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Original Research Article

Peri-Operative Factors Predicting Prolonged Postoperative Ileus After Emergency Bowel Surgery

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Abstract:

Background: Prolonged postoperative ileus (PPOI) is a significant complication following emergency bowel surgery that increases morbidity, hospital stay, and healthcare costs. Limited evidence exists regarding PPOI risk factors in emergency settings, particularly for hollow viscus perforation with peritonitis.

Objective: To identify peri-operative factors predicting PPOI following emergency bowel surgery for hollow viscus perforation.

Methods: This single-center cross-sectional analytical study was conducted at Medical College and S.S.G. Hospital, Vadodara, between December 2020 and December 2021. Consecutive sampling enrolled 120 patients undergoing emergency bowel surgery for hollow viscus perforation with peritonitis. PPOI was defined using standardized criteria as two or more of nausea/vomiting, inability to tolerate diet, absence of flatus/stool, abdominal distension, or radiological ileus evidence on or after postoperative day 4. Chi-square test assessed associations between categorical variables and PPOI development.

Results: PPOI incidence was 15% (18/120 patients). Significant predictors included male sex (21.8% vs 7.1%, p=0.02), age ≥60 years (25% vs 8.3%, p=0.012), smoking history (66.7%, p=0.019), pre-operative anemia (38.9%, p=0.043), hypoalbuminemia (33.3%, p=0.039), operative time ≥240 minutes (33.3%, p=0.039), resection anastomosis (50%, p=0.014), elevated WBC count on postoperative day 4 (72.2%, p=0.027), and anastomotic leakage (22.2%, p=0.01).

Conclusion: Multiple pre-operatives, intra-operative, and post-operative factors predict PPOI development. Risk stratification and targeted perioperative optimization strategies are essential for reducing PPOI incidence in resource-constrained emergency settings.

Keywords: Postoperative ileus; Emergency surgery; Hollow viscus perforation; Risk factors; Peritonitis.

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Introduction

Prolonged postoperative ileus (PPOI) is a common and clinically important complication of abdominal surgery that affects coordinated gastrointestinal motility without mechanical obstruction, causing oral intolerance, abdominal distension, nausea, vomiting, and delayed flatus or stool passage. [1] Although temporary ileus is a common physiological response after laparotomy, extended forms are associated with higher postoperative morbidity, hospital stay, and healthcare expenses. To facilitate study comparability, PPOI is defined as two or more of nausea or vomiting, inability to tolerate diet, absence of flatus or stool, abdominal distension, or radiological evidence of ileus on or after postoperative day four, without prior ileus resolution. [2] This definition has been widely adopted in subsequent clinical research. The pathogenesis of PPOI is complicated, encompassing neurogenic, inflammatory, pharmacologic, and metabolic pathways.[3,4] Intestinal surgery activates resident macrophages and other immune cells in the muscularis, releasing pro-inflammatory mediators such nitric oxide, prostaglandins, and cytokines that limit smooth muscle contractility and intestinal motility. After major open abdominal surgeries, substantial bowel handling and peritoneal contamination increase the inflammatory response and prolong gut dysfunction compared to minimally invasive methods. [5]

Postoperative ileus occurs in most patients after abdominal surgery, but clinically significant or

