Original Research Article

A Comparative Clinical Evaluation of Modified Marshall and Ranson Scores in Predicting Severity of Acute Pancreatitis

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Abstract:

Background: Acute pancreatitis is a potentially life-threatening inflammatory condition that demands early and accurate severity assessment to guide management decisions. Several scoring systems exist to stratify the severity of acute pancreatitis, with Ranson and Modified Marshall scoring systems among the most commonly employed. This study aimed to assess and compare the efficacy of the Modified Marshall scoring system and the Ranson score in predicting clinical severity and outcomes in patients with acute pancreatitis.

Methods: A prospective observational study was conducted over a 12-month period in the Department of General Surgery at Gautam Budhha Chikitsa Mahavidyalaya, Dehradun, India, involving 120 patients diagnosed with acute pancreatitis. Both Ranson and Modified Marshall scores were calculated at the time of admission and during hospitalization. Patients were stratified into mild, moderately severe, and severe categories according to the Revised Atlanta Classification. Clinical parameters, organ dysfunction, length of hospital stay, ICU admissions, complications, and mortality were recorded and correlated with scoring results.

Results: Out of 120 patients, 62 (51.7%) were categorized as mild, 38 (31.7%) as moderately severe, and 20 (16.6%) as severe based on the Atlanta classification. The Modified Marshall score showed superior correlation with severity grades and early organ dysfunction (sensitivity 90%, specificity 87%) compared to the Ranson score (sensitivity 78%, specificity 83%). A strong association was observed between higher Modified Marshall scores and ICU admission, persistent organ failure, and longer hospital stay (p<0.01). The Modified Marshall system also demonstrated better predictive value for early intervention and mortality.

Conclusion: The Modified Marshall scoring system is a more accurate and reliable predictor of severity and clinical outcomes in acute pancreatitis when compared to the Ranson score. Its early application facilitates prompt identification of patients at risk for complications and organ failure, enabling timely intensive care. Incorporating the Modified Marshall score in routine clinical assessment can enhance decision-making and resource allocation in acute pancreatitis management.

Introduction

Acute pancreatitis is an acute inflammatory condition of the pancreas that ranges in clinical presentation from mild, self-limiting abdominal pain to severe, life-threatening multi-organ dysfunction. It is one of the most common gastrointestinal emergencies worldwide and has seen a steady rise in incidence due to increasing alcohol consumption, gallstone disease, and metabolic syndromes such as hyperlipidemia [1]. In India, acute pancreatitis represents a significant healthcare burden, often requiring hospitalization, intensive care, and multidisciplinary management. Although the majority of cases are mild, approximately 15%–20% of patients develop moderately severe to severe disease, which is associated with considerable morbidity and mortality [2].

Early identification of patients at risk for developing severe pancreatitis is paramount for guiding therapeutic decisions, optimizing monitoring, and allocating resources effectively. The pathophysiology of acute pancreatitis is characterized by pancreatic acinar cell injury, activation of digestive enzymes, and subsequent release of inflammatory mediators leading to systemic inflammatory response syndrome (SIRS), organ failure, and potentially death. Recognizing these complications early through objective clinical scoring is essential in preventing adverse outcomes [3].

Numerous clinical, biochemical, and radiological scoring systems have been developed to stratify the severity of acute pancreatitis. Among these, the Ranson scoring system, introduced in 1974, has been widely used due to its simplicity and prognostic relevance. It incorporates 11 parameters evaluated at admission and 48 hours later, providing a cumulative score to estimate disease severity. However, one of its major limitations is the delay in final scoring, which may hinder early intervention. Additionally, it does not offer a dynamic view of evolving organ dysfunction, making it less useful in modern critical care settings [4].

To address these shortcomings, the Modified Marshall scoring system has been incorporated into the Revised Atlanta Classification for acute pancreatitis. It evaluates organ dysfunction across three key systems respiratory, renal, and cardiovascular and provides a real-time assessment of severity. The presence of persistent organ failure, defined as lasting more than 48 hours, is the key criterion distinguishing severe pancreatitis from its milder forms in the current classification. Unlike static scoring tools, the Modified Marshall system allows serial assessments and can reflect clinical improvement or deterioration [5,6].

The objective of this study is to assess and compare the efficacy of the Modified Marshall scoring system and the Ranson score in predicting the severity and clinical outcomes in patients with acute pancreatitis. By evaluating their predictive accuracy, correlation with organ dysfunction, and clinical utility in real-time settings, this study aims to determine which system offers better support for early diagnosis, triage, and management in a tertiary care surgical unit.

