Investigation of the Predictive Ability of the ED–SAS Scoring System on Mortality for Acute Pancreatitis at the Emergency Department

Mehmet Kemal Emem,[1] Rohat Ak,[2] Mazlum Kılıç[3]

[1]Department of Emergency Medicine, Balıklıgöl State Hospital, Şanlıurfa, Türkiye
[2]Department of Emergency Medicine, University of Health Sciences, Kartal Dr. Lütfi Kırdar City Hospital, İstanbul, Türkiye
3Department of Emergency Medicine, University of Health Sciences, Fatih Sultan Mehmet Training and Research Hospital, İstanbul, Türkiye

ABSTRACT

Objective: In the emergency department, death from acute pancreatitis may be predicted using the ED-SAS (emergency department peripheral capillary oxygen saturation, age, and systemic inflammatory response syndrome) scoring system.

Methods: One-center cohort observational research method was used in this study. It was decided to use a full case study technique. The hospital automation system was used to do retrospective screening on individuals who had presented to the emergency department with a diagnosis of acute pancreatitis. For the statistical evaluation of ED-SAS scoring system's ability to predict 30-day mortality, the area under the curve (AUC) and receiver operating characteristic (ROC) curve were used.

Results: A total of 112 patients were studied, with an average age of 62.5±18.4 years. The AUC (95% confidence interval: 0.696–0.856) for the ED-SAS scoring system for the prediction of death in patients with acute pancreatitis was 0.784 (Youden's index: 0.381), and the p-value was 0.001. The ED-SAS's sensitivity was 57.1%, specificity was 80.9%, positive predictive value was 16.7%, and negative predictive value was 96.6% when the cutoff number was greater than 1.

Conclusion: The ED-SAS may be used to predict 30-day mortality in individuals with acute pancreatitis in the ED.

INTRODUCTION

The incidence of acute pancreatitis is increasing day by day.[1] A study evaluating the frequency of acute pancreatitis in the USA found that 13–45 out of every 100 000 people have acute pancreatitis.[2] In general, while these patients receive effective diagnosis and treatment in the emergency department, morbidity and mortality rates are still considerable.[3] The increased morbidity and mortality rates are due to approximately 25% of patients having severe acute pancreatitis and 30% having pancreatitis necrosis.[4] Many parameters have been separately evaluated in predicting the mortality associated with this disease.[5,6] Many scoring systems to evaluate each parameter with a multidisciplinary

approach are also available, allowing for the prediction of prognosis. There is a growing body of research investigating the effectiveness of existing and new scoring systems and blood parameters in many different diseases.[5,7–10] The main purpose of all these scoring systems is the early prediction of mortality. However, in addition to being effective, an ideal scoring system should also be simple and clinically applicable. There is still a need for a simple, fast, and effective scoring system to predict prognosis in the early period of acute pancreatitis, given that guidelines emphasize the efficacy of early targeted fluid therapy in acute pancreatitis in the prognosis of the patient in the first 48 h.[11]

Systemic inflammatory response syndrome (SIRS) is a criterion that can be used to determine the severity of acute

pancreatitis.[12] SIRS is defined by a respiratory rate greater than 20 beats/min or partial pressure of carbon dioxide greater than 32 mmHg, a leukocyte count greater than 12 000 mm⁻³ or less than 4000 mm⁻³ or demonstrating 10% band formation, fever greater than 38°C or less than 36°C, and a heart rate greater than 90 beats/min.[12] Mild to severe hypoxia also damages the lungs in the early stages of acute pancreatitis, aggravating the condition.[13] ED-SAS is a three-criteria scoring method that requires the presence of two or more SIRS criteria, a minimum age of 60 years, and oxygen saturation (SpO_2) of less than 96%.

The usefulness of this scoring system in predicting acute pancreatitis mortality has been examined in the literature.[10,14,15]

MATERIALS AND METHODS

Study design and participants

Between January 2019 and December 2021, a single-center, retrospective, and observational design were used, and patients diagnosed with acute pancreatitis in Kartal Dr. Lütfi Kırdar City Hospital's emergency department were included. The research was examined and authorized as ethical by the hospital's local ethics committee (ruling number: 2022/514/222/19, date: March 30, 2022).