prolonged forms are reported in 5–30% of major elective gastrointestinal procedures and up to 25% after colorectal resections, depending on the definition. Male sex, advanced age, high ASA grade, open or converted operative technique, longer operative time, and higher intra operative bowel manipulation burden have been linked to PPOI after gastrointestinal surgery in many studies. [6] Chronic obstructive lung disease, heart disease, pre-existing constipation, and pre-operative anemia and hypoalbuminemia have also been linked to higher risk; however, studies vary. [7] Colorectal surgery is the main focus of PPOI research, with incidence rates of 10-30% and demonstrated effects on postoperative outcomes. In a comprehensive review and meta-analysis from the Annals of the Royal College of Surgeons of England, male sex was a consistent baseline risk factor for ileus, but age, BMI, smoking, and prior abdominal surgery had diverse correlations. Large database analyses in colorectal populations show that prolonged operative length, open surgery, and ileocolic or small bowel anastomoses increase PPOI risk, supporting technical and intra-operative variables. [8] Limited evidence exists on PPOI after emergency bowel surgery, particularly for hollow viscus perforation with widespread peritonitis. Sepsis, contamination, and intestinal edema can delay motility recovery and exacerbate risk factors, hence emergency laparotomy is usually performed. Hollow viscus perforation, caused by peptic ulcer disease, enteric fever, tuberculosis, and traumatic injury, is a common surgical emergency in low- and middle-income countries like India. Delayed presentation and resource constraints increase morbidity and mortality. Prolonged ileus can worsen post-operative infections, hinder nutritional rehabilitation, and lengthen hospital stay, straining already overwhelmed tertiary care hospitals. However, most ileus data in perforation peritonitis cohorts focus on postoperative morbidity or mortality rather than PPOI-specific indicators utilizing established definitions. To prevent and recognize PPOI, management guidelines recommend identifying modifiable risk factors and adopting multimodal strategies, such as minimizing opioid analgesia, optimizing fluid and electrolyte balance, mobilization, and enteral nutrition, as part of enhanced recovery after surgery (ERAS) pathways. [9] ERAS methods have been found to minimize ileus duration and hospital stay after elective colorectal surgery, but their efficacy in emergency settings, notably in hollow viscus perforation and widespread peritonitis, remains unclear. Therefore, context-specific emergency surgery data is needed to stratify risk and advise focused preventative efforts in resource-constrained settings. [10] Thus, this single-center analytical study from a western Indian tertiary care hospital sought to identify peri-operative predictors of PPOI, using a standardized definition aligned with international consensus, in emergency bowel surgery patients for hollow viscus perforation with peritonitis. This study aimed to identify peri-operative factors predicting prolonged postoperative ileus (PPOI) following emergency bowel surgery for hollow viscus perforation.

Methodology

This single-center cross-sectional analytical study was conducted at the Department of General Surgery, Medical College and S.S.G. Hospital, Vadodara, between December 2020 and December 2021.

Sampling: Consecutive sampling was employed to recruit the first 120 patients who met the eligibility criteria and presented to the emergency department during the study period. All patients were admitted through the emergency department and underwent emergency bowel surgery for hollow viscus perforation with peritonitis. Patients were subsequently categorized into two groups based on the development of PPOI on the fourth postoperative day: the PPOI group (n=18, 15%) and the non-PPOI group (n=102, 85%).

- **Inclusion Criteria**
    - Patients with age >18 years scheduled to undergo Emergency Surgery for hollow viscous perforation.
- **Exclusion Criteria**
    - Patient not giving consent.
    - Patient on pre-operative parenteral nutrition.
    - Patient that cannot participate in study due to dementia, language difficulties or post-operative delirium.
    - Patient requiring reoperation for any indication.
    - Patient taking chemotherapy or radiotherapy or on steroid therapy.

Data Collection Process and Tools: Comprehensive data collection occurred across three distinct phases. Pre-operatively, patient demographics, treatment history, past medical history (diabetes mellitus, chronic obstructive pulmonary disease, previous abdominal surgery), personal history (smoking), and laboratory investigations (complete blood count, serum electrolytes, albumin, renal and liver function tests) were systematically recorded. All patients received standardized pre-operative antibiotic prophylaxis consisting of intravenous ceftriaxone 1 gram and metronidazole 500 milligrams, and general anaesthesia was administered according to standard institutional protocols.

Intra-operatively, data captured included the anatomical segment of gastrointestinal tract involved, type of surgical procedure performed (primary suturing with or without omentopexy, resection anastomosis, or stoma formation), operative duration (categorized as <240 minutes or ≥240 minutes), and characteristics of peritoneal collection. Post-operatively, patients were monitored daily from day 1 through day 4. Notably, opioid analgesics were avoided for pain management; instead, diclofenac sodium 75 milligrams was administered intravenously twice daily. Daily assessments included clinical symptoms, vital signs, abdominal examination findings, surgical site infection status, drain output characteristics (type and amount), and laboratory parameters (haemoglobin, white blood cell count, serum electrolytes).

