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Evaluation of the Effectiveness of Glasgow Coma Scale and Parameters in the Decision Phase of Rapid Sequence Intubation in Altered Mental Status Developing During the Emergency Room Follow-up of Non-Traumatic Patients

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Research Article

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ABSTRACT

Abstract: Glasgow coma scale (GCS) is one of the most important parameters in deciding rapid sequential intubation (RSI) in emergency department (ED). The aim of this study is to determine the effectiveness of the GCS and each of its parameters in making RSI decisions in non-traumatic patients brought to the ED.

Methods: This prospective observational study was conducted in an ED of a tertiary training and research hospital, which accepts approximately 250.000 patients annually. The value of GCS and GCS parameters in deciding to intubation in patients with an RSI indication was compared with the Pearson χ2 test. Multivariate logistic regression analysis was used for assessment of combinations of GCS parameters.

Results: A total of 276 patients were included in the study. It was found that the mortality rates was statistically significantly higher in the cases with GCS 4-10 (including) in the combinations with the low motor response. Motor scoring was more statistically significant for mortality in the evaluation made by creating 120 combinations between the remaining 4-14 GCS scores after the 3 and 15 GCS scores of the cases were removed from the GCS scores.

Conclusion: It was found that the motor response showed more linear progress compared to the verbal response and eye response evaluation, and the other parameters were not linear in the evaluation between the GCS total score and GCS combinations of the cases. Motor response was determinant in the total GCS score.

Keywords: Emergency medicine, critical care, cardiopulmonary arrest

Travmatik Olmayan Hastaların Acil Servis İzleminde Gelişen Bilinç Değişikliğinde Hızlı Seri Entübasyona Karar Vermede Glasgow Koma Skalası ve Parametrelerinin Etkinliğinin Değerlendirilmesi

Süreç

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ÖZ

Amaç: Glasgow koma skalası (GKS), acil serviste hızlı ardışık entübasyona (HAE) karar vermede en önemli parametrelerden biridir. Bu çalışmanın amacı, acil servise getirilen travmatik olmayan hastalarda HAE kararları vermede GKS'nın ve parametrelerinin her birinin etkinliğini belirlemektir.

Yöntem: Bu prospektif gözlemsel çalışma, yılda yaklaşık 250.000 hasta kabul eden üçüncü basamak bir eğitim ve araştırma hastanesinin acil servisinde yürütülmüştür. HAE endikasyonu olan hastalarda entübasyona karar vermede GKS ve GKS parametrelerinin değeri Pearson χ2 testi ile karşılaştırıldı. GKS parametrelerinin kombinasyonlarının değerlendirilmesi için çok değişkenli lojistik regresyon analizi kullanıldı.

Bulgular: Toplam 276 hasta çalışmaya dahil edildi. Düşük motor yanıtlı kombinasyonlarda GKS 4-10 (dahil) olgularında mortalite oranlarının istatistiksel olarak anlamlı derecede yüksek olduğu bulundu. GKS skorlarından 3 ve 15 olan GKS skorları çıkarıldıktan sonra kalan 4-14 GKS skorları arasında 120 kombinasyon oluşturularak yapılan değerlendirmede motor skorlama mortalite için istatistiksel olarak daha anlamlıydı.

Sonuç: Olguların GKS toplam puanı ve GKS kombinasyonları arasında yapılan değerlendirmede motor yanıtın sözel yanıt ve göz yanıtı değerlendirmesine göre daha lineer ilerleme gösterdiği, diğer parametrelerin ise lineer olmadığı saptandı. Toplam GKS skorunda motor yanıt belirleyiciydi.

Anahtar sözcükler: Acil tıp, yoğun bakım, kardiyopulmoner arrest

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Introduction

Altered mental status (AMS) defines a wide clinical picture from drowsiness to coma. It is seen in approximately 4-10% of all admissions in emergency departments and approximately 30% among patients over 65 years of age [1, 2]. Various scales are used in ambulances, emergency departments, and intensive care units in the follow-up of patients with altered mental status. These scales include The Revised Trauma Score, TRISS, Acute Physiology and Chronic Health Evaluation, and Circulation. Glasgow Coma Scale (GCS) is the common point of all these scales [3, 4]. GCS is a scale used to objectively define the extent of altered mental status in all acute medical conditions and trauma patients and evaluates it in three ways according to the responses of patients which are eye response (E) [1-4], motor response (M) [1-6], and verbal response (V) [1-5] even though the scales given above as examples are known as scoring systems for trauma patients.

