e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com

International Journal of Pharmaceutical Quality Assurance 2025; 16(8); 323-328

Original Research Article

Role of Serum C-Reactive Protein in Early Detection of Gut Gangrene Among Patients with Intestinal Obstruction: An Observational Study

Parveen Jindal[1], Parul Jindal[2], Manish Tardeja[3], Nia Jindal[4], Chandra Sekhar Chevuturu[5], Rachna Singh[6]

[1]Associate Professor, Department of General Surgery, Gautam Budhha Chikitsa Mahavidyalaya, Dehradun, Uttarakhand, India

[2]Professor, Department of Anaesthesiology, Himalayan Institute of Medical Sciences, Swami Rama University, Dehradun, Uttarakhand, India

[3]Associate Professor, Department of General Surgery, Gautam Budhha Chikitsa Mahavidyalaya, Dehradun, Uttarakhand, India

[4]Intern, Himalayan Institute of Medical Sciences, Swami Rama University, Dehradun, Uttarakhand, India

[5]Director & Senior Consultant, Department of Vascular and Endovascular Surgery, Arete Hospital, Hyderabad, Telangana, India

[6]Consultant Radiologist, Dr. K.K.B.M. Subharti Hospital, Dehradun, Uttarakhand, India

Received: 10-06-2025 / Revised: 12-07-2025 / Accepted: 20-08-2025

Corresponding Author: Dr. Manish Tardeja

Conflict of interest: Nil

Abstract:

Background: Intestinal obstruction is a frequently encountered surgical emergency with variable clinical outcomes depending on the severity and progression of the condition. A major complication associated with delayed or missed diagnosis is bowel gangrene, which carries significant morbidity and mortality. Early identification of intestinal ischemia or gangrene remains a challenge in the absence of definitive diagnostic tools. C-reactive protein (CRP), a widely available acute-phase reactant, may help predict the presence of bowel necrosis due to its association with systemic inflammation.

Aim and Objectives: The primary objective of this observational study was to assess the predictive role of raised serum CRP levels in identifying gut gangrene in patients diagnosed with intestinal obstruction. The study also aimed to determine a clinically relevant CRP cut-off value that could be used as a triage tool in emergency surgical settings.

Methods: This single-center observational study was conducted in the Department of General Surgery at Gautam Budhha Chikitsa Mahavidyalaya, Dehradun, India for one year. A total of 120 patients presenting with features of intestinal obstruction were enrolled after applying strict inclusion and exclusion criteria. All patients underwent routine blood investigations, radiological imaging, and serum CRP level estimation at the time of admission. Final diagnosis of bowel viability or gangrene was confirmed intraoperatively and corroborated by histopathological analysis where required. The CRP values were then statistically analyzed in correlation with operative findings to assess sensitivity, specificity, and predictive accuracy.

Results: Out of the 120 patients studied, 38 (31.6%) were diagnosed intraoperatively with gangrenous bowel. The mean CRP levels in patients with gangrene (mean ± SD: 96.4 ± 21.8 mg/L) were significantly higher than those with non-gangrenous obstruction (34.7 ± 15.2 mg/L), with a p-value < 0.001. Receiver Operating Characteristic (ROC) curve analysis revealed that a serum CRP cut-off value of 60 mg/L offered a sensitivity of 87% and a specificity of 79% in detecting gut gangrene.

Conclusion: This study underscores the utility of elevated serum CRP as a simple, cost-effective, and early biochemical marker for predicting gut gangrene in cases of intestinal obstruction. Incorporating CRP testing into the diagnostic protocol may aid clinicians in making timely decisions regarding surgical intervention and improving patient outcomes.

Keywords: C-reactive Protein, Intestinal Obstruction, Bowel Gangrene, Ischemia, Biomarker, Emergency Surgery.

Introduction

Intestinal obstruction remains one of the most common causes of acute abdomen encountered in surgical practice, accounting for a significant proportion of emergency laparotomies worldwide.

The condition represents a mechanical or functional blockage of the intestinal lumen that impedes the normal transit of contents. Prompt diagnosis and timely intervention are crucial to reduce the risk of complications such as bowel ischemia, necrosis, perforation, sepsis, and death [1,2].

