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Original Research Article

PREDICTIVE VALUE OF EARLY SERUM C-REACTIVE PROTEIN LEVELS FOR ORGAN FAILURE IN ACUTE PANCREATITIS: A PROSPECTIVE OBSERVATIONAL STUDY

Siddhant Jain[1], Sanket Vijay Aru[2], Amit Anurag Singh[3]

[1]Senior Resident, Department of General Medicine, Netaji Subhash Chandra Bose Medical College Jabalpur, Madhya Pradesh, India.
[2]Senior Resident, Department of General Medicine, Netaji Subhash Chandra Bose Medical College Jabalpur, Madhya Pradesh, India.
[3]Associate Professor, Department of General Medicine, Netaji Subhash Chandra Bose Medical College Jabalpur, Madhya Pradesh, India.

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Corresponding Author:
Dr. Siddhant Jain,
Senior Resident, Department of General Medicine, Netaji Subhash Chandra Bose Medical College Jabalpur, Madhya Pradesh, India.
Email: siddhantj1611@gmail.com

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ABSTRACT

Background: Acute pancreatitis is a common clinical condition with variable severity. Early prediction of organ failure is essential for appropriate management. Serum C-reactive protein (CRP) is an inexpensive and widely available inflammatory marker that may help predict disease severity.
Objectives: To evaluate the predictive value of early serum CRP levels for predicting organ failure in patients with acute pancreatitis, determine the optimal cutoff value using ROC analysis, and assess its correlation with BISAP score.
Materials and Methods: This prospective observational study included 90 patients diagnosed with acute pancreatitis admitted between August 2022 and April 2024 at a tertiary care center. Serum CRP levels and BISAP scores were measured at admission. Organ failure was defined using the Modified Marshall Scoring System. Statistical analysis included Student's t-test, chi-square test, Fisher's exact test, and receiver operating characteristic (ROC) curve analysis.
Results: The mean CRP level in acute pancreatitis with no organ failure was 68.07 ± 44.88 mg/L, while in acute pancreatitis with organ failure it was 169.30 ± 38.83 mg/L. A CRP cutoff value of ≥143 mg/L predicted organ failure in acute pancreatitis with 90.5% sensitivity and 91.3% specificity (AUC = 0.93, 95% CI: 0.86–0.99, $p < 0.001$). A significant positive correlation was observed between CRP levels and BISAP score ($r = 0.645$, $p < 0.001$).
Conclusion: Early measurement of serum CRP within 48 hours of presentation is a reliable predictor of organ failure in acute pancreatitis. Combined use of CRP and BISAP score may improve early risk stratification and guide clinical management.
Keywords: Acute pancreatitis, C-reactive protein, BISAP score, Organ failure, ROC curve

INTRODUCTION

Acute pancreatitis is an inflammation of the pancreas that causes the autodigestion of the pancreas due to the activation of pancreatic enzymes.[1] The worldwide incidence of acute pancreatitis is 34 cases per 1,00,000 persons.[1] In India, the annual incidence is 28.7 per 1,00,000 persons.[2] The number of admissions has risen by at least 20% in the last ten years.[3] Approximately 80% of acute pancreatitis patients are mild and resolve on their own, without resulting in any long-term complications.[4] Severe disease manifests in approximately 20% of instances, resulting in necrosis.[4] The usual mortality rate for acute pancreatitis is around 2 to 5%, it escalates to 20% to 30% in severe instances.[4] The mortality in mild cases is approximately 1%.[4]

Etiologies include gallstones, alcohol, autoimmune pancreatitis, genetic, drugs, trauma, ERCP-induced pancreatitis, hypertriglyceridemia and infections.3 Gallstones are the most frequent cause, followed by alcohol consumption.[5] Less than 5% of acute pancreatitis cases are attributed to drugs, despite numerous medications being linked to the condition.[6] Hypertriglyceridemia represents 2–5% of total cases, generally occurring when fasting serum triglyceride levels surpass 1000 mg/dL.[3] The term idiopathic refers to a situation where all possible causes have been excluded.[3]

The standard approach for treating acute pancreatitis is conservative management, with surgery having a limited role in cases of acute illness. Since the implementation of early diagnostic methods and successful conservative treatment, there has been a reduction in overall mortality.[7] The Bedside index of Severity in Acute Pancreatitis (BISAP) score is a simple, reliable and quick tool for assessing disease severity upon admission.[8]

Serum C-reactive protein (CRP) is an acute-phase reactant synthesized by the liver in response to inflammation. It is an inexpensive, widely available, and reliable biomarker that has been shown to correlate with severity in acute pancreatitis. However, variations in demographic characteristics, etiological factors, and healthcare settings may influence its predictive accuracy and optimal cutoff values.

