Research Article

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Clinical Presentation, Etiology, Management Strategies and Outcomes of Non-Traumatic Ileal Perforation in a Tertiary Care Center: An Ambi-spective Observational Study

SakthiVel M[1], Sailesh I S Kumar[1*], Raja Vel Shantharam[2], Ashfaq Sulaiman Arif Abdul Rahuman[1], Ashok Nimmakanty Ramadas[1]

[1]Institute of General Surgery, Madras Medical College, Rajiv Gandhi Government General Hospital, Chennai, India

[2]Assistant Professor, Community Medicine, Sri Lalithambigai Medical College and Hospital, Dr. MGR Educational and Research Institute, Chennai, India

*Correspondence author: Sailesh I S Kumar, MBBS, Institute of General Surgery, Madras Medical College, Rajiv Gandhi Government General Hospital, Chennai, India-600003; Email: Sailesh.isk@gmail.com

Abstract

Background: Nontraumatic perforation of the ileum is still a difficult surgical emergency, which remains an important issue in regions where infectious diseases and chronic inflammatory conditions are prevalent. Moreover, patients commonly seek medical attention when symptoms have advanced with little time for delay. Untimely diagnosis or operative intervention may result in rapid deterioration of the clinical course and increased morbidity and mortality. It is important to gain a better insight into the way in which these patients present together with the conditions leading to preperforation and the intraoperative findings. These insights can help in the early detection and better decision-making of management.

Objective: The aim of this study was to outline the clinical features, etiological factors, surgical approaches and postoperative outcomes in individuals treated for non-traumatic ileal perforation at a tertiary care centre.

Methods: This ambispective observational study was conducted in the Department of General Surgery of a tertiary teaching hospital and included 157 patients in whom non-traumatic perforation of the ileum was confirmed during surgery. The cohort comprised both retrospectively identified cases and prospectively recruited participants. Information was collected on demographic characteristics, symptom duration, findings on clinical examination, laboratory results, imaging features, operative details, procedure undertaken, postoperative course and histopathological reports. All collected data were entered into a statistical database and analysed using SPSS software. Continuous variables were summarised using means with standard deviations or medians with interquartile ranges, based on distribution. Comparative analyses were performed to explore associations between factors such as time to hospital presentation, underlying aetiology, severity of peritoneal contamination and postoperative complications or death. Chi-square or Fisher's exact tests were used for categorical variables, while independent t-tests or Mann-Whitney U tests were applied for continuous variables. Statistical significance was set at p < 0.05.

Results: All patients had acute abdominal pain with either localized or widespread tenderness and several had pneumoperitoneum on imaging. There was significant variance in the time between the beginning of symptoms and operation and longer delays were substantially linked to more problems. The majority of patients had one or more ileal perforations with fecal or purulent contamination. While resection with anastomosis or stoma formation was reserved for gangrene, multiple perforations, cancer or tuberculous disease, primary closure was the most common technique. The most common postoperative complications were enterocutaneous fistula, surgical site infection and anastomotic leak. The most frequent causes were found to be cancer and typhoid illness. Higher complication rates were observed in patients with late presentation, severe contamination and malignant or tuberculous pathology. Mortality was linked to older age, septic shock and significant delays

in operative management.

Conclusion: The diagnosis and treatment of non-traumatic ileal perforation remain extremely difficult. Improving survival still requires prompt detection, vigorous resuscitation and early surgical surgery. While primary closure is adequate for straightforward perforations, complex etiologies often demand resection-based procedures. Routine histopathological assessment is crucial for defining the underlying cause and directing further management.

Keywords: Non-Traumatic Ileal Perforation; Etiology; Clinical Profile; Management and Complications

Introduction

Non-Traumatic Ileal Perforation (NTIP) is still among the hardest cases to deal with in surgery and is the main cause of death in such patients. This is particularly true in low- and middle-income nations where infectious disease patients are still highly prevalent. NTIP is different from traumatic perforations in that the perforation happens without any physical injury, but it has the same or worse consequences in terms of morbidity and mortality. The ileum has a high risk of perforation due to its peculiar anatomical and immunological properties, which include the presence of numerous Peyer's patches and lymphoid tissue that is prone to ulceration and perforation when infected or inflamed [1].

