



# A Useful Predictor for the Prognosis of Acute Pancreatitis: Lactate

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## ABSTRACT

**Objective:** In this study, it was aimed to show the prognostic value of Ranson score + lactate level created by adding lactate to Ranson score in patients diagnosed with acute pancreatitis in the emergency department.

**Material and Methods:** One hundred and sixty-three patients with acute pancreatitis were enrolled in this retrospective study. Demographic data, presentation time vital signs, biliary/non-biliary etiology, Ranson score, hospitalisation clinic, length of hospitalisation, and 30-day mortality rate data were noted. Ranson score and Ranson score + serum lactate levels were compared according to severity, prognosis and outcome.

**Results:** Complication occurrence ratio was 8.6%. Totally, 160 (98.2%) patients were discharged and 3 (1.8%) patients died. Serum lactate level was significantly related with hospitalization of more than 10 days ( $p < 0.05$ ). Correct prediction ratio of serum lactate level for complication occurrence during hospitalization was insufficient ( $p > 0.05$ ). Ranson score and serum lactate levels were significantly correlated ( $p < 0.05$ ). When we added lactate to Ranson score, correct outcome prediction ratio was significantly higher ( $p < 0.05$ ). Serum lactate level and length of hospitalization and mortality were positively correlated ( $p < 0.05$ ). According to ROC analyses, the cut-off level of serum lactate was 17.5 mg/dL for mortality prediction with 100% sensitivity and 75% specificity.

**Conclusion:** Serum lactate level is an important parameter in predicting severity, prognosis and outcome of patients with acute pancreatitis. When serum lactate level is added to RS, better prediction ratios for prognosis and outcome are determined. Serum lactate level can be a useful parameter for emergency clinicians to plan the treatment strategy of acute pancreatitis patients in emergency medicine.

**Keywords:** Acute pancreatitis, Ranson score, prognosis, lactate, emergency department

## Öz

### Akut Pankreatitin Prognozu İçin Yararlı Bir Öngörü: Laktat

**Giriş:** Bu çalışmada, acil serviste akut pankreatit tanısı alan hastalarda Ranson skoruna laktat eklenerek oluşturulan Ranson skoru + laktat seviyesinin prognostik değerinin gösterilmesi amaçlandı.

**Gereç ve Yöntemler:** Bu çalışmaya 163 AP hastasını dahil ettik. Demografik veriler, başvuru zamanı vital bulguları, biliyer/biliyer olmayan etiyoloji, Ranson skoru, yatış kliniği, hastanede yatış süresi ve 30 günlük ölüm oranı verileri kaydedildi. Ranson skoru ve Ranson skoru + serum laktat düzeyleri şiddet, prognoz ve sonuca göre karşılaştırıldı.

**Bulgular:** Komplikasyon oluşma oranı %8.6 idi. Toplam 160 (%98.2) hasta taburcu edildi ve 3 (%1.8) hasta öldü. Serum laktat düzeyi 10 günden fazla hastanede yatış ile anlamlı olarak ilişkiliydi ( $p < 0.05$ ). Serum laktat düzeyinin hastanede yatış sırasında komplikasyon oluşumu için doğru tahmin oranı yetersizdi ( $p > 0.05$ ). Ranson skoru ve serum laktat düzeyleri anlamlı olarak ilişkiliydi ( $p < 0.05$ ). Ranson skoruna laktat eklediğimizde doğru sonuç tahmin oranı anlamlı olarak yüksekti ( $p < 0.05$ ). Serum laktat düzeyi ile hastanede kalış süresi ve mortalite arasında pozitif korelasyon vardı ( $p < 0.05$ ). ROC analizlerine göre mortalite tahmini için serum laktat cut-off düzeyi %100 duyarlılık ve %75 özgüllük ile 17.5 mg/dL idi.

