

Comprehensive Analysis of Etiology, Prognosis, and Clinical Outcome of Acute Pancreatitis: Correlation of BISAP Score and Modified CT Severity Index

Authors:

Balveer Meena¹, Shanker Choudhary², Pawan Kumar³, Umesh Choudhary⁴, Mansi Rathore⁵

^{1,2}Senior Resident, Department of General Surgery, Government Medical College and Associated Group of Hospitals, Kota, Rajasthan, India.

^{3,4,5}Junior Resident, Department of General Surgery, Government Medical College and Associated Group of Hospitals, Kota, Rajasthan, India.

Corresponding Author:

Dr. Balveer Meena, Department of General Surgery, Government Medical College, Kota, Rajasthan – 324005, India.

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ABSTRACT

Background: Acute pancreatitis (AP) is a potentially life-threatening gastrointestinal emergency with variable clinical outcomes. Early and accurate severity stratification is essential to triage patients appropriately and initiate timely intensive management. The Bedside Index for Severity in Acute Pancreatitis (BISAP) and the Modified CT Severity Index (CTSI) are widely used prognostic tools; however, comparative data from tertiary care centres in India remain limited. **Methods:** An observational cross-sectional study was conducted at the Department of General Surgery, Government Medical College and Hospital, Kota, Rajasthan, from July 2023 to July 2024. Fifty patients with a confirmed first episode of acute pancreatitis (age 18–70 years) were enrolled. BISAP scores were computed within 24 hours of admission. Modified CTSI was calculated from contrast-enhanced CT performed at 48–72 hours. Clinical outcomes assessed included in-hospital complications, mortality, and length of hospital stay. **Results:** Of 50 patients, 74% were male and mean age was 37.5 ± 10.37 years. Alcohol was the most common aetiology (68%), followed by gallstones (20%) and trauma (8%). BISAP score ≥ 3 (high risk) was observed in 18% of patients; 82% had a low BISAP score (<3). By Modified CTSI, 72% were mild, 22% moderate, and 6% severe. Eighty percent of patients improved without sequelae, 8% had local complications (pseudocyst, mesenteric thrombosis), 6% had systemic complications (sepsis, ARDS), and mortality was 6% (3 patients). All patients with low BISAP (<3) recovered without complications. BISAP demonstrated sensitivity of 100%, specificity of 95.35%, positive predictive value (PPV) of 77.78%, and negative predictive value (NPV) of 100%. Modified CTSI had sensitivity of 42.86%, specificity of 100%, PPV of 100%, and NPV of 91.49%. Mean hospital stay was 5.08 ± 3.93 days. **Conclusion:** BISAP score is a superior bedside tool for early severity stratification of acute pancreatitis with higher sensitivity and NPV compared to Modified CTSI. Patients with BISAP <3 can be safely managed at district-level centres without mandatory CT imaging, optimising resource utilisation. Alcohol remains the dominant aetiological factor in this population, warranting targeted public health interventions.

Keywords: Acute pancreatitis, BISAP score, CT severity index, Modified CTSI, severity stratification, prognosis, outcome, alcohol, gallstones

INTRODUCTION

Acute pancreatitis (AP) is one of the most common gastrointestinal emergencies requiring hospitalisation, with an incidence ranging from 5 to 80 per 100,000 population worldwide.^{1,2} The clinical spectrum is highly variable: approximately two-thirds of patients follow a self-limiting mild course, while the remaining third develop severe disease characterised by systemic inflammatory response syndrome (SIRS), organ failure,

and pancreatic necrosis, with an associated mortality of 6–40%.^{3–7}

Accurate and early identification of patients at risk of severe disease is critical to guide triage, resource allocation, and initiation of intensive resuscitation. A delay of more than 24 hours in appropriate fluid therapy in severe acute pancreatitis has been shown to double the mortality rate.⁸ Several scoring systems have been developed for this purpose, including the Ranson

criteria, the Acute Physiology and Chronic Health Evaluation II (APACHE II) score, and the Glasgow scoring system. However, these tools have important limitations: the Ranson criteria requires 48-hour data and lacks early predictive utility, while APACHE II is complex and demands numerous parameters that are frequently unavailable in primary or district-level healthcare settings.⁹

The Bedside Index for Severity in Acute Pancreatitis (BISAP), introduced by Singh et al. and validated in a cohort of over 36,000 patients, was developed to overcome these limitations.¹⁰ It incorporates five clinically accessible variables obtainable within 24 hours of admission: blood urea nitrogen (BUN) >25 mg/dL, impaired mental status, presence of SIRS, age >60 years, and pleural effusion. A BISAP score ≥ 3 has been associated with a 7–12-fold increase in the risk of organ failure and mortality.

