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A Prospective Study Regarding Evaluation, Management, and Outcome of Gastrointestinal Perforation at RMCH&RC, Kanpur

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Abstract

Gastrointestinal (GI) perforation is a life-threatening surgical emergency characterized by full-thickness disruption of the gastrointestinal tract wall, leading to peritoneal contamination, sepsis, and high morbidity and mortality. This prospective study aimed to evaluate the clinical profile, management strategies, and outcomes of GI perforation at a tertiary care hospital in Northern India. A total of 50 patients admitted with GI perforation to the Department of General Surgery, RMCH&RC, Kanpur, from January 2023 to July 2024 were included. The mean age was 47.58 years, with a male preponderance (78%). Peptic ulcer disease (62%) was the most common etiology, followed by trauma (24%), tuberculosis (6%), and typhoid (6%). The duodenum was the most frequent site of perforation (48%). Most patients underwent omental patch repair (64%), with a postoperative complication rate of 52%, primarily surgical site infections. The mortality rate was 6%. Delayed presentation, shock, fecal peritoneal contamination, and age over 60 years were significant predictors of adverse outcomes. The study highlights the need for early diagnosis, aggressive resuscitation, timely surgery, and public health measures to reduce the burden of gastrointestinal perforations.

Keywords: ***Gastrointestinal perforation, peritonitis, peptic ulcer, abdominal surgery, omental patch repair, emergency laparotomy, clinical outcome, risk factors, morbidity, mortality.***

Introduction

Gastrointestinal (GI) perforation is a critical surgical emergency that represents a significant cause of morbidity and mortality worldwide. It is defined as a full-thickness disruption of the wall of the gastrointestinal tract, leading to the leakage of luminal contents, including food particles, digestive

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enzymes, and bacteria, into the peritoneal cavity, resulting in peritonitis and sepsis if not promptly managed [1,2]. Despite advancements in diagnostic modalities and surgical techniques, GI perforations remain a formidable challenge, particularly in resource-limited healthcare settings.

The gastrointestinal tract is a continuous muscular tube extending from the mouth to the anus, including the oesophagus, stomach, small intestine, large intestine, rectum, and accessory organs. Perforation can occur anywhere along this tract, with varying clinical implications depending on the anatomical site involved. Common causes of GI perforation include peptic ulcer disease, small bowel perforation secondary to typhoid or tuberculosis, traumatic injuries (both blunt and penetrating), inflammatory bowel diseases such as Crohn's disease, diverticulitis, malignancies, iatrogenic injuries during endoscopic procedures, and ischaemic bowel disease [3,4].

In India and other developing countries, peptic ulcer disease remains the predominant cause of GI perforation, particularly involving the duodenum and stomach [5]. This is attributed to factors such as Helicobacter pylori infection, widespread use of non-steroidal anti-inflammatory drugs (NSAIDs), smoking, alcohol consumption, and dietary habits [6]. In contrast, typhoid and tuberculosis-related perforations are more common in regions where these infectious diseases are endemic, often affecting the terminal ileum [7]. Traumatic perforations, including those resulting from road traffic accidents, falls, or assaults, also contribute significantly to the burden of gastrointestinal perforations, especially in urban centres [8].

The clinical presentation of GI perforation is variable and depends on several factors, including the site and size of perforation, duration since perforation, extent of peritoneal contamination, and the patient's underlying health status. Typically, patients present with sudden-onset severe abdominal pain, abdominal distension, nausea, vomiting, fever, and features of generalized peritonitis. In cases of delayed presentation or in elderly or immunocompromised individuals, classical symptoms may be masked, making diagnosis more challenging [9,10]. In such cases, a high index of suspicion and appropriate use of diagnostic tools are essential.

