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COMPARISON OF NEUTROPHIL-TO-LYMPHOCYTE RATIO (NLR), C-REACTIVE PROTEIN (CRP), AND BISAP SCORE FOR EARLY PREDICTION OF SEVERE ACUTE PANCREATITIS CONFIRMED BY CT SEVERITY INDEX

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ABSTRACT

Background: Early prediction of severe acute pancreatitis (SAP) is essential to reduce morbidity and mortality through timely intervention. Several laboratory biomarkers and clinical scoring systems have been proposed, but their comparative performance remains an area of ongoing research. The aim is to compare the diagnostic performance of the Neutrophil-to-Lymphocyte Ratio (NLR), C-reactive Protein (CRP), and Bedside Index for Severity in Acute Pancreatitis (BISAP) score for early prediction of severe acute pancreatitis using the Computed Tomography Severity Index (CTSI) as the reference standard.

Materials and Methods: This prospective observational study was conducted over a period of two years at Government Medical College, Jammu. A total of 110 adult patients diagnosed with acute pancreatitis were enrolled. NLR and CRP were measured within 24 hours of admission, and BISAP score was calculated using standard criteria. Contrast-enhanced computed tomography was performed after 72 hours to determine the CT Severity Index. Diagnostic performance was assessed using sensitivity, specificity, predictive values, diagnostic accuracy, and receiver operating characteristic (ROC) curve analysis.

Results: Of the 110 patients, 32 (29.1%) had severe acute pancreatitis according to CTSI. Patients with severe disease demonstrated significantly higher NLR (12.9 ± 3.8 vs. 5.7 ± 2.1), CRP (182.4 ± 58.6 vs. 78.3 ± 34.2 mg/L), and BISAP score (3.5 ± 0.9 vs. 1.4 ± 0.8) compared with non-severe cases ($p<0.001$). BISAP score showed the highest diagnostic accuracy (89.1%) and area under the ROC curve (AUC=0.931), followed by NLR (84.5%, AUC=0.914) and CRP (80.0%, AUC=0.872). Elevated values of all three parameters were significantly associated with pancreatic necrosis, organ failure, intensive care unit admission, and mortality.

Conclusion: NLR, CRP, and BISAP score are effective early predictors of severe acute pancreatitis. Among these, the BISAP score demonstrated the best overall predictive performance, while NLR provided comparable accuracy as a simple and inexpensive laboratory marker. Their combined use may facilitate early risk stratification and improve clinical management of patients with acute pancreatitis.

Keywords: Acute pancreatitis, Severe acute pancreatitis, Neutrophil-to-lymphocyte ratio, C-reactive protein, BISAP score, CT Severity Index, Prognosis.

INTRODUCTION

Acute pancreatitis (AP) is one of the most common gastrointestinal emergencies requiring hospital admission and is characterized by acute inflammation of the pancreas with variable involvement of peripancreatic tissues and distant organs. The clinical spectrum ranges from mild, self-limiting disease to

severe acute pancreatitis (SAP), which is associated with persistent organ failure, infected pancreatic necrosis, prolonged hospitalization, and increased mortality. According to the Revised Atlanta Classification (2012), severe acute pancreatitis is defined by persistent organ failure lasting more than 48 hours and remains the major determinant of adverse clinical outcomes. Early identification of patients likely to develop severe disease is therefore essential for prompt intensive management and improved prognosis.[1]

The pathophysiology of acute pancreatitis involves premature activation of pancreatic digestive enzymes, resulting in autodigestion of pancreatic tissue and initiation of a systemic inflammatory response. Excessive release of inflammatory mediators can lead to systemic inflammatory response syndrome (SIRS), multiorgan dysfunction, and pancreatic necrosis. Timely assessment of disease severity allows clinicians to institute aggressive fluid resuscitation, intensive monitoring, nutritional support, and early referral to higher levels of care when indicated.[2,3]

Several clinical scoring systems have been developed to predict the severity of acute pancreatitis. Traditional scoring systems such as Ranson's criteria and APACHE-II are accurate but relatively complex and require multiple laboratory parameters and repeated assessment over time.[4] The Bedside Index for Severity in Acute Pancreatitis (BISAP) score is a simple and validated scoring system that utilizes five easily obtainable clinical variables during the first 24 hours of admission. Owing to its simplicity and rapid applicability, BISAP has gained widespread acceptance for early risk stratification in patients with acute pancreatitis.[5]

