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Research Article

Evaluating The Predictive Role Of C-Reactive Protein In Assessing The Severity Of Acute Pancreatitis

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ABSTRACT

Objective: To evaluate the predictive value of C-reactive protein (CRP) levels, including absolute values and interval changes at 24, 48, and 72 hours, in assessing the severity of acute pancreatitis (AP) according to the Revised Atlanta Classification.

Study Design: Cross-sectional observational study.

Study Duration: This study was conducted at Shaheed Mohtarma Benazir Bhutto Medical College Lyari Karachi Hospital from January 2024 to January 2025.

Methods: This study included 166 patients aged 12-60 years selected via non-probability consecutive sampling. CRP was measured at admission and 24, 48, 72 hours. Severity was stratified as mild (no organ failure/complications), moderate (transient organ failure <48 hours or local complications), or severe (persistent organ failure >48 hours). Data analysis used SPSS v21.0, with frequencies/percentages for categorical variables, means ± SD for continuous, Shapiro-Wilk for normality, Pearson's correlation for CRP-severity associations, and chi-square tests ($p<0.05$ significant).

Results: The cohort had a mean age of 40 years (±5 SD), with 63.9% males (n=106). Disease severity distribution comprised mild cases at 19.9% (n=33), moderate at 51.2% (n=85), and severe at 28.9% (n=48). CRP levels increased progressively across groups: mild from 165 mg/dL to 202 mg/dL, moderate from 191 mg/dL to 263 mg/dL, and severe from 220 mg/dL to 342 mg/dL over 72 hours, achieving statistical significance at 72 hours ($p=0.032$). Interval changes were most pronounced in severe cases (+122 mg/dL total), compared to moderate (+72 mg/dL) and mild (+37 mg/dL).

Conclusion: CRP exhibits substantial predictive capability for AP severity, as interval changes prove equally effective as absolute values. Continuous monitoring facilitates early interventions, which may improve clinical outcomes in diverse settings.

Keywords: Acute Pancreatitis, C-Reactive Protein, Disease Severity, Revised Atlanta Classification, Efficacy.

INTRODUCTION

Acute pancreatitis (AP) is an acute inflammatory disorder of the pancreas, characterized by the premature activation of pancreatic enzymes, which leads to autodigestion of pancreatic tissue and potential systemic inflammatory responses [1]. Common etiological factors include gallstones, excessive alcohol consumption, and hypertriglyceridemia, with additional contributors such as medications and infections [2]. The global prevalence of AP ranges between 20 to 40 cases per 100,000 person-years with a mortality rate of 20-30% in severe cases [3]. According to a study, factors such as obesity, smoking, and comorbidities like diabetes significantly increase the likelihood of progression to severe disease, with recurrence rates influenced by etiology [4]. The rising burden

of the disease has also been seen in a systematic review, resulting in 115,053 deaths worldwide [5]. Similar patterns have been observed in Pakistan. A retrospective cohort in Lahore revealed that computed tomography severity indices correlated strongly with clinical outcomes in severe cases [6]. Another study demonstrated that elevated serum triglyceride levels (>500 mg/dL) were associated with increased severity and complications, supporting its use as an early prognostic marker [7].

Early prediction of AP severity is important for optimizing patient outcomes and avoiding complications. Research highlights that delays in severity assessment correlate with poorer prognosis, higher mortality, and increased healthcare costs [8, 9]. In this regard, several predictive tools have been established. These include scoring systems such as Ranson's criteria, Acute Physiology and Chronic Health Evaluation II (APACHE II), and Bedside Index for Severity in Acute Pancreatitis (BISAP) integrate clinical, laboratory, and physiological parameters, typically yielding area under the curve (AUC) values ranging from 0.70 to 0.85 for severity prediction [10, 11]. However, these tools have several limitations as they require 48-hour data collection, exhibit lower positive predictive value and sensitivity for mortality, and involve timing delays [12].

For decades, efforts have continued to develop a tool that enhances clinical evaluation in acute pancreatitis. One such tool is C-reactive protein (CRP) that stands out as a promising option [13]. CRP serves as an acute-phase protein primarily synthesized by the liver in response to interleukin-6, functioning as a non-specific marker of inflammation that typically peaks between 48 and 72 hours following the onset of symptoms [13]. In AP, CRP levels rise due to the systemic inflammatory response triggered by pancreatic tissue damage, making it a valuable tool for assessing disease progression [14]. It is routinely measured through simple blood tests, thus offering accessibility and cost-effectiveness in hospital settings [13, 14]. A study involving adult patients reported that CRP levels exceeding 221.5 mg/L at 48 hours predicted severe AP with 81.4% accuracy, 53.3% sensitivity, and 84.1% specificity, indicating that CRP outperformed some traditional hematological markers in early stratification [15]. Additionally, CRP levels below 50 mg/L at 24 hours post-admission reliably signal mild AP. This allows for increased care and resource allocation to higher-risk cases [16].