Physical examination often reveals generalized abdominal tenderness, guarding, rigidity, and absent bowel sounds, suggestive of peritonitis. However, clinical findings alone may be insufficient for diagnosis, especially in early or subtle cases. Imaging studies play a crucial role in the detection and localization of GI perforations. Plain erect abdominal and chest radiographs demonstrating free air under the diaphragm (pneumoperitoneum) remain a simple yet highly effective initial diagnostic tool [11]. Ultrasound may reveal free fluid or localized collections but has limitations in detecting small perforations. Contrast-enhanced computed tomography (CECT) of the abdomen is considered the gold standard in modern clinical practice, providing detailed information about the site, size, cause of perforation, and associated complications such as abscesses or bowel ischemia [12].

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Timely surgical intervention is the cornerstone of managing GI perforations. The choice of surgical procedure depends on several factors, including the site of perforation, size and number of perforations, degree of peritoneal contamination, underlying pathology, and the patient's overall condition. In cases of peptic ulcer perforation, omental patch repair (Graham's patch) is a well-established, simple, and effective surgical technique associated with favorable outcomes [13]. Small bowel perforations due to typhoid or tuberculosis may require primary closure, segmental resection, or exteriorization procedures such as ileostomy, depending on the extent of contamination and bowel viability [14]. Colonic perforations may necessitate resection with primary anastomosis or stoma formation. In hemodynamically stable patients with minimal contamination, laparoscopic surgery may be considered, offering advantages such as reduced postoperative pain and shorter hospital stays [15].

Postoperative care is critical in improving outcomes for patients with GI perforation. Aggressive fluid resuscitation, broad-spectrum antibiotics, nutritional support, and intensive care monitoring are essential components of perioperative management. Despite optimal surgical and supportive care, the risk of postoperative complications remains significant. Common complications include surgical site infections, intra-abdominal abscesses, wound dehiscence, paralytic ileus, sepsis, and multi-organ dysfunction, which may prolong hospital stay and increase mortality [16].

The prognosis of GI perforation largely depends on the timing of diagnosis and intervention, the etiology of the perforation, the extent of peritoneal contamination, and the presence of comorbidities such as diabetes, renal failure, or immunosuppression. Studies have consistently shown that delayed presentation, especially beyond 24–48 hours of symptom onset, is associated with higher rates of morbidity and mortality [17]. Similarly, advanced age, large perforation size, fecal contamination, and shock at presentation are independent predictors of poor outcomes [18].

In India, several studies have attempted to evaluate the clinical profile, management strategies, and outcomes of GI perforations. A study by Weledji et al. [1] highlighted the predominance of peptic ulcer-related perforations and emphasized the importance of early surgical intervention. Similarly, Doudakmanis et al. [6] discussed the role of bacterial translocation and sepsis in influencing postoperative outcomes in these patients. However, there remains a paucity of region-specific data, particularly from the Kanpur region and surrounding areas, which is essential to understand the local disease patterns, risk factors, and outcomes.

Recognizing this gap, the present prospective study was designed to evaluate the clinical profile, management, and outcomes of patients presenting with gastrointestinal perforation at Rama Medical College Hospital and Research Centre (RMCH&RC), Kanpur, Uttar Pradesh. This tertiary care institution caters to a large population from both urban and rural areas, providing a unique opportunity to study the disease burden in a diverse patient cohort.

The specific objectives of the study were:

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1. To analyze the demographic characteristics, including age, sex, socioeconomic status, and occupational profile of patients with GI perforation.
2. To determine the common etiologies and anatomical sites of perforation in this population.
3. To evaluate the clinical presentation, duration of symptoms, and factors associated with delayed presentation.
4. To assess intraoperative findings, surgical procedures performed, and immediate postoperative complications.
5. To identify predictors of morbidity and mortality in patients with GI perforation.

It is hoped that the findings of this study will contribute to the growing body of evidence regarding gastrointestinal perforations in the Indian context. By identifying the common etiologies, risk factors, and determinants of poor outcomes, this research may guide clinicians in formulating preventive strategies, optimizing management protocols, and ultimately improving patient outcomes in cases of gastrointestinal perforation.