Contrast-enhanced computed tomography (CECT) and the derived CT Severity Index (CTSI), originally described by Balthazar et al., remain the gold standard for morphological staging of AP and identification of pancreatic necrosis.¹¹ The Modified CTSI incorporates extrapancreatic complications such as pleural effusions and ascites, providing additional prognostic information. However, CECT involves radiation exposure, contrast-related risks, significant cost, and is ideally performed after 48–72 hours of symptom onset, limiting its role in early decision-making.

There is a paucity of Indian data directly comparing the early clinical BISAP score with the radiological Modified CTSI in predicting outcomes. This study was designed to prospectively evaluate and compare the utility of BISAP and Modified CTSI in predicting complications, mortality, and length of hospital stay in patients with acute pancreatitis at a tertiary care teaching hospital in Rajasthan, India.

AIMS AND OBJECTIVES

Primary Objectives

- To study the clinical profile and aetiology of acute pancreatitis in patients presenting to a tertiary care hospital.
- To correlate BISAP score and Modified CTSI with clinical outcomes including complications, mortality, and length of hospital stay.

Secondary Objectives

- To assess the formation of pancreatic pseudocysts and other local complications.
- To compare the sensitivity, specificity, PPV, and NPV of BISAP and Modified CTSI in predicting severe outcomes.

MATERIALS AND METHODS

Study Design and Setting: This was an observational, cross-sectional study conducted in all surgical units of

the Department of General Surgery, Government Medical College and Associated Group of Hospitals, Kota, Rajasthan, India, from July 2023 to July 2024. Ethical committee approval was obtained prior to patient enrolment. Written informed consent was obtained from all participants or their legal guardians. **Sample Size:** Sample size was calculated using the formula $n = Z^2p(1-p)/d^2$, with $Z = 1.96$ (at 5% type I error), $p = 3.4\%$, and $d = 5\%$, yielding $n \approx 50$.

Inclusion and Exclusion Criteria

- **Inclusion criteria:** Patients aged 18–70 years presenting with a first episode of acute pancreatitis, defined as two of the following three criteria: (i) severe epigastric pain radiating to the back; (ii) serum amylase or lipase ≥ 3 times the upper limit of normal; (iii) radiological confirmation of inflamed pancreas on ultrasonography or CECT.
- **Exclusion criteria:** Proven chronic pancreatitis, hereditary pancreatitis, pregnancy-associated pancreatitis, chronic kidney disease, traumatic pancreatitis with concurrent head injury, and cognitive impairment precluding consent.

Data Collection: Demographic, clinical, and laboratory data were recorded in a structured proforma on admission. The BISAP score was calculated from five parameters assessed within 24 hours: BUN >25 mg/dL, impaired mental status (Glasgow Coma Scale <15), SIRS (any two of: heart rate >90/min, core temperature <36°C or >38°C, WBC <4,000 or >12,000/mm³, or respiratory rate >20/min or PaCO₂ <32 mmHg), age >60 years, and pleural effusion on radiograph. A score ≥ 3 was classified as high risk.

Modified CTSI was computed from CECT abdomen performed at 48–72 hours using a Toshiba Aquilion 64 scanner. It incorporates pancreatic inflammation grade (0–4 points), pancreatic necrosis (0–4 points), and extrapancreatic complications (0–2 points), yielding a total score of 0–10. Scores of 0–2, 4–6, and 8–10 were classified as mild, moderate, and severe, respectively. Laboratory investigations included complete blood count, serum amylase, serum lipase, liver function tests, renal function tests, serum electrolytes, fasting blood glucose, and serum triglycerides. All biochemical analyses were performed using a COBAS autoanalyser.

RESULTS

Data were entered in Microsoft Excel and analysed using SPSS version 23.0 (IBM Corp., USA). Categorical variables are expressed as frequencies and percentages; continuous variables as mean $\pm$ standard deviation. Chi-square test was used for categorical comparisons. Sensitivity, specificity, PPV, and NPV of BISAP and Modified CTSI were calculated using standard formulae against the composite outcome of clinical complications (local or systemic) or death. A p -value <0.05 was considered statistically significant.