There is limited data from Central India evaluating the predictive value of early CRP levels and its correlation with BISAP score in acute pancreatitis. Therefore, this study was conducted to evaluate the predictive value of serum CRP levels and determine the optimal cutoff value in our regional patient population. Early identification of patients at risk of organ failure is crucial because it allows timely intensive monitoring, aggressive fluid resuscitation, and early referral to higher-level care, which may significantly improve clinical outcomes.

MATERIALS AND METHODS

Objectives of the study:

A prospective observational study was conducted in a tertiary care facility in Central India from August 2022 to April 2024.

Primary Objective:

To evaluate the predictive value of early serum C-reactive protein (CRP) levels in determining the organ failure in acute pancreatitis.

Secondary Objectives

1. To determine the optimal cutoff value of serum CRP for predicting organ failure in acute pancreatitis using ROC curve analysis.
2. To assess the correlation between serum CRP levels and BISAP score.
3. To describe the demographic, clinical, and etiological profile of patients with acute pancreatitis.

Inclusion Criteria

1. Patient over 18 years of age.
2. Diagnosed with acute pancreatitis within 72 hours according to the Revised Atlanta Classification 2012.
3. Patients who are willing to provide consent.

Exclusion Criteria

1. Patient under the age of 18.
2. Patients with chronic pancreatitis were excluded based on clinical history, biochemical findings, and imaging evidence. Patients with prior imaging (including CT scans performed for other indications) suggestive of chronic pancreatitis, such as pancreatic calcifications, ductal irregularity, or gland atrophy, were excluded from the study.
3. Patients who do not provide consent for the study.

Ninety patients in all were selected based on the predetermined inclusion and exclusion criteria.

Study size

The sample size was calculated based on the expected incidence of organ failure in acute pancreatitis. Previous studies using Revised Atlanta Classification 2012 have reported organ failure occurs in approximately 15-20% patients. Assuming an expected prevalence (p) of 15%, a 95% confidence level (Z = 1.96), and an allowable margin of error (d) of 8%. The minimum required sample size was calculated to be 77 patients using formula $n = (Z^2 \times p \times (1-p)) / d^2$. However, considering feasibility constraints and the study duration, 90 patients were included in the final analysis.

Methods

- Each individual provided informed and written consent, and their involvement in the project was voluntary.
- Relevant demographic information and background were gathered from the participants.
- The Revised Atlanta Classification was used to determine the diagnosis of acute pancreatitis and organ failure was defined according to the Modified Marshall Scoring System, as a score ≥2 in the respiratory, renal, or cardiovascular system, as recommended in Revised Atlanta Classification. [9]
- Severity classification in this study was based on Revised Atlanta Classification 2012, which defines severe acute pancreatitis as persistent organ failure lasting more than 48 hours. CT Severity Index (CTSI) was used to assess radiological severity but was not used as the primary criterion for severity classification.
- Patients were evaluated clinically and through laboratory and imaging investigations to confirm the diagnosis of acute pancreatitis and exclude alternative causes of systemic inflammation.

- The BISAP score was assessed within 24 hours of admission.[4]
- Contrast-enhanced computed tomography (CECT) was performed on day 7 of admission and severity was assessed using CTSI/Balthazar scoring.
- Patients were followed during the initial hospitalization period for the development of organ failure. Long-term follow-up outcomes such as mortality and post-discharge complications were not assessed as the study focused on early prediction.

Every patient underwent subsequent investigations: Complete blood picture, Renal Function Tests, Liver Function Tests, Serum Electrolytes, Serum Amylase and Lipase, Serum C Reactive Protein, Serum Calcium, ABG, Chest X-ray, USG Abdomen, CECT Abdomen.