Furthermore, public health measures aimed at early detection and treatment of common causes such as peptic ulcer disease, typhoid, and tuberculosis, as well as increasing awareness regarding the dangers of self-medication with NSAIDs and delayed hospital presentation, may help reduce the burden of gastrointestinal perforations. Strengthening healthcare infrastructure, particularly in peripheral and rural areas, to enable timely diagnosis and surgical intervention is equally vital in reducing the morbidity and mortality associated with this life-threatening condition.

Materials and Methods

Study Design and Setting

This was a prospective, hospital-based observational study conducted in the Department of General Surgery at Rama Medical College Hospital and Research Centre (RMCH&RC), Kanpur, Uttar Pradesh, India. RMCH&RC is a tertiary care teaching hospital catering to a large urban and rural population of the Kanpur region, making it an ideal centre for evaluating the clinical spectrum, management, and outcomes of gastrointestinal (GI) perforations.

The study was carried out over a period of 18 months, from **January 2023 to July 2024**. Ethical clearance for the study was obtained from the Institutional Ethics Committee of RMCH&RC prior to patient recruitment. All participants or their legal guardians provided written informed consent before enrollment in the study.

Study Design

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The study followed a **prospective, observational design**, where all consecutive patients presenting to the Emergency Department or the Outpatient Department (OPD) with clinical suspicion of GI perforation were evaluated, and those meeting the inclusion criteria were enrolled.

The aim was to comprehensively assess the demographic characteristics, clinical presentation, diagnostic modalities, surgical management strategies, and postoperative outcomes in patients diagnosed with gastrointestinal perforation.

Inclusion Criteria

- All patients aged 18 years and above presenting with acute gastrointestinal perforation confirmed by clinical evaluation, imaging studies, and/or intraoperative findings.
- Both traumatic (blunt and penetrating) and non-traumatic perforations of the gastrointestinal tract.
- Patients willing to provide informed consent for participation.

Exclusion Criteria

- Cases of **oesophageal perforation**, including Boerhaave's syndrome.
- Perforations of the hepatobiliary system, including gallbladder and biliary tract perforations.
- Iatrogenic perforations occurring during endoscopic procedures such as colonoscopy, endoscopic mucosal resection (EMR), endoscopic retrograde cholangiopancreatography (ERCP), laparotomy, or gynecological surgeries.
- Patients with a moribund general condition where operative intervention was deemed unfeasible after resuscitation (e.g., patients in refractory shock or advanced sepsis at presentation).

Sample Size Determination

The final sample size was **50 patients**, based on admission patterns to the Department of General Surgery for gastrointestinal perforations during the study period and considering the feasibility of patient follow-up and data collection. This number was also consistent with similar observational studies conducted at tertiary care centres [1,2].

Data Collection and Study Procedure

A pre-designed, structured proforma was used to record all relevant clinical, demographic, diagnostic, intraoperative, and outcome-related details. Data were collected by the principal investigator and supervised by senior faculty members.

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1. Demographic Profile

The following demographic details were documented:

- Age
- Sex
- Residence (urban/rural)
- Socioeconomic status (classified using the Modified Kuppuswamy Scale [3])
- Occupation

2. Clinical Presentation

Detailed history regarding presenting complaints was taken, including:

- Onset, duration, and severity of abdominal pain
- Abdominal distension
- Nausea/vomiting
- Constipation
- Fever
- Time from symptom onset to hospital presentation

3. Diagnostic Evaluation

All patients underwent the following investigations as appropriate:

- Routine hematological investigations, including complete blood count (CBC), renal function tests, liver function tests, serum electrolytes.
- Plain erect chest and abdominal X-rays to detect free air under the diaphragm.
- Ultrasonography (USG) abdomen to assess free fluid, localized collections, or pneumoperitoneum.
- Contrast-enhanced computed tomography (CECT) abdomen was performed in selected hemodynamically stable patients where the diagnosis remained uncertain or localization of perforation was required.

