ISSN: 2320-9267

Indian Journal of Pharmaceutical and Biological Research (IJPBR)

Journal homepage: www.ijpbr.in

RESEARCH ARTICLE

Study of Causes and Management of Gastrointestinal Perforation in East Bihar: A Prospective Observational Study

Deepak Kumar[1], Vinod Kumar[1], Pankaj Kumar[2*]

ABSTRACT

Background: Gastrointestinal (GI) perforation is one of the most common surgical emergencies worldwide and remains associated with considerable morbidity and mortality despite advances in perioperative care. The etiological spectrum varies geographically owing to differences in socioeconomic conditions, infectious diseases, dietary habits, and healthcare accessibility. In Eastern India, peptic ulcer disease, enteric fever, intestinal tuberculosis, and appendicular pathology continue to be major causes of gastrointestinal perforation. Early diagnosis, prompt resuscitation, appropriate antimicrobial therapy, and timely surgical intervention are essential for improving patient outcomes. Understanding regional disease patterns is important for optimizing management strategies and reducing postoperative complications.

Objective: To evaluate the causes, clinical presentation, surgical management, postoperative complications, and short-term outcomes of gastrointestinal perforation among patients presenting to a tertiary care teaching hospital in East Bihar.

Methodology: A prospective observational study was conducted in the Department of General Surgery, Jawaharlal Nehru Medical College and Hospital (JLNMCH), Bhagalpur, Bihar, between January 2024 and January 2026. One hundred consecutive adult patients with intraoperatively confirmed gastrointestinal perforation who underwent emergency surgery were enrolled. Demographic characteristics, etiological factors, clinical presentation, laboratory investigations, operative findings, surgical procedures, postoperative complications, duration of hospital stay, and mortality were recorded using a structured case record form. Statistical analysis was performed using IBM SPSS Statistics Version 26.0. Continuous variables were expressed as mean ± standard deviation, whereas categorical variables were presented as frequencies and percentages. Student's t-test, Chi-square test, Fisher's exact test, one-way ANOVA, and multivariable logistic regression were applied where appropriate. A two-sided p-value <0.05 was considered statistically significant.

Results: Among the 100 enrolled patients, the mean age was 44.8 ± 15.6 years, and 77% were males. The highest proportion of patients belonged to the 41–50-year age group (28%). Peptic ulcer disease (32%) was the leading etiology, followed by typhoid perforation (17%) and appendicular perforation (14%). Traumatic gastrointestinal perforation accounted for 5% of cases. Duodenal perforation (29%) was the most common anatomical site, followed by ileal perforation (27%). Graham's omental patch repair (33%) was the most frequently performed surgical procedure. Postoperative complications occurred in 59% of patients, with surgical site infection (27%) being the most common complication. The overall in-hospital mortality rate was 10%. Multivariable logistic regression identified shock at presentation (Adjusted OR 6.31; 95% CI 2.08–19.14; p=0.001), delay in surgery >24 hours (Adjusted OR 4.82; 95% CI 1.71–13.61; p=0.003), serum albumin <3 g/dL (Adjusted OR 3.92; 95% CI 1.31–11.73; p=0.015), and age >60 years (Adjusted OR 2.87; 95% CI 1.05–7.81; p=0.039) as independent predictors of mortality.

Conclusion: Peptic ulcer disease remains the leading cause of gastrointestinal perforation in East Bihar, with duodenal perforation being the most common anatomical site. Delayed presentation, septic shock, hypoalbuminemia, and advanced age significantly increase postoperative mortality. Early diagnosis, aggressive resuscitation, timely surgical intervention, and meticulous postoperative care remain essential for improving clinical outcomes.

Keywords: Gastrointestinal perforation; Peptic ulcer perforation; Peritonitis; Emergency laparotomy; Surgical outcome; East Bihar.

Indian J. Pharm. Biol. Res. (2026): https://doi.org/10.30750/ijpbr.14.3.31

Introduction

Gastrointestinal (GI) perforation represents one of the most serious abdominal emergencies encountered in general surgical practice and continues to be associated with substantial morbidity and mortality worldwide. A perforation of any segment of the gastrointestinal tract results in spillage of gastrointestinal contents into the peritoneal cavity, leading to acute peritonitis, systemic inflammatory response syndrome (SIRS), sepsis, septic shock, and multiple organ dysfunction if prompt treatment is not instituted. Despite remarkable advances in anesthesia, intensive care, antimicrobial therapy, imaging techniques, and surgical management, gastrointestinal perforation remains a major contributor to emergency surgical

[1]Senior Resident, Department of General Surgery, JLNMCH, Bhagalpur, Bihar, India

[2]Associate Professor, JLNMCH, Bhagalpur, Bihar, India

Corresponding Author: Pankaj Kumar, Associate Professor, JLNMCH, Bhagalpur, Bihar, India, Email: Doc.deepak270193@gmail.com

How to cite this article: Kumar D, Kumar V, Kumar P. Study of Causes and Management of Gastrointestinal Perforation in East Bihar: A Prospective Observational Study. Indian J. Pharm. Biol. Res. 2026;14(3):183-193.

