ORIGINAL ARTICLE / ÖZGÜN ARAŞTIRMA MAKALESİ

# Comparison of Predicting the Severity of Disease by Clinical and Radiological Scoring Systems in Acute Pancreatitis

*Akut Pankreatitte Klinik ve Radyolojik Skorlamaların Hastalığın Şiddetini Belirlemede Etkinliğinin Karşılaştırılması*

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**ABSTRACT**

**Aim:** Acute pancreatitis (AP) is a frequent reason for patient presentation in emergency department. It is hard to assess objectively the grade of the disease due to a wide range of clinical signs in terms of determination the need for intensive care or surgical intervention. At this stage there is not a unique, unified scoring system that determines the severity of the disease. In this study we aimed to compare clinically used AP scoring systems; Ranson, BISAP and Balthazar (CTSI), SIRS to predict disease severity.

**Material and Methods:** In this study, AP patients that were diagnosed by Atlanta criteria were analyzed retrospectively. The clinical, laboratory and radiological images and results of the patients were analyzed by using the "first 24 hours Ranson", "BISAP" and SIRS scores. The Balthazar scores were calculated from the CT reports retrospectively.

**Results:** Age, respiratory rate and BUN values of the patients with mortality were significantly higher than the patients who survived, whereas diastolic blood pressure, systolic BP blood pressure, SO2 and amylase values of the patients with mortality were found to be significantly lower than the patients who survived. When the 6 month mortality prediction of prognostic scoring systems was examined, it was found that the BISAP score could catch 94% of mortality (95% CI: 0.88-0.97), and the SIRS score could predict mortality by 74.7% (95% CI: 0,66-0,82).

**Conclusion:** Regarding the APs severity prediction, BISAP and SIRS scores were more sensitive and specific in terms of monthly and overall mortality in patients.

**Keywords**: Acute pancreatitis, BISAP, Balthazar, Ranson

**ÖZ**

**Amaç:** Akut pankreatit (AP) acil servis hasta başvurularının önemli nedenlerinden biridir. Çok çeşitli klinik belirtiler nedeniyle yoğun bakım veya cerrahi müdahale ihtiyacının belirlenmesi açısından hastalığın derecesini objektif olarak değerlendirmek zordur. Şu an, hastalığın şiddetini belirleyen mükemmel bir puanlama sistemi yoktur. Bu çalışmada hastalık şiddetini tahmin etmek için klinik olarak kullanılan AP skorlama sistemleri olan Ranson, BISAP ve Balthazar (CTSI), SIRS skorlamalarını karşılaştırmayı amaçladık.

**Gereç ve Yöntemler:** Bu çalışmada Atlanta kriterlerine göre tanı konulan AP hastaları retrospektif olarak incelendi. Hastaların klinik, laboratuvar sonuçları ve radyolojik görüntüleri kullanılarak "ilk 24 saat Ranson", "BISAP" ve SIRS skorları analiz edildi. Balthazar skorları geriye dönük olarak BT raporlarından hesaplandı.

**Bulgular:** Mortal seyreden hastaların yaş, solunum hızı ve BUN değerleri, hayatta kalanlara göre anlamlı olarak yüksek bulunurken, mortalitesi olan hastaların diyastolik kan basıncı, sistolik kan basıncı, SO2 ve amilaz değerleri anlamlı olarak düşük bulundu. Prognostik skorlama sistemlerinin 6 aylık mortalite tahmini incelendiğinde BİSAP skorunun mortalitenin %94'ünü yakalayabildiği (%95 GA: 0.88-0.97), SIRS skorunun mortaliteyi %74,7 (%95 CI: 0,66-0,82) öngörebildiği bulundu.

**Sonuç:** Hastalarda AP şiddeti tahmini ile ilgili olarak BİSAP ve SIRS skorları aylık ve genel mortalite açısından daha duyarlı ve spesifikti.

**Anahtar Kelimeler:** Akut pankreatit, BISAP, Balthazar, Ranson

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**Introduction**

Acute pancreatitis progresses with different severity of pathological changes, from edematous pancreatitis with a mild course to necrotizing pancreatitis with a severe clinical course. Therefore, the prognosis of the disease can show quite variable prognosis. In severe pancreatitis, local or systemic complications with high mortality can occur (1).