**Sonuç:** Serum laktat düzeyi, akut pankreatitli hastaların ciddiyetini, prognozunu ve sonucunu tahmin etmede önemli bir parametredir. Serum laktat düzeyi Ranson skoruna eklendiğinde prognoz ve sonuç için daha iyi tahmin oranları belirlendi. Serum laktat düzeyi, acil servisteki akut pankreatitli hastaların tedavi stratejisini planlamak için acil klinisyenler için yararlı bir parametre olabilir.

**Anahtar Kelimeler:** Akut pankreatit, Ranson skoru, prognoz, laktat, acil servis

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## INTRODUCTION

Acute pancreatitis (AP) is an inflammatory process of the pancreas. Mortality ratio of AP is nearly 3%-19% (1). Mortality is generally related with systemic inflammatory response within the first two weeks and complications and sepsis after two weeks (2,3). Annually, incidence is 4.9-35/100.000 in the United States and arises each year (4). Several scoring systems like the Ranson criteria have been developed to determine the mortality and prognosis of acute pancreatitis. Ranson score (RS) is a widely used scoring system in emergency clinics. Ranson et al. first defined these criteria in 1976. It consisted of five parameters, and some modifications were made for biliary pancreatitis (5). Mortality is correlated with RS. Patients whose RS is under three points are known as low-risk patients with a mortality ratio of 1.2% and a complication ratio of 3.7%. Patients with a RS of three and four are categorized as severe pancreatitis with 15% mortality, and this ratio increases up to 100% for RS five and six (5).

Serum lactate level is generally used for severity and treatment response in critically ill patients in the emergency department (ED). Serum lactate level arises in a lot of clinical situations and is related with tissue hypoperfusion and hypoxia. Recently, lactate level follow-up has become important for emergency clinicians in critically ill patients such as sepsis and multiorgan failure. It is suggested that serum lactate levels help to make correct mortality prediction in sepsis and septic shock (6,7). In this study, it was aimed to determine the mortality and prognosis prediction level of serum lactate level in patients with AP via adding it to RS and to compare whether serum lactate level and RS provide better prediction ratio than RS alone or not. The limit value for serum lactate level in severe AP was considered by evaluating mortality and length of hospitalization.

## MATERIALS and METHODS

One hundred and sixty-three of 570 patients diagnosed with AP between January 2019 and December 2019 were included in this retrospective study. Four hundred and seven patients were excluded due to lack of blood gas analyses. Following the receipt of the ethics committee approval, demographic data (age, sex), presentation time vital signs (systolic/diastolic blood pressure, heart rate) biliary/non-biliary etiology, RS, hospitalization clinic (inpatient clinic/intensive care unit), length of hospitalization, 30-day mortality ratios were noted. RS and RS + serum lactate levels were compared according to severity, prognosis and outcome. The outcome for 30-day mortality was investigated. All patients underwent statistical evaluation both for RS alone and RS + lactate level.

## Diagnostic Criteria, Inclusion Criteria and Exclusion Criteria

Diagnostic criteria of acute pancreatitis included abdominal pain, increase in serum amylase values three times above the normal value, lipase value above the normal value, and reporting of findings in favor of acute pancreatitis in computed abdominal tomography.

Patients over the age of 18 years with full file data were determined as inclusion criteria. Patients under 18 years of age, with missing file data, and with elevated amylase levels for any reason other than acute pancreatitis were determined as exclusion criteria.

## Statistical Analysis

SPSS 23.0 (IBM/USA) was used for all statistical analyses of the patients' data. Homogeneity of each parameter was evaluated with Kolmogorov Smirnov and Shapiro Wilks tests. Mean, median, and standard deviation were calculated for definitive data. Mann-Whitney U test was used for quantitative variables, and Chi-square test ( $\chi^2$ ) was used for qualitative variables. Spearman's correlation test was used for correlations. Standard methodology was used for improving the clinical decision rule (8). First, we chose categorical variables that provided  $p < 0.05$  in one variable analyses. Then, we chose probable continuous variables with  $p < 0.05$  that could be important clinical determinant in one variable analyses. Outcome variables were hospitalization more than 10 days and mortality. For improving new clinical rules, we used measurable parameters and categorical variables. ROC analysis was used for determining the cut-off level of serum lactate. Sensitivity and specificity were calculated. Significance level for  $p$  was 0.05 with 95% CI.