4. Intraoperative Assessment

All patients underwent emergency exploratory laparotomy after adequate resuscitation. Intraoperative findings recorded included:

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- Site of perforation
- Size of perforation (measured intraoperatively)
- Number of perforations (single/multiple)
- Degree of peritoneal contamination (serous/bile-stained/feculent)
- Associated bowel pathology (ulcer, gangrene, mass, etc.)
- Surgical procedure performed

5. Postoperative Management and Outcome Assessment

Postoperative parameters were documented, including:

- Need for intensive care unit (ICU) stay
- Duration of hospital stay
- Development of postoperative complications (e.g., wound infection, ileus, intra-abdominal abscess, sepsis)
- Mortality (in-hospital)

Statistical Analysis

Data were entered into **Microsoft Excel** and analysed using **IBM SPSS version 25.0** (Armonk, NY, USA). Descriptive statistics were used to summarise the data:

- Continuous variables were expressed as **mean ± standard deviation (SD)** or **median with interquartile range (IQR)** as appropriate.
- Categorical variables were summarised using frequencies and percentages.

For inferential statistics:

- The **Chi-square test** or **Fisher's exact test** was used to assess associations between categorical variables.
- The **Student's t-test** or **Mann–Whitney U test** was used for continuous variables, depending on data distribution.
- A **binary logistic regression analysis** was performed to identify independent predictors of postoperative morbidity and mortality.

A **p-value < 0.05** was considered statistically significant.

Tables and Study Data (Representative)

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Table 1: Age Distribution of Study Participants (N = 50)

Age Group (Years)	Frequency	Percentage (%)
21–30	4	8.0
31–40	11	22.0
41–50	16	32.0
51–60	8	16.0
61–70	9	18.0
>70	2	4.0

The most commonly affected age group was **41–50 years**, accounting for **32%** of cases, followed by 31–40 years (22%).

Table 2: Gender Distribution

Gender	Frequency	Percentage (%)
Male	39	78.0
Female	11	22.0

There was a **male predominance**, with males comprising nearly 78% of the study population.

Table 3: Socioeconomic Status of Participants (N = 50)

Socioeconomic Class	Frequency	Percentage (%)
Lower	1	2.0
Lower-Middle	30	60.0
Middle	17	34.0
Poor	1	2.0
Upper-Middle	1	2.0

A majority of patients (60%) belonged to the **lower-middle socioeconomic class**, reflecting the socioeconomic vulnerability of the population at risk.

Table 4: Etiological Distribution of GI Perforation (N = 50)

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Etiology	Frequency	Percentage (%)
Peptic Ulcer	31	62.0
Trauma	12	24.0
Tuberculosis	3	6.0
Typhoid Fever	3	6.0
Appendicitis	1	2.0

Peptic ulcer disease emerged as the most frequent cause, accounting for **62%** of cases, followed by trauma (24%).

Table 5: Site of Perforation

Site	Frequency	Percentage (%)
Duodenum	24	48.0
Stomach	11	22.0
Ileum	9	18.0
Jejunum	3	6.0
Colon	1	2.0
Appendicular	1	2.0

The **duodenum** was the most commonly involved site (48%), consistent with the high prevalence of peptic ulcer disease.

Table 6: Surgical Procedures Performed

Procedure	Frequency	Percentage (%)
Omental Patch Repair	32	64.0
Two-layer Closure	5	10.0
Ileostomy	3	6.0

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Procedure	Frequency	Percentage (%)
Resection and Anastomosis	2	4.0
Colostomy	1	2.0
Appendectomy & Lavage	1	2.0
Others	6	12.0

The **omental patch repair** was the most commonly performed procedure, especially in cases of duodenal and gastric perforations.