Collecting and processing data

Patients who presented to the emergency department with a 3-year history of abdominal pain and were diagnosed with acute pancreatitis using the International Classification of Diseases (9th revision, code 577.0 or 10th revision, code K 85) were retrospectively vetted using the hospital automation system. These patients' epicrises were evaluated. According to the American College of Gastroenterology's current guidelines, individuals with abdominal pain, high serum enzyme levels, and/or typical imaging abnormalities were included in the research.[13] Patients aged below 18 years, pregnant women, patients with chronic pancreatitis, those with liver failure, and those whose data could not be reached were excluded from the study. Vital signs, blood test results, and radiological images recorded at the time of their first admission to the hospital were obtained from the hospital automation system. All the radiological images were reevaluated by a radiologist working at the hospital, and the data were recorded on the prepared research form. Then, the ED-SAS scores of the patients were manually calculated using this data form.

Outcome measures

The major outcome measure was the score system's ability to predict death in individuals with acute pancreatitis. The secondary objective was to determine the predictive value of blood test results, imaging data, and vital signs for acute pancreatitis prognosis.

Statistics

SPSS v. 19.0 for Windows and MedCalc were used for statistical analysis. The mean and standard deviation values, as well as the numbers and percentage distribution, were used to describe the criterion. The Kolmogorov–Smirnov test was used to determine if the data were normally distributed. The receiver operating characteristic (ROC) analysis was used to establish the predictive potential of the ED-SAS scoring system in acute pancreatitis patients. A value of p<0.05 was used as a statistically significant threshold.

RESULTS

A total of 112 patients were included in the study, and their mean age was 62.5±18.4 years. Of the patients, 78 (69.7%) were females and 34 (30.3%) were males. Mortality was observed in 6.3% (n=7) of the patients. The mean length of hospital stay was determined as 8.1±7.87 days. Etiologically, 38.4% (n=43) of the patients had biliary pancreatitis, 7.1% (n=8) had pancreatitis secondary to hyperlipidemia, 3.6% (n=4) had alcoholic pancreatitis, 1.8% (n=2) had drug-induced pancreatitis, and 0.9% (n=1) had tumor-induced pancreatitis, while idiopathic pancreatitis was seen in 37.5% (n=42). In the computed tomography examinations, pancreatic edema was detected in 6.3% (n=7) of the patients, pancreatitis necrosis in 0.9% (n=1), and rectovesical collection in 4.5% (n=5). Table 1 presents the minimum, maximum, mean, and standard deviation values of the vital signs and blood parameters of the patients.

When the survivor and nonsurvivor groups were compared, statistically significant differences were found in relation to age, respiratory rate per minute, potassium, lactate dehydrogenase, calcium, partial oxygen pressure in blood gas (SpO_2), lactate, bicarbonate (HCO_3), partial oxygen pressure (pO_2), pH, and platelet count (p<0.05) (Table 2).

The area under the curve (AUC) value for the ED-SAS scoring system for predicting mortality in patients with acute pancreatitis was 0.784 (95% confidence interval [CI]: 0.696–0.856), Youden's index was 0.381, and the p-value was 0.001 (Fig. 1). The statistical analysis demonstrated that this scoring system predicted death in individuals with acute pancreatitis statistically substantially (p=0.001). It had a sensitivity of 57.1%, a specificity of 80.9%, a positive predictive value of 16.7%, and a negative predictive value of 96.6% for this prediction when the cutoff value was >1 (Table 3).

DISCUSSION

Acute pancreatitis is a disease often diagnosed in the emergency department. The diagnosis of acute pancreatitis is based on simple criteria specified by the American College of Gastroenterology, including abdominal pain, elevated serum enzymes, and/or typical findings on radiological imaging. However, the Acute Physiology and Chronic Health Evaluation II (APACHE II), Ranson, and Bedside Index of Severity in Acute Pancreatitis (BISAP) scoring systems, which are generally used to predict the prognosis of the

Table 1. Data concerning the variables investigated in the study

Variable	Minimum	Maximum	Mean number	Standard deviation %
Systolic pressure	70.00	123.50	143.36	106.69
Diastolic pressure	40.00	118.00	80.23	11.99
Heart rate	55.00	133.00	78.24	11.78
Fever	35.60	39.40	36.51	0.65
SaO_2	80.00	100.00	96.52	3.06
Respiratory rate per minute	12.00	40.00	16.09	3.66
Albumin	2.20	224.00	19.34	24.36
ALT	5.00	2513.00	115.81	278.35
AST	6.00	9397.00	186.40	978.56
CRP	3.11	1360.00	124.64	146.27
Glucose	32.00	374.00	105.11	45.58
Urea	6.00	160.00	31.69	25.10
Sodium	118.00	154.00	138.19	4.32
Potassium	2.70	5.80	3.90	0.58
LDH	114.00	1963.00	310.99	231.12
Calcium	6.47	9.90	8.43	0.60
Chloride	89.00	112.00	101.60	4.49
Creatinine	0.29	7.76	0.85	0.98

SaO_2: Saturation of oxygen; ALT: Alanine aminotransferase; AST: Aspartate aminotransferase; CRP: C-reactive protein; LDH: Lactate dehydrogenase.

disease, may not be very suitable for use at the emergency department because they require a detailed examination that takes an extended time. In particular, APACHE II contains too many parameters. Ranson scoring requires a very long follow-up and includes parameters that are not standardized at the emergency department. BISAP scoring requires at least one imaging method because it includes the variable of the presence/absence of pleural effusion.

