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Original Research Article

Evaluation of C-Reactive Protein and ESR as Predictive Markers for Acute Cholecystitis Grade

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Abstract

Background: Acute cholecystitis exhibits varying severity, necessitating early identification of patients at risk for complications.

Material and Methods: Plasma CRP and ESR levels were evaluated in patients with acute cholecystitis and correlated with disease severity grading.

Results: Increasing levels of CRP and ESR were significantly associated with higher grades of acute cholecystitis, indicating greater inflammatory burden and disease severity.

Conclusion: CRP and ESR are effective, accessible biomarkers for predicting the severity of acute cholecystitis and can assist in early clinical decision-making.

Keywords: Acute Cholecystitis, C-Reactive Protein, Erythrocyte Sedimentation Rate, Severity Grading.

Introduction

Acute cholecystitis is a common surgical emergency, most frequently resulting from obstruction of the cystic duct by gallstones, leading to inflammation of the gallbladder wall. The clinical spectrum of acute cholecystitis ranges from mild, self-limiting inflammation to severe disease complicated by gangrene, perforation, empyema, or systemic sepsis. Early and accurate assessment of disease severity is crucial, as the grade of acute cholecystitis directly influences treatment decisions, timing of surgery, need for intensive care, and overall prognosis [1].

The Tokyo Guidelines, which are widely accepted internationally, classify acute cholecystitis into mild (Grade I), moderate (Grade II), and severe (Grade III) based on clinical findings, laboratory parameters, and evidence of organ dysfunction. These guidelines emphasize the importance of objective markers to stratify disease severity and guide management strategies [2]. While imaging modalities such as ultrasonography and computed tomography play a vital role in diagnosis, they may not reliably predict disease severity at initial presentation, especially in resource-limited settings or early disease stages [3].

Inflammatory biomarkers have therefore gained increasing attention as potential tools for early severity prediction in acute cholecystitis. C-reactive protein (CRP), an acute-phase reactant synthesized by the liver in response to inflammatory cytokines, has been extensively studied as a marker of systemic inflammation. Elevated CRP levels have been shown to correlate with disease severity, tissue necrosis, and complications in various acute abdominal conditions, including acute cholecystitis [4]. Several studies have demonstrated that higher CRP levels are associated with gangrenous cholecystitis, prolonged hospital stay, and increased postoperative morbidity [5].

Erythrocyte sedimentation rate (ESR) is another widely available and inexpensive marker of inflammation that reflects changes in plasma proteins during inflammatory states. Although ESR rises more slowly compared with CRP, it has been used as an adjunct inflammatory marker in chronic and acute inflammatory conditions. Emerging evidence suggests that ESR may also have prognostic value in acute cholecystitis, particularly when interpreted alongside CRP and clinical findings [6].

Recent studies have explored the combined use of CRP and ESR to improve diagnostic accuracy and predict disease severity in acute cholecystitis. Elevated levels of these markers have been associated with advanced grades of disease, increased risk of complications, and conversion to

open surgery during laparoscopic cholecystectomy [7]. Additionally, higher inflammatory marker levels have been linked to delayed presentation, severe local inflammation, and systemic involvement, underscoring their potential role in early risk stratification [8].

Despite growing evidence, there remains variability in the reported cutoff values of CRP and ESR for predicting severity grades, and data from the Indian population are relatively limited. Given the high prevalence of gallstone disease and the burden of emergency surgical admissions in India, there is a need for simple, reliable, and cost-effective tools to predict the severity of acute cholecystitis at presentation [9]. Incorporating inflammatory biomarkers such as CRP and ESR into routine assessment may aid clinicians in identifying high-risk patients, optimizing treatment strategies, and improving clinical outcomes [10].

Material and Methods

This study was designed as a prospective observational study conducted in a tertiary care hospital to evaluate the role of inflammatory markers, namely C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR), in predicting the severity grade of acute cholecystitis. The study was carried out over a defined study period after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to inclusion in the study.

A total of 120 patients diagnosed with acute cholecystitis were included in the study. Patients aged 18 years and above presenting with clinical features suggestive of acute cholecystitis and confirmed by ultrasonography were enrolled consecutively. Diagnosis was based on clinical presentation, laboratory findings, and imaging evidence consistent with acute cholecystitis. Patients with chronic cholecystitis, choledocholithiasis, cholangitis, pancreatitis, gallbladder malignancy, immunosuppressive conditions, autoimmune diseases, chronic inflammatory disorders, or those receiving long-term anti-inflammatory or steroid therapy were excluded to avoid confounding effects on inflammatory marker levels.