The total GCS score could provide a useful summary of the severity of the patient clinic even though the clinical predictive power of the parameters in GCS was expressed equally predominantly at the time it was defined [5]. The opportunity to examine the GCS parameters separately is provided only with the possibility of accessing broad-based data sources over time even though the question of whether the total score or the parameters of GCS were more significant individually in the clinical prediction is still an ongoing debate [6]. However, most of these studies include patients with traumatic brain injury [7]. Several studies in the literature are related to the evaluation of altered mental status and total GCS score or parameters in non-traumatic patients [8, 9]. Patients in these study groups are also mostly patient groups with long-term intensive care follow-ups. However, rapid and correct decisions in the emergency room environment are directly related to the survival of the patients. Therefore, different definitions have been proposed for GCS score and RSI decision during patient follow-up in the emergency department guidelines [10].

The number of studies examining the total GCS score and individual parameters in the RSI decision of the patients followed up with different diagnoses in non-traumatic patients is limited in the literature [11]. Therefore, we aimed to measure the effectiveness of the use of GCS parameters individually and together in the decision of early rapid sequence intubation (RSI) in emergency physicians in patients who were brought to the emergency department of our hospital for non-traumatic reasons and who developed altered mental status during their follow-up in our study.

Materials and Methods

Study design and setting

This study was conducted in the emergency department of tertiary hospital, where approximately 250,000 patients were admitted annually. This prospective observational study, conducted between January 2018 and December 2020, was conducted according to the Helsinki protocol principles after obtaining the approval of the local ethics committee of the hospital signed. Consent was obtained from first-degree relatives in patients with RSI decisions. However, consent was not obtained from the relatives of the patients before RSI, but subsequent consent was requested from the relatives of the patients for the use of the data we recorded for these patients in order to avoid any delay in the diagnosis and treatment of patients in some patients and due to the medical necessity. The data of the patients whose consent was obtained in this way were also used in our study.

Study population

Patients who were admitted to the emergency department outpatient or via ambulances, who were not intubated, who did not undergo supraglottic airway, who were non-traumatic, and who were over 18 years of age constituted our potential study group. Patients who were intubated due to the way they came to the emergency department, patients who were admitted due to trauma, patients under the influence of alcohol or substance, patients with known pregnancy or pregnancy suspicion, patients under 18 years of age were excluded from the study.

Study protocol and data collection

Patients who could be included in the study were followed up in the emergency department. Demographic characteristics, vital signs, GCS measurements and comorbidities of these patients were recorded in the study forms at the time of intubation decision. Patients who were followed up in the potential study group and who were decided to receive RSI constituted our main study group. The following indications were taken as a basis in our study group when making the RSI decision: Patients with satO2 which could not be increased by simple methods (type 1 and type 2 respiratory failure, pneumonia), poor general condition, sepsis, cardiac arrest, cerebrovascular diseases, and status epilepticus patients. GCS evaluation and RSI indication were performed during working hours by a single senior assistant in the last year of specialty training in order to prevent decision-making and personal differences.

The GCS subscores of each patient (motor (m) 1-6, verbal (v) 1-5 and eye (e) 1-4 and the outcomes of the patients (discharge or death) were recorded for each case before RSI in the patients included in the study.

Outcome measurements

The primary outcome measurement of our study were the total GCS scores calculated in patients before RSI whereas secondary outcome measurement was the calculation of which of the GCS parameters was more effective in RSI decision in patients before RSI.

Statistical analysis

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) 23.0 statistical software (New York, USA) with serial number 10240642. The suitability of numerical data for normal

distribution was examined with a one-sample Kolmogorov-Smirnov test. Yates' χ2 test, Fisher's exact χ2 test, and Pearson χ2 test were used in qualitative data. The t-test was used for independent univariate data and the Kruskal Wallis test was used for multivariate data.

Combinations were created with polynomial regression analysis for multiple regression analysis. An evaluation was made between the multiple combinations created. Logistic regression analysis was used to examine the relationship between variables. Median (Minimum-Maximum) values were calculated if the descriptive statistics were not normally distributed in quantitative variables and arithmetic mean±standard deviation and numbers and percentages were given if they were normally distributed in the evaluation of categorical data. The significance limit was considered as $p<0.05$ for all statistics.