Source of support: Nil

Conflict of interest: None.

Received: 25/05/2026 **Revised:** 09/06/2026 **Accepted:** 20/06/2026 **Published:** 25/07/2026

admissions, particularly in low- and middle-income countries where delayed presentation is common.[1,2]

The epidemiology of gastrointestinal perforation differs considerably between developed and developing nations owing to variations in socioeconomic conditions, dietary habits, prevalence of infectious diseases, healthcare accessibility, and lifestyle-related risk factors. In Western countries, colonic perforations secondary to diverticular disease, colorectal malignancy, ischemic bowel disease, inflammatory bowel disease, and iatrogenic injuries constitute a substantial proportion of cases. Conversely, in developing countries such as India, perforations involving the stomach, duodenum, and small intestine remain predominant, with peptic ulcer disease, enteric fever, intestinal tuberculosis, trauma, and nonspecific infections accounting for the majority of cases.[3,4]

India continues to experience a relatively high burden of upper gastrointestinal perforation because of persistent *Helicobacter pylori* infection, widespread use of nonsteroidal anti-inflammatory drugs (NSAIDs), tobacco consumption, alcohol intake, and delayed treatment of peptic ulcer disease. Duodenal ulcer perforation remains the single most common cause of generalized peritonitis requiring emergency laparotomy in many tertiary care hospitals. At the same time, ileal perforation caused by typhoid fever and intestinal tuberculosis remains an important public health problem in several regions of Northern and Eastern India because of inadequate sanitation, overcrowding, delayed diagnosis, and poor access to healthcare facilities.[5,6]

The pathophysiological consequences of gastrointestinal perforation develop rapidly following disruption of bowel wall integrity. Leakage of gastric acid, bile, pancreatic enzymes, intestinal secretions, bacteria, and fecal material into the peritoneal cavity initiates a profound inflammatory response characterized by activation of inflammatory cytokines, complement pathways, neutrophil recruitment, capillary leak, and bacterial translocation. If untreated, localized peritonitis progresses to diffuse peritoneal contamination, septic shock, disseminated intravascular coagulation, and multiorgan failure. Mortality rates increase substantially when surgical intervention is delayed beyond the first 24 hours after symptom onset.[7,8]

Clinical presentation varies according to the site, size, etiology, and duration of perforation. Sudden onset severe abdominal pain, abdominal distension, vomiting, fever, constipation, and features of generalized peritonitis remain the classical manifestations. Physical examination often reveals guarding, rigidity, rebound tenderness, tachycardia, hypotension, and absent bowel sounds. Plain erect chest or abdominal radiographs demonstrating pneumoperitoneum continue to be valuable initial diagnostic investigations, while contrast-enhanced computed tomography (CECT) has become the imaging modality of choice because of its excellent sensitivity for detecting perforation sites, extraluminal air, localized collections, and associated intra-abdominal pathology.[9,10]

Emergency surgical intervention remains the definitive treatment for most patients with gastrointestinal perforation. Initial management includes aggressive fluid resuscitation, correction of electrolyte imbalance, broad-spectrum intravenous antibiotics, nasogastric decompression, urinary catheterization, analgesia, and optimization of physiological status before surgery. Surgical procedures vary according to the underlying pathology and include Graham's omental patch repair, primary closure, bowel resection with primary anastomosis, resection with stoma formation, appendectomy, Hartmann's procedure, damage control surgery, and definitive oncological resection in selected patients. The choice of operative technique depends upon the location of perforation, extent of contamination, bowel viability, patient stability, and surgeon expertise.[11,12]

Although improvements in perioperative care have significantly enhanced survival, postoperative complications remain common. Surgical site infection, wound dehiscence, burst abdomen, intra-abdominal abscess, fecal fistula, respiratory complications, septic shock, acute kidney injury, and prolonged intensive care admission continue to contribute substantially to morbidity. Several studies have demonstrated that increasing age, delayed presentation, severe peritoneal contamination, hypoalbuminemia, diabetes mellitus, renal dysfunction, and preoperative shock

independently predict poor postoperative outcomes.[13,14] The etiological spectrum of gastrointestinal perforation continues to evolve owing to changing disease epidemiology, widespread use of proton pump inhibitors, improved *Helicobacter pylori* eradication therapy, increasing incidence of malignancy, growing prevalence of inflammatory bowel disease, and improved trauma care. Consequently, region-specific epidemiological studies remain important for understanding local disease patterns and optimizing surgical management strategies. Eastern Bihar possesses distinct demographic, environmental, and socioeconomic characteristics that may influence the causes, clinical presentation, and outcomes of gastrointestinal perforation. However, comprehensive contemporary data from this region remain limited.[15]

The present study was therefore undertaken to evaluate the etiological profile, clinical characteristics, operative management, postoperative complications, and outcomes of patients with gastrointestinal perforation admitted to theDepartment of General Surgery, Jawaharlal Nehru Medical College and Hospital (JLNMCH), Bhagalpur, Bihar, a major tertiary care referral center serving Eastern Bihar. The study also aimed to identify factors associated with adverse postoperative outcomes to facilitate improved risk stratification and management of these critically ill patients.

