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Clinico-Epidemiological Profile and Short-Term Outcomes of Traumatic and Non-Traumatic Bowel Perforation

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Abstract: ***Background:*** ***Bowel perforation is a life-threatening surgical emergency associated with high postoperative morbidity and mortality. Comparative evidence on the clinico-epidemiological characteristics and short-term postoperative outcomes of traumatic and non-traumatic bowel perforations remains limited.*** ***Methods:*** ***A prospective observational study was conducted at a tertiary care teaching hospital between 2024 and 2025. Patients older than 12 years undergoing emergency surgery for bowel perforation were included. Demographic, clinical, laboratory, intraoperative, and postoperative data were collected prospectively. Postoperative complications were graded using the Clavien–Dindo classification.*** ***Results:*** ***Among 110 patients, most were male (66.4%), aged 21–60 years, and from rural areas. Surgical site infection (34.5%) was the most common postoperative complication, followed by severe intra-abdominal abscess (10.0%), anastomotic leakage (8.2%), and multiple organ dysfunction syndrome (6.4%). Overall, 37.3% required intensive care, 16.4% mechanical ventilation, and 19.1% vasopressor support. Mortality was 10.9%, and mean hospital stay was 9.8 ± 3.2 days. White blood cell count was significantly higher in traumatic cases, while postoperative complications, Clavien–Dindo grades, intensive care requirement, and mortality were similar between groups.*** ***Conclusions:*** ***Traumatic and non-traumatic bowel perforations showed comparable short-term postoperative outcomes, highlighting the importance of prompt diagnosis, standardized perioperative care, and timely surgical intervention.***

Keywords: bowel perforation, traumatic bowel perforation, non-traumatic bowel perforation, postoperative complications, Clavien-Dindo classification.

1. Introduction

Bowel perforation means a complete perforation of the gastrointestinal tract with leakage of the contents into the peritoneal cavity and is a surgical emergency. This can rapidly progress to peritonitis, systemic inflammatory response, sepsis, multiorgan dysfunction, and, if untreated, death. Although the perioperative management and imaging have improved greatly, bowel perforation still has a high morbidity and mortality, as reported from 30% to 50% in severe cases [1, 2].

Bowel perforation can have a variety of causes and is generally classified into two groups: traumatic and non-traumatic. Traumatic perforation is typically caused by a blunt or penetrating abdominal lesion, while non-traumatic perforation is due to infectious/inflammatory, ischemic, neoplastic, iatrogenic, and other pathological conditions. The etiology is different from one country to another, and the most common causes are trauma, bowel obstruction, and malignancy in more developed countries, and typhoid fever, intestinal tuberculosis, HIV infection, and parasitic disorders in less developed countries. Clinical presentation, treatment strategy, and postoperative outcome are affected by these etiological variations [1,3].

Early diagnosis and surgical intervention are important factors that affect survival. Multidetector computed tomography (MDCT) is the best imaging modality to identify the site of perforation, underlying pathology, and associated complications, which is essential for prompt surgical management [1,3]. The postoperative results after perforation of the bowel are, however, affected by patient-related and disease-related factors. Physiological state at admission, organ dysfunction, and amount of contamination, low postoperative albumin, and delayed surgery are significant factors affecting postoperative morbidity and mortality. There has also been an association with increased risk of complications, including surgical site infection, intra-abdominal abscess, long-term hospitalisation, and death with delayed treatment. Although the peri- and critical care management has improved, postoperative complications still occur and continue to be a major clinical problem. [1, 4–6]

Although numerous studies have investigated bowel perforation, traumatic and non-traumatic cases have largely been evaluated separately. Comparative evidence examining their clinico-epidemiological characteristics and short-term postoperative outcomes within the same patient cohort remains limited, particularly in resource-constrained tertiary care settings. Therefore, the present study aimed to compare the clinico-epidemiological characteristics and short-term

postoperative outcomes of patients undergoing emergency surgery for traumatic and non-traumatic bowel perforation at a tertiary care center.

2. Materials and Methods

Study Design and Setting

The present study is a prospective observational study in the general surgery department of B.R.D. Medical College, Gorakhpur, a tertiary care teaching hospital, over 12 months period from 2024 to 2025. The objective of the study was to compare the clinico-epidemiological profile and short-term postoperative details regarding the patients undergoing emergency surgical treatment for both traumatic and non-traumatic bowel perforation.