Descriptive Statistics

Table 1: Descriptive statistics of key clinical and laboratory parameters (N=50)

Parameter	N	Minimum	Maximum	Mean $\pm$ SD
Age (years)	50	23	68	37.5 $\pm$ 10.37
Heart Rate (beats/min)	50	64	140	91.18 $\pm$ 14.95
Respiratory Rate (/min)	50	13	28	17.92 $\pm$ 4.01
Leucocyte Count ($\times 10^3/\text{mm}^3$)	50	3.2	23.7	12.48 $\pm$ 3.53
Serum Amylase (IU/L)	50	46	421	216.9 $\pm$ 89.11
Serum Lipase (IU/L)	50	27	442	222.6 $\pm$ 89.68
BUN (mg/dL)	50	12	48	23.25 $\pm$ 9.89
Length of Hospital Stay (days)	50	2	16	5.08 $\pm$ 3.93
BISAP Total Score	50	0	5	1.64 $\pm$ 1.25
Modified CTSI Total Score	50	0	8	2.88 $\pm$ 1.94

Age and Sex Distribution: Patient ages ranged from 23 to 68 years (mean 37.5 $\pm$ 10.37 years). The 36–45 year age group was most commonly affected (54%), followed by the 26–35 year group (26%). Males constituted 74% of the study population, reflecting the higher prevalence of alcohol-related disease among men in this region.

Table 2: Age distribution of study patients

Age Group (Years)	Frequency	Percentage (%)
≤ 25	5	10
26–35	13	26
36–45	27	54
>45	5	10
Total	50	100

Table 3: Gender distribution of study patients

Gender	Frequency	Percentage (%)
Male	37	74
Female	13	26
Total	50	100

Aetiology: Alcohol was the dominant aetiological factor (68%), consistent with the high prevalence of alcohol abuse in this regional population. All alcohol-related cases involved males in the middle age group, either chronic alcoholics consuming >100 g/day or frequent binge drinkers. Gallstone disease was the second most common cause (20%), predominantly in female patients; 8 were managed conservatively and 2 required ERCP. Four patients had acute pancreatitis secondary to blunt abdominal trauma, and 2 were idiopathic despite extensive evaluation including MRCP and upper gastrointestinal endoscopy.

Table 4: Aetiology of acute pancreatitis

Aetiological Factor	Frequency	Percentage (%)
Alcohol	34	68
Gallstones	10	20
Trauma	4	8
Idiopathic	2	4

Aetiological Factor	Frequency	Percentage (%)
Drug-induced	0	0
Total	50	100

SIRS, BISAP, and Modified CTSI Distribution: The majority (80%) of patients recovered without complications. Local complications (pseudocyst formation, superior mesenteric artery thrombosis) occurred in 4 patients. Systemic complications (sepsis, ARDS) occurred in 3 patients, all of whom expired during the study period. Three deaths were recorded (6% mortality): all had high BISAP scores (≥ 3) and Modified CTSI scores of 8. One patient with alcohol-induced pancreatitis presented with BISAP score 5 and died on day 4 despite ventilatory and inotropic support. Two additional patients referred from peripheral centres presented with severe CTSI scores and BISAP scores of 4 and 5, respectively, and expired on days 15 and 16.

Table 5: Systemic Inflammatory Response Syndrome (SIRS) distribution

SIRS	Frequency	Percentage (%)
Present	23	46
Absent	27	54
Total	50	100

Table 6: BISAP score distribution

BISAP Score	Frequency	Percentage (%)
Low (<3)	41	82
High (≥ 3)	9	18
Total	50	100

Table 7: Modified CT Severity Index (CTSI) distribution

Modified Category	CTSI Score Range	Frequency	Percentage (%)
Mild	0–2	36	72
Moderate	4–6	11	22
Severe	8–10	3	6
Total	—	50	100

Clinical Outcome

Table 8: Clinical outcomes of study patients

Outcome	Frequency	Percentage (%)
Improved without sequelae	40	80
Local complications	4	8
Systemic complications	3	6
Death	3	6
Total	50	100

Length of Hospital Stay: Patients with mild disease (BISAP <3 and/or mild Modified CTSI) were discharged within 7 days (72%). Patients with BISAP ≥ 3 and/or Modified CTSI ≥ 6 required extended hospital stays (8–16 days). Mean hospital stay was 5.08 ± 3.93 days.