Quality Control Measures

- All surgical procedures were performed by or under direct supervision of experienced consultant surgeons.
- Standardised intraoperative protocols were followed.
- Data collection was monitored by senior faculty to ensure completeness and accuracy.
- Double data entry was conducted to minimise transcription errors.

Ethical Considerations

The study protocol was reviewed and approved by the **Institutional Ethics Committee of RMCH&RC, Kanpur**.

- Written informed consent was obtained from all participants.
- Confidentiality of patient information was maintained throughout the study.
- No financial burden was imposed on participants for study-related investigations.

Limitations

- Single-centre study, limiting generalisability.
- Exclusion of oesophageal and hepatobiliary perforations narrows the spectrum studied.
- Small sample size compared to larger multicentric studies.
- Follow-up beyond hospital discharge was not part of the study design.

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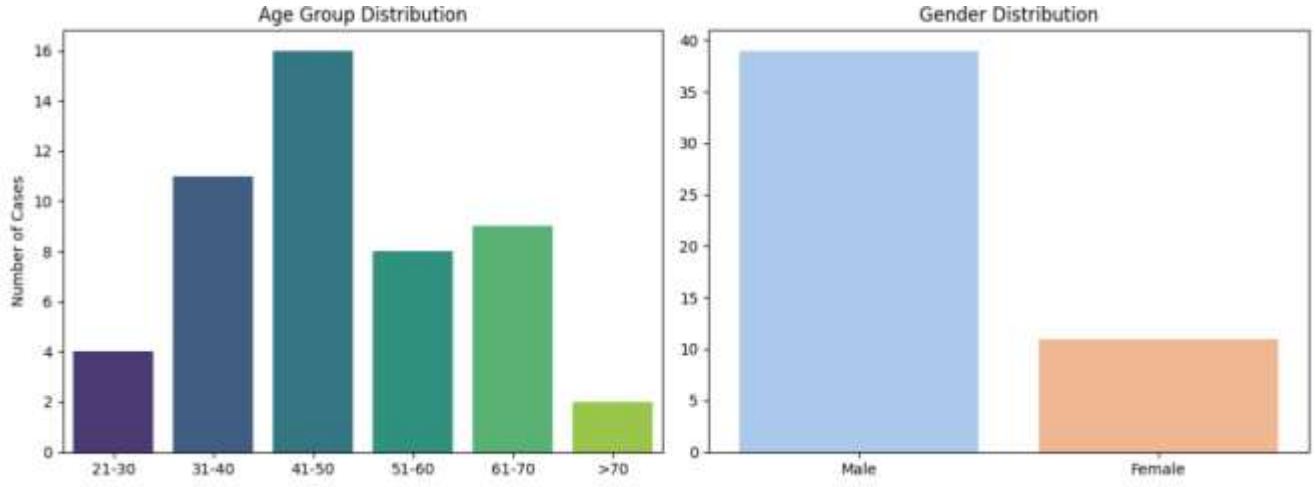