Due to the wide range of clinical findings of AP, it is difficult to objectively evaluate the findings in grading the severity of the disease (2). In addition, predicting the clinical severity of the disease is important in determining and planning the need for systemic antibiotics, intensive care or surgical treatment. Many scoring systems have been developed for this purpose until today. Ranson, APACHE-II and Atlanta criteria are the most commonly used and known scoring systems (3-5). Today, newer scoring systems such as BISAP are also used to predict mortality (6). Ranson Score is inable to calculate total score at the time of admission to the hospital so there is a need to wait until the end of 48 hours for the final evaluation. Some clinicians tend to use a radiological scoring system such as CT Severity Score (CTSI) (Balthazar) (7).

In this study, it was aimed to compare the value of Ranson, BISAP, SIRS and CTSI in predicting the severity of the disease.

**Material and Methods**

For this study, demographic, clinical, radiological and laboratory data of patients aged> 18 years who were diagnosed with acute pancreatitis and hospitalized in the emergency department (ED) were prospectively collected and these data were analyzed retrospectively. Approval was obtained from the Marmara University Study Ethics Committee (protocol number 09.2015.320/70737436-050.06.04) for this study, and written consent was obtained from all patients included in the study.

The sample calculation made over the area under the ROC curve; when type 1 error (α error) is taken as 0.05 and type 2 error (error) is taken as 0.20, the area under the ROC curve is considered 0.65 and the H0 hypothesis is 0.50, and the required sample number is 114. Assuming a loss probability of 10%, 121 people are sufficient for universe representation.

Patients>18 years of age who were diagnosed with AP in the ED and underwent abdominal CT imaging were included in our study. Among 138 patients, 9 patients were excluded from the study due to incomplete recording of the data. Eight patients were excluded from the study because CT scans could not be completed due to various reasons. The number of patients included in the study was 121.

Inclusion criterias were;

1. ≥18 years
2. Meeting the clinical diagnostic criteria for acute pancreatitis
3. Abdominal CT is present.

The following patient groups were not included in the study:

1. Doesn't sign the consent form,
2. Pregnant patients.

Atlanta criteria were used for the diagnosis of acute pancreatitis (8).

- Typical abdominal pain
- An increase in serum Amylase and \ or Lipase values more than 3 times the upper limit of normal
- Detection of findings compatible with Acute Pancreatitis in Computed Tomography

Patients with 2 or more of these findings were considered to be diagnosed with AP. Demographic, clinical and laboratory data of patients diagnosed with AP were recorded. The CT scan indication was given by the doctor who made the diagnosis. All of the CT scans were taken in our institution with Siemens, 128 detector Definition AS (Siemens AG, Germany) device. The radiologists who interpreted these CT scans were unaware of the study and patient outcomes. For every patient diagnosed with AP; age, gender, vital signs, laboratory data, duration of hospitalization, duration of intensive care unit (ICU), 1-month and 6 month mortality were recorded. At the end of the study, using the clinical, laboratory and radiological imaging of the patients, the "first 24 hour Ranson", BISAP, SIRS and Balthazar scores were calculated retrospectively.

The severity of the disease was classified according to the "Revised Atlanta Criteria" and the clinical outcomes of the patients were determined through digital records (8). For patient outcome; length of stay, length of stay in intensive care unit, operation need and mortality rates were taken as reference.

Statistical analysis were performed using Medcalc version 14.0 software. The conformity of the variables to normal distribution was examined by visual (histogram and probability graphs) and analytical methods (Kolmogorov-Smirnov / Shapiro-Wilk tests). Descriptive analyzes were given using mean, standard deviation and median for normally distributed variables. Pearson's Chi-Square and Fisher's Exact Tests on 2x2 eyes were compared. Bonferroni correction and post-hoc analysis were performed in eyes more than 2x2. In cases where the data did not show normal distribution, groups of 2 were evaluated with the Mann Whitney U test. In the study, ROC analysis was performed and curves were drawn for the mortality prediction of scoring systems. The situations where the p-value was less than 0.05 were evaluated as statistically significant results.

## Results

Total 121 patients were included in our study. Age, vital signs, biochemical data, length of stay of the patients are shown in Table 1. When the physical findings of the patients were examined; altered mental status was found in 7 patients (5.8%), pleural effusion in 11 patients (9.1%). In addition, 5 patients were followed in the intensive care unit, while the remaining 116 patients were followed in the wards. Of the 121 patients, 4 died within the first month and 7 died within 6 months.

When the relationship between 6-month mortality and age, vital signs and biochemical parameters were examined; age, respiratory rate and BUN values of the patients with mortality were significantly higher than the patients who survived, and DBP, SBP, oxygen saturation and amylase values were found to be significantly lower than the patients who survived (Table 1).