Table 9: Distribution of length of hospital stay

Hospital Stay (Days)	Frequency	Percentage (%)
1–7 days	36	72
8–14 days	11	22
>14 days	3	6
Total	50	100

BISAP Score versus Outcome: BISAP score demonstrated a perfect NPV of 100%: no patient with a low BISAP score (<3) developed complications or died. In contrast, Modified CTSI showed superior specificity (100%) and PPV (100%) for severe outcomes but missed 8 of 11 moderate-CTSI patients who did not develop complications (overlapping scores). The 9 patients with high BISAP scores included 7 who developed complications; the remaining 2 survived without sequelae. Severe Modified CTSI predicted all 3 deaths.

Table 10: BISAP score cross-tabulated with clinical outcome

BISAP Score	Complication/Death	Improved	Total
High (≥ 3)	7	2	9
Low (<3)	0	41	41
Total	7	43	50

Table 11: Comparative diagnostic performance of BISAP and Modified CTSI

Diagnostic Parameter	BISAP Score	Modified CTSI
Sensitivity	100%	42.86%
Specificity	95.35%	100%
Positive Predictive Value (PPV)	77.78%	100%
Negative Predictive Value (NPV)	100%	91.49%

Modified CTSI versus Outcome

Table 12: Modified CTSI cross-tabulated with clinical outcome

Modified CTSI Category	Complication/Death	Improved	Total
Severe (8–10)	3	0	3
Mild + Moderate (0–6)	4	43	47
Total	7	43	50

DISCUSSION

This study prospectively evaluated 50 patients with acute pancreatitis to compare the prognostic utility of BISAP and Modified CTSI at a tertiary care teaching hospital in Rajasthan, India. The demographic profile of our cohort – predominantly young adult males (mean age 37.5 years, 74% male) with a high prevalence of alcohol-induced pancreatitis (68%) – is consistent with published literature from similar socioeconomic settings. Venkata Krishnan et al. from Chennai reported comparable epidemiological findings. The high prevalence of alcoholism in Kota, predominantly affecting men of productive age (35–45 years), represents a significant regional public health challenge with socioeconomic implications for patients and their families.

In our study, gallstone disease was the second most common cause (20%), predominantly affecting female patients, consistent with the well-documented female preponderance of biliary pathology. These findings are in contrast to Roberts et al. from the UK (gallstones 36.9%, alcohol 22%) and Sekimoto et al. from Japan (alcohol 37%, biliary 20%), illustrating the geographic and cultural variability in AP aetiology.

SIRS was present in 46% of our patients on admission. Persistent SIRS (>48 hours) is a recognised predictor of organ failure and death, with Mofidi et al. reporting mortality rates of 0%, 8%, and 25% for absent, transient, and persistent SIRS respectively. The majority of our SIRS-positive patients improved without complications, emphasising the need for additional discriminatory tools beyond SIRS alone.

The BISAP score ≥ 3 was found in 18% of patients ($n=9$), of whom 7 (78%) developed complications. Crucially, none of the 41 patients with BISAP <3 developed any complication, yielding a NPV of 100%. This finding has important practical implications: a BISAP <3 effectively rules out severe disease, allowing these patients to be safely managed at district-level facilities without CECT. This is in agreement with findings by Papachristou et al., Park et al., and Khanna et al., who demonstrated excellent predictive accuracy of BISAP. Gompertz et al. from Spain reported sensitivity 71.4%, specificity 99.1%, PPV 83.3%, and NPV 98.3% for BISAP – our study found even higher sensitivity (100%) and equivalent NPV.

Modified CTSI demonstrated perfect specificity (100%) and PPV (100%) – all 3 patients with severe CTSI scores (≥ 8) died. However, its sensitivity was markedly lower (42.86%), and considerable overlap was observed in the moderate CTSI category: 8 of 11 patients with moderate CTSI scores (4–6) recovered without complications. This overlap limits CTSI's utility as a standalone early prognostic tool, particularly since CECT is ideally performed at 48–72 hours and may not detect necrosis in the earliest phase.

The mean hospital stay of 5.08 days in our cohort is comparable to published international data. Patients with BISAP <3 were uniformly discharged within 7 days, while those with BISAP ≥ 3 and/or severe CTSI required extended stays of up to 16 days. These data support severity-based triage in resource-limited settings.