- PPOI was diagnosed when patients exhibited at least two of the following five criteria on or after postoperative day 4:
    - nausea and vomiting,
    - inability to tolerate solid or semi-liquid diet,
    - absence of flatus or stool passage,
    - abdominal distension,
    - radiological confirmation showing gastric distension, air-fluid levels, or dilated bowel loops without a transition point.

Ethical Considerations: The study received institutional approval and permission from the Dean of Medical College Vadodara, the Medical Superintendent of S.S.G. Hospital, and the Dean of Faculty of Medicine, M.S. University of Baroda to utilize necessary hospital facilities. Written informed consent was obtained from all participants prior to enrolment.

Statistical Analysis: Chi-square test was utilized to assess associations between categorical variables and PPOI development. Statistical significance was set at $p<0.05$. Data analysis was performed using MedCalc Software Version 12.5.0, while Microsoft Word and Excel were employed for generating tables and graphical representations.

Results

The study included 120 patients who underwent emergency surgery for hollow viscus perforation at the Department of General Surgery, Medical College and S.S.G. Hospital, Vadodara, between December 2020 and December 2021. Of these, 18 patients (15%) developed prolonged postoperative ileus (PPOI) and were classified into the PPOI group, while 102 patients (85%) who did not develop PPOI were classified into the non-PPOI group.

Demographic Characteristics: The study population comprised 64 males (53.3%) and 56 females (46.7%). Among patients who developed PPOI, 14 were male (77.8%) and 4 were female (22.2%), indicating a significantly higher incidence of PPOI in males (21.8% vs 7.1%, p=0.02). Regarding age distribution, 72 patients were below 60 years and 48 patients were 60 years or older. PPOI occurred in 6 patients (8.3%) aged <60 years and in 12 patients (25%) aged ≥60 years, with age ≥60 years being a statistically significant risk factor (p=0.012).

Pre-operative Risk Factors: Analysis of personal and past medical history revealed that among PPOI patients, 12 (66.7%) had a history of smoking, which was statistically significant (p=0.019). Four patients (22.2%) had undergone previous abdominal surgery (p=0.49), 3 patients (16.7%) had diabetes mellitus (p=0.74), and 2 patients (11.1%) had chronic obstructive pulmonary disease (p=0.41). Neither previous abdominal surgery, diabetes mellitus, nor COPD showed statistical significance in predicting PPOI.

Table 1: Preoperative laboratory Investigations among PPOI and Non PPOI patients

Pre-Operative Lab Investigations	PPOI	Non-PPOI	Total	P value
Anemia	7(28%)	18(72%)	25	0.043
WBC	11(15.1%)	62(84.9%)	73	0.56
Hypoalbuminemia	6(30%)	14(70%)	20	0.039
Hypokalaemia	4(18.2%)	18(81.8%)	22	0.64

Pre-operative laboratory investigations demonstrated significant associations with PPOI development. Anemia was present in 7 PPOI patients (38.9%) and was found to be a statistically significant predictor (p=0.043). Similarly, hypoalbuminemia was present in 6 PPOI patients (33.3%) and showed significant association (p=0.039). However, pre-operative leukocytosis (WBC count >12,000/cumm) and hypokalemia were not statistically significant predictors, with p-values of 0.56 and 0.64 respectively.

Intra-operative Observations: Among the 18 PPOI patients, 13 (72.2%) underwent upper gastrointestinal surgery and 5 (27.8%) underwent lower gastrointestinal surgery, though the site of surgery was not a significant predictor (p=0.83 for upper GI, p=0.78 for lower GI). Operative time emerged as a significant factor, with 6 PPOI patients

(33.3%) having procedures lasting ≥240 minutes (p=0.039).