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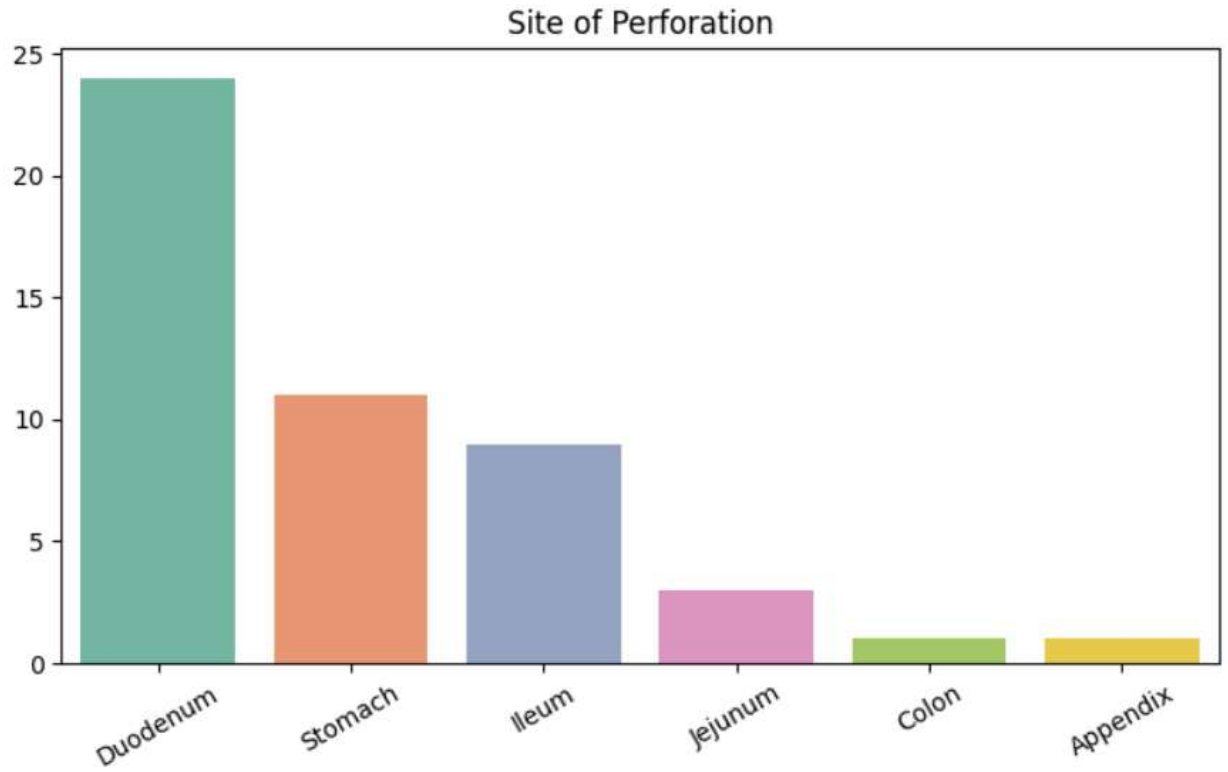

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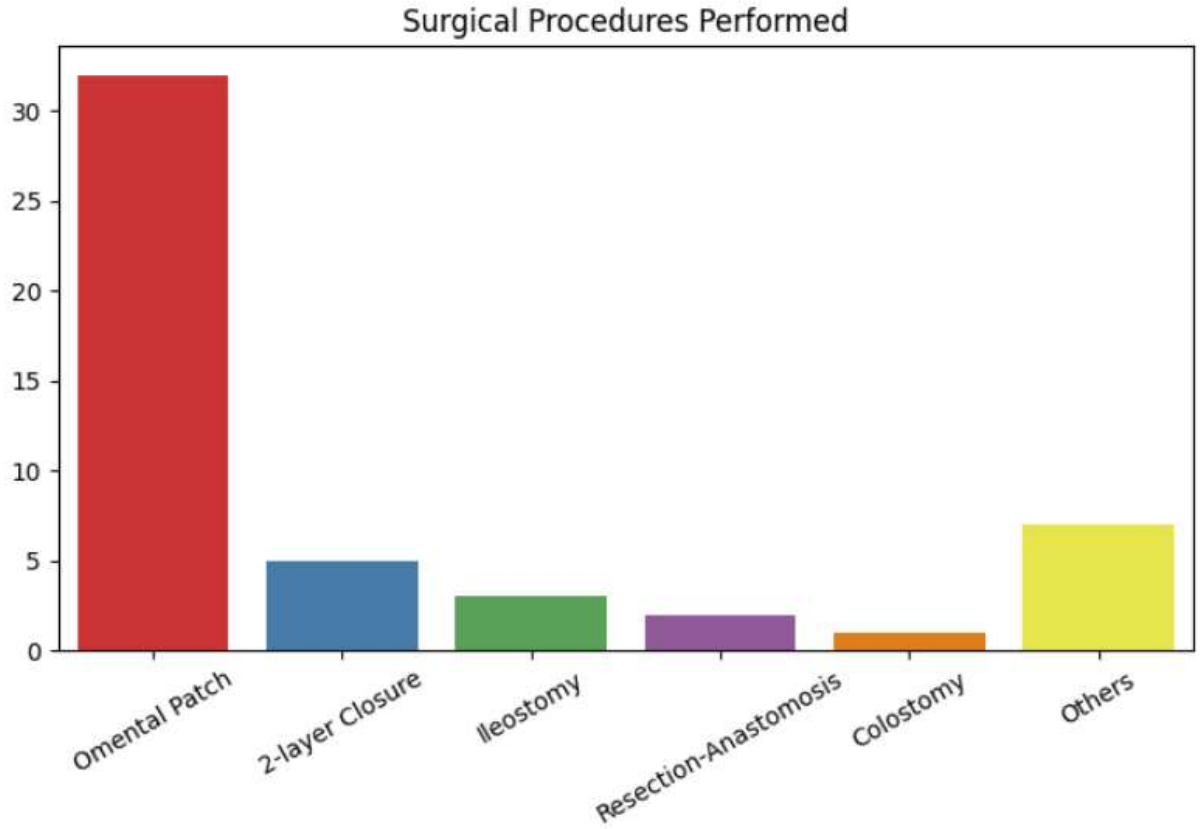

