

Comparison of the scoring systems for predicting mortality in intoxicated patients hospitalized to the ICU: a prospective observational study

Zehirlenme sonucu yoğun bakıma yatırılan hastalarda mortaliteyi belirlemede skora sistemlerinin karşılaştırılması: ileri dönük gözlemsel bir çalışma

Seçgin Söyüncü

Associate Prof., M.D.
Department of Emergency Medicine
Akdeniz University
ssoyuncu@akdeniz.edu.tr

Fırat Bektaş

Asist. Prof., M.D.
Department of Emergency Medicine
Akdeniz University
fbektas@akdeniz.edu.tr

Abstract

Purpose: The aim of this study was to evaluate the power of various scoring systems (APACHE II, MEES, REMS, RAPS and GCS) in predicting prognosis of severely poisoned patients who require tracheal intubation.

Material and Methods: This prospective observational study was conducted in an emergency department of a tertiary care hospital. The study population was chosen from the group of patients over 16 years of age who presented with intoxication to the emergency department and required tracheal intubation and intensive care unit admission in a 2-year period. APACHE II, MEES, REMS, RAPS, and GCS scores of the patients were calculated and compared.

Results: A total of 30 (8%) patients were intubated and admitted to the intensive care unit during the study period. Twenty seven (90%) patients were discharged after intensive care unit treatment and 3 (10%) died. The APACHE II score was found to have the best AUC value (0.975, 95% CI: 0.841-0.993; p=0.0001) in predicting in-hospital mortality of study patients. Although the APACHE II scale has the highest AUC value, there was no statistically significant difference found between the five scales.

Conclusion: Consequently, the RAPS and GCS scales should be used in severely intoxicated patients because of their comparative simplicity.

Key words: **Glasgow Coma Scale; Intoxication; Prognosis; Score Systems.**

Özet

Amaç: Bu çalışmanın amacı; entübasyon ihtiyacı gerektiren şiddetli bir şekilde zehirlenmiş hastalarda prognozun belirlenmesinde çeşitli skorlama sistemlerinin (APACHE II, MEES, REMS, RAPS ve GKS) etkisini değerlendirmektir.

Yöntem ve Gereçler: Bu ileriye dönük gözlemsel çalışma üçüncü basamak bir acil serviste yapılmıştır. Bu çalışmaya 2 yıllık sürede 16 yaş üzerinde trakeal entübasyon ihtiyacı gösteren zehirlenmiş hastalar alınmıştır. Hastaların APACHE II, MEES, REMS, RAPS ve GKS skorları hesaplanmış ve karşılaştırılmıştır.

Bulgular: Çalışma periyodu boyunca toplam 30 (%8) hasta entübe edildi ve yoğun bakıma yatırıldı. Hastaların ortalama yaşı 30.87±14.52 idi ve 16 (%53,3) hasta erkekti. Hastalardan 27 (%90)'si yoğun bakımdan tabursu olurken 3 (%10) hasta öldü. Çalışma hastalarında hastane içi mortaliteyi belirlemede en iyi AUC değeri (0.975, 95% CI: 0.841-0.993; p=0,0001) APACHE II skorundaydı. RAPS, MEES, REMS ve GKS değerleri sırasıyla bunu takip etti. Bununla birlikte bu beş skorlama sisteminin AUC değerleri arasında istatistiksel anlamlılık bulunmadı.

Sonuç: En iyi AUC değeri APACHE II skorunda olmasına rağmen beş skorlama sistemi arasında istatistiksel bir anlamlılık yoktur. Böylelikle RAPS ve GKS skorlama sistemleri basit kullanımları nedeniyle şiddetli zehirlenmiş hastalarda prognozu belirlemede kullanılabilir.

Anahtar Kelimeler: **Hızlı Akut Fizyoloji Skoru; Glasgow Koma Skoru; Prognoz; İntoksikasyon.**

Submitted : June 01, 2009
Revised : April 01, 2010
Accepted : February 09, 2011

Corresponding Author:

Doç. Dr. Seçgin Söyüncü,
Akdeniz Üniversitesi, Acil Tıp Anabilim Dalı,
Antalya, Türkiye

Phone : +90- 242 2496183
e-mail : ssoyuncu@akdeniz.edu.tr

Introduction

There are many scoring systems to define the severity and prognosis of illnesses. However, the validity of these scoring systems is controversial. An ideal risk adjustment scoring system for emergency care must be composed of a limited number of variables and accurately predict clinical status and patient outcome.