The SIRS criteria can be used in many diseases in the emergency department due to their simplicity and practicality.[13] However, their effectiveness and adequacy are still debated.[14] In a previous study evaluating 2011 patients with acute pancreatitis, ED-SAS was found to be effective in predicting 30-day mortality,[15] which supports our findings. The two most important features that distinguish ED-SAS from other scoring methods used in acute pancreatitis are the evaluation of age over 60 years and a saturation level below 96%. Elderly patients have more comorbid diseases and are more exposed to the long-term effects of these diseases. Reduced saturation has also been considered in the scoring system because it can be an early indicator of shock and can be used to predict mortality.

A study comparing ED-SAS with five traditional scoring systems in acute pancreatitis found striking results. Despite including fewer parameters, ED-SAS was determined to be more effective than the Ranson, modified Glasgow, and BISAP scoring systems (p<0.05).[10] The ED-SAS score alone was reported to be effective both in our study and in the previous comparative study (AUC >0.75). The presence of persistent organ failure for more than 48 h is the most important predictor of poor prognosis in acute pancreatitis.[11] ED-SAS contains variants that include systemic

responses to organ failure. This fact is supported by parameters including both the SIRS criteria and saturation. The SIRS criteria are used prognostically in many different critically ill patients, including sepsis. The rapid prediction of progression to organ failure may help reduce mortality in patients with acute pancreatitis.

This study has certain limitations. The retrospective and single-centered design constitute an important limitation. The evaluation of hospitalization and mortality only due
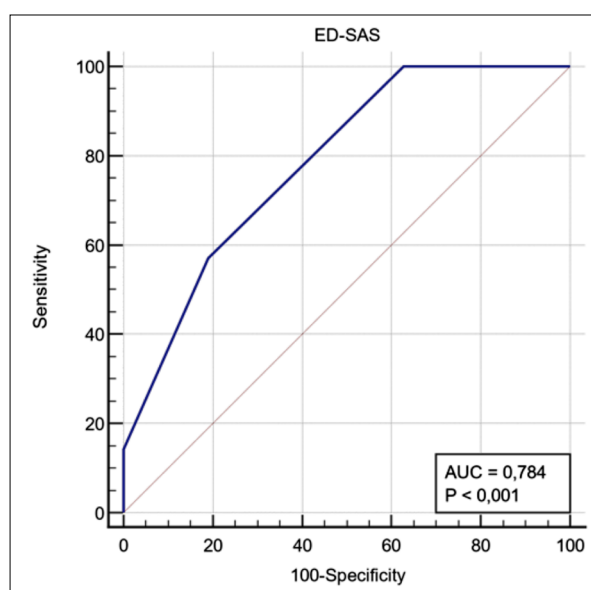

Figure 1. Receiver operating characteristic curve of the ED-SAS scoring system in the prediction of mortality in patients with acute pancreatitis

Table 2. Comparison of the patient characteristics between the survivor and nonsurvivor groups