Results

A total of **50 patients** diagnosed with gastrointestinal (GI) perforation were enrolled during the study period. The **age of participants ranged from 21 to 78 years**, with a mean age of **47.58 ± 13.66 years**. The most affected age group was **41–50 years**, accounting for **32%** of cases, followed by **31–40 years (22%)** and **61–70 years (18%)**.

There was a clear **male predominance**, with **78% (n=39)** of patients being male and **22% (n=11)** being female. The majority of patients (**60%**) belonged to the **lower-middle socioeconomic class**, while **34%** were from the middle class. Occupationally, **manual laborers (42%)** and **farmers (22%)** constituted the largest groups, reflecting the socio-economic and occupational vulnerability contributing to disease burden.

All patients presented with **abdominal pain**, which was a universal symptom. Other common presenting complaints included **abdominal distension (72%)**, **vomiting (60%)**, **constipation (46%)**, and **fever (44%)**. Notably, **36%** of patients presented within **24 hours** of symptom onset, **40%** between **25–48 hours**, and **24%** after **48 hours**, with delayed presentation beyond 48 hours significantly associated with increased postoperative complications and mortality.

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The most frequent cause of GI perforation was **peptic ulcer disease**, observed in **62%** of patients, followed by **trauma (24%)**, **tuberculosis (6%)**, **typhoid fever (6%)**, and **appendicitis-related perforation (2%)**.

Anatomically, the **duodenum** was the most common site of perforation (**48%**), followed by the **stomach (22%)**, **ileum (18%)**, **jejunum (6%)**, and **colon (2%)**. A single case of appendicular perforation was also noted.

Intraoperative findings revealed that **86%** of patients had perforation sizes ≤1.0 cm, with only **2%** having perforations >2.1 cm. Single perforations were identified in **92%** of cases, while **8%** had multiple perforations.

The most commonly performed surgical procedure was **omental patch repair (64%)**, predominantly in duodenal and gastric perforations. Other procedures included **two-layer closure (10%)**, **ileostomy (6%)**, **resection-anastomosis (4%)**, and **colostomy (2%)**.

Postoperatively, **52%** of patients developed complications, with surgical site infections and ileus being most frequent. The **in-hospital mortality rate** was **6%**, and **ICU care** was required in approximately one-third of patients.