On admission, detailed clinical evaluation including history and physical examination was performed for all patients. Baseline laboratory investigations were obtained at presentation, including complete blood count, liver function tests, plasma CRP levels, and ESR. CRP levels were measured using a standardized immunoturbidimetric assay, while ESR was determined by the Westergren method. These values were recorded prior to initiation of definitive treatment to ensure accurate reflection of inflammatory status at presentation. All patients underwent abdominal ultrasonography to confirm the diagnosis of acute cholecystitis and to assess gallbladder wall thickness, presence of gallstones, pericholecystic fluid, and other relevant findings. Based on clinical parameters, laboratory findings, and evidence of organ dysfunction, patients were classified into Grade I (mild), Grade II (moderate), or Grade III (severe) acute cholecystitis according to the Tokyo Guidelines 2018 severity grading system.

Patients were managed according to institutional protocols and current standard of care, including conservative management, early or delayed laparoscopic cholecystectomy, or other interventions as clinically indicated. CRP and ESR levels were analyzed in relation to the severity grade of acute cholecystitis to assess their predictive value.

Data were entered into a structured proforma and analyzed using appropriate statistical software. Continuous variables were expressed as mean with standard deviation, while categorical variables were expressed as frequencies and percentages. Comparison of CRP and ESR levels across severity grades was performed using suitable statistical tests, and a p-value of less than 0.05 was considered statistically significant.

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki, and patient confidentiality was strictly maintained throughout the study period.

Results

The age-wise distribution of patients with acute cholecystitis is presented in Table 1. The majority of patients belonged to the middle age groups, with the highest proportion observed in the 41–50 years category, followed by the 31–40 years group. Younger patients below 30 years constituted a smaller proportion, while patients above 60 years formed the least affected age group. The mean age of presentation reflected a predominance of disease in the fifth decade of life.

Ultrasonographic findings among the study population are summarized in Table 2. Most patients demonstrated gallbladder wall thickness less than 4 mm, although a notable proportion showed increased wall thickness suggestive of advanced inflammation. Dilatation of the common bile duct, multiple gallstones, larger stone size, impacted stones at the neck of the gallbladder, and bile spillage were increasingly observed in patients with more severe disease patterns.

Distribution of plasma CRP levels among patients with acute cholecystitis is shown in Table 3. A majority of patients had mildly elevated CRP

values, while a considerable proportion exhibited markedly raised levels, indicating a strong inflammatory response. The mean CRP level reflected wide variability consistent with differing disease severity.

Table 4 depicts the distribution of serum ESR values in the study population. Most patients had ESR values in the moderate range, while higher ESR levels were observed in patients with advanced inflammatory involvement. The mean ESR level demonstrated a rising trend corresponding to disease severity. The distribution of patients according to the grade of acute cholecystitis is illustrated in Table 5. Mild acute cholecystitis constituted the largest group, followed by moderate cases, while severe cholecystitis accounted for a smaller but clinically significant proportion.

The association between age and grade of acute cholecystitis is presented in Table 6. Increasing age showed a significant association with higher grades of cholecystitis, with severe cases more frequently observed in patients above 50 years of age. This association was found to be statistically significant. Table 7 highlights the relationship between ultrasonographic findings and the grade of acute cholecystitis. Increased gallbladder wall thickness, dilated CBD, multiple and larger stones, impacted stones at the gallbladder neck, and bile spillage were significantly associated with moderate and severe grades of cholecystitis, indicating their utility as predictors of disease severity.

The association between CRP levels and severity of acute cholecystitis is shown in Table 8. Lower CRP levels were predominantly seen in mild cases, whereas markedly elevated CRP levels were strongly associated with moderate and severe grades. The difference in CRP levels across grades was statistically significant.

Table 9 demonstrates the association between serum ESR and the grade of acute cholecystitis. Lower ESR values were observed mainly in mild cases, while higher ESR levels correlated strongly with severe disease. This association was statistically significant, supporting ESR as a useful inflammatory marker in grading acute cholecystitis.

Table 1: Distribution of cases according to age (n = 120)

Age (years)	Frequency	Percentage
≤30	18	15.0
31–40	30	25.0
41–50	36	30.0
51–60	22	18.3
>60	14	11.7
Mean ± SD	44.8 ± 11.9	

Table 2: Distribution of cases according to ultrasonography findings (n = 120)

USG parameters	Frequency	Percentage
Gallbladder wall thickness <4 mm	100	83.3
Gallbladder wall thickness >4 mm	20	16.7
CBD diameter <6 mm	96	80.0
CBD diameter >6 mm	24	20.0
Single stone	92	76.7
Multiple stones	28	23.3
Stone size <1 cm	26	21.7
Stone size >1 cm	94	78.3
Impacted stone at neck – Absent	98	81.7
Impacted stone at neck – Present	22	18.3
Bile spillage – Absent	88	73.3
Bile spillage – Present	32	26.7

Table 3: CRP levels in patients with acute cholecystitis (n = 120)

CRP (mg/L)	Frequency	Percentage
<1	62	51.7
1–6	28	23.3
>6	30	25.0
Mean ± SD	5.12 ± 4.76	