When the relationship between altered consciousness, presence of pleural effusion and 1- and 6-month mortality was examined, although the 1-month mortality rate was higher in patients with altered consciousness and pleural effusion, the difference between them was not statistically significant (p>0.05).

When the relationship between acute pancreatitis prognostic scoring methods and 1-month mortality was examined; it was found that Ranson classification did not make a significant difference between survival groups in terms of 1-month mortality (p>0.05), however, there are significant statistical significance in terms of SIRS, BISAP and CTSI scores(p<0.05) (Table 2).

When the predictions of 1- and 6-month mortality of prognostic scoring methods are examined by ROC analysis, it is seen that the best score is BISAP (Figure 1). It was found that the BISAP score could catch 94% of mortality (95% CI: 0.88-0.97), and the SIRS score could predict mortality by 74.7% (95% CI: 0,66-0,82). Seven patients died in 6 months, and three of them had a BISAP score of 4, three had a score of 3, and one had a score of 2.

If the threshold value of the BISAP score was taken above 1, it was found that it could predict all patients who died within 1 month (sensitivity 100%), but its specificity was found to be slightly low (70.09%) . When the threshold value is above 2, the overall mortality sensitivity was 85.7% (95% CI: 42.1-99.6) and the specificity was 91.2% (95% CI: 84.5-95.7) (AUC; 0.94) .

| | **Total (n:121) mean ±SD** | **Survival (n:114) mean ±SD** | **Exitus (n:7) mean ±SD** | **p** |
|---|---|---|---|---|
| **Age** | 55,9 ± 16,6 | 54,7 ± 16,1 | 75,7 ± 12,4 | 0,001 |
| **DBP *** | 75,9 ± 16,1 | 76,7 ± 15,9 | 62,9 ± 16,7 | 0,027 |
| **SBP*** | 129,9 ± 26,2 | 131,4 ± 26,0 | 106,1 ± 17,5 | 0,006 |
| **Heart rate** | 85,4 ± 15,6 | 84,9 ± 15,5 | 94,0 ± 16,0 | 0,136 |
| **Respiratory rate** | 19,2 ± 3,1 | 19,0 ± 3,0 | 23,4 ± 2,2 | <0,001 |
| **Temperature** | 36,8 ± 0,6 | 36,8 ± 0,6 | 37,0 ± 0,9 | 0,929 |
| **Saturation** | 97,1 ± 1,3 | 97,2 ± 1,3 | 96,1 ± 1,2 | 0,026 |
| **Leucocyte count** | 13012,3 ± 5544,1 | 13121,8 ± 5460,0 | 11228,5 ± 7024,6 | 0,357 |
| **Glucose** | 157,7 ± 68,6 | 155,7 ± 62,6 | 190,0 ± 139,0 | 0,991 |
| **AST*** | 197,6 ± 197,0 | 201,3 ± 201,3 | 136,4 ± 94,4 | 0,693 |
| **ALT*** | 173,3 ± 182,3 | 178,3 ± 185,9 | 92 ± 76,0 | 0,457 |
| **LDH*** | 436,1 ± 338,5 | 440,3 ± 345,9 | 366,9 ± 184,9 | 0,673 |
| **BUN*** | 18,3 ± 12,9 | 17,4 ± 12,6 | 32,7 ± 11,1 | <0,001 |
| **Amilase** | 1269,0 ± 1223,0 | 1326,2 ± 1232,2 | 336,9 ± 491,0 | 0,010 |
| **Lipase** | 2302,7 ± 3092,5 | 2410,7 ± 3148,5 | 543,9 ± 865,5 | 0,053 |

*ALT: Alanine aminotransferase, AST: Aspartate aminotransferase, LDH: Lactate dehydrogenase, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, BUN: Blood urea nitrogen, MAP: Mean arterial pressure