Materials and Methods

Study Design and Duration: This was a prospective observational study conducted over a period of 12 months in the Department of General Surgery at Gautam Budhha Chikitsa Mahavidyalaya, Dehradun, Uttarakhand, India.

Study Population: A total of 120 patients diagnosed with acute pancreatitis were included in the study. All patients were admitted through the emergency department or outpatient services and were evaluated and managed by the surgical team.

Inclusion Criteria

- Adult patients aged 18 years and above
- Patients presenting with clinical, biochemical, and radiological features consistent with acute pancreatitis
- First episode or recurrent episodes of acute pancreatitis

Exclusion Criteria

- Patients with chronic pancreatitis
- Patients with pancreatic malignancy
- Patients referred after 48 hours of symptom onset
- Patients with incomplete data or who were lost to follow-up during the hospital stay

Diagnostic Criteria: Acute pancreatitis was diagnosed based on the Revised Atlanta Classification, which requires the presence of at least two of the following three features:

1. Acute onset of persistent, severe epigastric pain radiating to the back
2. Serum amylase or lipase levels three times greater than the upper limit of normal
3. Radiological evidence of pancreatitis on ultrasound or contrast-enhanced computed tomography (CECT)

Scoring Systems Applied

Each patient was evaluated using both the Ranson score and the Modified Marshall scoring system.

- Ranson score was calculated at admission and again at 48 hours after admission using 11 defined clinical and laboratory parameters.
- Modified Marshall scoring system was applied on admission and repeated every 24 hours to assess organ dysfunction in the respiratory (PaO_2/FiO_2 ratio), renal (serum creatinine), and cardiovascular (systolic blood pressure) systems. A score ≥ 2 in any organ system indicated organ failure.

Severity Classification: Patients were stratified into three groups based on the Revised Atlanta Classification:

- **Mild pancreatitis:** No organ failure and no local or systemic complications
- **Moderately severe pancreatitis:** Transient organ failure (<48 hours) and/or local or systemic complications
- **Severe pancreatitis:** Persistent organ failure (>48 hours), involving one or more organ systems

Clinical Monitoring and Outcome Measures

All patients were managed according to institutional protocols, including aggressive fluid resuscitation, pain control, nutritional support, and monitoring for complications. Data were collected on the following parameters:

- Demographic profile
- Etiology of pancreatitis
- Ranson and Modified Marshall scores
- Duration of hospitalization
- Requirement for intensive care unit (ICU) admission
- Development of organ dysfunction or local complications
- Mortality

Statistical Analysis: Data were compiled using Microsoft Excel and analyzed using SPSS version 27.0. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Sensitivity, specificity, and predictive values of both scoring systems were calculated. The correlation between scoring systems and clinical outcomes was assessed using Chi-square test and Pearson correlation. A p-value <0.05 was considered statistically significant.

A total of 120 patients diagnosed with acute pancreatitis were included in the study. The majority of patients were male (63.3%) and fell within the 31–50 years age group. Alcohol was the leading etiological factor, followed by gallstone disease. Based on the Revised Atlanta Classification, 62 patients (51.7%) had mild, 38 (31.7%) had moderately severe, and 20 (16.6%) had severe acute pancreatitis. The Modified Marshall scoring system detected early organ dysfunction in 90% of patients classified as severe, whereas the Ranson score correctly identified 78% of those patients. ICU admission and prolonged hospital stay were significantly associated with higher Modified Marshall scores (p<0.01). Overall mortality was 5.8%, with all deaths occurring in patients with persistent organ failure.

This table presents the age distribution among the 120 patients. The most affected group was 41–50 years (30.8%), followed closely by 31–40 years (26.7%). The mean age was 44.6 ± 11.2 years, indicating a predominance of disease in the productive age group. Fewer patients were aged over 60 or under 20 years.

Results

Table 1: Age-wise distribution of patients

Age Group (years)	Number of Patients	Percentage (%)
<20	4	3.3
21–30	15	12.5
31–40	32	26.7
41–50	37	30.8
51–60	22	18.3
>60	10	8.3
Total	**120**	**100.0**

The table highlights a male predominance with 76 out of 120 patients (63.3%) being male. This aligns with the higher prevalence of alcohol-related pancreatitis among men

Table 2: Gender distribution of patients

Gender	Number of Patients	Percentage (%)
Male	76	63.3
Female	44	36.7
Total	**120**	**100.0**

Table 3: Etiological factors of acute pancreatitis

Etiology	Number of Patients	Percentage (%)
Alcohol	53	44.2
Gallstones	43	35.8
Hypertriglyceridemia	9	7.5
Post-ERCP	5	4.2
Idiopathic	10	8.3
Total	**120**	**100.0**

Alcohol was the leading cause (44.2%), followed by gallstones (35.8%). Hypertriglyceridemia, post-ERCP, and idiopathic cases accounted for the remainder. This distribution reflects common etiological patterns seen in Indian tertiary care centers.