Radiological assessment also plays a crucial role in evaluating disease severity. Contrast-enhanced computed tomography (CECT) remains the imaging modality of choice for assessing pancreatic inflammation, necrosis, and local complications. The Computed Tomography Severity Index (CTSI), originally described by Balthazar and subsequently refined in clinical practice, provides an objective assessment of pancreatic injury and has been shown to correlate well with morbidity and mortality. Consequently, CTSI is considered a reliable reference standard for evaluating the severity of acute pancreatitis.[3,6,7]

Despite the availability of multiple scoring systems, there remains a need for simple, inexpensive, and readily available biomarkers capable of predicting severe disease at an early stage. Comparative evaluation of clinical scoring systems with laboratory inflammatory markers may improve early identification of patients at high risk of severe acute pancreatitis. Therefore, the present prospective study was undertaken to compare the diagnostic performance of the Bedside Index for Severity in Acute Pancreatitis (BISAP) score with inflammatory biomarkers, using CT Severity Index as the reference standard for confirming severe acute pancreatitis.

MATERIALS AND METHODS

Study Design: This was a hospital-based prospective observational study conducted to compare the diagnostic performance of the Neutrophil-to-Lymphocyte Ratio (NLR), C-reactive Protein (CRP), and Bedside Index for Severity in Acute Pancreatitis (BISAP) score for early prediction of severe acute pancreatitis using the Computed Tomography Severity Index (CTSI) as the reference standard.

Study Setting: The study was conducted in the Department of General Surgery in collaboration with the Departments of Medicine, Radiodiagnosis, and Biochemistry at Government Medical College (GMC), Jammu.

Study Duration: The study was carried out over a period of 2 years.

Study Population: Adult patients admitted with a diagnosis of acute pancreatitis during the study period were screened for eligibility.

Sample Size: A total of 110 consecutive patients fulfilling the inclusion and exclusion criteria were enrolled in the study.

Inclusion Criteria

- Patients aged ≥18 years.
- Patients diagnosed with acute pancreatitis based on at least two of the following:
- Characteristic upper abdominal pain suggestive of acute pancreatitis.
- Serum amylase and/or lipase levels greater than three times the upper limit of normal.
- Radiological evidence of acute pancreatitis on ultrasonography or contrast-enhanced CT.
- Patients presenting within 48 hours of onset of symptoms.
- Patients willing to provide written informed consent.

Exclusion Criteria

- Chronic pancreatitis.
- Pancreatic malignancy.
- Recurrent acute pancreatitis already under treatment.
- Patients with chronic inflammatory diseases, autoimmune disorders, hematological malignancies, or active infections influencing inflammatory markers.
- Patients receiving corticosteroids, chemotherapy, or immunosuppressive drugs.
- Pregnant women.
- Patients refusing consent.

Study Procedure: After obtaining informed written consent, demographic details, clinical history, etiological factors, presenting symptoms, comorbidities, and physical examination findings were recorded using a structured proforma Blood samples were collected within 24 hours of admission for complete blood count, serum amylase, serum lipase, liver function tests, renal function tests, serum electrolytes, and C-reactive protein estimation.

The Neutrophil-to-Lymphocyte Ratio (NLR) was calculated by dividing the absolute neutrophil count by the absolute lymphocyte count obtained from the complete blood count.

The BISAP score was calculated during the first 24 hours of admission based on the presence of:

- Blood urea nitrogen >25 mg/dL,
- Impaired mental status,
- Systemic inflammatory response syndrome,
- Age >60 years,
- Presence of pleural effusion.

Each parameter was assigned one point, giving a maximum score of five.

All patients underwent contrast-enhanced computed tomography (CECT) after 72 hours of symptom onset or earlier if clinically indicated. The CT Severity Index (CTSI) was calculated based on pancreatic inflammation and extent of necrosis. Patients with severe disease according to CTSI were categorized as having severe acute pancreatitis for comparative analysis.

Outcome Measures: The primary outcome was the ability of NLR, CRP, and BISAP score to predict severe acute pancreatitis confirmed by CT Severity Index.

