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Comparative Predictive Value of the Harmless Acute Pancreatitis Score, Ranson Score, and Neutrophil-to-Lymphocyte Ratio for Mortality Prediction in Patients with Acute Pancreatitis Presenting to the Emergency Department

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Abstract

Objective: Early risk stratification in acute pancreatitis (AP) is essential for guiding clinical decisions in the emergency department (ED). This study aimed to compare the clinical utility of three accessible indicators—Harmless acute pancreatitis score (HAPS), Ranson score, and neutrophil-to-lymphocyte ratio (NLR)—in predicting in-hospital mortality.

Materials and Methods: This retrospective cohort study included 347 adult patients (≥18 years) diagnosed with non-traumatic AP between January 2020 and January 2024 at a tertiary care ED. The diagnosis was established using the American College of Gastroenterology criteria. HAPS, Ranson score (based on admission data), and NLR were calculated at initial presentation. Patients with chronic pancreatitis, traumatic etiology, malignancy-related AP, or incomplete data were excluded. Predictive performance for in-hospital mortality was evaluated using receiver operating characteristic analysis and compared using the DeLong test.

Results: In-hospital mortality occurred in 35 patients (10.1%). HAPS showed a sensitivity of 82.9%, specificity of 64.7%, and a negative predictive value (NPV) of 97.1%. Ranson score had a sensitivity of 68.6%, specificity of 72.8%, and NPV of 95.4%. NLR ≥4.9 yielded a sensitivity of 82.9%, specificity of 59.9%, and NPV of 96.9%. Area under the curve (AUC) values were 0.757 [95% confidence interval (CI): 0.708-0.801] for HAPS, 0.755 (95% CI: 0.706-0.799) for Ranson, and 0.642 (95% CI: 0.589-0.692) for NLR. No significant difference was observed between HAPS and Ranson (p=0.956), while comparisons involving NLR approached statistical significance.

Conclusion: HAPS and Ranson scores demonstrated comparable and superior performance in predicting in-hospital mortality in patients with AP. Due to its simplicity and excellent NPV, HAPS may be particularly useful as a bedside exclusion tool in the emergency setting.

Keywords: Acute pancreatitis, mortality prediction, emergency department, risk stratification, Harmless acute pancreatitis score

Introduction

Acute pancreatitis (AP) is a common gastrointestinal emergency characterized by the sudden onset of pancreatic inflammation, typically presenting with upper abdominal pain [1]. Although the majority of cases are mild and self-limiting, approximately 15-20% may progress to persistent organ failure, which significantly increases the risk of mortality. Due to this clinical heterogeneity, accurate risk stratification in the early phase of emergency department (ED) presentation is of paramount importance for guiding triage decisions, determining the appropriate level of care, and ensuring the efficient allocation of medical resources [2].

Several clinical scoring systems have been developed to predict the severity of AP [3]. Tools such as the Ranson score, APACHE

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II, and BISAP are commonly used in clinical practice. However, many of these systems rely on time-dependent laboratory parameters or require complex calculations, which may limit their practicality in ED settings where rapid decision-making is essential [3].

In this context, models based on simple, rapidly applicable, and easily accessible parameters have gained prominence. The Harmless acute pancreatitis score (HAPS) is a bedside risk stratification tool designed to identify patients unlikely to develop severe disease, utilizing only three fundamental clinical variables [4]. Although the Ranson score is based on a broader set of parameters, it remains one of the most widely used and validated classical scoring systems for AP in the literature [5]. On the other hand, the neutrophil-to-lymphocyte ratio (NLR), derived from complete blood count parameters, is considered a biomarker reflecting systemic inflammation [6]. In recent years, it has emerged as a prognostic indicator in numerous critical illnesses, including AP [6].

Although various studies have explored the prognostic utility of these parameters in patients with AP, the comparative performance of HAPS, the Ranson score, and NLR in predicting in-hospital mortality during the early phase of ED presentation has not been clearly established in the literature [4-6]. The aim of this study is to comparatively evaluate the predictive value of the HAPS, Ranson score, and NLR in forecasting in-hospital mortality among patients presenting to the ED with AP, and to elucidate their potential roles in early risk stratification.

Materials and Methods

Study Design and Participants

A retrospective cohort was used in this study. The research was conducted on patients diagnosed with AP in the adult Emergency Department of University of Health Sciences Türkiye, Haydarpaşa Numune Training and Research Hospital, a tertiary university-affiliated hospital, between January 1, 2020, and January 1, 2024. Eligible cases were identified through the hospital information management system using the International Classification of Diseases, 10th Revision codes. To minimize selection bias, all consecutive patients who met the inclusion criteria were enrolled in the study.