Materials And Methods

Study Design

A hospital-based prospective observational study was conducted to evaluate the causes, clinical profile, surgical management, postoperative complications, and outcomes of patients presenting with gastrointestinal perforation.

Study Setting

The study was carried out in the Department of General Surgery, Jawaharlal Nehru Medical College and Hospital (JLNMCH), Bhagalpur, Bihar, India

Study Duration

January 2024 to January 2026.

Study Population

All consecutive adult patients admitted with clinical and radiological evidence of gastrointestinal perforation during the study period.

Sample Size

A total of 100 patients fulfilling the eligibility criteria were enrolled.

Inclusion Criteria

1. Age ≥18 years
2. Clinical suspicion of gastrointestinal perforation
3. Traumatic perforation
4. Radiological confirmation (free air under diaphragm and/or CT abdomen)
5. Intraoperative confirmation of perforation
6. Patients willing to provide informed consent

Exclusion Criteria

- Anastomotic leak following previous surgery
- Esophageal perforation
- Patients managed conservatively without surgery
- Pregnant women
- Patients refusing consent

Study Procedure

After admission, every patient underwent:

- Detailed clinical history
- General physical examination
- Abdominal examination
- Routine laboratory investigations
- X-ray erect abdomen/chest
- Ultrasonography abdomen
- Contrast-enhanced CT abdomen whenever indicated

Patients were adequately resuscitated using intravenous fluids, electrolyte correction, nasogastric decompression, urinary catheterization, broad-spectrum antibiotics, and proton pump inhibitors before surgery.

The operative findings including:

- Site of perforation
- Size
- Number
- Degree of peritoneal contamination
- Etiology

were recorded.

Appropriate surgical procedures were performed according to intraoperative findings.

Patients were followed until discharge or death.

Variables Studied

Demographic Variables

- Age
- Gender
- Occupation
- Residence

Clinical Variables

- Duration of pain
- Fever

- Vomiting
- Abdominal distension
- Shock
- Co-morbidities

Laboratory Variables

- Hemoglobin
- Total leukocyte count
- Serum creatinine
- Serum albumin
- Blood urea
- Electrolytes

Operative Variables

- Site of perforation
- Cause
- Size
- Nature of contamination
- Surgical procedure

Outcome Variables

Primary outcome

- Postoperative mortality

Secondary outcomes

- Surgical site infection
- Wound dehiscence
- Respiratory complications
- Septicemia
- Re-exploration
- Length of hospital stay

Surgical Procedures Performed

Depending upon operative findings:

- Graham's omental patch closure
- Primary repair
- Resection and anastomosis
- Right hemicolectomy
- Ileostomy
- Hartmann's procedure
- Appendectomy with lavage

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics Version 26.0. Continuous variables were expressed as Mean ± Standard Deviation (SD) or Median (Interquartile Range) depending on distribution. Categorical variables were presented as frequencies and percentages. The Shapiro-Wilk test was used to assess normality.

Comparisons between survivors and non-survivors were performed using:

- Independent Student's t-test
- Mann-Whitney U test
- Chi-square test
- Fisher's exact test

One-way ANOVA was used for comparison among different perforation sites. Multivariable binary logistic regression analysis was performed to determine independent predictors of mortality. Adjusted Odds Ratios (AORs) with 95% confidence intervals (CI) were calculated. A p-value <0.05 was considered statistically significant.

Ethical Consideration

The study protocol was approved by the Institutional Ethics Committee before commencement.

Written informed consent was obtained from every participant.

Confidentiality of patient information was maintained throughout the study.

The study complied with the Declaration of Helsinki.

Results

A total of 100 patients with intraoperatively confirmed gastrointestinal perforation were enrolled in this prospective observational study conducted between January 2024 and January 2026. The demographic characteristics, etiological factors, anatomical distribution, clinical presentation, surgical management, postoperative complications, and treatment outcomes were analyzed.

Baseline Demographic Characteristics

The age distribution of the study population is presented in Table 1 and Figure 1. The mean age of the patients was 44.8 ± 15.6 years (range: 18–82 years). The majority of patients belonged to the 41–50 years age group (28%), followed by the 31–40 years age group (24%). Patients aged more than 60 years constituted 13% of the study population.