Acute Physiology and Chronic Health Evaluation (APACHE) scoring system was described by Knaus and co-workers in 1985 (1). APACHE uses a point score based on 12 routine physiologic measurements, together with age and previous health status, for use on intensive care patients. The variables included in the APACHE II system are: body temperature, mean arterial pressure, heart rate, oxygenation of arterial blood (PaO₂), arterial pH, serum sodium, serum potassium, serum creatinine, hematocrite, white blood count and Glasgow Coma Scale (GCS). The maximal APACHE II score is 71 (2). The APACHE II score of the patients was recorded on the day of admission to the hospital, however the other scores were recorded to the emergency department (ED) admission. However, the APACHE II score includes several blood chemistry variables and is therefore not suitable for quick scoring in the ED. Mainz Emergency Evaluation Score (MEES), Rapid Emergency Evaluate Score (REMS), Rapid Acute Physiology Score (RAPS) and Glasgow Coma Scale (GCS) are other scoring systems used in the pre-hospital setting and in the ED.

MEES is a descriptive scoring system that includes GCS, pulse rate, respiratory rate, systolic blood pressure, arterial oxygen saturation, electrocardiogram and pain (3). RAPS is developed by taking some parameters of APACHE II that can be easily obtained in the out-of-hospital setting. These variables were mean arterial pressure, pulse rate, respiratory rate, and GCS (4). The maximum RAPS score is 16. REMS is a recent modification of RAPS obtained by adding peripheral oxygen saturation and age to the four variables mentioned above. The scoring range for each variable is 0 to 4, and the maximal score is 26 in the REMS system (4). GCS was first described in 1974 as a tool for monitoring mental status of intensive care unit (ICU) patients with head injury (5). The GCS consists of three domains: eye opening, verbal response and motor response.

Although the scoring systems evaluating mental status have been studied in intoxicated patients (6-8), the validity of descriptive and prognostic scoring systems in these

patients is not well-defined. The aim of this study is to evaluate the value of various scoring systems (APACHE II, MEES, REMS, RAPS and GCS) in predicting prognosis of severely poisoned patients who require tracheal intubation.

Materials and Methods

Study Design. This prospective observational study was conducted in an ED of a tertiary care hospital with an approximate 2006 annual census of 50,000.

Study Population and Setting. Patients over 16 years of age who presented to the ED with intoxication between May 2005 and May 2007 were included in the study. The study population was composed of patients from this group who required tracheal intubation and were admitted to the intensive care unit. APACHE II, MEES, REMS, RAPS, and GCS scores of the patients were calculated.

Statistical Analysis. The study data was analyzed in SPSS 16.0 for Windows and Med Calc 7.2. The continuous variables were presented as mean \pm standard deviation and frequent variables were presented as rates. Receiving operating characteristic curve (ROC) analysis was performed in order to determine the predictive value of each scale for mortality. Area under the curve (AUC) values with 95% confidence intervals (95% CI) was used to compare the scales after ROC analysis. The positive likelihood ratio was used to determine cut-off values. All the hypotheses were constructed as two-tailed and a p value of ≤ 0.05 was considered significant.

Results

During the study period, 377 patients presented to the ED with intoxication due to various toxic materials. Seventy seven patients admitted to the hospital. A total of 30 (8%) patients who were intubated and admitted to the ICU composed the study population (Figure 1). The mean age of study subjects was 30 ± 14 (minimum: 17 – maximum: 65) years and 53.3% (16) of them were male. Twenty seven patients (90%) were discharged after ICU treatment and 3 (10%) patients died.

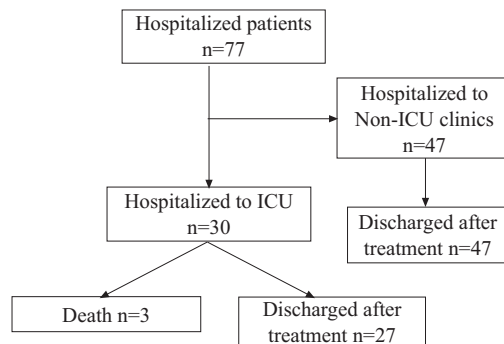


Figure 1. Patient flow chart

The most ingested toxic substances found were antidepressants (10 patients, 33.4%) and organophosphates (9 patients, 30%). Table I shows the toxic substances ingested by the study patients. Two patients who ingested organophosphate and one patient who ingested methanol died. Table II shows the features of the patients who died.