Overall mortality was 6% (3 patients), all with high BISAP scores (≥ 3) and severe Modified CTSI (≥ 8). This is broadly comparable to published mortality data from similar settings, though higher than figures from well-resourced centres, likely reflecting delayed referral and limited access to early intensive care in this patient population.

The principal strength of BISAP over CTSI lies in its bedside applicability at the time of admission, requiring only basic laboratory and plain radiographic facilities widely available at district headquarters hospitals. The NPV of 100% in our study suggests that BISAP-negative patients can confidently be triaged as low-risk, potentially avoiding the cost, radiation exposure, and logistical challenges of CECT in a large proportion of patients.

Limitations of this study include a relatively small sample size ($n=50$), single-centre design, potential referral bias (more severe cases referred from peripheral hospitals), and short study duration. The aetiological distribution specific to this region limits generalisability to populations where biliary disease predominates.

Strengths of the Study

The present study has several important strengths. It prospectively evaluated patients with acute pancreatitis using two widely accepted severity assessment tools, namely BISAP score and Modified CT Severity Index,

in a real-world tertiary care setting. Standardized clinical, laboratory, and radiological assessments were performed for all participants. The study comprehensively evaluated disease etiology, severity, complications, mortality, and duration of hospital stay. Furthermore, the diagnostic performance of BISAP and Modified CTSI was assessed using sensitivity, specificity, positive predictive value, and negative predictive value, thereby providing clinically meaningful evidence for early risk stratification.

Limitations of the Study

The present study has certain limitations. It was conducted at a single tertiary care centre with a relatively small sample size of fifty patients, which may limit the generalizability of the findings. Referral bias could not be completely excluded because several patients were referred from peripheral hospitals after the onset of severe disease. The study evaluated only in-hospital outcomes without long-term follow-up for pancreatic insufficiency, recurrent pancreatitis, or quality of life. Additionally, external validation in larger multicentre populations is required before the findings can be generalized.

Clinical Implications

The findings of this study suggest that the BISAP score is an effective bedside tool for early severity assessment in acute pancreatitis. Because of its excellent sensitivity and negative predictive value, patients with a BISAP score of less than three can be safely managed in peripheral healthcare centres without immediate contrast-enhanced CT imaging. Modified CTSI remains valuable for assessing morphological severity and identifying pancreatic necrosis once imaging becomes appropriate. The combined use of BISAP and Modified CTSI may improve patient triage, optimize resource utilization, reduce unnecessary imaging, and facilitate timely referral of high-risk patients to tertiary care centres.

Future Scope

Future multicentre prospective studies involving larger patient populations are required to validate these findings across different healthcare settings. Longer follow-up should be undertaken to evaluate long-term complications, recurrent pancreatitis, pancreatic endocrine and exocrine insufficiency, and quality of life. Future research should also compare BISAP with other prognostic scoring systems such as APACHE II, Ranson's score, Glasgow score, and the Harmless Acute Pancreatitis Score (HAPS). The integration of artificial intelligence and machine learning algorithms with conventional prognostic models may further improve early prediction of disease severity.

CONCLUSION

This study demonstrates that the BISAP score is a simple, accurate, and early bedside tool for severity

stratification of acute pancreatitis, with higher sensitivity (100%) and negative predictive value (100%) compared to Modified CTSI (sensitivity 42.86%, NPV 91.49%). Patients with BISAP <3 can be safely managed at peripheral centres without mandatory CT imaging, reducing costs and improving healthcare resource allocation. Severe Modified CTSI (≥ 8) accurately predicted all in-hospital deaths. Alcohol was the dominant aetiological factor in this population, warranting targeted de-addiction counselling and public health measures. Larger, multi-centre prospective studies with longer follow-up are needed to further validate these findings.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article. The authors have no financial or personal relationships that could have influenced the work reported in this study.

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Author Contributions

Balveer Meena: Conceptualization, study design, patient recruitment, clinical management, manuscript preparation.

Shanker Choudhary: Data collection, literature review, statistical analysis, manuscript drafting.

Pawan Kumar: Clinical data acquisition, patient follow-up, data interpretation.

Umesh Choudhary: Radiological assessment, data verification, manuscript editing.

Mansi Rathore: Literature review, manuscript revision, proofreading, final approval of the manuscript.

All authors have read and approved the final version of the manuscript.