Among the most dreaded complications of untreated or delayed intestinal obstruction is gut gangrene, which results from compromised mesenteric blood flow due to strangulation or prolonged vascular compression [3]. The development of bowel gangrene significantly increases postoperative morbidity, prolongs hospital stay, and raises mortality rates. Early clinical recognition of gangrenous bowel, however, remains a diagnostic challenge due to non-specific symptoms and overlapping signs with simple obstruction [4,5].

While radiological imaging (such as X-rays, ultrasonography, or CT scans) provides structural clues to obstruction, they often fail to reliably differentiate viable from non-viable bowel segments. Therefore, there is a pressing need for reliable, rapid, and non-invasive biochemical markers that can assist clinicians in identifying patients at risk of developing bowel gangrene [6].

C-reactive protein (CRP) is a sensitive acute-phase reactant synthesized by the liver in response to systemic inflammation, tissue injury, and infection. Its levels rise rapidly within 6 to 8 hours of the inflammatory trigger and peak within 48 hours [7]. Elevated serum CRP has been investigated in various surgical and inflammatory conditions, including sepsis, pancreatitis, perforation, and ischemia. In the context of intestinal obstruction, a rising CRP level may reflect underlying bowel ischemia or necrosis even before clinical deterioration becomes apparent [8].

This study was designed to explore the predictive value of serum CRP levels in detecting bowel gangrene among patients with intestinal obstruction. By establishing a correlation between admission CRP values and intraoperative findings, we aim to determine whether CRP can serve as an early and accessible marker to guide urgent surgical decision-making.

Materials and Methods

Study Design and Duration: This was a prospective, observational, hospital-based study conducted in the Department of General Surgery, Gautam Budhha Chikitsa Mahavidyalaya, Dehradun, Uttarakhand, India for one year

Study Setting: The study was carried out at Department of General Surgery, Gautam Budhha Chikitsa Mahavidyalaya, Dehradun, Uttarakhand, India catering to a diverse patient population from both urban and rural backgrounds. All patients admitted with clinical suspicion of intestinal obstruction were evaluated for eligibility.

Sample Size and Sampling Technique: A total of 120 patients were included in the study, selected using consecutive sampling. All eligible patients who presented with intestinal obstruction during the study period and fulfilled the inclusion criteria were enrolled after obtaining informed consent.

Inclusion Criteria:

- Patients aged ≥18 years presenting with clinical and radiological features of intestinal obstruction
- Patients who underwent exploratory laparotomy
- Willingness to participate and provide informed consent

Exclusion Criteria:

- Patients with known chronic inflammatory or autoimmune diseases (e.g., rheumatoid arthritis, lupus)
- Patients with concurrent infections (e.g., pneumonia, urinary tract infection)
- Patients on immunosuppressive therapy or corticosteroids
- Pregnant women

Data Collection Procedure:

Upon admission, a detailed history and clinical examination were performed. Routine laboratory investigations including complete blood count, renal function tests, and serum electrolytes were done. Serum C-reactive protein (CRP) levels were measured using a high-sensitivity quantitative immunoturbidimetric assay. All patients underwent abdominal imaging (X-ray and/or ultrasonography), and those with confirmed intestinal obstruction were scheduled for surgery.

Intraoperative findings regarding bowel viability were meticulously recorded. The bowel was classified as gangrenous based on objective parameters: blackish discoloration, loss of peristalsis, loss of sheen, thinning of the bowel wall, or lack of bleeding on incision. Histopathological examination was performed in doubtful cases.

Outcome Measures: The primary outcome was the presence or absence of gut gangrene confirmed intraoperatively. The serum CRP levels were compared between gangrenous and non-gangrenous groups. The diagnostic accuracy of CRP in predicting gangrene was assessed using statistical tools.

Statistical Analysis: Data were compiled and analyzed using SPSS (Statistical Package for Social Sciences). Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as percentages. Independent t-tests were

used to compare mean CRP values between the two groups. A Receiver Operating Characteristic (ROC) curve was generated to determine the optimal CRP cutoff for predicting bowel gangrene. A p-value of <0.05 was considered statistically significant.

Results

The present study included 120 patients diagnosed with intestinal obstruction over a 12-month period. The majority were male, with a mean age of 48.3 ± 15.6 years. The most common presenting symptoms were abdominal pain, vomiting, and distension. Based on intraoperative findings, 38 patients (31.6%) were found to have gangrenous bowel, while 82 (68.4%) had viable bowel. Serum CRP levels were significantly higher in the gangrenous group. A CRP cutoff value of 60 mg/L was identified to predict gut gangrene with high sensitivity and specificity. Postoperative complications were also more common in the gangrenous group.