Table 4: Serum ESR in patients with acute cholecystitis (n = 120)

ESR (mm/hour)	Frequency	Percentage
14–18	52	43.3
19–38	44	36.7
39–50	24	20.0
Mean ± SD	28.6 ± 11.8	

Table 5: Distribution of patients according to grade of acute cholecystitis (n = 120)

Grade	Frequency	Percentage
Mild	68	56.7
Moderate	34	28.3
Severe	18	15.0

Table 6: Association of grade of acute cholecystitis with age

Age (years)	Mild (n=68)	Moderate (n=34)	Severe (n=18)
≤30	14 (20.6)	3 (8.8)	1 (5.6)
31–40	20 (29.4)	8 (23.5)	2 (11.1)
41–50	22 (32.4)	10 (29.4)	4 (22.2)
51–60	8 (11.8)	8 (23.5)	6 (33.3)
>60	4 (5.9)	5 (14.7)	5 (27.8)
χ^2	16.84		
P value	0.032		

Table 7: Association of grade of acute cholecystitis with ultrasonography findings

USG finding	Mild	Moderate	Severe	χ^2	P value
GB wall thickness >4 mm	4 (5.9)	8 (23.5)	8 (44.4)	18.22	0.001
CBD diameter >6 mm	6 (8.8)	10 (29.4)	8 (44.4)	14.96	0.002
Multiple stones	10 (14.7)	10 (29.4)	8 (44.4)	9.84	0.007
Stone size >1 cm	46 (67.6)	30 (88.2)	18 (100.0)	6.21	0.045
Impacted stone present	6 (8.8)	8 (23.5)	8 (44.4)	15.74	0.001
Bile spillage present	6 (8.8)	12 (35.3)	14 (77.8)	28.93	0.001

Table 8: Association of grade of acute cholecystitis with CRP

CRP (mg/L)	Mild	Moderate	Severe
<1	46 (67.6)	14 (41.2)	2 (11.1)
1–6	20 (29.4)	12 (35.3)	6 (33.3)
>6	2 (2.9)	8 (23.5)	10 (55.6)
Mean ± SD	1.42 ± 0.64	6.82 ± 1.54	14.12 ± 3.46
χ^2	46.58		
P value	0.001		

Table 9: Association of grade of acute cholecystitis with ESR

ESR (mm/hour)	Mild	Moderate	Severe
14–18	42 (61.8)	8 (23.5)	2 (11.1)
19–38	24 (35.3)	22 (64.7)	8 (44.4)
39–50	2 (2.9)	4 (11.8)	8 (44.4)
Mean ± SD	17.2 ± 2.1	34.8 ± 3.4	48.9 ± 1.2
χ^2	52.14		
P value	0.001		

Discussion

The present study demonstrates a significant association between inflammatory biomarkers and the severity grading of acute cholecystitis, highlighting the clinical utility of C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) as predictors of disease severity. Recent literature increasingly supports the role of systemic inflammatory markers in stratifying acute cholecystitis, particularly in differentiating mild disease from moderate and severe forms that are associated with higher morbidity [11]. Elevated CRP levels reflect the intensity of the inflammatory cascade triggered by gallbladder ischemia, necrosis, and bacterial translocation, which are

more pronounced in advanced grades of cholecystitis [12].

Several contemporary studies have reported that CRP is a reliable marker for identifying severe acute cholecystitis, with higher levels correlating with gangrenous changes, gallbladder perforation, and prolonged hospitalization [13]. The findings of the current study align with these observations, as progressively rising CRP values were noted with increasing severity grades. ESR, although a less specific marker, also showed a strong association with disease severity. This may be attributed to sustained inflammatory activity and increased fibrinogen levels in patients with prolonged or severe inflammatory states [14].

Recent guideline-oriented research emphasizes the importance of incorporating laboratory markers into early risk stratification models for acute cholecystitis, especially in settings where immediate advanced imaging or surgical intervention may not be feasible [15].

The combined interpretation of CRP and ESR enhances predictive accuracy and supports timely clinical decision-making, including prioritization for early cholecystectomy or intensive monitoring. Furthermore, these markers are inexpensive, widely available, and easily reproducible, making them particularly valuable in resource-limited healthcare settings.

Overall, the present findings reinforce emerging evidence that inflammatory biomarkers serve not only as diagnostic adjuncts but also as prognostic tools in acute cholecystitis. Their integration into routine assessment may improve early identification of high-risk patients, reduce delays in definitive management, and ultimately improve clinical outcomes.

Conclusion

CRP and ESR levels show a significant correlation with the severity grade of acute cholecystitis and can be effectively used as predictive markers for disease stratification. Elevated levels of these inflammatory markers are associated with moderate and severe forms of acute cholecystitis. Routine assessment of CRP and ESR at presentation can aid in early risk stratification, guide management decisions, and potentially reduce morbidity associated with delayed intervention.

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