## RESULTS

In our study, we included 86 (52.8%) females and 77 (47.2%) males, totally 163 patients with AP. Mean age of the patients was  $56.8 \pm 17.75$  (min= 20-max= 94). Fifty-one percent of the patients were biliary and 48.5% was nonbiliary AP. Mean serum lactate level of our study group was  $13.91 \pm 7.66$  (min= 4, max= 74) mg/dL. Analysis results of the patients' vital signs, demographic data, Ranson scores, length of hospital stay and outcomes are given in Table 1.

According to RS, 54 (33.1%) patients had zero point, 47 (28.8%) patients had one point, 38 (23.3%) patients had two points, 21 (12.9%) patients had three points and 3 (1.8%) patients had four points. Complications occurred in 14 (8.6%) patients during hospitalization. Three (1.8%) patients died and 160 (98.2%) patients were discharged after hospitalization.

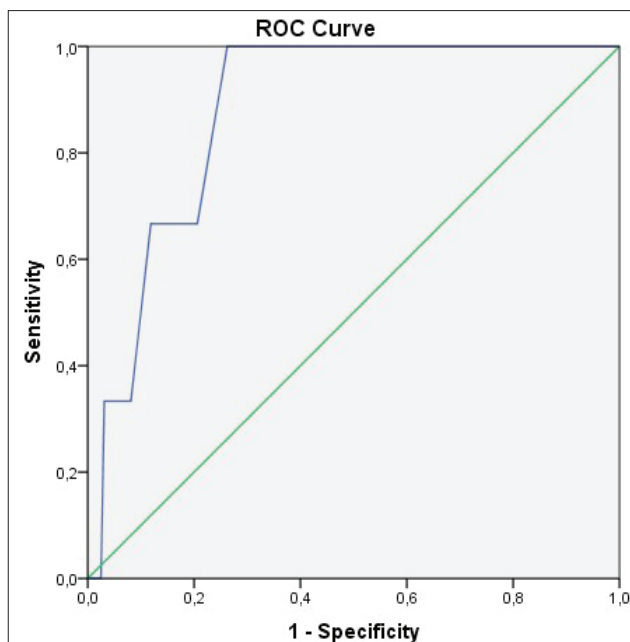
**Table 1.** Analysis of patients' vital signs, demographic data, Ranson scores, length of hospital stay and outcomes

	Number (N)	Percentage (%)
Sex		
Male	86	52.8
Female	77	47.2
Biliary		
Non-biliary	84	51.5
Complication	79	48.5
Outcome		
Discharge	14	8.6
Exitus	16	98.2
	3	1.8
	Mean (min-max)	Standart Deviation
Age	56.8 (20-94)	17.75
Systolic blood pressure	124.4 (80-180)	23.91
Diastolic blood pressure	76.6 (50-110)	13.66
Pulse (per minute)	81 (37-120)	13.36
Fever (°C)	36.95 (36-39.5)	0.5
Pulse-oximeter (%)	96.6 (88-100)	3.14
Lactate (mg/dL)	1.53 (0.44-8.14)	0.84
Ranson score	1.21 (0-4)	1.09
Length of stay in the inpatient clinic (day)	4.8 (1-35)	4.9
Intensive care length of stay (day)	5.3 (1-14)	4.03

Serum lactate level was related with hospitalization of more than 10 days ( $p < 0.05$ ) and mortality ( $p < 0.05$ ). Mean initial serum lactate level of the patients hospitalized for more than 10 days was  $19.86 \pm 6.9$  mg/dL, this value was  $13.32 \pm 7.49$  mg/dL in patients hospitalized for less than ten days. ED serum lactate level was not related with complication occurrence ( $p > 0.05$ ). Serum lactate level and RS of the patients were positively correlated ( $p < 0.05$ ). Length of hospitalization and mortality were also correlated ( $p < 0.05$ ). RS + serum lactate significantly predicted the outcome of AP patients ( $p < 0.05$ ).