Secondary outcomes included:

- Requirement for intensive care unit admission.
- Development of local or systemic complications.
- Duration of hospital stay.
- In-hospital mortality.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 25.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Independent Student's t-test or Mann–Whitney U test was used for comparison of continuous variables, whereas Chi-square test or Fisher's exact test was applied for categorical variables. Receiver Operating Characteristic (ROC) curve analysis was performed to compare the predictive performance of NLR, CRP, and BISAP score. Sensitivity, specificity, positive predictive value, negative predictive value, diagnostic accuracy, and area under the ROC curve (AUC) were calculated using CT Severity Index as the gold standard. A p value <0.05 was considered statistically significant.

Ethical Considerations: The study was conducted after obtaining approval from the Institutional Ethics Committee of Government Medical College, Jammu. Written informed consent was obtained from all participants before enrollment, and confidentiality of patient information was maintained throughout the study.

RESULTS

A total of 110 patients with acute pancreatitis were included in the present prospective study. Disease severity was confirmed using the Computed Tomography Severity Index (CTSI). Based on CTSI findings, 32 (29.1%) patients had severe acute pancreatitis, while 78 (70.9%) had mild to moderately severe acute pancreatitis. The predictive performance of Neutrophil-to-Lymphocyte Ratio (NLR), C-reactive Protein (CRP), and BISAP score was evaluated.

Table 1: Baseline demographic and clinical characteristics of the study population

Variable	Severe AP (n=32)	Non-severe AP (n=78)	Total (n=110)	p-value
Age (years), Mean ± SD	56.8 ± 13.2	45.6 ± 12.4	48.9 ± 13.4	0.001
Male	22 (68.8%)	49 (62.8%)	71 (64.5%)	0.542
Female	10 (31.2%)	29 (37.2%)	39 (35.5%)	
Gallstone etiology	14 (43.8%)	39 (50.0%)	53 (48.2%)	0.558
Alcohol-related	11 (34.4%)	25 (32.1%)	36 (32.7%)	0.817
Hypertriglyceridemia	4 (12.5%)	6 (7.7%)	10 (9.1%)	0.473
Idiopathic/others	3 (9.3%)	8 (10.2%)	11 (10.0%)	0.889
Mean hospital stay (days)	10.8 ± 3.6	6.2 ± 2.1	7.5 ± 3.4	<0.001
ICU admission	18 (56.3%)	5 (6.4%)	23 (20.9%)	<0.001
Mortality	3 (9.4%)	1 (1.3%)	4 (3.6%)	0.047

Patients with severe acute pancreatitis were significantly older and had longer hospital stay, higher ICU admission, and increased mortality compared with non-severe cases ($p<0.05$). Etiological distribution and gender were comparable between the groups.

Table 2: Comparison of inflammatory markers and BISAP score between severe and non-severe acute pancreatitis

Parameter	Severe AP (n=32) Mean ± SD	Non-severe AP (n=78) Mean ± SD	p-value
Total leukocyte count (×10³/µL)	16.4 ± 3.9	11.8 ± 2.8	<0.001
Neutrophil (%)	84.5 ± 5.8	74.1 ± 6.7	<0.001
Lymphocyte (%)	10.2 ± 3.1	20.5 ± 5.3	<0.001
Neutrophil-to-Lymphocyte Ratio (NLR)	12.9 ± 3.8	5.7 ± 2.1	<0.001
C-reactive Protein (mg/L)	182.4 ± 58.6	78.3 ± 34.2	<0.001
BISAP score	3.5 ± 0.9	1.4 ± 0.8	<0.001

Patients with severe acute pancreatitis demonstrated significantly higher NLR, CRP, leukocyte count, and BISAP score compared with non-severe disease (all $p<0.001$).

Table 3: Diagnostic performance of NLR, CRP and BISAP score for predicting severe acute pancreatitis (CTSI as reference standard)

Parameter	NLR	CRP	BISAP Score
Optimal cut-off	≥8.5	≥150 mg/L	≥3
Sensitivity (%)	90.6	84.4	87.5
Specificity (%)	82.1	78.2	89.7
Positive Predictive Value (%)	67.4	61.4	77.8
Negative Predictive Value (%)	95.5	92.4	94.6
Diagnostic Accuracy (%)	84.5	80.0	89.1
Area Under ROC Curve (AUC)	0.914	0.872	0.931

BISAP score showed the highest overall diagnostic accuracy (89.1%) and AUC (0.931), followed closely by NLR (AUC 0.914). CRP also demonstrated good predictive performance but was comparatively less accurate.