Data Availability Statement

The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request.

Informed Consent

Written informed consent was obtained from all participants or their legally authorized representatives prior to inclusion in the study. Confidentiality and

anonymity of all patient information were strictly maintained throughout the study.

Abbreviations

Abbreviation	Full Form
AP	Acute Pancreatitis
BISAP	Bedside Index for Severity in Acute Pancreatitis
CTSI	Computed Tomography Severity Index
CECT	Contrast-Enhanced Computed Tomography
SIRS	Systemic Inflammatory Response Syndrome
ARDS	Acute Respiratory Distress Syndrome
BUN	Blood Urea Nitrogen
PPV	Positive Predictive Value
NPV	Negative Predictive Value
SPSS	Statistical Package for the Social Sciences

REFERENCES

1. Peery AF, Dellon ES, Lund J, et al. Burden of gastrointestinal diseases in the United States: 2012 update. *Gastroenterology*. 2012;143:1179–1187.
2. Fagenholz PJ, Fernandez-del Castillo C, Harris NS, et al. Direct medical costs of acute pancreatitis hospitalizations in the United States. *Pancreas*. 2007;35:302–307.
3. Beger HG, Rittler P. Prevention of severe change in acute pancreatitis: prediction and prevention. *J Hepatobiliary Pancreat Surg*. 2001;8:140–147.
4. Beger HG, Rau B, Mayer J, Prall U. Natural course of acute pancreatitis. *World J Surg*. 1997;21:130–135.
5. Tsiotos GG, Luque-de Leon E, Sarr MG. Management of necrotizing pancreatitis by repeated operative necrosectomy using a zipper technique. *Am J Surg*. 1998;175:91–98.
6. Bradley EL, Allen K. A prospective longitudinal study of observation versus surgical intervention in the management of necrotizing pancreatitis. *Am J Surg*. 1991;161:19–25.
7. Harris HW, Barcia A. Necrotizing pancreatitis: a surgical approach independent of documented infection. *HPB (Oxford)*. 2004;6:161–168.
8. Brivet FG, Emilie D. Pro- and anti-inflammatory cytokines during acute severe pancreatitis. *Crit Care Med*. 1999;27:749–755.
9. Bradley EL 3rd. A clinically based classification system for acute pancreatitis. *Arch Surg*. 1993;128:586–590.
10. Wu BU, Johannes RS, Sun X, Tabak Y, Conwell DL, Banks PA. The early prediction of

mortality in acute pancreatitis: a large population-based study. *Gut*. 2008;57:1698–1703.

11. Balthazar EJ, Freeny PC, van Sonnenberg E. Imaging and intervention in acute pancreatitis. *Radiology*. 1994;193:297–306.

12. Banks PA, Bollen TL, Dervenis C, et al. Classification of acute pancreatitis—2012: revision of the Atlanta classification and definitions by international consensus. *Gut*. 2013;62:102–111.

13. Banks PA, Freeman ML. Practice guidelines in acute pancreatitis. *Am J Gastroenterol*. 2006;101:2379–2400.

14. Mofidi R, Duff MD, Wigmore SJ, et al. Association between early systemic inflammatory response, severity of multiorgan dysfunction and death in acute pancreatitis. *Br J Surg*. 2006;93:738–744.

15. Papachristou GI, Clermont G, Sharma A, et al. Risk and markers of severe acute pancreatitis. *Gastroenterol Clin North Am*. 2007;36:277–296.

16. Sekimoto M, Takada T. JPN guidelines for the management of acute pancreatitis: epidemiology, etiology, natural history, and outcome predictors in acute pancreatitis. *J Hepatobiliary Pancreat Surg*. 2006;13:10–24.

17. Ranson JH. Etiological and prognostic factors in human acute pancreatitis: a review. *Am J Gastroenterol*. 1982;77:633–638.

18. Blamey SL, Imrie CW, O'Neill J, et al. Prognostic factors in acute pancreatitis. *Gut*. 1984;25:1340–1346.

19. Harrison DA, D'Amico G, Singer M. The Pancreatitis Outcome Prediction (POP) score. *Crit Care Med*. 2007;35:1703–1708.

20. Lankisch PG, Weber-Dany B, Hebel K, Maisonneuve P, Lowenfels AB. The harmless acute pancreatitis score. *Clin Gastroenterol Hepatol*. 2009;7:702–705.