According to ROC analysis, serum lactate level has 100% sensitivity and 75% specificity with a cut-off value of 17.5 mg/dL for the prediction of mortality (Figure 1). Patients with a serum lactate level  $\geq 17.50$  were hospitalized for more than 10 days ( $p < 0.05$ ).

We evaluated different combinations with RS and serum lactate levels, and serum lactate levels were accepted as a new criterion. In patients with  $RS \geq 2 +$  lactate  $\geq 17.5$  mg/dL, mortality was predicted with a sensitivity of 100% and specificity of 80.7%.

**Figure 1.** ROC Curve for mortality according to sensitivity and specificity of the Ranson score + lactate levels.

## DISCUSSION

Severity and mortality of acute pancreatitis prediction scoring systems have been recently investigated (9-13). The optimal scoring system is controversial, but RS is widely used in emergency clinics. According to RS, more than two points requires intensive care unit hospitalization and known as severe pancreatitis. Blood glucose, aspartate aminotransferase, lactate dehydrogenase, age, and white blood cell count criteria are used to calculate the score. It is a simple method, but in clinical practice, it can be seen that clinical decision for acute pancreatitis require other parameters.

Lactate is a simple and easy reachable parameter and can be obtained from both arterial and venous blood gas analyses. Serum lactate level is known as an important predictor of the severity of critical diseases such as sepsis (14). Arterial, venous and capillary lactate levels showed similarity to determine the mortality and severity. According to a study, >1.6 mmol/L (14.41 mg/dL) venous lactate level is related with severe sepsis with 81% sensitivity and 80% specificity. Prediction levels for mortality in sepsis were  $1.8 \pm 1.7$  mmol/L for venous,  $2.3 \pm 2.1$  mmol/L for arterial, and  $2.7 \pm 2.5$  mmol/L for capillary lactate (15). We used venous lactate levels in our study because arterial blood gas analysis is not routinely tested in acute pancreatitis patients.

Valverde-López et al. have evaluated 269 patients prospectively to assess and compare the predicting ability of some scores and biomarkers in acute pancreatitis. They have examined blood urea nitrogen (BUN), C-reactive protein, lactate and creatinine levels at admission and at the 48<sup>th</sup> hour and calculated bedside index for the severity of acute pancreatitis (BISAP) score of the patients. According to this study, BISAP has been concluded as the best predictor on admission for determining severe acute pancreatitis, intensive care unit hospitalization and mortality. The authors have suggested that BUN at 48 h and BISAP are the best predictors for mortality and creatinine 48 h for ICU admission. Lactate has shown an AUC of 0.79 (CI= 0.71-0.88), 0.87 (CI= 0.78-0.96), and 0.77 (CI= 0.67-0.87) for severity, mortality, and ICU admission, respectively. Lactate has been found 87.5% sensitive and 82.7% specific for mortality for levels >2.8 meq/L (12.6 mg/dL, 1.4 mmol/L). The authors have suggested lactate as a useful parameter for acute pancreatitis patients (16). In our study, cut-off level of lactate was 17.5 mg/dL with 100% sensitivity and 75% specificity for determining mortality. These values were 100% and 80.7% for RS + lactate. In addition, we also concluded that high lactate levels were related with hospitalization of more than 10 days. Hospitalization length has not been addressed in the study by Valverde-López. So, our study may be helpful to predict hospitalization length.

## CONCLUSION

Serum lactate level, especially when used with RS, may be a useful marker to predict mortality and hospitalization length.

**Ethics Committee Approval:** The study was approved by the Adana City Training and Research Hospital's Ethical Committee (Decision Number: 687, Date: 15.01.2020).

**Author Contributions:** Concept/Design: MP, SY, AA; Analysis/ Interpretation: All of authors; Data Acquisition: MP, MÇ, AK, SS, KŞ; Writing: All of authors; Critical Revision: SY, AA, AK; Final Approval: All of authors.

**Conflict of Interest:** All authors declare that they have no conflict of interest.

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