The diagnosis of AP was established based on the guidelines of the American College of Gastroenterology (ACG), requiring the presence of at least two of the following criteria: (i) acute-onset, characteristic upper abdominal pain; (ii) serum amylase or lipase levels at least three times the upper limit of normal; (iii) imaging findings consistent with AP on contrast-enhanced computed tomography (CT) or magnetic resonance imaging (MRI).

Inclusion Criteria

- Adults aged 18 years and older
- Diagnosis of AP according to ACG criteria
- Presence of contrast-enhanced CT or MRI findings supporting the diagnosis
- Availability of complete data for HAPS, Ranson score, and NLR

Exclusion Criteria

- Patients under the age of 18
- Cases of pancreatitis secondary to trauma
- Known history of chronic pancreatitis
- Secondary pancreatitis due to malignancy or postoperative causes
- Missing laboratory data or absence of imaging confirming the diagnosis

Data Collection Process

Demographic characteristics, presenting complaints, vital signs, laboratory results, and radiological imaging data of the patients were retrospectively retrieved from the hospital information system. All measurements were based on data obtained at the time of ED admission.

Variables and Measurements

HAPS was calculated based on the hematocrit level, serum creatinine concentration, and the presence or absence of peritoneal signs on physical examination at presentation. The Ranson score was calculated based on admission parameters. The NLR was derived from the complete blood count performed at the time of presentation. Mortality was defined as death occurring at any time during the hospital stay.

Ethical Approval

The study was approved by the University of Health Sciences Türkiye, Haydarpaşa Numune Training and Research Hospital, Clinical Research Ethics Committee (approval number: HNEAH-GOAEK/KK/2025/92, date: 22.07.2025). All procedures were conducted in accordance with the ethical standards of the 2013 revised version of the Declaration of Helsinki and relevant national ethical guidelines. Since the data were analyzed retrospectively and anonymized, individual informed consent was not required.

Statistical Analysis

All statistical analyses were conducted using SPSS (version 25.0; IBM Corp., Armonk, NY, USA) and MedCalc (version 14.8.1; MedCalc Software Ltd., Ostend, Belgium). The distribution of continuous variables was assessed using the Kolmogorov-Smirnov test. Non-normally distributed data were presented as medians with interquartile ranges, while categorical variables

were summarized as frequencies and percentages (%). Differences between two groups were analyzed using the Mann-Whitney U test for continuous variables and the chi-square (χ^2) test for categorical variables. The discriminatory power of the HAPS, Ranson score, and NLR in predicting mortality was evaluated using receiver operating characteristic (ROC) curve analysis. The area under the curve (AUC) was calculated for each of these variables. Differences between ROC curves were compared using the DeLong test. Optimal cut-off values were determined according to Youden's index (J). A p-value of <0.05 was considered statistically significant in all analyses.

Results

A total of 347 patients who met the predefined inclusion and exclusion criteria were included in the study. The mean age of the study population was 64.5±14.2 years. Of the patients, 28.2% (n=98) were male and 71.8% (n=249) were female. The in-hospital mortality rate was 10.1% (n=35). Analyses were conducted by comparing the demographic, clinical, and laboratory characteristics between survivors and non-survivors.

Comparative analyses revealed statistically significant differences in several clinical and laboratory parameters between patients who survived and those who died during hospitalization. According to the Mann-Whitney U test, systolic blood pressure (122.0 mmHg vs. 136.0 mmHg, p<0.001) and diastolic blood pressure (78.0 mmHg vs. 82.0 mmHg, p=0.001) were significantly lower in the non-survivors group. In contrast, heart rate (88 vs. 77 beats/min, p=0.003) and respiratory rate (17 vs. 16 breaths/min, p=0.028) were significantly higher in non-survivors.

Moreover, white blood cell count (p=0.034), aspartate aminotransferase (p=0.013), lactate dehydrogenase (p<0.001), neutrophil count (p=0.001), NLR (p=0.006), and serum creatinine levels (p<0.001) were all significantly elevated in the non-survivor group. No statistically significant differences were observed between the groups in terms of body temperature, oxygen saturation, hemoglobin, hematocrit, platelet count, lymphocyte count, or glucose levels (p>0.05) (Table 1).