Table 2: Intraoperative observations among PPOI and Non PPOI patients

Intra-Operative Observations		PPOI	Non-PPOI	Total	P value
Surgery	Upper GI	13(14.6%)	76(85.4%)	89	0.83
	Lower GI	5(16.1%)	26(83.9%)	31	0.78
Operation time	<240 mins	12(12%)	88(88%)	100	0.46
	≥240 mins	6(30%)	14(70%)	20	0.039
Type of procedure	Primary suturing	6(8.3%)	66(91.7%)	72	0.056
	Resection anastomosis	9(29%)	22(71%)	31	0.014
	Stoma formation	3(17.6%)	14(82.4%)	17	0.74

The type of surgical procedure showed important associations with PPOI. Among PPOI patients, primary suturing with or without omentopexy was performed in 6 patients (33.3%, p=0.056), resection anastomosis in 9 patients (50%, p=0.014), and stoma formation in 3 patients (16.7%, p=0.74). Resection anastomosis was identified as a statistically significant risk factor for PPOI development.

Post-operative Findings

Sequential post-operative evaluation from day 1 to day 4 revealed progressive changes. On post-operative day 1, surgical site infections were present in 8 PPOI patients (44.4%), with 5 superficial, 1 deep, and 2 organ space infections. Seven patients (38.9%) had elevated WBC counts, and 4 patients (22.2%) had hypokalaemia.

Table 3: Post operative observations among PPOI and Non PPOI patients

Post-Operative Observations		PPOI	Non-PPOI	Total	P value
Abdominal Infections	Superficial	4(15.4%)	22(84.6%)	26	0.95
	Deep	4(18.2%)	18(81.8%)	22	0.64
	Organ Space	5(20%)	20(80%)	25	0.43
	Total	13(17.8%)	60(82.2%)	73	0.14
WBC Count (>12000)		13(22.4%)	45(77.6%)	58	0.027
Hypokalaemia		6(23.1%)	20(76.9%)	26	0.19

By post-operative day 2, surgical site infections increased to 10 patients (55.6%), comprising 6 superficial, 2 deep, and 2 organ space infections. Nine patients (50%) demonstrated leucocytosis, and 7 patients (38.9%) had hypokalaemia. On post-operative day 3, infections were observed in 13 patients (72.2%), with 10 patients (55.5%) showing elevated WBC counts and 5 patients (27.8%) having hypokalaemia.

On post-operative day 4, when PPOI was definitively diagnosed, 13 patients (72.2%) had surgical site infections, 13 patients (72.2%) had WBC counts >12,000/cumm (p=0.027), and 6 patients (33.3%) had hypokalaemia (p=0.19). Elevated WBC count on day 4 was a statistically significant predictor.

Drain Output Analysis: Drain output characteristics on post-operative day 4 provided important diagnostic information. Eight PPOI patients (44.4%) had drain output >100 mL, which was statistically significant (p=0.01). The type of drain output included serosanguinous in 8 patients (44.4%), purulent in 3 patients (16.7%), serous in 3 patients (16.7%), bilious in 2 patients (11.1%), and fecal in 2 patients (11.1%). Fecal drain output emerged as a significant predictor (p=0.046), while anastomotic leakage manifesting as fecal or bilious drainage was also statistically significant (p=0.01).

Clinical Manifestations of PPOI: Among the 18 patients diagnosed with PPOI on post-operative day 4, all patients (100%) demonstrated inability to tolerate food and absence of flatus. Additionally, 15 patients (83.3%) had abdominal distension, 14 patients (77.8%) showed air-fluid levels on X-ray abdomen, and 13 patients (72.2%) experienced vomiting.

Discussion

The present study found a PPOI incidence of 15% following emergency bowel surgery for hollow viscus perforation. This rate is notably higher than reported in elective surgeries but consistent with emergency settings. Vather et al reported PPOI incidence of 14% after colorectal surgery with emergency procedures carrying substantially higher risk. [11]

Demographic Risk Factors: In the present study the incidence of PPOI is 21.8% in men and 7.1% in females following emergency hollow viscous perforation surgery. The male sex is identified as a statistically significant risk factor for the development of PPOI (P value 0.02). In the case of females, the p-value is 0.14, indicating statistical

insignificance. This finding aligns with multiple large-scale studies: Chapuis et al found male gender as an independent risk factor with 15.9% incidence (p=0.001). [12]