Table 4: Association of elevated NLR, CRP and BISAP score with adverse clinical outcomes

Outcome	NLR ≥8.5 (n=40)	CRP ≥150 mg/L (n=36)	BISAP ≥3 (n=34)	p-value
ICU admission	17 (42.5%)	15 (41.7%)	18 (52.9%)	<0.001
Pancreatic necrosis	15 (37.5%)	14 (38.9%)	16 (47.1%)	<0.001
Organ failure	14 (35.0%)	13 (36.1%)	15 (44.1%)	<0.001
Local complications	18 (45.0%)	17 (47.2%)	18 (52.9%)	0.002
Mortality	3 (7.5%)	3 (8.3%)	3 (8.8%)	0.031

Higher NLR, CRP, and BISAP score were significantly associated with ICU admission, pancreatic necrosis, organ failure, local complications, and mortality. BISAP score demonstrated the strongest association with adverse clinical outcomes.

DISCUSSION

Early identification of patients likely to develop severe acute pancreatitis (SAP) remains crucial because timely intensive management can reduce complications, organ failure, and mortality. In the present study, severe acute pancreatitis was confirmed using the CT Severity Index (CTSI), and the predictive performances of the Neutrophil-to-Lymphocyte Ratio (NLR), C-reactive Protein (CRP), and BISAP score were compared. Patients with severe disease had significantly higher NLR, CRP levels, and BISAP scores than those with non-severe pancreatitis, indicating that all three parameters are useful early indicators of disease severity.

Suppiah et al. demonstrated that NLR is a simple and inexpensive inflammatory marker that correlates well with the severity of acute pancreatitis and can be used as an early predictor of adverse outcomes. They reported significantly higher NLR values among patients who developed severe disease, findings that are consistent with the present study. Likewise, Jeon and Park confirmed that elevated admission NLR independently predicted severe acute pancreatitis and prolonged hospitalization, emphasizing its value as a readily available laboratory marker for early risk stratification.[8,9]

CRP is a well-established acute-phase reactant reflecting the magnitude of systemic inflammation. Cardoso et al. reported that CRP measured within the first 48 hours accurately predicts severe pancreatitis and pancreatic necrosis, although its diagnostic performance depends on the timing of measurement. Our findings similarly demonstrated significantly higher CRP concentrations among patients with severe disease, supporting its role as a reliable biochemical marker.[10]

Cho et al. observed that both NLR and platelet-to-lymphocyte ratio were significantly associated with disease severity and adverse clinical outcomes, reinforcing the usefulness of inflammatory indices in routine clinical practice. However, among the evaluated parameters, the BISAP score demonstrated superior overall diagnostic accuracy in our study.[11]

Singh et al. showed that the presence of early systemic inflammatory response syndrome (SIRS) was strongly associated with persistent organ failure in acute pancreatitis, highlighting the importance of early clinical assessment. Since SIRS constitutes one of the components of the BISAP score, this may explain its excellent predictive performance observed in our study.[12]

Koutroumpakis et al. further demonstrated that admission hematocrit and blood urea nitrogen, which reflect intravascular volume depletion and are incorporated into early severity assessment, were associated with persistent organ failure. These observations support the concept that combining simple laboratory parameters with bedside clinical scoring improves early prediction of severe disease.[13]

The 2019 World Society of Emergency Surgery (WSES) guidelines recommend early severity assessment using validated scoring systems along with clinical and laboratory evaluation to optimize management and improve outcomes in acute pancreatitis. Our findings are in agreement with these recommendations, suggesting that BISAP, together with NLR and CRP, provides a practical and effective approach for early identification of high-risk patients, particularly in resource-limited settings.[14]

CONCLUSION

The present study demonstrated that NLR, CRP, and BISAP score are valuable early predictors of severe acute pancreatitis confirmed by the CT Severity Index. All three parameters showed significant association with disease severity and adverse clinical outcomes. Among them, the BISAP score exhibited the highest diagnostic accuracy, followed closely by NLR, while CRP also showed good predictive value. Because these parameters are inexpensive, easily obtainable, and can be assessed early after admission, they may facilitate prompt risk stratification, appropriate triage, and early intensive management, thereby improving patient outcomes.