By employing a dry, single-use syringe and needle while minimizing stasis, samples of blood were drawn from the antecubital vein. Two milliliters of venous blood were collected in an EDTA vial for the CBC, and eight milliliters of venous blood were collected in a plain vial and allowed to clot at room temperature before centrifugation for serum separation. After clot formation, serum studies were performed using this sample. The test results were analyzed in the biochemistry lab of the tertiary care center, using the RX MODENA machine, Version 3.0 (RX9003)

Statistical Analysis

Results for categorical variables are displayed as frequencies (%), results for continuous variables are displayed as mean ± standard deviation or median (interquartile range). Statistical significance is evaluated at the 5% level. The Student's t-test (two-tailed, independent) was used to evaluate continuous variables, while the chi-square or Fisher's exact test was used to compare categorical data between two or more groups. Statistical significance was defined as a two-tailed p-value of less than 0.05. Receiver operating characteristic (ROC) curve analysis was performed to evaluate the diagnostic performance of CRP for predicting organ failure in acute pancreatitis, and the area under the ROC curve (AUROC) was computed. The raw data was managed in a Microsoft Excel spreadsheet before being analyzed using the Statistical Package for the Social Sciences (SPSS) version 22.00 (IBM Corp., Armonk, NY, USA). The findings were examined and contrasted with earlier studies to reach pertinent conclusions.

RESULTS

Baseline Distribution

Over the study period, 90 individuals were evaluated. The majority of patients were in the 26–35 year age group (38 out of 90, 42.2%). Males constituted 87.8% of the study population, while females accounted for 12.2%. The predominant symptom reported was abdominal pain (100%), with nausea (85.6%) and vomiting (74.4%) following closely behind. The most common association was with alcohol (76.7%), followed by gallstones (24.4%). The most prevalent addiction was alcohol and tobacco chewing (84.4%), followed by alcohol alone (76.7%). There was also an association with tobacco chewing (41.1%) and cigarette smoking (23.3%). CRP levels measured indicated that most patients had CRP levels ranging from 30 to 150 mg/L (58.7%), with a significant portion having levels exceeding 150 mg/L (26.7%). The smallest group of patients presented with CRP levels below 30 mg/L (14.4%). BISAP scores recorded on the day of presentation showed that the majority of patients had scores of 1 and 2, each accounting for 30%, followed by a score of 0 at 23.3%. The majority of patients had a CTSI score between 4–6 (46.7%), followed by a score between 0–3 (28.9%), and then a score between 7–10 (24.4%). In terms of organ failure, 10% of patients had AKI alone, 7.7% had ALI alone, and 5.5% had both AKI and ALI. In terms of the organ failure, most patients (76.7%) were diagnosed with no organ failure, while the rest (23.3%) showed organ failure. The present study primarily evaluated early in-hospital outcomes, and extended follow-up data were not available. The distribution of patients concerning all the mentioned parameters is outlined in **Table 1**.

Table 1: Baseline Distribution of Patients with Acute Pancreatitis

	Frequency (n)	Percentage (%)
Age (in years)		
• 18-25	17	18.9
• 26-35	38	42.2
• 36-45	19	21.1
• 46-55	9	10.0
• 56-65	7	7.8
Gender		
• Male	79	87.8
• Female	11	12.2
Clinical Presentation		
• Abdominal Pain	90	100
• Vomiting	67	74.4
• Nausea	77	85.6
• Fever	24	26.6
	23	25.5

• Obstipation	6	6.7
• Shortness of breath	42	46.6
• Abdominal tenderness	11	12.2
• Jaundice		
Etiology & Association		
• Alcohol	69	76.7
• Gall Stones	22	24.4
• Hypertriglyceridemia	2	2.2
• Trauma	1	1.1
Addiction History		
• Alcohol	69	76.7
• Cigarette Smoking	21	23.3
• Tobacco Chewing	37	41.1
• Alcohol and Tobacco Chewing	76	84.4
• Ganja Smoking	3	3.3
• IV Drug Abuser	1	1.1
• No addiction	8	8.8
CRP Levels (mg/L)		
• 5-30	13	14.4
• 30-150	53	58.7
• >150	24	26.7
BISAP Score on the day of presentation		
• 0	21	23.3
• 1	27	30
• 2	27	30
• 3	13	14.4
• 4	1	1.1
• 5	1	1.1
BSIAP Score components		
• BUN >25 mg/dl	18	20
• Impaired mental status	2	2.2
• SIRS	51	56.6
• Age >60 years	4	4.4
• Presence of pleural effusion	54	60
CTSI Score on Day 7		
• 0-3	26	28.9
• 4-6	42	46.7
• 7-10	22	24.4
Organ Failure Distribution		
• No Organ Failure	69	76.7
• Organ Failure	21	23.3
Type of Organ Failure		
• AKI alone	9	10
• ALI alone	7	7.7
• Both AKI and ALI	5	5.5