Results

A total of 276 patients were included in the study. The mean age of the cases was 72 ±14 (27-99) years, the mean age in females was 75 ± 14 (27-98) years, and the mean age in males was 71 ± 12 (34-99) years. The mean age was found to be significantly higher in female cases ($p<0.05$). Vital values of the patients were obtained from the pre-RSI evaluations of the cases in the emergency department. Vital results and demographic data of the patients included in the study are presented in Table 1. In addition, no significant statistical difference was found between vital results and genders upon subgroup analyses.

Table 1. Demographics of the Study Population Vital Results at the Time of RSI

Parameter	Mean ±	SD	Minimum	Maximum	p*
Age (Years)	**73±14**		**27**	**99**	
Female (Year)	75±14		27	98	**.006**
Male (Year)	71±12		34	99	
Systolic Blood Pressure (mmHg)	**119±37**		**50**	**270**	.774
Female (mmHg)	118±37		50	270	
Male (mmHg)	119±37		50	240	
Systolic Blood Pressure (mmHg)	**67±19**		**20**	**130**	.209
Female (mmHg)	66±18		20	115	
Male (mmHg)	68±19		21	130	
Pulse (rate/min)	**101±27**		**37**	**220**	.769
Female (rate/min)	100±26		42	220	
Male (rate/min)	101±28			197	
Respiratory rate (/min)	**25±8**		**10**	**50**	.470
Female (/min)	27±8		10	50	
Male (/min)	25±9		10	50	
Saturation %	**87±10**		**42**	**100**	.629
Female (%)	87±10		60	100	
Male (%)	87±10		42	100	
Fever (°C)	**37±8**		**34.0**	**41.6**	.904
Female (°C)	37±1		34.0	41.6	
Male (°C)	37±1		34.8	39.8	

* Independent t-test was used.

It was observed as a result of the RSI examination of the cases that respiratory failure constituted the most common indication for intubation (36.2%; n=100), the second most common indication was altered mental status (21.7%; n=60), and the third most common indication was the poor general condition at the time of admission (11.2%; n=31). No statistically significant differences were also found between RSI indications and genders ($p>0.05$) (Table 2). The differences between the RSI indications of the cases and the mean (IQR) values of the components of the GCS score were statistically significant ($p<0.001$) (Table 3).

Table 2. RSI indications and gender distribution

	Gender		
Endotracheal Intubation Indications	**Female n (%)**	**Male n (%)**	**P**
Type 1 Respiratory Failure	15 (28)	38 (72)	
Type 2 Respiratory Failure	27 (57)	20 (43)	
Poor General Condition	17 (55)	14 (45)	
Altered Mental Status	27 (45.0)	33 (55.0)	
Cardiac Arrest	6 (31.6)	13 (68.4)	
Pneumonia	10 (52.6)	9 (47.4)	
Airway Protection	13 (72.2)	5 (27.8)	
Sepsis	6 (46.2)	7 (53.8)	
Seizure	3 (37)	5 (63)	
Other*	2 (25.0)	6 (75.0)	
Total	126	150	0.065

* To Prevent Aspiration Risk
Pearson X2 test was used.

Table 3. Differences between Endotracheal Intubation Indications and Mean GCS Components of the Cases

	GCS Components		
Endotracheal Intubation Indications	**Eye Response Median (IQR)**	**Motor Response Median (IQR)**	**Verbal Response Median (IQR)**
Respiratory Failure$^{\beta}$	4.0 (1.0)	5.0 (2.0)	4.0 (3.0)
Poor General Condition	2.5 (2.0)	4.0 (2.0)	2.0 (3.0)
Altered Mental Status	2.0 (2.5)	4.0 (4.0)	2.0 (2.0)
Cardiac Arrest	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)
Pneumonia	3.0 (1.5)	5.0 (2.0)	2.0 (2.0)
Airway Protection	2.0 (3.0)	3.5 (3.0)	1.0 (1.0)
Sepsis	2.0 (2.0)	5.0 (2.0)	3.0 (3.0)
Seizure	4.0 (1.0)	6.0 (0.0)	5.0 (1.0)
Other	3.0 (2.0)	5.0 (2.5)	2.0 (2.5)
p*	**<0.001**	**<0.001**	**<0.001**

β type 1 and type 2 total
*** Kruskal Wallis test was used.**

No statistically significant differences were found in terms of both total GCS value and median (IQR) values of GCS components in determining mortality when the success of total GCS scores and median (IQR) values of GCS components in determining mortality was evaluated (p>0.05) (Table 4).