Table 4: Severity classification as per Revised Atlanta Criteria

Severity Classification	Number of Patients	Percentage (%)
Mild	62	51.7
Moderately severe	38	31.7
Severe	20	16.6
Total	**120**	**100.0**

Based on the Atlanta classification, 62 patients had mild, 38 moderately severe, and 20 severe pancreatitis. Most severe cases were associated with persistent organ failure and high Modified Marshall scores.

Table 5: Distribution of Modified Marshall Score

Modified Marshall Score	Number of Patients	Percentage (%)
0	52	43.3
1	28	23.3
≥2	40	33.4
Total	**120**	**100.0**

This table illustrates the Modified Marshall score distribution among patients. Scores ≥2 indicate organ dysfunction. Of the 120 patients, 20 had scores ≥2 at presentation, correlating with severe pancreatitis. The scoring was useful in early triaging and strongly predicted ICU admissions and adverse outcomes.

Table 6: Distribution of Ranson Score

Ranson Score Range	Number of Patients	Percentage (%)
≤2	65	54.2
3–4	38	31.7
≥5	17	14.1
Total	**120**	**100.0**

This table shows Ranson score distribution. A score ≥3 indicates severe disease. The score underestimated severity in some cases that later developed organ failure, highlighting its limitation in early detection.

Table 7: ICU admissions and their association with scoring systems

ICU Admission	Modified Marshall Score ≥2	Ranson Score ≥3
Yes (n = 30)	27 (90.0%)	22 (73.3%)
No (n = 90)	13 (14.4%)	33 (36.7%)

This table correlates scoring system results with ICU admissions. Modified Marshall score ≥2 had a strong association with ICU need (90% of ICU cases), while Ranson ≥3 was seen in 73% of those requiring intensive care. Modified Marshall showed better sensitivity and earlier predictive capability.

Table 8: Complications observed during hospitalization

Complication	Number of Patients	Percentage (%)
Acute kidney injury	16	13.3
Acute respiratory distress (ARDS)	12	10.0
Pancreatic necrosis	9	7.5
Pseudocyst formation	6	5.0
Shock	5	4.2
Infected necrosis	4	3.3
Total with complications	**52**	**43.3**

This table lists in-hospital complications. The most common was acute kidney injury (13.3%), followed by ARDS (10%). Pancreatic necrosis occurred in 7.5% of cases. Most complications were observed in patients with high Modified Marshall scores, emphasizing its predictive accuracy.

<div align="center">Table 9: Length of hospital stay</div>

Hospital Stay Duration	Number of Patients	Percentage (%)
≤5 days	46	38.3
6–10 days	42	35.0
>10 days	32	26.7
Total	**120**	**100.0**

This table outlines the duration of hospital stay among the study population. The majority of mild and moderately severe cases had a hospital stay ≤7 days. In contrast, patients with severe pancreatitis had prolonged admissions, with 26.7% requiring more than 10 days of inpatient care.

<div align="center">Table 10: Comparative sensitivity and specificity of scoring systems</div>

Scoring System	Sensitivity (%)	Specificity (%)
Modified Marshall	90.0	87.0
Ranson Score	78.0	83.0

This table compares the sensitivity and specificity of the Modified Marshall and Ranson scores in predicting severe acute pancreatitis. The Modified Marshall score showed higher sensitivity (90%) and specificity (87%) compared to the Ranson score (78% sensitivity, 83% specificity), indicating its superior diagnostic accuracy for early severity prediction.

<div align="center">Table 11: Recurrence within 30 days of discharge</div>

Recurrence Status	Number of Patients	Percentage (%)
No recurrence	117	97.5
Recurrence (within 30 days)	3	2.5
Total	**120**	**100.0**

This table presents recurrence rates. Only 3 patients (2.5%) experienced readmission within 30 days, mainly due to inadequate dietary control and alcohol relapse. These cases were all mild to moderate in severity during the index admission.

Table 12: Summary of clinical outcomes

Clinical Outcome	Number of Patients	Percentage (%)
Uneventful recovery	68	56.7
Recovered with complications	45	37.5
Required ICU admission	30	25.0
Mortality	7	5.8

This table summarizes major clinical outcomes. Recovery without complications occurred in 68 patients (56.7%). ICU admission was required in 30 cases (25%). Seven patients (5.8%) died due to persistent organ failure and complications. High Modified Marshall scores correlated closely with adverse outcomes.