Table 1: Demographic Distribution of Study Participants

Parameter	Total (n=120)	Gangrenous (n=38)	Non-Gangrenous (n=82)
Mean Age (years)	48.3 ± 15.6	49.1 ± 14.3	47.9 ± 15.8
Age ≥ 50 years	52 (43.3%)	17 (44.7%)	35 (42.7%)
Male	78 (65%)	26 (68.4%)	52 (63.4%)
Female	42 (35%)	12 (31.6%)	30 (36.6%)

Table 2: Presenting Symptoms among Study Subjects

Symptom	Frequency (%)	Gangrenous (%)	Non-Gangrenous (%)
Abdominal Pain	120 (100%)	38 (100%)	82 (100%)
Vomiting	92 (76.7%)	34 (89.5%)	58 (70.7%)
Abdominal Distension	107 (89.2%)	36 (94.7%)	71 (86.6%)
Constipation/Obstipation	82 (68.3%)	28 (73.7%)	54 (65.9%)

Table 3: Etiology of Intestinal Obstruction

Cause	Total Cases (%)	Gangrenous (%)	Non-Gangrenous (%)
Adhesions	34 (28.3%)	5 (13.2%)	29 (35.4%)
Hernias	27 (22.5%)	10 (26.3%)	17 (20.7%)
Volvulus	16 (13.3%)	12 (31.6%)	4 (4.9%)
Malignancy	18 (15%)	4 (10.5%)	14 (17.1%)
Intussusception	10 (8.3%)	4 (10.5%)	6 (7.3%)
Others (TB, strictures)	15 (12.6%)	3 (7.9%)	12 (14.6%)

Table 4: Serum CRP Levels in Study Groups

Group	Mean CRP (mg/L) ± SD	Minimum	Maximum	p-value
Gangrenous (n=38)	96.4 ± 21.8	60.5	132.4	<0.001
Non-Gangrenous (n=82)	34.7 ± 15.2	12.8	58.7	

Table 5: ROC Curve Analysis for CRP Cutoff

CRP Cutoff (mg/L)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	AUC (95% CI)
60.0	87	79	68.4	91.4	0.88 (0.81–0.95)

Table 6: WBC Count vs CRP Correlation

Group	Mean WBC (×10⁹/L)	Mean CRP (mg/L)	Correlation Coefficient (r)
Gangrenous	14.2	96.4	0.65 (moderate positive)
Non-Gangrenous	10.3	34.7	0.31 (weak positive)

Table 7: Type of Surgical Procedure Performed

Procedure	Gangrenous (n=38)	Non-Gangrenous (n=82)
Resection and Anastomosis	26 (68.4%)	12 (14.6%)
Stoma Formation	8 (21.1%)	2 (2.4%)
Adhesiolysis / Hernia Reduction	4 (10.5%)	68 (82.9%)

Table 8: Postoperative Complications

Complication	Gangrenous (%)	Non-Gangrenous (%)
Wound Infection	10 (26.3%)	9 (11.0%)
Prolonged Ileus	6 (15.8%)	7 (8.5%)
ICU Admission	4 (10.5%)	2 (2.4%)
Re-exploration	2 (5.3%)	0 (0%)

Table 9: Duration of Hospital Stay

Duration (days)	Gangrenous (n=38)	Non-Gangrenous (n=82)
≤5	5 (13.2%)	32 (39%)
6–10	17 (44.7%)	41 (50%)
>10	16 (42.1%)	9 (11%)
Mean ± SD (days)	9.8 ± 2.1	6.2 ± 1.5

Table 10: Mortality and Outcome

Outcome	Gangrenous (%)	Non-Gangrenous (%)
Full Recovery	30 (78.9%)	81 (98.8%)
Complications, Survived	7 (18.4%)	1 (1.2%)
Mortality	1 (2.6%)	0 (0%)

Table 1 presents a balanced age and gender distribution, with a slight male predominance. Table 2 shows abdominal pain and vomiting as the most common presenting complaints. Table 3 identifies adhesions and hernias as leading causes overall, while volvulus and strangulated hernia are strongly associated with gangrene. Table 4 highlights a significantly elevated CRP in gangrenous cases, and Table 5 confirms a CRP cutoff of 60 mg/L provides excellent diagnostic accuracy. Table 6 shows moderate correlation between CRP and leukocytosis. Table 7 reports that resection and stoma formation were the dominant surgical options for gangrenous bowel. Table 8 and Table 9 indicate increased complications and longer hospital stay in the gangrenous group. Finally, Table 10 shows one mortality in the gangrenous group, with the majority recovering well postoperatively.