Study Population

The study was conducted on a consecutive series of patients who had been seen between December 1, 2001, and March 29, 2003, with a diagnosis of traumatic or nontraumatic bowel perforation, who underwent surgery within 24 hours. Patients who did not receive surgery, patients with post-surgical leak or perforation of the anastomosis, patients lost to follow-up during the hospital stay, and patients who did not give informed consent were excluded from the study.

Sample Size

A total of 110 consecutive eligible patients who met the predefined inclusion and exclusion criteria were enrolled during the study period. As this was a prospective observational study, all eligible patients presenting to the study center within the study period were included until completion of data collection.

Data Collection and Variables

A predesigned case record form was used to collect data in a prospective manner. Demographic factors were age, sex, and place of residence. Clinical variables included presenting symptoms, trauma history, presence of comorbidities, smoking and drinking habits, and physical examination: abdominal tenderness, guarding, rigidity, and peritonitis.

Complete blood count, renal and liver function tests, serum electrolytes, blood glucose estimation, plain chest/abdominal radiograph, ultrasound, and computed tomography (CT) as clinically indicated were performed as preoperative tests.

Intraoperative variables were studied, such as perforation site, number and size of the perforations, degree of peritoneal contamination, degree of peritonitis, and operative findings. The types of surgeries performed were primary repair, primary repair with loop ileostomy, modified Graham's patch repair, bowel resection/anastomosis, and loop ileostomy according to clinical condition and intraoperative findings.

Postoperative Management and Outcome Measures

Postoperative care was standard, with the provision of intravenous fluids, wide-spectrum antibiotics, analgesics, nutritional support, and intensive care management if necessary, all supplied to all patients. Patients were followed up every day while in the hospital or until reaching a recovery state or death.

The main one was postoperative complications after surgery. Secondary outcomes were the severity of postoperative complications, intensive care unit (ICU) admission, hospital stay, short-term clinical outcome (recovery or mortality), and mortality. Complications after surgery were surgical site infection, intra-abdominal abscess, postoperative sepsis, anastomotic leak, and multi-organ dysfunction syndrome. Clavien–Dindo classification was adopted to assess the severity of the complications [7].

Statistical Analysis

Microsoft Excel was used to enter data, and IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA) was used to analyze the data. Categorical and continuous variables were reported as frequencies and percentages and as mean ± SD, respectively. The independent t-test for continuous variables and chi-square test or Fisher's exact test for categorical variables were used for comparisons between the two groups of trauma and non-trauma. We set a two-tailed p-value <0.05 as statistically significant.

Ethical Considerations

Institutional Ethics Committee of B.R.D. The Medical College, Gorakhpur, approved the study before the recruitment of the participants. All the participants or their legal representatives signed informed consent forms prior to participation. The study was done in compliance with the principles of ethics of the Declaration of Helsinki.

3. Results

Table 1 and Figure 1 show the characteristics of the study population. Of the 110 patients included, most were aged 21–60 years, with a predominance of males (73/110, 66.4%) and rural residents (69/110, 62.7%). Diabetes mellitus (13/110, 11.8%) and hypertension (6/110, 5.5%) were the most common comorbidities, while alcohol use (17/110, 15.5%) was more frequent than smoking (6/110, 5.5%). All patients had abdominal pain (100%), abdominal distention (84.5%), and fever (67.3%), whilst vomiting occurred in 8.2% of patients.

Table 1: Distribution of socio-demographic profile, comorbidities, addiction history, and presenting clinical features among study participants

Section	Parameter	Category	Frequency
Socio-demographic profile	Age group	<20 years	15
		21–40 years	32
		41–60 years	33
		>60 years	30
	Gender	Male	73
		Female	37
	Residence	Rural	69
		Urban	41
Comorbidities and addiction history	Comorbidity	DM	13
		HTN	6
		CKD	0
		CLD	0
		Malignancy	0
	Addiction history	Smoking	6
		Alcohol	17
Presenting clinical features	Clinical feature	Abdominal pain	110
		Vomiting	9
		Fever	74
		Distension	93