The baseline characteristics are presented in Table 2.

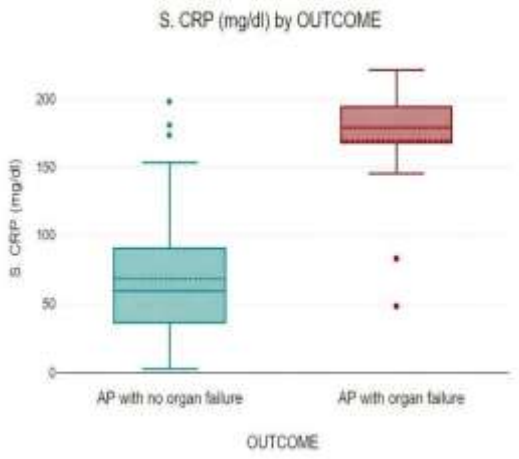
Table 2: Baseline Characteristics of Patients with Acute Pancreatitis with no organ failure and Acute Pancreatitis with organ failure

	Patients with AP with no organ failure (n=69)	**Patients with AP with organ failure (n=21)**	**P Value**
Age (years)	36.3 ± 11.5	36.0 ± 11.8	0.91
Sex (Male) (%)	60/69 (86.9%)	19/21 (90.4%)	0.67
Weight (kg)	63.7 ± 10.5	63.2 ± 8.2	0.86
Height (m)	165.8 ± 8.0	169.3 ± 8.9	0.09
BMI (kg/m^2)	23.1 ± 3.1	22.0 ± 2.7	0.16
Systolic Blood Pressure (mmHg)	119.3 ± 17.4	122.6 ± 23.7	0.48
Diastolic Blood Pressure (mmHg)	77.2 ± 10.8	77.6 ± 12.5	0.90
PaO2/FiO2	352 ± 60.1	182 ± 73.5	**0.05**
Hemoglobin (gm/dl)	12.3 ± 2.8	12.7 ± 3.2	0.58
Hematocrit (%)	37.0 ± 9.0	38.4 ± 11.1	0.56
TLC (x10^3 cells/uL)	10.2 (7.5-13.1)	15.0 (11.5-17.7)	**0.001**
Neutrophils (%)	80 (72-85)	83 (80-87)	**0.04**
Lymphocytes (%)	12 (9-21)	11 (7-12)	0.16
NLR	6.5 (3.4-9.4)	7.4 (6.8-12.2)	0.78
Platelets (Lacs cells/uL)	2.1 (1.5-2.6)	2.2 (1.4-2.5)	0.43
Creatinine (mg/dL)	0.87 (0.76-1.02)	1.97 (0.93-2.4)	**<0.001**
Urea (mg/dL)	25.8 (21.2-35.3)	44.1 (37.2-82.5)	**<0.001**
BUN (mg/dL)	12.0 (10.0-17.5)	20.6 (17.4-38.5)	**<0.001**
Na+ (meq/L)	140 (137-142)	139 (134-143)	0.65
K+ (meq/L)	4.0 (3.7-4.2)	4.4 (4.2-5.0)	0.44
RBS (mg/dL)	92.7 (76.6-105.3)	105 (84.0-136.5)	**0.02**

