic factor for poor outcome, while Seymour⁶ and Holler⁷ stated that systolic blood pressure can give an early prediction of patients' mortality, which were not in conjunction with the result that showed no different between both groups. The difference in outcome might be due to the difference and diversity in this study's population. In this study, the subjects had a normal mean systolic blood pressure, which was 126mmHg, while Ljunggren⁴ stated that a systolic blood pressure less than 90 mmHg was associated with increased mortality. Besides, the presence of intracranial process would usually affect arterial blood pressure. The result of this study would have been different if the subjects had only been patients with decreased consciousness due to intracranial abnormality. Further study is needed to evaluate prognostic value of GCS, age, and blood pressure towards outcome in patients with decreased consciousness due to intracranial abnormality.

Blood pressure changes between a healthy person and a patient might give a better insight compared to measurement in the ER. Hocht¹³ stated that blood pressure variation can affect therapy and prognostic value. Oxygen saturation can also be done in the ER to predict mortality.^{14,15} Individually, GCS and age showed a significant different towards the outcomes, as stated by Martin¹⁶ and McNett.¹⁷ The lower the GCS score, the bigger the probability of brain damage. Age was also an independent predictor towards mortality in patients with ischemic stroke and trauma.^{18,19}

Multivariate analysis of GCS and age resulted in probability equation to predict the outcome of patients with decrease consciousness. The calibration test resulted in good calibration value ($p=0.499$). The discrimination test resulted in strong interpretation AUC value, which was higher than Wahyu's study.¹ The addition of age as an independent predictor to the new equation is higher 3.2% compared to GCS as the only predictor.

Measurements done to the patients in the ER

are considered early evaluations. Further supporting examinations would have better prediction value, such as APACHE II examination done to critical patients since it measures vital organs functions through advance laboratory exams.

Conclusion

The combination of Glasgow Coma Scale and age is accurate in predicting the outcome of patients with decrease consciousness. Systolic blood pressure was not associated with the outcome of patients with decrease consciousness.

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