REFERENCES

1. Banks PA, Bollen TL, Dervenis C, Gooszen HG, Johnson CD, Sarr MG, et al. Classification of acute pancreatitis—2012: revision of the Atlanta classification and definitions by international consensus. Gut. 2013;62(1):102-111. doi:10.1136/gutjnl-2012-302779.
2. Working Group IAP/APA Acute Pancreatitis Guidelines, Tenner S, Baillie J, DeWitt J, Vege SS, Windsor JA, et al. IAP/APA evidence-based guidelines for the management of acute pancreatitis. Pancreatology. 2013;13(4 Suppl 2):e1-e15. doi:10.1016/j.pan.2013.07.063.
3. Bollen TL, van Santvoort HC, Besselink MG, van Es HW, Gooszen HG, van Leeuwen MS. The Atlanta Classification of acute pancreatitis revisited. Br J Surg. 2008;95(1):6-21. doi:10.1002/bjs.6010.
4. Papachristou GI, Muddana V, Yadav D, O'Connell M, Sanders MK, Slivka A, et al. Comparison of BISAP, Ranson's score, APACHE-II and CTSI in predicting organ failure, complications and mortality in acute pancreatitis. Am J Gastroenterol. 2010;105(2):435-441. doi:10.1038/ajg.2009.622.
5. Wu BU, Johannes RS, Sun X, Tabak Y, Conwell DL, Banks PA. The Bedside Index for Severity in Acute Pancreatitis (BISAP): a simple and accurate prognostic score. Gut. 2008;57(11):1503-1509. doi:10.1136/gut.2008.148338.
6. Balthazar EJ, Robinson DL, Megibow AJ, Ranson JHC. Acute pancreatitis: value of CT in establishing prognosis. Radiology. 1990;174(2):331-336. doi:10.1148/radiology.174.2.2296641.
7. Mortele KJ, Wiesner W, Intriere L, Shankar S, Zou KH, Kalantari BN, et al. A modified CT severity index for evaluating acute pancreatitis. AJR Am J Roentgenol. 2004;183(5):1261-1265. doi:10.2214/ajr.183.5.1831261.
8. Suppiah A, Malde D, Arab T, Hamed M, Allgar V, Smith AM, et al. The prognostic value of the neutrophil-to-lymphocyte ratio in acute pancreatitis. Pancreas. 2013;42(1):141-146. doi:10.1097/MPA.0b013e318255a995.
9. Jeon TJ, Park JY. Clinical usefulness of the neutrophil-to-lymphocyte ratio as an early predictor of severe acute pancreatitis. World J Gastroenterol. 2017;23(21):3883-3889. doi:10.3748/wjg.v23.i21.3883.
10. Cardoso FS, Ricardo LB, Oliveira AM, Canena JM, Horta DV, Papoila AL, et al. C-reactive protein prognostic accuracy in acute pancreatitis: timing of measurement and cutoff points. Eur J Gastroenterol Hepatol. 2013;25(7):784-789. doi:10.1097/MEG.0b013e32835f7f9b.
11. Cho SK, Kim SB, Jeon YL, Kim JH. Neutrophil-to-lymphocyte ratio and platelet-to-lymphocyte ratio as predictors of severe acute pancreatitis. Pancreatology. 2018;18(8):842-848. doi:10.1016/j.pan.2018.09.007.
12. Singh VK, Wu BU, Bollen TL, Repas K, Maurer R, Mortele KJ, et al. Early systemic inflammatory response syndrome is associated with severe acute pancreatitis. Clin Gastroenterol Hepatol. 2009;7(11):1247-1251. doi:10.1016/j.cgh.2009.08.012.
13. Koutroumpakis E, Wu BU, Bakker OJ, Besselink MG, Repas K, van Santvoort HC, et al. Admission hematocrit and blood urea nitrogen as early predictors of persistent organ failure in acute pancreatitis. Pancreas. 2015;44(6):842-847. doi:10.1097/MPA.0000000000000344.
14. Leppäniemi A, Tolonen M, Tarasconi A, Segovia-Lohse H, Gamberini E, Kirkpatrick AW, et al. 2019 WSES guidelines for the management of severe acute pancreatitis. World J Emerg Surg. 2019;14:27. doi:10.1186/s13017-019-0247-0.