Total Bilirubin (mg/dL)	1.1 (0.7-1.9)	1.1 (0.8-2.3)	0.29
Direct Bilirubin (mg/dL)	0.42 (0.25-0.85)	0.50 (0.18-1.16)	0.19
Indirect Bilirubin (mg/dL)	0.7 (0.42-0.97)	0.73 (0.59-1.11)	0.55
AST (IU/L)	39 (30-57)	32 (24-56)	0.93
ALT (IU/L)	29 (20-50)	39 (24-53)	0.09
Total Protein (gm/dL)	6.3 (5.8-6.6)	6.2 (5.6-6.6)	0.69
Albumin (gm/dL)	3.4 (3.1-4.1)	3.2 (2.8-3.9)	0.31
Globulin (gm/dL)	2.8 (2.4-3.1)	2.6 (2.4-3.3)	0.76
Cholesterol (mg/dL)	145 (139-170)	150 (131-180)	0.98
Triglyceride (mg/dL)	110 (85-153)	104 (84-132)	0.51
HDL (mg/dL)	41 (38-47)	42 (39-50)	0.58
LDL (mg/dL)	81 (73-102)	92 (78-105)	0.93
VLDL (mg/dL)	18 (17-27)	17.6 (17-24)	0.53
Amylase (U/L)	353 (190-715)	650 (277-809)	0.17
Lipase (U/L)	279 (208-511)	471 (325- 721)	0.27
Calcium (mg/dL)	9.1 (8.6-9.2)	8.9 (8.2-9.2)	0.45
CRP (mg/L)	59.3 (36.3-90.7)	178.6 (167.5-194)	**<0.001**
CTSI Score on Day 7	4 (2-5)	8 (8-10)	**<0.001**
BISAP Score	1 (0-2)	3 (2-3)	**<0.001**

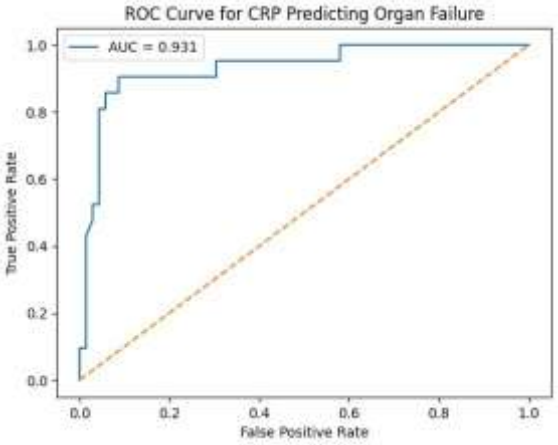
CRP characteristics with Acute Pancreatitis without organ failure and Acute Pancreatitis with organ failure

In cases of acute pancreatitis with no organ failure, the distribution of CRP values is positively skewed, exhibiting a median of 59.30 (ranging from 36.3 to 90.7) mg/L. The average CRP value for acute pancreatitis without organ failure is 68.07 ± 44.88 mg/L. Conversely, in organ failure acute pancreatitis, CRP values demonstrate a negatively skewed distribution, with a median value of 178.60 (between 167.5 and 194) mg/L. The average CRP value for acute pancreatitis with organ failure stands at 169.30 ± 38.83 mg/L. [Figure 1]



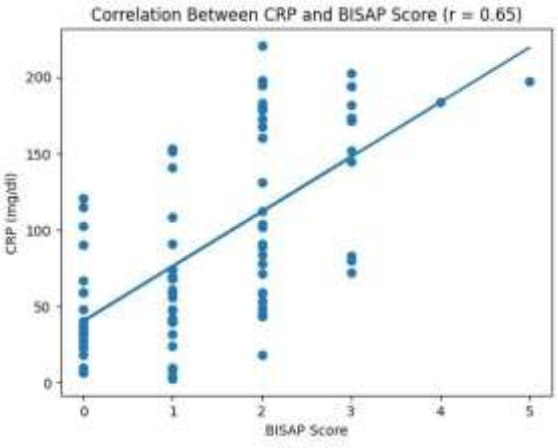
ROC Curve of CRP Value for predicting organ Failure in Acute Pancreatitis

The ROC curve presented indicates that a CRP level of 143 mg/L or higher is an effective predictor of organ failure in Acute Pancreatitis, demonstrating a 90.50% sensitivity and 91.30% specificity. The measure of area under the curve (AUC) is 0.93, and the standard error is 0.033, with a 95% confidence interval (CI) which ranges from 0.86 to 0.99, and a p-value <0.001. [Figure 2]