Age ≥60 years emerged as another significant predictor in the present study, with PPOI rates of 25% compared to 8.3% in younger patients (p=0.012). A meta-analysis of baseline risk factors by Lee et al identified increasing age as significantly associated with PPOI development. [13] The pathophysiology likely involves age-related decline in enteric nervous system function, reduced numbers of interstitial cells of Cajal that serve as gastrointestinal pacemakers, and compromised mesenteric perfusion. [11]

Pre-operative Modifiable Factors: The present study found smoking history in 66.7% of PPOI patients (p=0.019). Smoking impairs gastrointestinal motility through nicotine-mediated sympathetic activation, oxidative stress-induced damage to enteric neurons, and chronic low-grade inflammation affecting the myenteric plexus. [14]

Pre-operative anemia was present in 38.9% of PPOI patients (p=0.043) in the present study. Anemia impairs intestinal tissue oxygenation, potentially exacerbating post-operative bowel wall oedema and compromising smooth muscle contractility necessary for coordinated peristalsis. [15] The present study found hypoalbuminemia in 33.3% of PPOI patients (p=0.039). Amati et al reported lower baseline albumin levels in patients who developed POI after emergency surgery (33.40 vs 35.00 g/L, p=0.0213). [9]

Intra-operative Determinants: The present study found operative time ≥240 minutes in 33.3% of PPOI cases (p=0.039). Amati et al reported significantly longer surgery duration in patients developing POI (112 vs 92.5 minutes, p=0.0050). [9] A study conducted by Artinyan et al demonstrated that total surgical time was an independent predictor of POI duration (p=0.045). [16] Prolonged surgery increases intestinal manipulation intensity, triggering activation of resident macrophages and mast cells within the muscularis externa. Kalff et al demonstrated that surgically induced leukocytic infiltration within the intestinal muscularis externa mediates late postoperative ileus through inflammatory pathways. [17]

The present study uniquely identified resection anastomosis as a significant risk factor (50% of PPOI patients, p=0.014). This finding reflects disruption of enteric neuromuscular continuity across the anastomotic site. Bowel resection interrupts the myenteric plexus and networks of interstitial cells of Cajal, creating physical barriers to electromechanical coupling essential for coordinated propagation of peristaltic waves. [18]

Post-operative Complications: The present study found elevated WBC count >12,000/cumm on post-operative day 4 in 72.2% of PPOI patients (p=0.027). Amati et al demonstrated that higher postoperative SOFA scores and elevated CRP levels on postoperative day 2 were independent predictors of POI (p=0.0037 and p=0.048 respectively). [9] Stein et al demonstrated that leukocyte-derived interleukin-10 and inflammatory cell infiltration into the muscularis externa are central to POI pathophysiology. [19] Persistent leukocytosis signals ongoing intra-abdominal inflammation that perpetuates cytokine-mediated suppression of intestinal contractility.

Anastomotic leakage occurred in 22.2% of PPOI cases in the present study (p=0.01). Peters et al found that POI was present in 20.9% of patients with anastomotic leakage versus 3.1% without leakage (OR 12.57, 95% CI 2.73–120.65, p=0.0005). [20] Anastomotic dehiscence with enteric contamination triggers severe inflammatory responses with bacterial translocation, creating sustained sympathetic overdrive and inflammatory mediator release that profoundly suppresses intestinal motility. [20] Amati et al demonstrated that POI positively correlated with postoperative respiratory complications, surgical site infections, and prolonged ICU stay, highlighting the systemic impact of delayed bowel recovery. [9]

This study is having single-center cross-sectional design, which restricts generalizability to broader populations and prevents establishment of causal relationships between identified risk factors and PPOI development. Additionally, the relatively small sample size, particularly the PPOI group (n=18), limited statistical power to detect associations with less common risk factors and precluded robust multivariable analysis to control for confounding variables.

Conclusion

This study identified male sex, age ≥60 years, smoking, pre-operative anemia and hypoalbuminemia, operative time ≥240 minutes, resection anastomosis, elevated post-operative leucocytosis, and anastomotic leakage as significant predictors of PPOI following emergency bowel surgery. These findings underscore the importance of risk stratification and targeted perioperative optimization strategies to reduce PPOI incidence in resource-constrained emergency settings.

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