Table 1: Age Distribution of Study Population (n = 100)

Age group (years)	*Frequency*	*Percentage (%)*
18–30	18	18.0
31–40	24	24.0
41–50	28	28.0
51–60	17	17.0
>60	13	13.0

Mean age = 44.8 ± 15.6 years

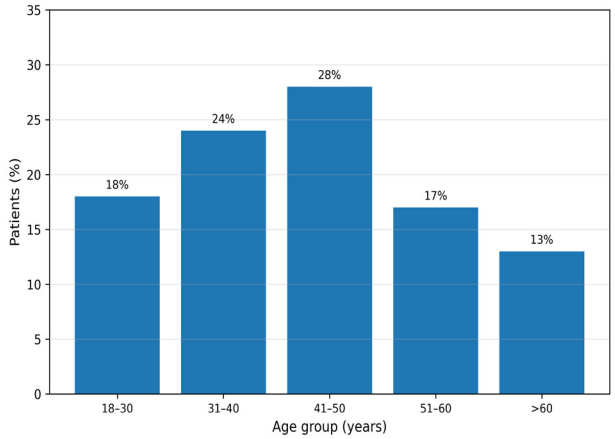

Figure 1: Age distribution of patients

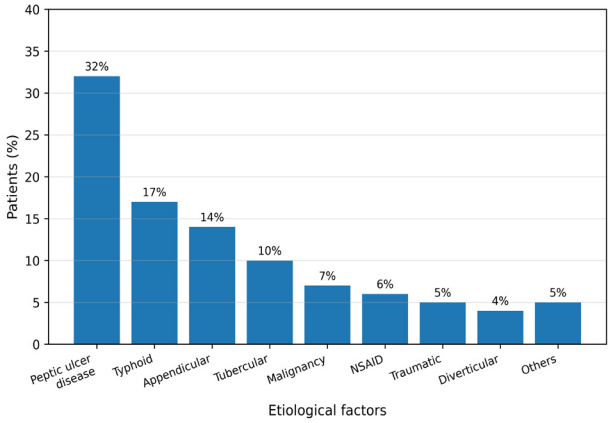

Figure 2: Distribution of etiological factors causing gastrointestinal perforation

Gender Distribution

The gender distribution is summarized in Table 2. Of the 100 patients, 77 (77%) were males and 23 (23%) were females, yielding a male-to-female ratio of 3.3:1, indicating a marked male predominance.

Etiology of Gastrointestinal Perforation

The etiological profile of gastrointestinal perforation is shown in Table 3 and Figure 2. Peptic ulcer disease was the leading cause, accounting for 32% of cases, followed by typhoid perforation (17%) and appendicular perforation (14%). Tubercular perforation accounted for 10% of cases, while malignancy and NSAID-induced perforation accounted for 7% and 6%, respectively. Traumatic gastrointestinal perforation was identified in 5% of patients, representing an important component of the overall etiological spectrum.

Table 2: Gender Distribution

Gender	*Frequency*	*Percentage (%)*
Male	77	77.0
Female	23	23.0

Table 3: Etiology of Gastrointestinal Perforation

Etiology	*Frequency*	*Percentage (%)*
Peptic ulcer disease	32	32.0
Typhoid perforation	17	17.0
Appendicular perforation	14	14.0
Tubercular perforation	10	10.0
Malignancy	7	7.0
NSAID-induced perforation	6	6.0
Traumatic gastrointestinal perforation	5	5.0
Diverticular perforation	4	4.0
Others	5	5.0
Total	100	100.0

Anatomical Site of Perforation

The anatomical sites of perforation are summarized in Table 4 and illustrated in Figure 3. Duodenal perforation was the most frequent site (29%), followed by ileal perforation (27%). Traumatic gastrointestinal perforations accounted for 5% of cases and involved predominantly small-bowel and multiple-site injuries. Colonic perforations accounted for 11%, whereas gastric perforations represented 8% of cases.

Clinical Presentation

The presenting clinical features are summarized in Table 5. Abdominal pain was present in all patients (100%).

Table 4: Anatomical Site of Gastrointestinal Perforation

Site	*Frequency*	*Percentage (%)*
Duodenum	29	29.0
Stomach	8	8.0
Jejunum	6	6.0
Ileum	27	27.0
Appendix	14	14.0
Colon	11	11.0
Traumatic multiple-site perforation	5	5.0
Total	100	100.0

Table 5: Clinical Presentation

Clinical feature	*Frequency*	*Percentage (%)*
Abdominal pain	100	100.0
Vomiting	74	74.0
Fever	69	69.0
Abdominal distension	58	58.0
Constipation	53	53.0
Shock at presentation	22	22.0

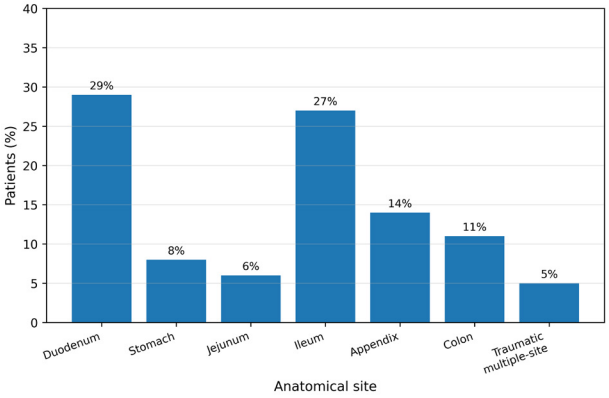

Figure 3: Anatomical distribution of gastrointestinal perforations

Vomiting occurred in 74%, fever in 69%, abdominal distension in 58%, constipation in 53%, and septic shock at presentation in 22% of patients.