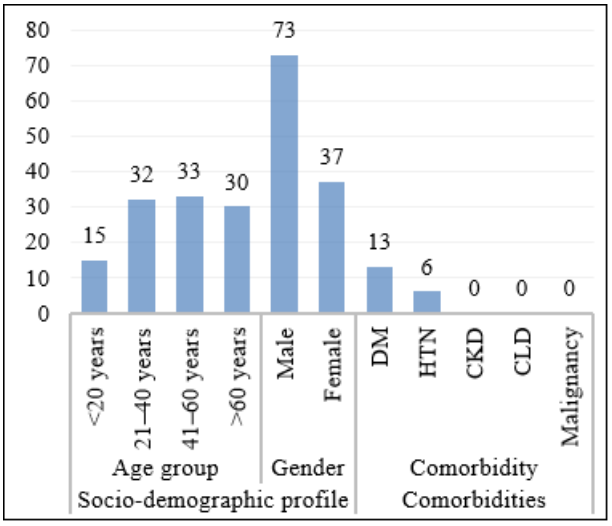

Figure 1: Distribution of age groups, sex, and comorbidities among study participants

Postoperative results are shown in Table 2 and Figure 2. The surgical site infection was the most prevalent postoperative complication (38 out of 110 cases; 34.5%), followed by severe intra-abdominal abscess (11 out of 110 cases; 10.0%), anastomotic leakage (9 out of 110 cases; 8.2%), and MODS (7 out of 110 cases; 6.4%). In total, ICU admittance occurred in 41 (37.3%) patients, where 18 (16.4%) required mechanical ventilation and 21 (19.1%) received vasopressor therapy. Most patients recovered following surgery (98/110, 89.1%), while 12 (10.9%) died. The mean duration of hospital stay was 9.8 ± 3.2 days.

Table 2: Distribution of postoperative complications, ICU requirement, outcome, and hospital stay among the study participants

Parameter	Category	Frequency
Postoperative complication	Surgical site infection	38
	Severe intra-abdominal abscess	11
	Anastomotic leak	9
	MODS	7
ICU requirement	ICU admission	41
	Ventilator support	18
	Vasopressor use	21
Outcome	Recovered	98
	Mortality	12
Hospital stay	Mean ± SD days	9.8 ± 3.2

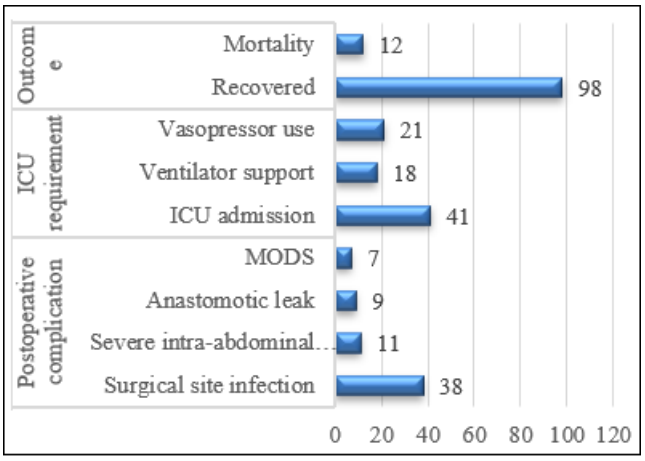

Figure 2: Distribution of postoperative complications, ICU requirements, clinical outcomes, and hospital stay among the study participants.

Comparison between the number of postoperative complications and outcomes of both the traumatic and non-traumatic groups is shown in Table 3. Postoperative infection was common in the non-traumatic group (24 vs. 14), but anastomotic leakage (5 vs. 4) and multiple organ dysfunction syndrome (4 vs. 3) were relatively common in the traumatic group. Intra-abdominal abscess was present in 7 non-traumatic and 4 traumatic patients. Likewise, the need for mechanical ventilation (10 vs. 8), vasopressors (12 vs. 9), and postoperative sepsis (18 vs. 12) was greater in the non-traumatic group. Nevertheless, no significant differences were seen in the postoperative complications and outcome measures in both groups (all $p > 0.05$).