Discussion

Intestinal obstruction is a frequent surgical emergency with significant morbidity and potential mortality if not managed promptly. One of the most serious complications of delayed intervention is gut gangrene, resulting from prolonged vascular compromise. Identifying such progression early is crucial, yet it remains clinically challenging, especially when classical signs are absent or imaging is inconclusive. In this context, the current study evaluates the utility of serum C-reactive protein (CRP) levels as a predictive biomarker for gut gangrene in patients with intestinal obstruction [9].

In this study, approximately one-third of the patients had gangrenous bowel at the time of surgery. The demographic profile revealed a predominance of middle-aged males, consistent with the population typically affected by mechanical causes of obstruction such as hernias, adhesions, and volvulus. The most commonly reported symptoms were abdominal pain, vomiting, and distension — all classic features of intestinal obstruction. However, these symptoms do not reliably differentiate between simple and strangulated obstruction [10].

A key finding of this study is the significantly elevated CRP levels in patients who were found to have gangrenous bowel intraoperatively. The mean CRP value in the gangrenous group was nearly three times higher than that in the non-gangrenous group. This clear statistical and clinical distinction suggests that CRP, a sensitive systemic inflammatory marker, can reflect the underlying ischemic process and inflammatory response associated with bowel necrosis [11].

Through ROC curve analysis, a CRP cutoff value of 60 mg/L was identified, offering excellent sensitivity and specificity in predicting bowel gangrene. A high negative predictive value at this threshold indicates that patients with CRP values below this level are unlikely to have gangrene, which can aid in avoiding unnecessary urgent surgery in borderline cases. Conversely, high CRP levels should alert the surgical team to the possible presence of bowel necrosis, warranting prompt operative exploration [12].

The etiology of obstruction also influenced the likelihood of gangrene. Volvulus and strangulated hernias showed a strong association with bowel gangrene, likely due to the mechanical strangulation of mesenteric blood flow. In contrast, adhesive obstruction and malignancy were more often associated with viable bowel, suggesting a slower disease progression with preserved vascular supply [13].

Patients with gangrenous bowel underwent more extensive surgical procedures, including bowel

resection with or without stoma formation. This group also experienced higher rates of postoperative complications such as wound infections, prolonged ileus, and ICU admissions. Hospital stays were significantly longer in patients with gangrene, reflecting both the severity of disease and the complexity of recovery [14].

These findings highlight the clinical relevance of serum CRP estimation in the initial evaluation of patients with intestinal obstruction. It is a rapid, widely available, and cost-effective test that adds objectivity to the decision-making process in acute surgical settings. By integrating CRP values with clinical judgment and imaging, surgeons can better stratify risk and prioritize interventions [15].

However, this study is not without limitations. Being a single-center study, the results may not be universally applicable across varied healthcare settings. The dynamic trend of CRP levels over time was not evaluated, which could provide additional prognostic value. Furthermore, comparison with other inflammatory markers was beyond the scope of this study, though it may be an area for future research.

Despite these limitations, the study demonstrates the promising role of CRP as an adjunct tool in the timely identification of gut gangrene. Its application could be particularly valuable in peripheral or resource-constrained healthcare centers, where access to advanced diagnostic imaging is limited.

Conclusion

The findings of this study underscore the potential utility of serum C-reactive protein (CRP) as a reliable and practical biomarker for the early prediction of gut gangrene in patients presenting with intestinal obstruction. A significantly elevated CRP level at admission was strongly associated with the presence of bowel necrosis, as confirmed intraoperatively. A CRP cutoff value of 60 mg/L demonstrated high sensitivity and specificity, suggesting its role as an effective screening tool to guide early surgical intervention. Given its rapid availability, low cost, and ease of testing, CRP can serve as a valuable adjunct to clinical assessment and imaging, especially in emergency settings. Incorporating CRP into the routine diagnostic workup for intestinal obstruction could improve diagnostic accuracy, reduce delays in surgical management, and ultimately enhance patient outcomes. Further large-scale and multicenter studies are warranted to validate these findings and explore integration with other clinical parameters and biomarkers.