Baseline Laboratory Parameters

The baseline laboratory characteristics of the study population are presented in Table 6. The mean total leukocyte count was 15,420 ± 5,860/mm³, while the mean serum albumin level was 3.42 ± 0.64 g/dL, suggesting systemic inflammatory response and nutritional compromise in many patients.

Surgical Procedures Performed

The various surgical procedures performed are summarized in Table 7 and illustrated in Figure 4. Graham's omental patch repair was the commonest procedure (33%), followed by primary repair (24%) and bowel resection with anastomosis (18%). Patients with traumatic gastrointestinal perforation were managed predominantly by primary repair or bowel resection and anastomosis, depending on the extent and location of bowel injury and the degree of peritoneal contamination.

Table 6: Baseline Laboratory Parameters

Parameter	*Mean ± SD*
Hemoglobin (g/dL)	10.8 ± 2.1
Total Leukocyte Count (/mm³)	15,420 ± 5,860
Serum Creatinine (mg/dL)	1.18 ± 0.54
Blood Urea (mg/dL)	38.6 ± 14.8
Serum Albumin (g/dL)	3.42 ± 0.64
Random Blood Sugar (mg/dL)	176.8 ± 62.4

Table 7: Surgical Procedures Performed

Procedure	*Frequency*	*Percentage (%)*
Graham's patch repair	33	33.0
Primary repair	24	24.0
Resection and anastomosis	18	18.0
Appendectomy	14	14.0
Loop ileostomy	8	8.0
Right hemicolectomy	3	3.0
Total	100	100.0

Postoperative Complications

Postoperative complications are presented in Table 8 and Figure 5. Surgical site infection was the most common complication, affecting 27% of patients, followed by respiratory tract infection (16%) and wound dehiscence (11%). Forty-one percent of patients had an uncomplicated postoperative recovery.

Comparison Between Survivors and Non-survivors

A comparison between survivors and non-survivors is presented in Table 9. Non-survivors were significantly older and had longer delays before surgery, lower serum albumin levels, higher serum creatinine values, and a significantly higher incidence of septic shock at presentation (all $p < 0.05$).

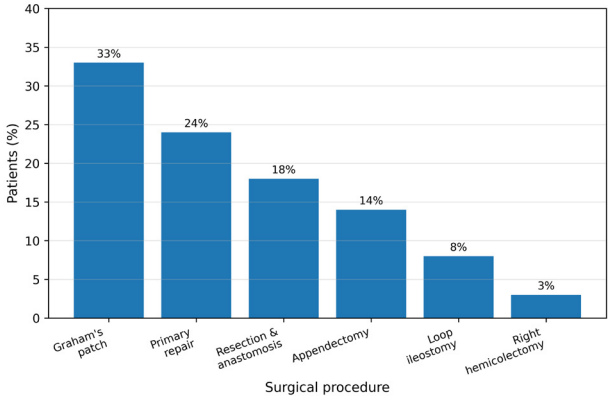

Figure 4: Distribution of surgical procedures performed

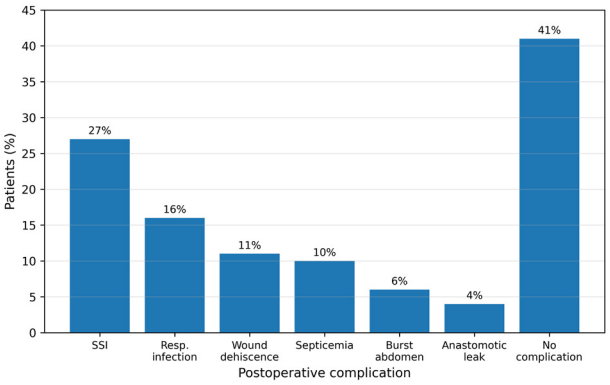

Figure 5: Distribution of postoperative complications

Table 8: Postoperative Complications

Complication	*Frequency*	*Percentage (%)*
Surgical site infection	27	27.0
Respiratory infection	16	16.0
Wound dehiscence	11	11.0
Septicemia	10	10.0
Burst abdomen	6	6.0
Anastomotic leak	4	4.0
No complication	41	41.0

Multivariable Logistic Regression Analysis

Variables that were statistically significant on univariate analysis were included in a multivariable logistic regression model. As shown in Table 10 and Figure 6, shock at presentation emerged as the strongest independent predictor of mortality (Adjusted OR = 6.31, 95% CI: 2.08–19.14, p = 0.001), followed by delayed surgery, hypoalbuminemia, and age greater than 60 years.