In the analysis of categorical variables, the presence of impaired mental status was significantly associated with increased mortality (85.7% vs. 1.6%, p<0.001). Among comorbid conditions, congestive heart failure (p=0.007), cerebrovascular disease (p=0.002), chronic renal failure (p=0.002), and chronic kidney disease (p=0.032) were significantly associated with in-hospital mortality. No statistically significant association was observed between mortality and other comorbidities such as diabetes mellitus, hypertension, coronary artery disease, or malignancy (p>0.05) (Table 2).

Regarding outcome parameters, both the need for intensive

Table 1. Comparison of clinical and laboratory parameters between survivors and non-survivors

Parameter	Survivors [median (25-75)]	Non-survivors [median (25-75)]
Age, years	64.00 (56.00-71.00)	67.00 (62.00-73.00)
Systolic blood pressure (mmHg)	136.00 (127.00-152.00)	122.00 (95.00-138.00)
Diastolic blood pressure (mmHg)	82.00 (75.00-89.00)	78.00 (63.00-83.00)
Pulse (beats/min)	77.00 (71.00-84.00)	88.00 (72.50-104.00)
Body temperature (°C)	36.50 (36.30-36.80)	36.50 (36.15-37.25)
Peripheral O_2 saturation (%)	96.00 (95.00-98.00)	96.00 (92.00-97.50)
Respiratory rate (breaths/min)	16.00 (14.00-18.00)	17.00 (15.00-20.00)
White blood cells (10^3/µL)	10.40 (8.47-13.60)	12.10 (10.45-14.10)
AST (U/L)	37.50 (27.00-60.25)	54.00 (28.00-399.00)
Glucose (mg/dL)	106.00 (90.00-134.25)	84.00 (67.50-146.50)
LDH (U/L)	251.50 (187.00-328.25)	446.00 (264.00-596.00)
Hemoglobin (g/dL)	13.80 (12.50-14.90)	13.50 (12.05-14.75)
Hematocrit (%)	41.40 (37.50-44.70)	40.50 (36.15-44.25)
Platelets (10^3/µL)	241.00 (177.75-279.25)	237.00 (176.50-246.50)
Neutrophils (10^3/µL)	6.35 (4.70-9.22)	8.80 (8.20-10.45)
Lymphocytes (10^3/µL)	1.60 (1.20-2.20)	1.50 (1.30-2.25)
Neutrophil/lymphocyte ratio	4.13 (2.60-6.64)	6.13 (5.42-7.03)
Creatinine (mg/dL)	0.80 (0.66-1.00)	1.11 (0.75-1.41)

AST: Aspartate aminotransferase, LDH: Lactate dehydrogenase

care unit (ICU) admission (94.3% vs. 6.1%, p<0.001) and the requirement for mechanical ventilation (94.3% vs. 1.0%, p<0.001) were strongly associated with mortality.

The predictive performance of the three scoring systems for in-hospital mortality was compared using ROC curve analysis.

The AUC was calculated as 0.757 [95% CI: 0.708-0.801] for the HAPS, 0.755 [95% confidence interval (CI): 0.706-0.799] for the Ranson score, and 0.642 (5% CI: 0.589-0.692) for the NLR. In terms of diagnostic accuracy, the highest sensitivity (82.9%) was observed for both HAPS (+) and NLR (cut-off >4.9), while the highest specificity (72.8%) was noted with the Ranson score (cut-off >1). The highest negative predictive value (NPV) was achieved by HAPS at 97.1%.

Pairwise comparisons of the ROC curves were performed using the DeLong test. No statistically significant difference was observed between HAPS and the Ranson score (AUC difference =0.002, 95% CI: -0.070 to 0.074, p=0.957). The comparison between HAPS and NLR showed an AUC difference of 0.115 (95% CI: -0.006 to 0.236, p=0.063), while the difference between Ranson and NLR was 0.113 (95% CI: -0.013 to 0.238, p=0.078). Although the latter two comparisons indicated a numerical trend toward better performance of HAPS and Ranson over NLR, these did not reach statistical significance.

The ROC curve analysis comparing the predictive performance of HAPS, Ranson score, and NLR is shown in Figure 1.The cut-off based diagnostic performance metrics of HAPS, NLR, and Ranson scores are summarized in Table 3.