Table 3: Comparison of Postoperative Complications and Outcomes between Non-traumatic and Traumatic Bowel Perforation Groups

Section	Outcome	Category	Non-traumatic Frequency	Traumatic Frequency	χ^2 value	p-value
Postoperative complications	SSI	Yes	24	14	0.69	0.401
	Anastomotic leak	Yes	4	5	Fisher exact	0.108
	Severe intra-abdominal abscess	Yes	7	4	0.12	0.723
	MODS	Yes	3	4	Fisher exact	0.142
Postoperative outcomes	Ventilation	Yes	10	8	1.66	0.198
	Vasopressor	Yes	12	9	1.51	0.219
	Postoperative sepsis	Yes	18	12	1.25	0.263
	Anastomotic leak	Yes	4	5	Fisher exact	0.108
	Severe intra-abdominal abscess	Yes	7	4	0.13	0.723
	MODS	Yes	3	4	Fisher exact	0.142

Distribution of the postoperative complication severity in terms of Clavien-Dindo classification is depicted in Table 4. The most prevalent grade was Grade I complication in both categories, followed by Grade II, III, and IV. The incidence of Grade V (death) was found in 5 cases for non-traumatic patients and 7 cases for traumatic patients. But overall, the distribution of Clavien-Dindo grade was not significantly different in two categories ($\chi^2 = 5.71$, $p = 0.222$) (Table 4 and Figure 3).

Table 4: Comparison of Clavien-Dindo classification between non-traumatic and traumatic bowel perforation groups

Clavien-Dindo grade	Non-traumatic Frequency	Traumatic Frequency	χ^2 value	p-value
Grade I	28	8	5.71	0.222
Grade II	20	9		
Grade III	12	5		
Grade IV	10	6		
Grade V / Death	5	7		

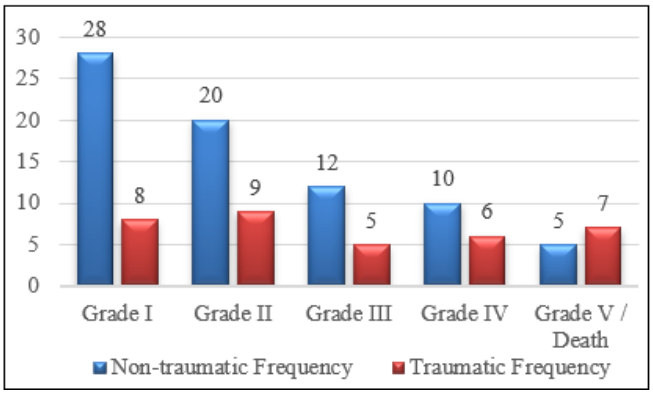

Figure 3: Comparison of Clavien–Dindo classification grades between traumatic and non-traumatic bowel perforation groups.

Comparison of Demographic, Clinical, Laboratory, and Intraoperative Factors between Non-Traumatic and Traumatic Groups is shown in Table 5 below. The mean age and the basal vital parameters like heart rate, systolic and diastolic blood pressure, respiration rate, body temperature, oxygen saturation, and Glasgow Coma Score, among others, were comparable between both groups (all $p > 0.05$). Also, hemoglobin, C-reactive protein, procalcitonin, serum lactate, serum albumin, and time taken for surgery did not show any significant difference. Total leukocyte count is the only parameter that was different between the groups, where the traumatic group had significantly high leukocyte count compared to the non-traumatic group (12,078.86 ± 7,962.85 vs. 9,275.47 ± 5,217.94 cells/mm³; $p = 0.030$) (Table 5).

Table 5: Category-wise risk factor comparison between non-traumatic and traumatic groups

Category	Parameter	Non-traumatic (Mean ± SD)	Traumatic (Mean ± SD)	t-value	p-value
Demographic factor	Age (years)	45.47 ± 18.85	45.46 ± 19.30	0.002	0.998
Vital parameters	Pulse (beats/min)	105.87 ± 14.33	108.83 ± 16.38	-0.964	0.337
	SBP (mmHg)	104.95 ± 18.87	100.89 ± 14.89	1.120	0.265
	DBP (mmHg)	69.41 ± 11.56	65.89 ± 8.68	1.605	0.111
	RR (breaths/min)	19.16 ± 2.45	19.43 ± 2.85	-0.508	0.613
	Temperature (°C)	37.90 ± 0.46	37.99 ± 0.53	-0.888	0.376
Oxygenation status	SpO_2 (%)	96.72 ± 0.95	96.60 ± 1.31	0.544	0.588
Neurological status	GCS	14.35 ± 1.16	14.51 ± 1.01	-0.736	0.463
Hematological parameter	Hb (g/dL)	11.00 ± 2.03	10.47 ± 1.96	1.304	0.195
Inflammatory/infective markers	TLC (cells/mm³)	9275.47 ± 5217.94	12078.86 ± 7962.85	-2.204	0.030*
	CRP (mg/L)	38.24 ± 14.26	40.26 ± 11.80	-0.731	0.466
	Pro-calcitonin (ng/mL)	7.20 ± 9.03	6.20 ± 2.69	0.642	0.522
Tissue perfusion marker	Lactate (mmol/L)	3.00 ± 0.87	2.97 ± 0.90	0.174	0.862
Nutritional/biochemical marker	Albumin (g/dL)	2.83 ± 0.59	2.87 ± 0.55	-0.289	0.773
Intraoperative factor	Surgery duration (hrs)	2.46 ± 0.28	2.43 ± 0.21	0.585	0.560