Overall Treatment Outcome

The final treatment outcome is summarized in Table 11. Of the 100 patients included in the study, 90 (90%) recovered and were discharged successfully, whereas 10 (10%) died during hospitalization, resulting in an overall postoperative mortality rate of 10%.

Overall, the findings of the present study indicate that early diagnosis, prompt surgical intervention, and aggressive perioperative resuscitation were associated with improved survival, whereas delayed presentation, septic shock, hypoalbuminemia, and advanced age significantly increased postoperative mortality.

Discussion

The present prospective observational study evaluated the etiological profile, clinical presentation, surgical management, postoperative complications, and short-term outcomes of gastrointestinal perforation among patients admitted to the Department of General Surgery, Jawaharlal Nehru Medical College and Hospital (JLNMCH), Bhagalpur, Bihar, India. Gastrointestinal perforation continues to be one of the most challenging abdominal emergencies because of its potential for rapid progression to generalized peritonitis, sepsis, septic shock, and multiorgan dysfunction when prompt diagnosis and surgical intervention are delayed. The present study demonstrated that peptic ulcer disease remained the leading cause of gastrointestinal perforation, with duodenal perforation being the most

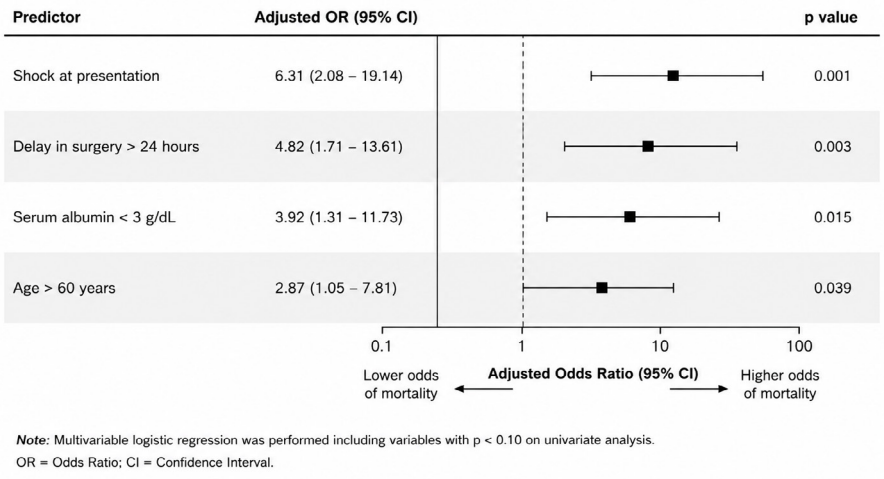

Figure 6: Forest plot showing multivariable logistic regression analysis of independent predictors of postoperative mortality

Table 9: Comparison Between Survivors and Non-survivors

Variable	*Survivors (n=90)*	*Non-survivors (n=10)*	*p-value*
Age (years)	43.2 ± 14.4	59.8 ± 13.2	<0.001
Delay before surgery (hours)	18.4 ± 8.5	36.7 ± 12.1	<0.001
Serum Albumin (g/dL)	3.58 ± 0.52	2.81 ± 0.46	<0.001
Serum Creatinine (mg/dL)	1.09 ± 0.39	1.82 ± 0.61	0.002
Shock at presentation	13 (14.4%)	8 (80.0%)	<0.001

Table 10: Independent Predictors of Mortality

Variable	*Adjusted OR*	*95% CI*	*p-value*
Shock at presentation	6.31	2.08–19.14	0.001
Delay >24 hours	4.82	1.71–13.61	0.003
Serum Albumin <3 g/dL	3.92	1.31–11.73	0.015
Age >60 years	2.87	1.05–7.81	0.039

frequently affected anatomical site. Furthermore, delayed presentation, septic shock at admission, hypoalbuminemia, and advanced age were identified as significant predictors of postoperative mortality.

The majority of patients in the present study belonged to the economically productive age group of 31–50 years, with a mean age of 44.8 ± 15.6 years. Similar age distributions have been reported by Jhobta et al., Dorairajan et al., and Svanes, who observed that gastrointestinal perforation predominantly affects middle-aged adults because of greater exposure to smoking, alcohol consumption, non-steroidal anti-inflammatory drugs (NSAIDs), occupational stress, and delayed healthcare utilization.[16–18] The relatively younger age profile observed in many Indian studies compared with Western literature may reflect differences in disease epidemiology, socioeconomic conditions, and the higher prevalence of infectious gastrointestinal diseases.