		Mean–Median	Standard deviation IQR	p-value
Length of hospital stay (days)	Survivor	7.09–6.0	4.51	0.166
	Nonsurvivor	23.29	14.0	22.49
Age	Survivor	61.51–64.0	18.29	0.029
	Nonsurvivor	76.71	82.0	13.98
Systolic pressure	Survivor	145.10–130.5	109.85	0.147
	Nonsurvivor	117.29	119.0	24.36
Diastolic pressure	Survivor	80.70–80.0	11.90	0.132
	Nonsurvivor	73.29	72.0	12.04
Heart rate	Survivor	77.62–76.5	11.22	0.139
	Nonsurvivor	87.57	88.0	16.65
Fever	Survivor	36.50–36.3	0.64	0.775
	Nonsurvivor	36.63	36.3	0.73
SaO_2	Survivor	96.61–97.0	2.91	0.779
	Nonsurvivor	95.14	96.0	4.95
Respiratory rate per min	Survivor	15.73–16.0	3.19	0.004
	Nonsurvivor	21.43	19.0	6.00
Albumin	Survivor	19.76–24.0	24.91	0.061
	Nonsurvivor	13.00	2.9	12.99
ALT	Survivor	85.16–53.5	102.21	0.895
	Nonsurvivor	575.57	38.0	994.58
AST	Survivor	64.10–32.0	90.91	0.205
	Nonsurvivor	2021.00	46.0	3658.32
CRP	Survivor	123.97–94.3	149.04	0.601
	Nonsurvivor	134.67	90.3	103.33
Glucose	Survivor	105.72–92.0	45.77	0.785
	Nonsurvivor	96.00	102.0	44.86
Urea	Survivor	30.07–24.0	22.88	0.066
	Nonsurvivor	56.00	48.0	43.03
Sodium	Survivor	138.03–138.0	4.07	0.847
	Nonsurvivor	140.57	137.0	7.21
Potassium	Survivor	3.92–3.9	0.54	0.042
	Nonsurvivor	3.59	3.2	1.06
LDH	Survivor	289.19–24.8	212.32	0.001
	Nonsurvivor	638.00	690.0	271.62
Calcium	Survivor	8.49–8.47	0.53	0.004
	Nonsurvivor	7.52	7.48	0.87
Chloride	Survivor	101.93–102.0	4.07	0.081
	Nonsurvivor	96.57	93.0	7.46
Creatinine	Survivor	0.83–0.59	0.97	0.054
	Nonsurvivor	1.24	1.0	0.99
ED-SAS score	Survivor	0.82–1.0	0.73	0.007
	Nonsurvivor	1.71	2.0	0.76

The Mann-Whitney U test was used. IQR: Interquartile range; SaO_2: Saturation of oxygen; ALT: Alanine aminotransferase; AST: Aspartate aminotransferase; CRP: C-reactive protein; LDH: Lactate dehydrogenase.

Table 3. Statistical results of the ED-SAS scoring system in the prediction of mortality in acute pancreatitis

	AUC	Cut-off	Sensitivity	Specificity	+LR	-LR	PPV
ED-SAS	0.784 (0.696-0.856)	>1	57.1 (18.4-90.1)	80.9 (72.1-88.0)	3.0	0.53	16.7

AUC: Area under the curve; LR: Likelihood Ratios; PPV: Positive Predictive Value.

to acute pancreatitis can be another limitation. There is a need for long-term prospective studies that evaluate the comorbidities of patients prognostically.

According to our findings, the ED-SAS scoring system is a useful tool for reducing mortality in acute pancreatitis. Using this scoring system in the emergency department can help prevent mortality by initiating targeted treatments early.

Ethics Committee Approval

This study approved by the Kartal Dr. Lütfi Kırdar City Hospital Clinical Research Ethics Committee (Date: 30.03.2022, Decision No: 2022/514/222/19).

Informed Consent

Retrospective study.

Peer-review

Internally peer-reviewed.

Authorship Contributions

Concept: R.A., M.K., M.K.E.; Design: R.A., M.K., M.K.E.; Supervision: M.K.E.; Fundings: R.A.; Materials: R.A., M.K.E.; Data: R.A., M.K.; Analysis: R.A., M.K.; Literature search: M.K., M.K.E; Writing: R.A., M.K., M.K.E.; Critical revision: M.K., M.K.E.

Conflict of Interest

None declared.

REFERENCES

1. Krishna SG, Kamboj AK, Hart PA, Hinton A, Conwell DL. The changing epidemiology of acute pancreatitis hospitalizations: a decade of trends and the impact of chronic pancreatitis. Pancreas 2017;46:482.

2. Yadav D, Lowenfels AB. The epidemiology of pancreatitis and pancreatic cancer. Gastroenterology 2013;144:1252–61. [CrossRef]

3. Eachempati SR, Hydo LJ, Barie PS. Severity scoring for prognostication in patients with severe acute pancreatitis: comparative analysis of the Ranson score and the APACHE III score. Arch Surg 2002;137:730–6. [CrossRef]

4. Barauskas G, Ignatavičius P, Vitkauskienė A, Pundzius J, Dambrauskas Ž. Impact of etiology on course and outcomes of severe acute pancreatitis. Medicina 2015;51:167–72. [CrossRef]

5. Hökenek NM, Seyhan AU, Erdoğan MÖ, Tekyol D, Yılmaz E, Korkut S. Evaluation of blood gas analysis as a mortality predictor. South Clin Ist Euras 2019;30:228–31. [CrossRef]

6. Hökenek ÜD, Özcan FG, Sevdi MS, Erkalp K, Selcan A. Mortality predictors in sepsis: a retrospective study. J Turk Soc Intens Care 2021;19:82–9. [CrossRef]

7. Ak R, Hökenek NM. Comparison of AIMS65 and Glasgow Blatchford scores in predicting mortality in patients with upper gastrointestinal bleeding. Rev Assoc Med Bras 2021;67:766–70. [CrossRef]

8. Ak R, Doğanay F, Unal Akoğlu E, Akoğlu H, Uçar AB, Kurt E, et al. Predictive value of scoring systems for the diagnosis of acute appendicitis in emergency department patients: Is there an accurate one? Hong Kong J Emerg Med 2020;27:262–9. [CrossRef]

9. Ak R, Kurt E, Bahadirli S. Comparison of 2 risk prediction models specific for COVID-19: the brescia-COVID respiratory severity scale versus the quick COVID-19 severity index. Disaster Med Public Health Prep 2021;15:e46–e50.