Table 2. Clinical characteristics and outcomes according to survival status (n, %)

Variable	Survivors, n (%)	Non-survivors, n (%)	p-value
Demographics			
Gender (male)	90 (28.8%)	8 (22.9%)	0.554*
Impaired mental status	5 (1.6%)	30 (85.7%)	<0.001#
Etiology of pancreatitis			
Biliary	119 (38.1%)	11 (31.4%)	0.468*
Drug-induced	6 (1.9%)	0 (0.0%)	>0.99#
Alcoholic	11 (3.5%)	0 (0.0%)	0.611#
Idiopathic	138 (44.2%)	14 (40.0%)	0.720*
Hyperlipidemia (etiology)	37 (11.9%)	5 (14.3%)	0.593*
Malignancy (etiology)	2 (0.6%)	0 (0.0%)	>0.99#
Comorbidities			
Diabetes mellitus	80 (25.6%)	9 (25.7%)	>0.99#
Hypertension	120 (38.5%)	16 (45.7%)	>0.99*
Coronary artery disease	38 (12.2%)	2 (5.7%)	0.466*
Congestive heart failure	13 (4.2%)	6 (17.1%)	0.401*
Chronic pulmonary disease	20 (6.4%)	0 (0.0%)	0.007*
Arrhythmia	21 (6.7%)	2 (5.7%)	0.242#
Cerebrovascular disease	6 (1.9%)	5 (14.3%)	>0.99#
Chronic renal failure	20 (6.4%)	0 (0.0%)	0.002*
Chronic kidney disease	14 (4.5%)	5 (14.3%)	0.242#
Malignancy (comorbidity)	18 (5.8%)	0 (0.0%)	0.032*
Radiological findings			
Pancreatic edema	18 (5.8%)	0 (0.0%)	0.235#
Peripancreatic fluid collection	14 (4.5%)	0 (0.0%)	0.376#
Pancreatic necrosis	5 (1.6%)	0 (0.0%)	>0.99#
Outcomes			
ICU admission	19 (6.1%)	33 (94.3%)	<0.001*
Mechanical ventilation	3 (1.0%)	33 (94.3%)	<0.001*

*Chi-square test was used.
#Fisher's exact test was used.
ICU: Intensive care unit

Table 3. Comparison of cut-off based diagnostic metrics for HAPS, NLR, and Ranson scores in predicting mortality

Score	Criterion	Youden index J	Sens.	Spec.	PLR	NLR	PPV	NPV
HAPS	>0	0.476	82.86	64.74	2.35	0.26	20.9	97.1
NLR	>4.9	0.427	82.86	59.94	2.07	0.29	18.8	96.9
Ranson	>1	0.413	68.57	72.76	2.52	0.43	22.0	95.4

HAPS >0 indicates the presence of at least one adverse parameter (hematocrit ≥43% in men or ≥39.6% in women, serum creatinine >2 mg/dL, or presence of peritoneal signs), meaning that the patient does not fulfill the criteria for harmless acute pancreatitis.

Sens.: Sensitivity, Spec.: Specificity, PLR: Positive likelihood ratio, NLR: Negative likelihood ratio, PPV: Positive predictive value, NPV: Negative predictive value

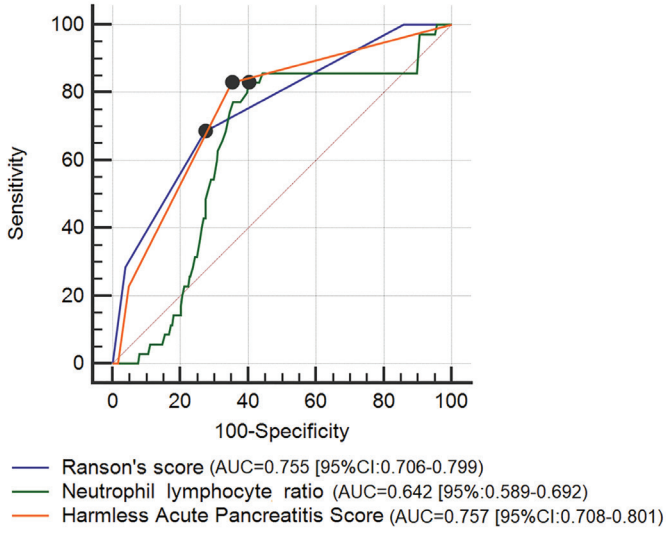

Figure 1. Comparison of ROC curves for prognostic scores in predicting 30-day mortality in acute pancreatitis

AUC: Area under the curve, ROC: Receiver operating characteristic

Discussion

This study aimed to evaluate and compare the diagnostic performance of the HAPS, Ranson score, and NLR in predicting in-hospital mortality among patients presenting to the ED with AP. The findings demonstrated that both HAPS and the Ranson score exhibited strong and comparable discriminatory performance, whereas NLR showed a lower predictive accuracy in comparison to these two scoring systems.