Table I. Causes of Poisoning.

Ingested Toxic Substances	Patients Number	%
Antidepressant		
Tricyclic Antidepressants	8	26.7
Other antidepressants	2	6.7
Organophosphate	9	30.0
Alcohol		
Ethanol	3	10
Methanol	1	3.3
Beta-adrenergic Receptor Blocking Agent	2	6.7
Carbon Monoxide	2	6.7
Cocaine	1	3.3
Opioid	1	3.3
Anti-epileptic	1	3.3

Table II. The Demographics and Scores of Dead Patients.

Age	Gender	APACHE II	RAPS	MEES	REMS	GCS	Substance
48	Male	28	9	8	15	3	Organophosphate
23	Male	30	16	6	20	3	Organophosphate
26	Male	35	10	14	10	3	Methanol

APACHE II score has the best AUC value (0.975, 95% CI: 0.841-0.993; $p=0.0001$) in predicting prognosis mortality of study patients. RAPS, MEES, REMS and GCS followed APACHE II, respectively. However, the differences between the AUC values of the five scoring systems were not statistically significant. Table III displays

the AUC values of all the scoring systems. The prognostic features of four descriptive scoring systems were compared with APACHE II scoring system and the differences were not found to be statistically significant (Table IV).

Table III. Comparison of the AUC Values in Predicting in-Hospital Mortality.

Scoring Systems	AUC	SE	95% CI	p value
APACHE II	0.975	0.064	0.841 to 0.993	0.0001
GCS	0.870	0.083	0.697 to 0.964	0.0001
MEES	0.920	0.060	0.760 to 0.986	0.0001
RAPS	0.932	0.103	0.777 to 0.990	0.0001
REMS	0.889	0.128	0.720 to 0.973	0.0024

AUC: Area Under the Curve; SE: Standard Error; CI: Confidence Interval

Table IV. Comparison of the Assessment Systems in Predicting in-Hospital Mortality

Scale	Best cutoff point	Sensitivity (%)	Specificity (%)	Positive Likelihood Ratio	Negative Likelihood Ratio
APACHE II	27	100	96.3	27.0	0
MEES	14	100	74.0	3.86	0
RAPS	8	100	81.4	5.4	0
REMS	9	100	74.0	3.86	0
GCS	3	100	74.0	3.86	0

Consequently, all of these scoring systems can be used for predicting prognosis. However, if the APACHE II (0.975±0.064) score was accepted as the better scoring system according to AUC values, the sequence of

prognostic factors of other scoring systems is as follows: RAPS (0.932±0.103), MEES (0.920±0.060), and REMS (0.889±0.128) GCS (0.870±0.083) (Figure 2).

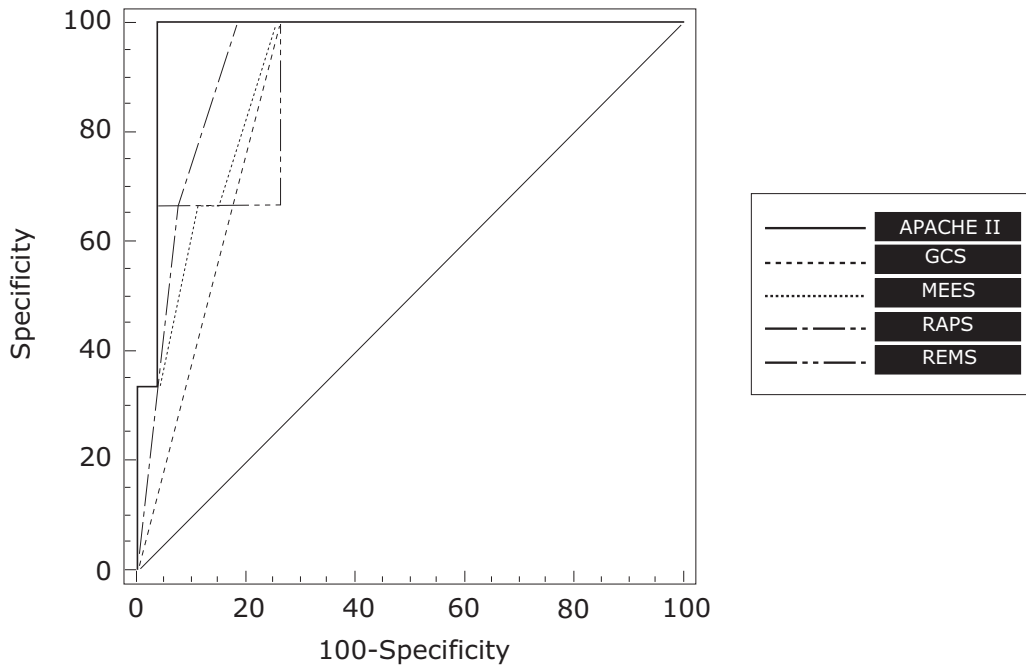


Figure 2. The ROC curve for the APACHE II, GCS, MEES, RAPS, and REMS.