Table 4. The success of GCS Score and Components in Determining Mortality

	Primary Outcome		
Parameter	**Survive Median (IQR)**	**Dead Median (IQR)**	**p***
GCS (Total)	10.0 (11.5)	9.0 (7.0)	.407
GCS (Eye)	3.0 (3.0)	3.0 (2.0)	.830
GCS (Verbal)	2.0 (5.0)	2.0 (3.0)	.247
GCS (Motor)	5.0 (4.0)	4.0 (3.0)	.506

*** Independent t-test was used.**

It was found that the mortality rate was statistically significantly higher in the cases with GCS 4-10 (including) in the combinations with the low motor response and that motor scoring was more important for mortality (it was found statistically significant that the mortality rate was high in the cases with low motor scores) in the evaluation made by creating 120 combinations between the remaining 4-14 after the 3 and 15 scores of the cases were removed from the GCS scores (some combinations were not taken because they were not seen in the study). There was no significant difference in this relationship in patients with GCS>10 (Table 5).

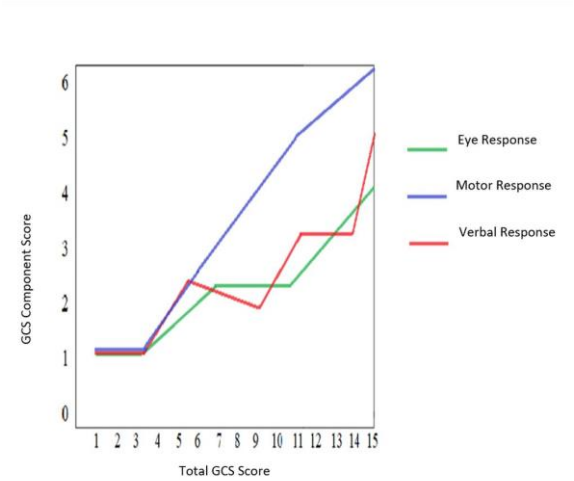
Table 5. Evaluation of Mortality Ratios of Cases According to GCS Score Combinations

GCS Total Score	Eye	Motor	Verbal	Mortality Rate	p
15	5	6	4	-	-
	3	6	5	0.12	.134
14	4	6	4	0.19	
	3	6	4	0.11	
	3	5	5	0.21	
	3	6	4	0.18	
13	4	5	4	0.23	.074
	4	6	3	0.16	
	3	5	4	0.18	
12	4	5	3	0.14	.054
	3	6	3	0.10	
	2	5	4	0.14	
11	3	5	3	0.15	.108
	4	5	2	0.17	
	2	4	4	0.21	
	2	5	3	0.14	
	3	4	3	0.19	
10	3	5	2	0.17	**.041**
	3	6	1	0.11	
	4	4	2	0.23	
	4	5	1	0.16	
	2	4	3	0.19	
	2	5	2	0.16	
	3	3	3	0.28	
9	3	4	2	0.20	**.047**
	4	3	2	0.26	
	4	4	1	0.22	
	1	5	2	0.20	
	2	3	3	0.34	
	2	4	2	0.27	
8	2	5	1	0.21	**.028**
	3	3	2	0.31	
	3	4	1	0.26	
	4	3	1	0.38	
	1	4	2	0.28	
7	2	3	2	0.39	**.011**
	2	4	1	0.25	
	4	1	2	0.43	
	1	3	2	0.39	
	1	4	1	0.38	
6	2	3	1	0.40	**.008**
	3	1	2	0.58	
	4	1	1	0.54	
	1	2	2	0.51	
5	1	3	1	0.42	**.039**
	2	2	1	0.53	
	1	1	2	0.64	
4	1	2	1	0.54	**.023**
	2	1	1	0.61	
3	1	1	1	-	-

Polynomial Regression Analysis Test was used.