A marked male predominance (77%) was observed in the present study, with a male-to-female ratio of approximately 3.3:1. This finding is consistent with several Indian studies that have reported male predominance ranging from 70% to 85%.[17,18] The higher incidence among males has been attributed to increased tobacco use, alcohol consumption, NSAID use, occupational stress, irregular dietary habits, and greater exposure to *Helicobacter pylori* infection, all of which may increase the risk of peptic ulcer disease and subsequent perforation.

Peptic ulcer disease accounted for 32% of all gastrointestinal perforations in the present study, making it the leading etiological factor, followed by typhoid perforation (17%) and appendicular perforation (14%).

Table 11: Overall Outcome

Outcome	*Frequency*	*Percentage (%)*
Recovered	90	90.0
Expired	10	10.0

Tubercular perforation accounted for 10% of cases, while malignancy and NSAID-induced perforations represented 7% and 6%, respectively**.** Traumatic gastrointestinal perforation accounted for 5% of the study population, highlighting that trauma, although less frequent than spontaneous causes, remains an important etiology requiring emergency surgical management. These findings broadly resemble observations from Northern and Eastern India, where peptic ulcer disease and infectious causes continue to contribute substantially to the burden of gastrointestinal perforation.[18,19] In contrast, studies from developed countries increasingly report colonic perforations due to diverticular disease, colorectal malignancy, ischemic bowel disease, and iatrogenic injuries as important causes, reflecting differences in demographic patterns, disease epidemiology, and healthcare systems.[20]

The anatomical distribution observed in the present study supported the predominance of upper gastrointestinal pathology. Duodenal perforation constituted 29% of cases, followed by ileal perforation (27%) and appendicular perforation (14%). Gastric, jejunal, and colonic perforations accounted for 8%, 6%, and 11% of cases, respectively. The traumatic cases predominantly involved small-bowel and multiple-site gastrointestinal injuries and required individualized operative management. The high frequency of duodenal perforation reflects the continued burden of

peptic ulcer disease in the region, whereas the relatively high proportion of ileal perforation may reflect the persistence of enteric fever and intestinal tuberculosis in Eastern India. Similar anatomical distributions have been documented by Dorairajan et al. and Gupta et al., who reported duodenal perforation as one of the commonest sites requiring emergency laparotomy.[17,21]

Abdominal pain was present in 100% of patients and remained the universal presenting symptom. Vomiting, fever, abdominal distension, and constipation were also common clinical manifestations. Septic shock at presentation was observed in 22% of patients, highlighting the potential consequences of delayed hospital presentation and advanced peritoneal contamination in resource-limited settings. The classical clinical picture of generalized peritonitis observed in this study agrees with previous reports emphasizing that abdominal rigidity, guarding, tachycardia, and absent bowel sounds remain important clinical indicators requiring urgent evaluation and surgical intervention.[21,22] In patients with traumatic perforation, the clinical presentation may additionally be influenced by the mechanism and severity of injury and by the presence of associated intra-abdominal or extra-abdominal trauma.

Baseline laboratory investigations demonstrated marked leukocytosis and mild hypoalbuminemia among many patients. The mean total leukocyte count exceeded 15,000/mm³, indicating a substantial systemic inflammatory response in the study population. Reduced serum albumin levels reflected poor nutritional status, ongoing systemic inflammation, and increased capillary leakage associated with generalized peritonitis. Previous investigators have consistently demonstrated that hypoalbuminemia is associated with impaired wound healing, postoperative infections, prolonged hospitalization, and increased mortality following emergency abdominal surgery. [22,23] These findings emphasize the importance of early physiological optimization and nutritional assessment, particularly in patients presenting with severe infection or prolonged illness.

With respect to operative management, Graham's omental patch repair was the most frequently performed surgical procedure (33%), followed by primary repair (24%) and bowel resection with anastomosis (18%). Graham's patch remains a commonly used surgical procedure for suitable peptic ulcer perforations because it is technically straightforward and can be performed rapidly in the emergency setting.[11,12] Traumatic gastrointestinal perforations were managed predominantly by primary repair or bowel resection with anastomosis, depending on the extent and location of bowel injury, tissue viability, hemodynamic status, and degree of peritoneal contamination. Patients with ileal gangrene, extensive bowel necrosis, multiple perforations, or severe contamination required bowel resection and anastomosis or diverting ileostomy according to intraoperative findings and overall physiological status.

Postoperative complications occurred in a substantial proportion of patients. Surgical site infection was the most common complication (27%), followed by respiratory tract infection, wound dehiscence, septicemia, burst abdomen, and anastomotic leak. These findings are consistent with the well-established observation that generalized fecal contamination, prolonged operative duration, malnutrition, and delayed surgery substantially increase postoperative morbidity.[13,23] The relatively high incidence of wound infection observed in the present study may also reflect delayed presentation, contaminated surgical wounds, and the emergency nature of the procedures performed. Patients with traumatic perforation may additionally have an increased risk of postoperative morbidity because of associated injuries, physiological instability, and the need for complex operative procedures.