Discussion

The evaluation of patients in the ED necessitates an objective assessment of status and rapid and accurate triage. A good scoring system analyzing patient status may be beneficial in predicting the prognosis of patients. Many scoring systems have been developed for this purpose. These scoring systems may be either for specific diseases (acute coronary syndromes, stroke, asthma, etc) (9-11) or for a special group of patients (trauma, surgical, ICU) (12-17).

These scoring systems, except APACHE II, are mainly descriptive scales rather than predictive tools for prognosis. However, recent studies reported similar prognostic values for other scoring systems when compared to APACHE II. Up until now, studies generally focused on the ability of GCS and AVPU (Alert-Verbal-Pain- Unresponsive) to assess the mental status of intoxicated patients (6, 7). The utility and prognostic abilities of the other scales have not been studied yet.

Patients with intoxication are seen first in the ED. Each year, more than 2 million human exposures are reported to poison centers in the United States (18). The prevalence of patients admitted to the ICU due to intoxication differs with the studies. Kelly et al. reported a rate of 1.6% intubated patients that are admitted to the ICU because of intoxication (3). Chan and co-workers stated this rate as 10% (8) and the value was found to be 8% in this study. Grmec and co-workers (3) stated the mortality rate of intoxicated patients admitted to the ICU as 8.9% and Chan and co-workers as 7.3% (8). Three patients (10%) died in this study. Unverir and co-workers were analyzed retrospectively, patients with antidepressant poisoning admitted to an ED. A total of 356 antidepressant poisoning cases were evaluated in their study. They found that endotracheal intubation was required in 9.6% of cases and suicide attempts, classification of the antidepressant, ECG findings, seizure, GCS score and number of detected antidepressant overdose risk assessment criteria affects the need for intubation in patients with antidepressant poisoning. (19).

The interobserver reliability of GCS in intoxicated patients was stated to be good (6) despite the moderate interobserver reliability in patients with altered mental status (20). The other parameters other than GCS in MEES, REMS and RAPS scoring systems are measurable variables and do not differ between observers.

Grmec and co-workers stated no difference between APACHE II, GCS and MEES scales in comatose patients (3). Olsson et al. reported similar AUC values for APACHE II and REMS in predicting prognosis mortality, however REMS was found to be better predictor of mortality than RAPS in their study (21). This is also supported by the results of Goodacre and co-workers (4). The present study found no statistical difference between the five scales. Actually, these findings of the present study are in concordance with the literature, since the previous studies evaluating the validity of various scales found no difference between the simple and more complex scales. Even the subunits of GCS are found to be as valid as the total GCS score (22). According to these results, RAPS and GCS should be used in patients who present with intoxication to the ED because of their simplicity. GCS is also commonly used throughout the world.

This study was conducted in a hospital which has 50,000 annual visits per year. During a two- year period, 30 patients who were eligible for study inclusion criteria were enrolled to the study from a total of 377 intoxicated patients. Only 3 patients were died in this period. The small number of patients (These were the intensive care unit patients) who were enrolled to the study and died is a limitation of this study. Because of this reason we may have a bias. One of the limitations of this study was that a single measurement was made of the MEES, REMS, RAPS, and GCS scores. Because consciousness level can fluctuate rapidly in some poisoned patients, serial assessments would have been of benefit. Finally, this was a single-center study; multicenter validation or longer study period would lend increased study population.

In conclusion, although the APACHE II scale has the highest AUC value, there was no statistically significant difference found between the five scales examined.