10. Erdogan MÖ, Hokenek NM. How to score acute pancreatitis in the emergency setting: five systems against ED-SAS. Signa Vitae 2021;17:122–9.

11. Gliem N, Ammer-Herrmenau C, Ellenrieder V, Neesse A. Management of severe acute pancreatitis: an update. Digestion 2021;102:503–7. [CrossRef]

12. Mofidi R, Duff M, Wigmore S, Madhavan K, Garden O, Parks R. Association between early systemic inflammatory response, severity of multiorgan dysfunction and death in acute pancreatitis. Br J Surg 2006;93:738–44. [CrossRef]

13. Imrie C, Ferguson J, Murphy D, Blumgart L. Arterial hypoxia in acute pancreatitis. Br J Surg 1977;64:185–8.

14. Miller J, Wu Y, Safa R, Marusca G, Bhatti S, Ahluwalia G, et al. Derivation and validation of the ED-SAS score for very early prediction of mortality and morbidity with acute pancreatitis: a retrospective observational study. BMC Emerg Med 2021;21:16. [CrossRef]

15. Ahluwalia G, Wu Y, Gomez H, Farook N, Scott A, Nair V, et al. 475: Emergency department spo2, age, and sirs (ed-sas) score predicts mortality in acute pancreatitis. Crit Care Med 2020;48:218.

16. Tenner S, Baillie J, DeWitt J, Vege SS. American College of Gastroenterology guideline: management of acute pancreatitis. Am J Gastroenterol 2013;108:1400–15. [CrossRef]

17. Barichello T, Generoso JS, Singer M, Dal-Pizzol F. Biomarkers for sepsis: more than just fever and leukocytosis—a narrative review. J Crit Care 2022;26:14. [CrossRef]

18. Sparks R, Harada A, Chavada R, Trethewy C. Comparison of different sepsis scoring systems and pathways: qSOFA, SIRS, Shapiro criteria and CEC SEPSIS KILLS pathway in bacteraemic and non-bacteraemic patients presenting to the emergency department. BMC Infect Dis 2022;22:76.

Acil Serviste Akut Pankreatitte ED–SAS Skorlama Sisteminin Mortalite Prediksiyon Yeteneğinin Araştırılması

Amaç: Acil serviste akut pankreatitten ölüm, ED-SAS (Emergency Department periferik kapiller oksijen satürasyonu, yaş ve Sistemik inflamatuar yanıt sendromu) skorlama sistemi (ED-SAS) kullanılarak tahmin edilebilir.

Gereç ve Yöntem: Bu çalışmada tek merkezli kohort gözlemsel araştırma yöntemi kullanılmıştır. Tam bir vaka çalışması tekniğinin kullanılmasına karar verildi. Hastane otomasyon sistemi ile acil servise akut pankreatit tanısı ile başvuran hastalarda retrospektif tarama yapıldı. ED-SAS skorlama sisteminin 30 günlük mortaliteyi tahmin etme yeteneğinin istatistiksel değerlendirmesi için eğri altında kalan alan (AUC) ve alıcı işletim karakteristik eğrisi (ROC) kullanıldı.

Bulgular: Yaş ortalaması 62.5±18.4 olan toplam 112 hasta incelendi. Akut pankreatitli hastalarda ölüm tahmini için ED-SAS skorlama sisteminin AUC'si (yüzde 95 güven aralığı: 0.696–0.856) 0.784 (Youden indeksi: 0.381) ve p değeri 0.001'dir. ED-SAS'ın duyarlılığı yüzde 57.1, özgüllüğü yüzde 80.9, pozitif öngörü değeri yüzde 16.7 ve cut-off sayısı 1'den büyük olduğunda negatif öngörü değeri yüzde 96.6 idi.

Sonuç: ED-SAS, acil serviste akut pankreatitli bireylerde 30 günlük mortaliteyi tahmin etmek için kullanılabilir.

Anahtar Sözcükler: Akut pankreatit; ED-SAS; mortalite.