4. Discussion

The clinico-epidemiological parameters and results of short-term surgery were compared in emergency surgical cases of traumatic and non-traumatic bowel perforation. The present prospective observational study compared the clinico-epidemiological parameters and the outcome of the short-term surgery between patients undergoing emergency surgery for traumatic and non-traumatic bowel perforation. The main results were that there were no statistically significant differences between the two groups with regard to postoperative complications, the severity of the complications, intensive care needs, or mortality. While differences in the number of postoperative complications were observed for individual complications, these were not statistically significant. In general, the present results indicate that the short-term postoperative outcomes were comparable in the two groups of traumatic and non-traumatic bowel perforation.

In this current study, males predominated as those with bowel perforation (66.4%), and were found to occur at all ages, with the highest incidence amongst those aged between 21 and 60 years. The results are similar to those of other studies by Sandu et al., Dakhore et al., and Shergill et al., which found gastrointestinal perforation to be more common in males and young to middle-aged adults. In the present study, the comparable mean age of the two groups (traumatic and non-traumatic) suggests that age was not a factor that differentiated the two etiological groups. Other factors associated with gastrointestinal perforation were also reported by Dakhore et al as a common risk factor in patients with gastrointestinal perforation, and Shergill et al as being associated with the observed male predominance, but these factors were not specifically evaluated in the present study [8-10]

All patients had abdominal pain as their initial symptom, and the next most frequent was abdominal distension, followed by fever, and vomiting was comparatively less. Dakhore et al and Shergill et al also described similar clinical features and abdominal pain as the common complaint in patients with gastrointestinal perforation [9, 10]. The clinical features depend on the location and cause of perforation, and non-classic or late presentations with sepsis have also been reported, which could cause a challenge for diagnosis [7]. Vital signs and Glasgow Coma Scale scores at presentation were similar between the traumatic and non-traumatic groups, indicating similar physiological status.

The laboratory parameters analysed were the only parameters that significantly differed between groups, with the total leukocyte count (TLC) being elevated in patients who had traumatic bowel perforation. This finding may indicate a higher acute inflammatory process due to traumatic tissue damage and agrees with the increased leukocyte count reported in patients who sustained more extensive penetrating traumatic injuries than patients with isolated abdominal

trauma by Díaz-Rosales et al. [11]. Conversely, the C-reactive protein, procalcitonin, serum lactate and serum albumin levels were similar in both groups. However, while not significantly different in the present study, Sung et al. have found that hypoalbuminemia was an independent risk factor for postoperative complications for patients with gastrointestinal perforation, regardless of the etiology, suggesting its prognostic significance [4].

In the present study, surgical site infection (SSI), intra-abdominal abscess, and anastomotic leak were the leading postoperative complications. This is similar to the results of Kudou et al. who also found that the most common postoperative complication after emergency surgery for colorectal perforation was wound infection, followed by intra-abdominal abscess [5]. The high incidence of SSI in bowel perforation could be due to the contamination of the operative field by bacteria and the necessity for emergency surgery, which both contribute to the risk of wound infection after surgery. Although the etiologies were different in the present study, the incidence of SSI was not significantly different between the traumatic and non-traumatic groups, which indicated that contamination resulting from bowel perforation itself may play a significant role in postoperative wound infections, regardless of the type of perforation.

When postoperative complications were analyzed between the two groups, surgical site infection was common in the non-traumatic group, while multiorgan dysfunction syndrome and anastomotic leak occurred slightly more often in the traumatic group. In addition, intra-abdominal abscess was more commonly seen in those who had non-traumatic perforation. None of these differences was statistically significant, however. Likewise, the nutritional status, ventilatory requirement, vasopressor use, and postoperative sepsis level were similar in both. The findings are also partly similar to the ones mentioned by Rauniyar et al. in both traumatic and non-traumatic ileal perforations, where the most common post-operative complication was wound sepsis, which still poses a significant level of morbidity [12].