Correlation between CRP level and BISAP Score

Statistical evaluation indicated a significant positive correlation between CRP levels and BISAP scores, demonstrated by a Pearson correlation coefficient of 0.645 (p-value < 0.001). Patients exhibiting elevated BISAP scores were likely to show increased CRP levels. [Figure 3]



DISCUSSION

We studied 90 patients who came to our hospital with acute pancreatitis during the study timeframe. According to our data 42.2% of the patients were between the ages of 26 and 35 years. The average

age was 36.23 (SD ± 11.55). Similar to earlier research, acute pancreatitis has been shown to affect individuals of any age. There were 87.8% males and 12.2% females in our research, which is consistent with a study conducted on 100 acute pancreatitis patients, where Deherkar JA et al,[7] reported that 63% of the studied population were males. This aligns with global epidemiology, that in acute pancreatitis males are more commonly affected than females.

The primary symptoms observed in our study group were abdominal pain (100%), followed by nausea (85.6%), vomiting (74.4%), fever (26.6%), obstipation (25.5%), and shortness of breath (6.7%). The most common association was with alcohol alone (76.7%), followed by gallstones (24.2%). The remaining associations included idiopathic (3.3%), hypertriglyceridemia (2.2%), and trauma (1.1%). There were no cases associated with drugs or post-ERCP. In research conducted by Zhang et al,[10] conducted in 2023, alcoholic etiology was found in 55.75%, gall stones in 29.2%, and hyperlipidemia in 14.15% of cases. Similarly, in another study by Hagjer et al,[11] 45% of cases were alcoholic, 40% had gallstone etiology, and 15% were idiopathic.

In our study of 90 patients, 76.7% had no organ failure, while 23.3% had organ failure. This result aligns with research conducted by Naciye et al,[12] who reported 23.8% of SAP cases in a study of 80 patients in 2019, while 76.2% had mild AP. Another study by Hagjer et al,[11] in 2018 showed 76.7% mild AP and 23.3% SAP in a study population of 60.

In the present study, organ failure was noted in the form of acute kidney injury (AKI) and acute lung injury (ALI). The majority of patients had AKI alone (10%), while ALI alone was seen in 7.7%. Only 5.5% had both AKI and ALI. Among the 21 AP patients with organ failure in this study, AKI was seen in 66.6% and ALI in 57%. A study by Lei H et al,[13] found ALI in 27.7% of 184 SAP cases. Similarly, a study by Devani et al,[14] found AKI in 7.9% and respiratory failure in 3.3% of all acute pancreatitis patients.

In our study, all,[13] patients with CRP values between 5–30 mg/L within 3 days of presentation had AP without organ failure (100%). Among the 24 patients with CRP values greater than 150 mg/L, 6 had AP without organ failure (25%) and 18 had AP with organ failure (75%). In a study by Vijaykumar,[15] CRP >210 mg/L at admission was associated with severe disease. Similarly, Parmar et al,[16] found that 52% of SAP patients had CRP values >150 mg/L.

In our study, all,[13] patients with CRP levels ranging from 5 to 30 mg/L had a BISAP score between 0 and 2 (100%). Out of the 66 patients with CRP levels below 150 mg/L, 93.9% exhibited a BISAP score of 0 to 2, while 6.1% had a BISAP score between 3 and 5. Among the 24 patients who had CRP levels exceeding 150 mg/L, 13 (54.1%) recorded a BISAP score of 0 to 2, and 11 (45.8%) had a BISAP score of 3 to 5. This aligns with research conducted by Krishna TG et al,[8] where group of patients with CRP levels below 150 mg/L, all had a BISAP score ranging from 0 to 2, while among those with CRP levels exceeding 150 mg/L, 65% exhibited BISAP scores of 0 to 2 and 35% had BISAP scores between 3 and 5.

A CRP level of ≥ 143 mg/L measured within 48 hours of presentation indicated organ failure in AP with a 90.5% sensitivity and 91.3% specificity. In a study by Pezzilli et al,[17] CRP >100 mg/L within the initial 24 hours suggested severe acute pancreatitis in 60-80 percent of individuals. A research by Kumar et al,[8] revealed that on day 2, the AUC for CRP was 0.93, demonstrating 100% sensitivity and 81.4% specificity for estimating the acute pancreatitis severity. Similarly, Stirling et al,[18] found that on the third day, a CRP level of 190 mg/L or greater exhibited an AUC of 0.84, indicating a sensitivity of 83.3% and a specificity of 69.5% for predicting the severity of acute pancreatitis. Our study demonstrated a significant correlation between early CRP levels and the development of organ failure in acute pancreatitis, yielding an AUC of 0.93 with a 95% confidence interval.