When examining the area under the ROC, AUC, the HAPS (AUC: 0.757) and the Ranson score (AUC: 0.755) demonstrated comparable levels of diagnostic accuracy. Both scores exhibited moderate-to-high discriminatory power. This finding is consistent with previous studies. For instance, in a study by Lankisch et al. [4] the HAPS was reported to have high sensitivity in ruling out severe AP, highlighting its utility in avoiding unnecessary hospitalizations. The Ranson score, on the other hand, has been widely used since its initial validation studies and is still regarded as a reliable tool for predicting various systemic complications in AP [5-7].

In this study, the NLR demonstrated a lower discriminatory power, compared to HAPS and the Ranson score, with an AUC of 0.642—approaching statistical significance without reaching it. This result suggests that inflammatory biomarkers may have limited utility in predicting mortality when used in isolation. Although previous research has proposed that NLR may be valuable in the prognostication of AP, the specificity (59.94%), and positive predictive value (18.8%) observed in this study indicate its relatively low positive predictive accuracy [6]. In the study conducted by Aykan et al. [8] patients with AP classified as severe according to the HAPS score had significantly higher mean NLR values compared to those with mild or moderate disease. The authors reported that elevated NLR levels were independent predictors of disease severity in AP, based on the HAPS classification. NLR has been reported to exhibit stronger predictive performance in systemic inflammatory conditions such as sepsis and COVID-19, but it may not be sufficient on its own in diseases with heterogeneous etiopathogenesis, such as AP [6,9].

In the comparative analysis using the DeLong test, no statistically significant difference was found between HAPS and the Ranson score (p=0.956), supporting the notion that both scoring systems offer a similar level of discriminatory performance. One major advantage of HAPS is its simplicity, as it relies on only three parameters readily available at the time of admission, making it a rapid and feasible tool in the emergency setting. Given the increasing patient burden and overcrowding in EDs, the availability of a simple and rapid risk stratification tool, such as HAPS, is particularly valuable for optimizing triage decisions and resource allocation [10]. This feature renders HAPS particularly practical in time-constrained environments. In contrast, the Ranson score includes parameters that require up to 48 hours of follow-up, making it more applicable to hospitalized patients [11]. Nonetheless in this study, even the modified version of the Ranson score calculated solely from admission parameters demonstrated comparable predictive performance with HAPS.

One of the most noteworthy findings of this study is the high NPV of the HAPS score (97.1%). This indicates that patients with low HAPS scores are at very low risk of in-hospital mortality, supporting the utility of HAPS as a reliable rule-out tool. The study by Maisonneuve et al. [12] states that the HAPS score accurately identifies non-severe cases of AP that do not require

ICU admission and facilitates the selection of patients who may be discharged after a short stay in a general ward or even managed at home [12]. Such a result highlights the potential role of HAPS in contributing to strategies aimed at reducing unnecessary hospital admissions in ED settings.

Study Limitations

This study has several limitations. First, its single-center and retrospective design may restrict the generalizability of the findings. Second, the calculations of HAPS and Ranson scores were based exclusively on admission data; notably, the classic 48-hour follow-up parameters required for the full Ranson score were not included. Moreover, the divergence from the conventional cut-off value for the Ranson score should be acknowledged as a limitation in terms of external validity.

Despite these limitations, the study has important strengths, including an adequate sample size, a comprehensive evaluation of independent variables, and methodological rigor, particularly through the use of the DeLong test for ROC curve comparisons.

Conclusion

This study demonstrated that both the HAPS and the Ranson score are strong and comparable predictive tools for estimating in-hospital mortality among patients presenting to the ED with AP, whereas the NLR exhibited relatively weaker diagnostic performance. In clinical decision-making processes, the HAPS score stands out due to its rapid applicability and high rule-out capacity. Future research should focus on validating these scoring systems through prospective, multicenter studies, ideally incorporating biomarker-based predictive models.

Ethics

Ethics Committee Approval: The study was approved by the University of Health Sciences Türkiye, Haydarpaşa Numune Training and Research Hospital, Clinical Research Ethics Committee (approval number: HNEAH-GOAEK/KK/2025/92, date: 22.07.2025).

Informed Consent: Since the data were analyzed retrospectively and anonymized, individual informed consent was not required.

Footnotes

Conflict of Interest: No conflict of interest was declared by the author.

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