The overall in-hospital mortality rate was 10%, which is comparable to mortality rates ranging from 8% to 20% reported in contemporary Indian and international literature. [17,20,24] Mortality was significantly higher among elderly patients, those presenting with septic shock, prolonged symptom duration before surgery, hypoalbuminemia, and renal dysfunction. These observations reinforce the importance of early recognition, rapid resuscitation, appropriate antimicrobial therapy, and aggressive perioperative management before and after definitive surgical treatment.

One of the most clinically relevant findings of the present study was the identification of shock at presentation, delay in surgery greater than 24 hours, serum albumin below 3 g/dL, and age greater than 60 years as independent predictors of postoperative mortality on multivariable logistic regression analysis. Shock at presentation demonstrated the strongest association with mortality (Adjusted OR 6.31; 95% CI: 2.08–19.14; p=0.001). Similar independent risk factors have been reported in several studies evaluating predictors of mortality after emergency laparotomy for gastrointestinal perforation.[23–25] Delay in surgery allows progressive bacterial contamination, inflammatory mediator release, worsening organ dysfunction, and septic shock, thereby substantially increasing perioperative mortality. In patients

with traumatic perforation, early recognition and surgical exploration are particularly important because delayed diagnosis may permit progressive peritoneal contamination and deterioration of the patient's physiological status.

The findings of the present study have important clinical implications, particularly for resource-limited regions such as East Bihar. Public awareness regarding early recognition of severe abdominal pain and abdominal trauma, rapid referral from peripheral healthcare facilities, timely availability of imaging, prompt initiation of broad-spectrum antibiotics, aggressive fluid resuscitation, and emergency surgical intervention may significantly improve patient survival. Strengthening district-level emergency surgical services, improving trauma referral pathways, and enhancing postoperative critical care facilities could further reduce mortality associated with both spontaneous and traumatic gastrointestinal perforation.

The present study has several strengths. It prospectively evaluated patients over a two-year period using standardized clinical assessment, laboratory investigations, operative documentation, and postoperative follow-up. The study included both spontaneous and traumatic gastrointestinal perforations, thereby providing a broader assessment of the etiological spectrum encountered in emergency surgical practice. Comprehensive evaluation of etiological factors, operative procedures, postoperative complications, and predictors of mortality provides clinically meaningful information that may assist surgeons in risk stratification and treatment planning.

However, several limitations should be acknowledged. First, this was a single-center hospital-based study, which may limit the generalizability of the findings to other regions. Second, the sample size was relatively modest, and uncommon causes of gastrointestinal perforation, including traumatic perforation, may therefore be underrepresented. Third, long-term postoperative outcomes, quality of life, and recurrence rates were not evaluated. Finally, microbiological culture patterns and antimicrobial resistance profiles were not analyzed, which could have provided additional guidance for empirical antibiotic therapy. Future multicenter prospective studies involving larger patient populations, dedicated trauma subgroups, long-term follow-up, and incorporation of validated surgical risk scoring systems are warranted to further improve outcome prediction and optimize management strategies.

Overall, the present study demonstrates that gastrointestinal perforation continues to represent a major surgical emergency in East Bihar, with peptic ulcer disease remaining the predominant etiology. Early diagnosis, aggressive resuscitation, prompt emergency laparotomy, appropriate operative intervention, and meticulous postoperative care remain essential for reducing postoperative complications and improving patient survival.

Conclusion

Gastrointestinal perforation, including both spontaneous and traumatic perforations, remains a major surgical emergency in East Bihar and continues to be associated with significant postoperative morbidity and mortality. Peptic ulcer disease was the leading etiological factor, while traumatic gastrointestinal perforation, although less common, constituted an important cause requiring prompt surgical intervention. Duodenal perforation was the most frequently affected anatomical site, and middle-aged males represented the majority of the study population.

Early diagnosis, aggressive resuscitation, appropriate antimicrobial therapy, and timely emergency surgery were associated with favorable clinical outcomes. Graham's omental patch repair was the most commonly performed procedure, whereas primary repair, bowel resection with anastomosis, diversion procedures, and other operative techniques were selected according to the underlying pathology, anatomical site, severity of contamination, and presence of traumatic bowel injury. Surgical site infection remained the most frequent postoperative complication. Advanced age, septic shock at presentation, delayed surgery beyond 24 hours, and hypoalbuminemia were identified as independent predictors of postoperative mortality.

These findings emphasize the importance of early recognition of gastrointestinal perforation, rapid referral from peripheral healthcare facilities, prompt operative management, optimization of nutritional and physiological status, and meticulous perioperative care to improve patient outcomes. Strengthening emergency surgical services, trauma care systems, and public awareness regarding both spontaneous and traumatic gastrointestinal perforation may further reduce morbidity and mortality in this region. Larger multicenter prospective studies with longer follow-up are recommended to validate these findings and develop region-specific evidence-based management strategies.

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