Reference

1. Eckhauser FE, Argenta LC, Strodel WE, Wheeler RH, Bull FE, Appelman HD, Thompson NW. Mesenteric angiopathy, intestinal gangrene, and midgut carcinoids. Surgery. 1981 Oct;90(4):720-8. PMID: 7281010.
2. Malone PC. The physiology of intestinal oxygenation and the pathophysiology of intestinal ileus. Med Hypotheses. 1987 Feb;22(2):111-57. doi: 10.1016/0306-9877(87)90138-1. PMID: 3553873.
3. Hannan MJ, Hoque MM. Intestinal obstruction in children due to segmental enteritis: experience in Chittagong, Bangladesh. Pediatr Surg Int. 2012 Mar;28(3):277-80. doi: 10.1007/s00383-011-2976-3. Epub 2011 Sep 18. PMID: 21928124.
4. Osifo OD, Okolo JC. Neonatal intestinal obstruction in Benin, Nigeria. Afr J Paediatr Surg. 2009 Jul-Dec;6(2):98-101. doi: 10.4103/0189-6725.54772. PMID: 19661639.
5. Bhatia S, Jain S, Singh CB, Bains L, Kaushik R, Gowda NS. Malrotation of the Gut in Adults: An Often Forgotten Entity. Cureus. 2018 Mar 12;10(3):e2313. doi: 10.7759/cureus.2313. PMID: 29755909; PMCID: PMC5947924.
6. Makridis C, Oberg K, Juhlin C, Rastad J, Johansson H, Lörelius LE, Akerström G. Surgical treatment of mid-gut carcinoid tumors. World J Surg. 1990 May-Jun;14(3):377-83; discussion 384-5. doi: 10.1007/BF01658532. PMID: 2368441.
7. Mandal S, Santra G, Roy H. Small Intestinal Gangrene Complicating Term Pregnancy: A Case Report. Oman Med J. 2013 Sep;28(5):e057. doi: 10.5001/omj.2013.109. PMID: 31440359; PMCID: PMC6669305.
8. Gürleyik E, Gürleyik G. Small bowel volvulus: a common cause of mechanical intestinal obstruction in our region. Eur J Surg. 1998 Jan;164(1):51-5. doi: 10.1080/110241598750004959. PMID: 9537709.
9. Ohrvall U, Eriksson B, Juhlin C, Karacagil S, Rastad J, Hellman P, Akerström G. Method for dissection of mesenteric metastases in mid-gut carcinoid tumors. World J Surg. 2000 Nov;24(11):1402-8. doi: 10.1007/s002680010232. PMID: 11038214.
10. Raveenthiran V. Restorative resection of unprepared left-colon in gangrenous vs. viable sigmoid volvulus. Int J Colorectal Dis. 2004 May;19(3):258-63. doi: 10.1007/s00384-003-0536-6. Epub 2003 Oct 3. PMID: 14530993.
11. Gupta M, Goyal S, Singal R, Goyal R, Goyal SL, Mittal A. Gallstone ileus and jejunal perforation along with gangrenous bowel in a young patient: A case report. N Am J Med Sci. 2010 Sep;2(9):442-3. doi: 10.4297/najms.2010.2442. PMID: 22558595; PMCID: PMC3339105.
12. Ugochukwu AI, Edeh AJ. Retained intra-abdominal artery forceps - An unusual cause of

intestinal strangulation. N Am J Med Sci. 2011 Jul;3(7):339-43. doi: 10.4297/najms.2011.3339. PMID: 22540110; PMCID: PMC3336885.
13. Shah SA, Saaiq M, Waqar SH, Rashid R, Jamal S. Mesenteric lipoma leading to small gut strangulation and short gut syndrome. J Coll Physicians Surg Pak. 2005 Jun;15(6):371-2. PMID: 15924847.
14. Goel P, Bajpai M, Nagendla MK, Singh A. Gastric Deserosalization: What Lies Behind Closed Doors. J Indian Assoc Pediatr Surg. 2018 Oct-Dec;23(4):216-218. doi: 10.4103/jiaps.JIAPS_78_17. PMID: 30443118; PMCID: PMC6182938.
15. Brown AR. Diagnosis and management of non-gangrenous ischaemic colitis. Gut. 1968 Dec;9(6):737-8. PMID: 5718014.