References

1. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: a severity of disease classification system. *Crit Care Med* 1985;13: 818-829.
2. Olsson T, Terent A, Lind L. Rapid Emergency Medicine Score can predict long-term mortality in nonsurgical emergency department patients. *Acad Emerg Med* 2004; 11:1008-1013.
3. Grmec S, Gasparovic V. Comparison of APACHE II, MEES and Glasgow Coma Scale in patients with nontraumatic coma for prediction of mortality. *Acute Physiology and Chronic Health Evaluation. Mainz Emergency Evaluation System. Crit Care* 2001;5:19-23.
4. Goodacre S, Turner J, Nicholl J. Prediction of mortality among emergency medical admissions. *Emerg Med J* 2006; 23:372-375.
5. Teasdale G, Jennett B. Assessment of coma and impaired consciousness. A practical scale. *Lancet* 1974; 2:81-84.
6. Heard K, Bebart VS. Reliability of the Glasgow Coma Scale for the emergency department evaluation of poisoned patients. *Hum Exp Toxicol* 2004; 23:197-200.
7. Kelly CA, Upex A, Bateman DN. Comparison of consciousness level assessment in the poisoned patient using the alert/verbal/painful/unresponsive scale and the Glasgow Coma Scale. *Ann Emerg Med* 2004; 44: 108-113.
8. Chan B, Gaudry P, Grattan-Smith TM, et al. The use of Glasgow Coma Scale in poisoning. *J Emerg Med* 1993; 11:579-582.
9. Antman EM, Cohen M, Bernink PJ, et al. The TIMI risk score for unstable angina/non-ST elevation MI: A method for prognostication and therapeutic decision making. *JAMA* 2000; 284:835-842.
10. Rodrigo G, Rodrigo C. A new index for early prediction of hospitalization in patients with acute asthma. *Am J Emerg Med* 1997; 15:8-13.
11. Lim WS, van der Eerden MM, Laing R, et al. Defining community acquired pneumonia severity on presentation to hospital: an international derivation and validation study. *Thorax* 2003; 58:377-382.
12. Rowan KM, Kerr JH, Major E, McPherson K, Short A, Vessey MP. Intensive Care Society's Acute Physiology And Chronic Health Evaluation (APACHE II) study in Britain and Ireland: a prospective, multicenter, cohort study comparing two methods for predicting outcome for adult intensive care patients. *Crit Care Med* 1994; 22:1392-1401.
13. Wong DT, Crofts SL, Gomez M, McGuire GP, Byrick RJ. Evaluation of predictive ability of APACHE II system and hospital outcome in Canadian intensive care unit patients. *Crit Care Med* 1995; 23:1177-1183.
14. Giangiuliani G, Mancini A, Gui D. Validation of a severity of illness score (APACHE II) in a surgical intensive care unit. *Intensive Care Med* 1989; 15:519-522.
15. Poenaru D, Christou NV. Clinical outcome of seriously ill surgical patients with intra-abdominal infection depends on both physiologic (APACHE II score) and immunologic (DHT score) alterations. *Ann Surg* 1991; 213: 130-136.
16. Bosscha K, Reijnders K, Hulstaert PF, Algra A, van der Werken. Prognostic scoring systems to predict outcome in peritonitis and intra-abdominal sepsis. *Br J Surg* 1997; 84:1532-1534.
17. Berger MM, Marazzi A, Freeman J, Chioléro R. Evaluation of the consistency of Acute Physiology And Chronic Health Evaluation (APACHE II) scoring in a surgical intensive care unit. *Crit Care Med* 1992; 20:1681-1687.
18. Watson WA, Litovitz TL, Klein-Schwartz W, et al. 2003 annual report of the American Association of Poison Control Centers Toxic Exposure Surveillance System. *Am J Emerg Med*. 2004; 22:335-404.
19. Unverir P, Atilla R, Karcioğlu O, Topacoglu H, Demiral Y, Tuncok Y. A retrospective analysis of antidepressant poisonings in the emergency department: 11-year experience. *Hum Exp Toxicol* 2006; 25:605-612.
20. Gill M, Martens K, Lynch EL, Salih A, Green SM. Interrater reliability of 3 simplified neurologic scales applied to adults presenting to the emergency department with altered levels of consciousness. *Ann Emerg Med* 2007; 49:403-407.
21. Olsson T, Lind L. Comparison of the rapid emergency medicine score and APACHE II in nonsurgical emergency department patients. *Acad Emerg Med* 2003; 10:1040-1048.
22. Marmarou A, Lu J, Butcher I, et al. Prognostic value of the Glasgow Coma Scale and Pupil Reactivity in Traumatic brain injury assessed pre-hospital and on enrollment: An impact analysis. *J Neurotrauma*. 2007; 24: 270-280.