The Clavien–Dindo classification system, which is a simple and widely accepted classification system for assessing surgical morbidity [7], was used to further categorize postoperative complications. There were more Grade I and Grade II complications in the non-traumatic group and more Grade V (death) complications in the traumatic group. But the distribution of the Clavien-Dindo grade was not significantly different between the two groups. This indicates that the severity of complications after surgery did not differ significantly according to underlying cause. In line with the current study, Kudou et al. found that Clavien–Dindo grade ≥ IIIa was an independent risk factor for hospital mortality after emergency surgery for gastrointestinal perforation and showed the importance of standardizing complication grading in the assessment of prognosis in patients with gastrointestinal perforation [5].

Forty-one (37.3%) of the patients required ICU admission, 18 (16.4%) of whom needed mechanical ventilation, and 21 (19.1%) were given vasopressor support. The overall mortality rate was 10.9% (12/110), and the mean hospital stay was 9.8 ± 3.2 days. These results have been similar to those reported in the modern emergency gastrointestinal perforation series. Sung et al. reported a combined mortality of 11% for 354 patients treated within Acute Care Surgery, which is similar to what was seen in this study [4]. Lee et al. also showed that there was a higher mortality rate with time-to-surgery ≥16 hours (5.7% vs. 11.4% early and late surgery groups, respectively), though this was not statistically significant following propensity matching [6]. Time to surgery was not assessed in this study, but the mortality rate was found to be within the range recorded by these more recent series and was similar to the mortality rates recorded in other tertiary emergency surgical centres.

The mean time taken in the hospital in this study was 9.8 ± 3.2 days. It was less than the average number of days taken in the hospital, 14 days according to the report by Aljehaiman et al., who examined the average hospital stay in cases of traumatic small bowel perforation [2]. In the same context, Sharma et al. found that the use of an enhanced recovery after surgery (ERAS) program decreased the average postoperative hospital stay compared to conventional perioperative procedures [3]. This implies that disease severity and perioperative care contribute to the time spent in the hospital due to bowel perforation.

In terms of diagnosis, wherever there was any clinical uncertainty, MDCT proved to be the main imaging technique used in accordance with the known fact that this technique is used to investigate a suspected gastrointestinal perforation. As stated by Kulinna-Cosentini et al., both radiologists and clinicians need to know the CT and fluoroscopic signs to differentiate between life-threatening postoperative conditions and usual postoperative features [13]. Similarly, Lee et al. pointed out the utility of CT in diagnosing the actual cause behind non-traumatic gastrointestinal perforation and helping surgeons make preoperative differentiation between peptic ulcers, ischaemia, inflammation, and malignancy [14]. In the current study population, clinical evaluation, along with MDCT wherever necessary, was adequate to make a diagnosis in order to go ahead with surgical intervention. In the present cohort, clinical assessment supplemented by MDCT when indicated provided sufficient diagnostic information to proceed with operative management, with intraoperative findings confirming the perforation site and guiding the definitive surgical procedure [14].

On balance, these results reveal that while traumatic and nontraumatic bowel perforations may be different in terms of pathophysiology, their outcomes in the immediate postoperative period have been largely similar when treated at a tertiary healthcare facility. This suggests the necessity for prompt diagnosis and treatment of perforated bowels regardless of their cause.

The current study had some strengths. The prospective nature of the study, the recruitment of patients consecutively, and the evaluation of traumatic and non-traumatic cases within one institution allowed for the comparison of groups within a standard management system. Moreover, the study used standardized data gathering and Clavien-Dindo classification of complications that increased the comparability of the results. Nevertheless, there were several limitations in this study. First, it is a single-centre study, which can reduce its

external validity. Second, the follow-up period was limited only to the current hospital stay; therefore, no long-term results could be obtained. Finally, the non-traumatic group included a variety of etiologies that prevented subgroup analysis by cause of perforation. Although the sample size was adequate for the primary comparison, it may have been insufficient to detect differences in less frequent outcomes, such as anastomotic leak and multiorgan dysfunction syndrome. Future multicentre studies with larger cohorts, longer follow-up, and etiology-specific analyses are warranted to validate these findings and better define postoperative risk across different types of bowel perforation.

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