**Table 1.** The comparison of 6-month survival status and the age, laboratory findings, vital signs

| | | Mortality (1 month) | | | | |
|---|---|---|---|---|---|---|
| | | Survival | | Exitus | | |
| | | n | % | n | % | p[1] |
| Ranson | 0 | 18 | (15,4) | 0 | (,0) | |
| | 1 | 37 | (31,6) | 1 | (25,0) | |
| | 2 | 35 | (29,9) | 2 | (50,0) | 0,875 |
| | 3 | 17 | (14,5) | 1 | (25,0) | |
| | 4 | 9 | (7,7) | 0 | (,0) | |
| | 5 | 1 | (,9) | 0 | (,0) | |
| SIRS | 0 | 29 | (24,8) | 0 | (,0) | |
| | 1 | 37 | (31,6) | 0 | (,0) | |
| | 2 | 32 | (27,4) | 3 | (75,0) | 0,006 |
| | 3 | 17 | (14,5) | 0 | (,0) | |
| | 4 | 2 | (1,7) | 1 | (25,0) | |
| BISAP | 0 | 41 | (35,0) | 0 | (,0) | |
| | 1 | 41 | (35,0) | 0 | (,0) | |
| | 2 | 22 | (18,8) | 1 | (25,0) | 0,001 |
| | 3 | 8 | (6,8) | 1 | (25,0) | |
| | 4 | 5 | (4,3) | 2 | (50,0) | |
| CTSI | 0 | 42 | (35,9) | 0 | (,0) | |
| | 1 | 23 | (19,7) | 2 | (50,0) | |
| | 2 | 23 | (19,7) | 0 | (,0) | |
| | 3 | 21 | (17,9) | 0 | (,0) | 0,005 |
| | 4 | 5 | (4,3) | 2 | (50,0) | |
| | 5 | 2 | (1,7) | 0 | (,0) | |
| | 6 | 1 | (,9) | 0 | (,0) | |

[1]Fisher Freeman Halton Testi

**Table 2.** One-month mortality status according to prognostic scoring methods

If the threshold value of the SIRS score was taken above 1, it was found that it could predict all patients who died within 1 month (sensitivity 100%), but the specificity was found to be low (56.41%). When the threshold value is above 1, the overall mortality sensitivity was found to be 100% (95% CI: 59.0-100.0) and the specificity was 57.89% (95% CI: 48.3-67.1) (AUC; 0, 74).

## Discussion

In this study we found that BISAP and SIRS scores were more sensitive and specific in terms of monthly and overall mortality in patients. It has been one of the studies supporting the low mortality prediction of Ranson classification.

The mean age of the AP patients we screened retrospectively was 55.90 ± 16.60 years, and the average length of stay was 7.33 ± 6.10 (days). While 7 (5.80%) of the patients included in our study died in 6 months, 4 (3.30%) of them occurred within the first month. In Polishchuk et al study from Israel, mean age was 60.70± 19.80 years. Mortality was observed 4.30% of the cases (9).

When biochemical parameters and vital signs were considered individually, a close relationship was found between mortality and blood pressure, as well as, respiratory rate (positive) and partial oxygen pressure (negative) showed a statistical significance according to the mortality status of the patients. In addition, it was observed that the BUN level, another parameter of the BISAP score, was significantly higher in mortal patients. In a study in which Koutroumpakis et al. re-analyzed three independent cohort studies post hoc, the increase in hematocrit and BUN values at the time of admission were the parameters that showed the most significant relationship in terms of permanent organ damage and pancreatic necrosis (10). In our study, although the hematocrit values were not included in the study, consistent results were obtained in the BUN parameter. In the study of Yang et al., the high BUN that developed 48 hours after admission to the hospital was found to be a significant indicator of the development of permanent organ damage (11).