Table 1: Summary of Key Findings (N = 50)

Parameter	Frequency/Mean ± SD	Percentage (%)
Mean Age (years)	47.58 ± 13.66	-
Male Gender	39	78.0
Lower-middle Socioeconomic Class	30	60.0
Peptic Ulcer Disease	31	62.0
Duodenal Perforation	24	48.0
Omental Patch Repair	32	64.0
Postoperative Complications	26	52.0
Mortality	3	6.0

Discussion

Gastrointestinal perforation continues to be a major surgical emergency worldwide, with significant morbidity and mortality. The present study provides insight into the clinical profile, management, and outcomes of GI perforation in a tertiary care setting in Northern India.

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In this study, the majority of patients were in the **41–50 year age group**, which aligns with previous reports suggesting peak incidence of GI perforations in middle-aged individuals [1,2]. The marked **male preponderance** observed is consistent with literature, possibly attributable to higher rates of risk factors such as smoking, alcohol consumption, NSAID use, and occupational hazards among males [3,4].

The predominance of patients from lower-middle socioeconomic backgrounds reflects the association between low socio-economic status, poor health-seeking behavior, and delayed access to healthcare [5]. The high percentage of manual laborers and farmers reinforces the occupational risks and socio-economic vulnerability of this patient population.

Peptic ulcer disease, accounting for **62%** of perforations, remains the leading cause, consistent with other Indian and global studies [6,7]. Factors such as Helicobacter pylori infection, widespread NSAID use, and stress likely contribute to this trend. Trauma was the second most common cause, highlighting the need for preventive measures and awareness regarding abdominal trauma in the community [8].

The **duodenum** was the most frequently involved site, which correlates with the high incidence of peptic ulcer-related perforations. The predominance of small perforations (≤1.0 cm) allowed for successful use of **omental patch repair** in the majority of cases, reaffirming its role as a safe and effective surgical option [9,10].

Despite timely surgical intervention, postoperative complications occurred in over **50%** of patients, with surgical site infections and paralytic ileus being most common. Delayed presentation beyond **48 hours** was significantly associated with increased complications and mortality, underscoring the importance of early diagnosis and management [11,12].

The mortality rate of **6%** observed in this study is comparable to international standards but highlights the severity of the condition, particularly in delayed or complicated cases [13,14]. Older age, delayed presentation, shock at admission, and fecal contamination remain well-established predictors of adverse outcomes [15].

Overall, this study emphasizes the critical need for early identification, aggressive resuscitation, prompt surgical management, and postoperative care to improve outcomes in GI perforation.

Conclusion

Gastrointestinal perforation remains a life-threatening surgical emergency with significant morbidity and mortality, particularly in low-resource settings. This prospective study highlights the demographic, etiological, and clinical patterns of GI perforation in patients presenting to a tertiary care centre in Kanpur.

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Peptic ulcer disease continues to be the most common cause of perforation, followed by trauma, tuberculosis, and typhoid fever. The **duodenum** was the most frequently affected site, with small perforations amenable to **omental patch repair**, which remains the mainstay of surgical management in such cases.

The study observed a high rate of postoperative complications, particularly among patients presenting late or with advanced peritonitis. These findings reinforce the importance of timely diagnosis, early surgical intervention, and comprehensive perioperative care.

Despite optimal surgical management, mortality remains a concern, especially in elderly patients, those with delayed presentation, or those presenting with septic shock. Public awareness regarding the risks of self-medication with NSAIDs, early symptom recognition, and timely access to surgical care is crucial to improving outcomes.

Strengthening primary healthcare, improving referral systems, and enhancing surgical and critical care infrastructure, particularly in rural and semi-urban areas, are vital steps towards reducing the burden of GI perforations.

In conclusion, early diagnosis, prompt surgical management, and comprehensive perioperative care are essential to reduce the morbidity and mortality associated with gastrointestinal perforation. Public health measures addressing modifiable risk factors, coupled with systemic improvements in healthcare delivery, are crucial in improving outcomes for affected individuals.

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