It was found that the motor response showed more linear progress compared to the verbal response and eye response evaluation, and the other parameters were not linear in the evaluation between the GCS total score and GCS combinations of the cases. The total GCS

score indicates that the motor response is decisive in the evaluation in this case (Figure 1).



Discussion

Teasdale and Jennett described GCS for the first time in 1974 as a practical way of measuring "impaired depth and duration of consciousness" for various reasons [9]. Interestingly, the deficiencies in GCS were also noticed by its creators and they observed that the assumptions that "each of the three parts of the scale should be considered of equal value, each step still needs to be tested" were valid in their study in 1977 [10]. Studies were started to be conducted on the total score of GCS and the clinical predictive values of each parameter with the development of the possibility of conducting large-scale studies in the following years [5, 11, 12]. The fact that they mostly examine patients with severe head trauma has led us to examine the power of GCS total score and each parameter to make early intubation decision in non-traumatic patients who come with altered mental status in emergency department conditions or who develop an altered mental status during follow-up even though these studies are large-scale studies.

The mean age of the patients was found to be 44 (23-65) in the study conducted by Al-Salamah et al. with 795 patients and 70% of the patients were male in the literature [15]. Similarly, Amir Nik et al. compared the GCS and Acute Physiology and Chronic Health Evaluation (APACHE) II scores of 125 patients and reported that the mean age of the patients was 42 (25-60) years and 80.8% were male patients [16]. This study was conducted with a total of 276 patients. Our study was evaluated in accordance with the literature with male gender dominance, while the age difference was found to be incompatible with the literature in terms of gender difference. We think that this incompatibility is due to the fact that our study group is a patient group with additional comorbidity with non-traumatic complaints.

Irfan et al. reported in their study with 115 patients that the most common indication for intubation was respiratory tract problems (32.1%; n= 37). Similarly, respiratory failure (36.2%; n=100) was the first indication for intubation in our study and altered mental status (21.7%; n=60) was the second most common indication for intubation. This result seems to be consistent with the literature. It is seen that the need for intubation of patients is evaluated as an independent factor associated with low score GCS and mortality in the same study by Irfan et al [17]. No statistically significant differences were found in terms of both total GCS value and median (IQR) values of GCS components in determining mortality when the success of total GCS scores and median (IQR) values of GCS components in determining mortality was evaluated in our study ($p>0.05$).

Buitendag et al. evaluated the motor response score of GCS in 830 patients and showed that survival increased with the increase in the score value of the component in cases with traumatic brain injury [18]. Motor response score alone was obtained as a significant independent result in the prediction of 2-week mortality in a study conducted by Sacco et al. with 188 non-traumatic patients [19]. Healey et al. stated in a large-scale retrospective study that the motor response score of GCS included almost all the information of GCS, that it could be evaluated even in intubated patients and could statistically mean much better than GCS and emphasized that only motor response score should replace GCS (5). We found that the motor response component of GCS was guiding in making RSI decisions and predicting the mortality of patients in our study of non-traumatic patients. We also evaluated this by creating 120 combinations between the remaining 4-14 (including) after the 3 and 15 scores of the cases were removed from the GCS. We found that there was a statistically significant, high mortality rate in combinations with low motor response in cases with GCS 4-10 (including) and that motor scoring was more important for mortality. Mortality was also found to be statistically significant in patients with the same GCS score but low motor response score.

Limitation

Our main limitation is that this study, which evaluates the decision-making power of only the motor component of GCS for RSI in non-traumatic patients, could not be evaluated with a larger number of patients. In addition, that consciousness evaluation is not reliable, and pharmacologically paralyzed patients, patients with high spinal cord injuries, and patient groups under the influence of alcohol use are another limitation. Paralysis after sedoanalgesia is also considered as another limitation. Waiting for drug elimination before evaluating the motor subscore of the patients will be a simple approach in these cases. It should also be kept in mind that the standard face response to only sound and painful stimuli cannot be a reliable evaluation in emergency departments in quadriplegic cases. We would like to note that the motor subscore of the GCS will not be decided alone for RSI purposes, other evaluations should also be taken into account in these cases.

Conclusion

This study suggests that only the motor component of the GCS can be used instead of the Glasgow coma scale when making the decision for serial sequential intubation in non-traumatic patients. We think that this proposal can be strengthened with future studies.

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