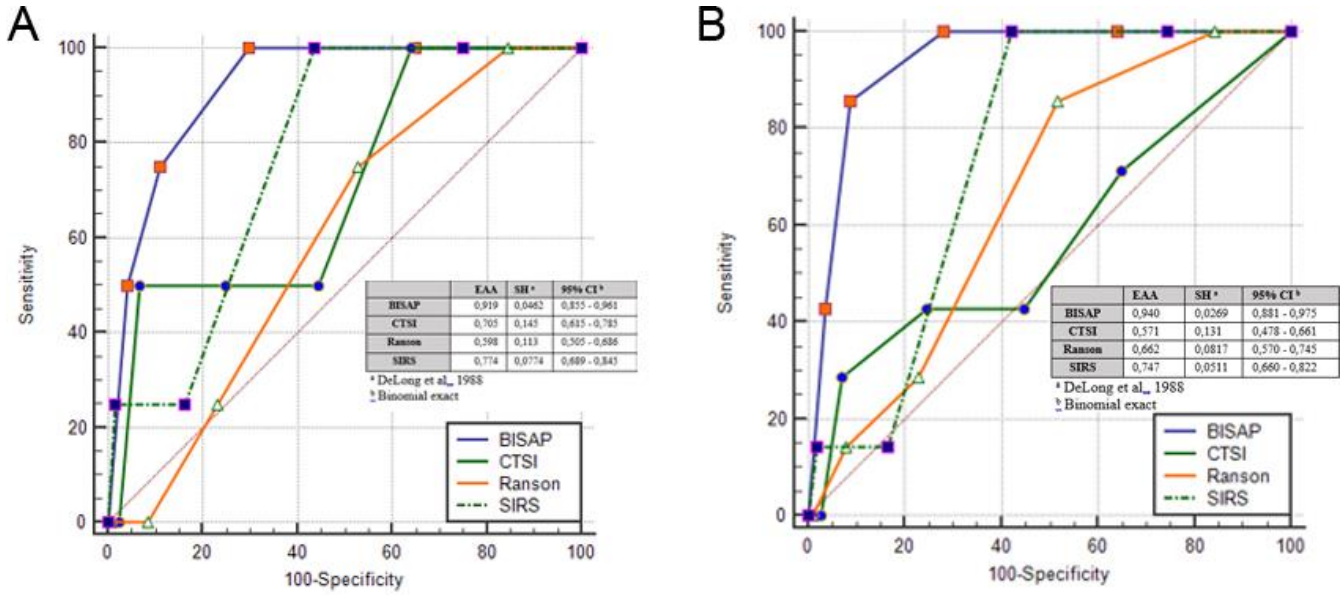


**Figure 1.** The ROC curve of 1(A)- and 6 (B)-month mortality of prognostic scoring methods

In this study, 7 (5.80%) of the patients had change in consciousness and 11 (9.10%) had pleural effusion. Although the monthly and general mortality was higher in patients with altered consciousness and plevral effusion, the relationship between them was not found to be significant due to the insufficiency of the sample. In the study of Heller et al., pleural effusion in moderate pancreatitis was 8.60%, while this increased to 84.20% in severe pancreatitis (12). Although Heller et al. stated that pleural effusion is highly significant with the severity of the disease, the relationship with mortality and morbidity was not investigated. Gumaste et al. found pleural effusion in 13.40% of patients with AP in a retrospective study and stated that all pleural effusions were resolved without any intervention (13).

Various classification systems are used to determine the clinical severity and prognosis in acute pancreatitis. The main ones are Ranson criteria, APACHE II score, BISAP, SIRS, Atlanta and Balthazar classifications (14). Mortality and morbidity are mostly used as indicators of prognosis in AP. In our study, one month and 6 month mortality were used as prognosis indicators. Considering the threshold scores determined by ROC curves in both mortality, the highest sensitivity and specificity values belong to the BISAP scoring system. Secondly, the mortality prediction of the SIRS score, which is one of the parameters that already helps in the calculation of the BISAP score, has been found to have high sensitivity and specificity. In the studies of Papachristou et al. investigating the relationship between BISAP, Ranson, APACHE II and CTSI scoring systems with organ failure, complications and mortality in AP patients, the AUCs of BISAP, Ranson, APACHE II and CTSI scores in terms of predicting severe acute pancreatitis were 0.81, 0.94, 0.78, 0.84 respectively (15). One of the seven patients who died during the study had a BISAP score of 1, two of them had a score of 2, and four had a score of 3 . Similarly, in our study, seven patients died, and three of them had a BISAP score of 4, three had a score of 3, and one had a score of 2. In our study, the AUCs of BISAP, Ranson, SIRS and CTSI scores in terms of predicting overall mortality were 0.94, 0.66, 0.74 and 0.57 respectively. Although similar results were obtained especially in the BISAP scoring system, the prediction success of Ranson and CTSI scores was found to be lower in our study. In Liu's study, CTSI, EPIC and BISAP scores were significantly high in severe pancreatitis (16). Although the CTSI score did not give very good results in predicting prognosis in our study, many researchers stated that this score gave consistent results (17-19). In a study by Zhang et al. comparing the BISAP score in AP patients in the Chinese population with the Ranson and APACHE II scores, the BISAP score was found to be significantly higher in patients with mortality ($p < 0.001$) (20).

Although our study is conducted on a sufficient sample, it has some limitations, as the indication for CT was given by another physician unaware from this study, it could not be standardized. In addition, the fact that patients' additional comorbidities were not taken into account. ED was crowded, so missing values are present.

**Conclusion**

In conclusion mortality increased significantly as the SIRS, BISAP and CTSI scores increased. It has been one of the studies supporting the low mortality prediction of Ranson classification.

**Conflict of Interest:** The authors declare no conflict of interest regarding this study.

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