These studies indicate that better patient outcomes can be achieved with early severity assessment in AP. However, routine tools such as chest radiographs and blood tests offer much insights but often fall short due to insufficient evidence supporting their robust predictive capabilities, hence further statistical validation is required to establish reliability. This study aims to investigate the predictive value of CRP levels in assessing the severity of AP.

METHODOLOGY

In this s total of 166 participants were enrolled, with the sample size computed through the WHO open-epi calculator, incorporating a 5% margin of error and a 95% confidence interval. Participants were selected through non-probability consecutive sampling from those presenting at the facility. To be eligible, individuals needed to be between 12 and 60 years old, of any gender, and provide written informed consent upon arrival with symptoms of acute pancreatitis. Exclusion criteria were applied to those with underlying conditions such as diabetes mellitus, congestive heart failure, pancreatic or other cancers, chronic pancreatitis, or pregnancy.

Diagnosis required meeting at least two of the following: typical abdominal pain suggestive of pancreatitis, serum amylase or lipase levels exceeding three times the upper normal limit, or imaging confirmation via contrast-enhanced CT, ultrasound, or MRI. Disease severity was stratified as follows: mild cases showed no evidence of organ failure or complications; moderately severe cases involved temporary organ failure lasting under 48 hours or localized systemic issues without ongoing failure; and severe was marked by persistent organ failure beyond 48 hours. The primary focus was evaluating how well absolute CRP values compared to changes in CRP over intervals at 24, 48, and 72 hours predicted disease progression. CRP readings were taken at admission and these follow-up points, alongside assessments of severity using the Revised Atlanta criteria. Key endpoints included patient recovery rates, development of complications like pancreatic necrosis, abscess formation, or pseudocysts, and overall mortality.

Participant information was gathered using a predefined questionnaire that captured essential details, including demographic and

socioeconomic profiles, symptoms upon presentation, medical history, physical exam results, lab tests with timed CRP measurements, and CT scan interpretations. Ethical clearance was secured from the Institutional Review Board.

Data processing utilized SPSS version 21.0 software. For categorical data, frequencies and percentages were computed, while continuous variables were expressed as means with standard deviations. Data distribution normality was assessed via the Shapiro-Wilk test. Relationships between rising CRP concentrations and severity were examined using Pearson's correlation coefficient, and chi-square tests determined statistical significance, with a threshold of $p < 0.05$ considered significant.

RESULTS

The sample included 166 patients with a mean age of 40 years (±5 SD). Males comprised 63.9% (n=106) and females 36.1% (n=60), indicating a male predominance. The diagnostic performance of C-reactive protein (CRP) was notable, with a true positive rate of 87.3% (n=145), suggesting CRP is a strong indicator for diagnosing acute pancreatitis. Only 12.7% (n=7) were false negatives. There is no mortality in 72 hours as the cases were followed up to 72 hours. In terms of disease severity, 19.9% (n=33) had mild pancreatitis, 51.2% (n=85) had moderate disease, and 28.9% (n=48) experienced severe forms. This distribution shows that most patients presented with moderate to severe pancreatitis.

Table 1: C-Reactive Protein Statistics

Variable	Statistic
Mean Age (Years)	40 (SD ± 5)
Gender	
Male	106 (63.9%)
Female	60 (36.1%)
Diagnostic Value of CRP	
True Positive	145 (87.3%)
False Negative	07 (12.7%)
Disease Severity	
Mild	33 (19.9%)
Moderate	85 (51.2%)
Severe	48 (28.9%)

CRP levels increased progressively over time across all disease severity groups. At 0 hours, mild cases had an average CRP of 165 mg/dL, rising to 202 mg/dL by 72 hours. Moderate cases showed a steeper increase from 191 mg/dL to 263 mg/dL. In severe cases, CRP began at 220 mg/dL and peaked at 342 mg/dL by 72 hours. The trend indicates a clear correlation between higher CRP values and increasing disease severity. While p-values at earlier time points (0–48 hours) were not statistically significant (>0.05), the p-value at 72 hours was 0.032, indicating a statistically significant difference among the severity groups.

Table 2: CRP Point Values by Disease Severity and Time (mg/dL)

Disease Severity	N	0 Hours	24 Hours	48 Hours	72 Hours
Mild	33	165	182	195	202
Moderate	85	191	215	247	263
Severe	48	220	240	274	342
p Value		0.065	0.068	0.057	0.032

In mild cases, CRP levels rose slowly, with a total increase of 37 mg/dL over 72 hours. Moderate cases showed a more significant rise of 72 mg/dL, while severe cases exhibited the steepest increase, 121 mg/dL from 0 to 72 hours. The sharp rise in severe cases, particularly the 68 mg/dL increase between 48 and 72 hours, reflects the inflammatory escalation and worsening disease.