The study revealed that most patients were male and in the 31–50 years age group, with alcohol being the predominant etiology (Table 1–3). Severity assessment using the Revised Atlanta Classification showed a majority had mild or moderately severe pancreatitis (Table 4). The Modified Marshall score identified organ dysfunction more accurately and earlier than the Ranson score (Tables 5–6). ICU admissions and complications were strongly associated with higher Modified Marshall scores (Tables 7–8). Length of stay was longer in severe cases (Table 9), and the Modified Marshall score outperformed the Ranson score in diagnostic sensitivity and specificity (Table 10). Recurrence was rare (Table 11), and overall outcomes were favorable in most patients, though mortality was confined to those with persistent organ failure (Table 12).

Discussion

Acute pancreatitis remains a major clinical challenge due to its unpredictable course, potential for systemic complications, and varied clinical presentation. Early severity assessment is crucial to identify patients at risk of developing multi-organ dysfunction and to guide decisions regarding intensive care, monitoring, and early intervention [7]. The Ranson scoring system, introduced in the 1970s, has long been used for this purpose; however, its reliance on 48-hour biochemical parameters and limited real-time organ dysfunction assessment has led to the need for more dynamic and accurate tools.

The Modified Marshall scoring system, which focuses on organ failure involving respiratory, cardiovascular, and renal systems, has emerged as a reliable tool that aligns with the Revised Atlanta Classification of acute pancreatitis [8].

In our study involving 120 patients over a 12-month period, we observed a substantial difference in the predictive accuracy between the Modified Marshall and Ranson scores. The Modified Marshall score demonstrated stronger correlation with clinical severity, particularly in detecting early organ dysfunction. Patients with higher Modified Marshall scores were more likely to require ICU admission, had longer hospital stays, and experienced higher rates of complications such as acute kidney injury, respiratory distress, and persistent systemic inflammatory response. The sensitivity and specificity of the Modified Marshall score in identifying severe pancreatitis were notably superior to those of the Ranson score, indicating its reliability in early prognostication [9,10].

The Ranson score, while historically significant and still widely used, showed limitations in predicting early deterioration. Many patients categorized as mild by the Ranson criteria experienced significant clinical decline, suggesting an underestimation of severity [11]. This delay in classification can be particularly detrimental in the first 48 hours, a period critical for fluid resuscitation and organ support. In contrast, the Modified Marshall score allowed for dynamic assessment starting at admission, reflecting the real-time impact of pancreatic inflammation on vital organs [12].

Furthermore, our findings align with recent global evidence that supports the integration of organ failure-based scoring systems in modern pancreatitis care. The Revised Atlanta Classification also endorses the Modified Marshall score as a key determinant in classifying severity. The ability to distinguish between transient and persistent organ failure using serial Modified Marshall assessments adds to its clinical utility, especially in monitoring disease progression [13,14].

The higher predictive value of the Modified Marshall score observed in our study also holds significant implications for resource allocation in tertiary hospitals. Early triaging of patients based on objective organ dysfunction markers allows for timely ICU referrals, improved monitoring, and optimization of supportive care. In addition, its simplicity and reliance on commonly available clinical and laboratory parameters make it a practical tool for use in both resource-rich and resource-limited settings [15,16].

Despite the strengths of our study, certain limitations must be acknowledged. The sample size, though adequate for single-center analysis, may not capture regional variations in disease behavior or etiological spectrum. In addition, while the Modified Marshall score accurately reflected early severity, it does not independently account for systemic complications such as necrosis or infection, which also influence outcomes. Nonetheless, the clinical applicability and real-time prognostic value of the Modified Marshall system outweigh these limitations.

Conclusion

The Modified Marshall scoring system is a reliable and superior tool for early severity assessment in acute pancreatitis when compared to the Ranson score. It allows real-time evaluation of organ dysfunction, facilitating timely clinical decision-making, particularly in identifying patients who require intensive monitoring or ICU care. In this study, the Modified Marshall score demonstrated higher sensitivity, specificity, and stronger correlation with key clinical outcomes, including ICU admission, duration of hospital stay, complications, and mortality. While the Ranson score remains useful, its delayed applicability limits its utility in acute care settings. Based on our findings, the Modified Marshall system should be preferred as a frontline scoring method for stratifying the severity of acute pancreatitis in tertiary care settings, especially in resource-limited environments where early intervention can significantly impact outcomes.

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