Our study found that in AP with no organ failure, the mean CRP value was 68.07 ± 44.88 mg/L (range 2.87–198.10 mg/L), while in AP with organ failure, the mean CRP was 169.30 ± 38.83 mg/L (range 48.64–220.60 mg/L). Research conducted by Sharma et al,[19] indicated that mild AP had a CRP level ranging from 24 to 48 mg/L, whereas SAP exhibited a CRP range from 96 to 192 mg/L. Another study by Karabuga et al,[20] reported that mild AP had a CRP of 51.0 ± 6.6 mg/L and SAP had a CRP of 118.1 ± 9.4 mg/L.

CT Severity Index reflects radiological severity, whereas Revised Atlanta Classification defines clinical severity based on persistent organ failure. In our study, although several patients demonstrated higher CTSI scores, only those with persistent organ failure were classified as severe acute pancreatitis. This distinction explains the difference between CTSI-based radiological severity and clinically defined severity. The present study was not designed to evaluate correlation between CRP and CT-based severity. Therefore, detailed statistical analysis of CRP with CT findings was not performed.

Although CRP is widely used as a marker of inflammation, it is not specific to acute pancreatitis and may be elevated in other inflammatory conditions, particularly alcohol-related liver disease and biliary infections. However, all patients in this study were diagnosed with acute pancreatitis based on standard clinical, biochemical, and radiological criteria. Nevertheless, the possibility of confounding due to underlying inflammatory conditions cannot be completely excluded.

Limitations of the study

Results with a maximum risk of 5%, a minimum power of 85%, and a significance level of 5%

(defined as significant at a 95% confidence interval) were obtained from the 90-person sample. However, a greater sample size would probably produce more reliable outcomes. We did not consider genetic causes of acute pancreatitis, as this would have been both complex and expensive. There could have been a selection bias, given that the study was carried out at only one center.

CONCLUSION

In summary, this prospective observational study was conducted in the Department of Medicine at a tertiary care center and included 90 patients diagnosed with acute pancreatitis. The study population showed a male predominance, with most patients belonging to the 26–35 year age group. Alcohol and biliary disease were identified as the most common etiological factors, consistent with previous studies. This study demonstrated that serum C-reactive protein (CRP) levels measured within 48 hours of presentation are a reliable indicator of organ failure in acute pancreatitis. This study emphasizes early prediction of organ failure and does not address long-term outcomes. Acute pancreatitis with organ failure had significantly higher CRP levels compared to those with no organ failure. Receiver operating characteristic (ROC) curve analysis identified an optimal CRP cutoff value of ≥143 mg/L for predicting organ failure in acute pancreatitis in our study population, with high sensitivity and specificity. A notable positive correlation was observed between CRP levels and the BISAP score on the day of initial presentation. The BISAP score is particularly advantageous due to its simplicity, ease of use, and rapid bedside applicability compared to conventional scoring systems. This research suggests that by assessing early CRP levels and determining the BISAP score, we can forecast the progression of the disease and assist clinicians in early identification and management. These findings support the role of CRP as a simple, cost-effective, and reliable biomarker for organ failure prediction in acute pancreatitis, particularly in resource-limited settings which allow timely intensive monitoring and management, potentially improving outcomes.

Author Contributions

Every author has examined the final version slated for publication and has consented to take responsibility for all components of the work.

Concept and design: Amit Anurag Singh

Acquisition, analysis or interpretation of data: Siddhant Jain, Amit Anurag Singh, Sanket Vijay Aru

Drafting of manuscript: Siddhant Jain, Amit Anurag Singh

Critical review of the manuscript and Supervision: Amit Anurag Singh

Disclosure

Human subjects: All study participants gave their consent. Institutional Ethics Committee, NSCB Medical College, Jabalpur, MP, India has issued approval No. IEC/2022/8629-20.

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