Table 3: CRP Interval Change Over Time

Disease Severity	0–24h	24–48h	48–72h

Mild	+17	+13	+07
Moderate	+24	+32	+16
Severe	+20	+34	+68

DISCUSSION

Acute pancreatitis represents a significant public health challenge, as its sudden nature demands greater alertness and preparation from healthcare systems [17]. Predicting the level of severity allows for the use of more suitable treatments, which can improve patient outcomes. CRP shows great potential here, offering a low-cost, fast, simple, and dependable way to predict disease advancement [14]. This study shows that interval changes in CRP levels from the time of admission are just as useful for predicting severity as absolute values. Following some discussion, the Atlanta classification was revised in 2012 to reflect better knowledge of how acute pancreatitis works. This update added a moderately severe category for cases with temporary organ impairment [18]. Although past studies have looked at CRP's role in assessing acute pancreatitis severity, many were conducted before the revised Atlanta system, making them less relevant to current standards [17, 19].

Regarding CRP's diagnostic performance, our findings indicate a true positive rate of 87.3% and a false negative rate of 12.7%. This indicated its strong utility in identifying AP cases. This performance aligns meta-analysis of 41 studies (n=6,156) by Wu et al., which reported pooled sensitivity of 76% and specificity of 79% for CRP in severity prediction, thus making it a reliable early marker [14]. Another study supports our high true positive finding by reporting 88.2% for the C-reactive protein/albumin ratio (at a cutoff of ≥2.7) in predicting prolonged hospital stay, which serves as a proxy for disease severity [20]. There is some contrasting evidence too. For example, Walker et al. reported lower sensitivity (53-68%), where CRP thresholds like >108 mg/L yield AUCs of 0.92 in pediatric cohort, highlighting age-related limitations not evident in our adult-focused results [21]. The severity distribution in our study (mild (19.9%), moderate (51.2%), and severe (28.9%) indicates a predominance of moderate cases under the revised Atlanta classification. This mirrors a WSES guideline noting 20-30% severe forms in cohorts with organ failure [22]. Aligning somewhat, Chen et al. noted 37% mild and 63% moderate-severe [23], while Kim and Kim described mild AP in 40.8% of 103 cases, with lower severe proportions (potentially 20-30%) [16].

Our findings revealed a progressive elevation in CRP levels across all severity groups of AP over 72 hours, with severe cases exhibiting the most pronounced increases (from 220 mg/dL to 342 mg/dL) by 72 hours. This pattern indicates CRP's delayed peak and its correlation with disease progression. Hu et al. supported our findings by reporting that CRP levels typically rise over 48-72 hours, with values exceeding 150 mg/L at 48 hours associating with moderate-to-severe AP. This mirrors our moderate (247 mg/dL) and severe (274 mg/dL) cohorts at that interval [24]. Shepur et al. further corroborated this by reporting mean CRP at 48 hours of 64.69 mg/dL (SD 62.35) in mild/moderate versus 104.13 mg/dL (SD 39.75) in severe pancreatitis [25]. In contrast, some studies also report earlier predictive power of CRP. A study reported that CRP <50 mg/L at 24 hours predicted mild pancreatitis with an AUC of 0.787 [16], differing from our non-significant early p-values and suggesting variability in timing influenced by etiological factors or comorbidities.

Our results indicate distinct patterns in CRP interval changes across AP severity levels, with severe cases demonstrating a marked increase of +68 mg/dL between 48 and 72 hours. These findings align with Stirling et al., who reported that an interval increase exceeding 90 mg/dL from admission to 48 hours predicted severe AP with a positive predictive value of 30 [17]. In contrast, Ahmad et al. observed a lower positive predictive value of 26% for interval changes greater than 90 mg/dL at 48 hours in predicting complicated AP [26]. This differs from our emphasis on post-48-hour surges, which potentially indicated etiological or timing differences that delay peak inflammation in certain populations. Future implications include extending routine CRP monitoring beyond 48 hours to enhance predictive models, particularly in resource-limited settings, and integrating interval data with machine learning for personalized risk assessment.

Our study has certain limitations that could limit its generalizability. To begin with, we based CRP measurements and their changes

on the admission time. We did not document the length of symptoms before patients reached the hospital. If the inflammation was already advanced by the time they were admitted, this could make it harder to detect quick changes or early increases in CRP. In addition, the absolute CRP values might better show the state of the condition from an earlier point.

CONCLUSION

This study highlights the strong predictive role of CRP in assessing AP severity, with interval changes proving as effective as absolute levels for early detection. Our results show that progressive CRP rises, especially in severe cases, align with disease progression, offering clinicians a simple way to guide early interventions and improve outcomes. While the findings support CRP's role in modern classifications like the revised Atlanta system, they also highlight the need for timely monitoring. Moving forward, incorporating CRP metrics into routine protocols could enhance patient care. Future research should explore combined biomarkers for even greater accuracy. Moreover, early intervention, including fluid management and the timely use of antibiotics, remains critical in altering the course of the disease and improving patient prognosis

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