In previous centuries, Non-Traumatic Intestinal Perforation (NTIP) in countries with low development was primarily related to infectious diseases like enteric fever and tuberculosis. Typhoid fever, which is caused by *Salmonella Typhi*, has been acknowledged for centuries as the major cause of ileal perforation in those regions where it is endemic. The perforation is often the result of necrosis of lymphoid tissue along the anti-mesenteric border. Many studies conducted in different centers have consistently pointed out that typhoid perforation gives rise to the largest number of NTIP cases and, at the same time, it is one of the most important reasons for performing emergency laparotomies [2]. Earlier historical documentations also mentioned very high death rates in the pre-antibiotic period spanning over a few centuries and very little reduction in mortality rates occurred in the subsequent years after the advent of antibiotics and the usage of modern surgical techniques and perioperative care [3].

Besides typhoid fever, intestinal tuberculosis is still a major contributor to NTIP cases in areas where tuberculosis is common. Tuberculous ileitis may cause stricturing, necrosis or ulceration that can result in perforation of the gut, especially in the case of untreated or disseminated disease. Abdominal tuberculosis has been featured fairly in clinical reviews as both a diagnostic and therapeutic challenge, owing to its non-specific presentation and delayed detection [4]. Reports from surgical centres have shown that surgeons encounter tuberculous perforations quite frequently in association with multiple ulcerations, dense adhesions or mesenteric lymphadenopathy, all of which make operative management more difficult [5].

Over the last few decades, the spectrum of NTIP causes has undergone a change. Non-infectious agents like Crohn's disease, small-bowel cancers, ischemic enteritis, drug-related ulceration and idiopathic perforations are being more and more accepted to account for the majority of cases in the surgical series raised from both developed and underdeveloped countries [6]. The global increase in inflammatory bowel disease has led to an increase in the number of patients with perforated Crohn's, which in some cases, has been free perforation requiring emergency laparotomy. Neoplastic perforations, although not very common, bring along specific difficulties with the draped or infiltrated bowel segments and happen frequently in older or immunocompromised patients [6,7].

Despite the use of advanced imaging and laboratory diagnostics, NTIP (Nonspecific Tuberculosis Peritonitis) still presents with vague or non-specific signs and symptoms, which are very much like other causes of acute abdomen. Clinical signs like diffuse abdominal pain, fever, vomiting and the presence of peritonitis are common but not specific for NTIP. Delays in diagnosis are frequent, especially in areas with limited healthcare resources and these delays have a direct impact on postoperative morbidity and mortality. Studies indicate that the time interval between the onset of symptoms and surgical intervention is one of the most influential predictors of outcome [1,2,8]. Pneumoperitoneum radiographs are helpful, although not always; plain abdominal radiographs may miss free air in a large number of cases [9].Therefore, early clinical suspicion is very important. The variety of causes also makes diagnosis harder; for example, in case of typhoid perforation, the doctor usually knows exactly where to look, but the non-infectious perforations may happen anywhere and often have atypical presentations.

Surgical intervention is still the most important method of treatment. The selection of surgical procedure primary closure, resection with anastomosis or stoma creation-is determined by the intraoperative findings such as the size and number of perforations, degree of contamination, viability of bowel and underlying pathology. Primary closure may be enough for the correction of isolated perforations with only slight contamination; however, in cases with necrosis, many perforations or large areas of fecal peritonitis, segmental resection is frequently the option taken. Systematic reviews of typhoid perforation point to the very high risk of leakage after simple closure in severely contaminated fields and go on to suggest resection in some cases [10]. Tubercular perforations also demonstrate higher failure rates with simple closure, making resection more appropriate [11].

One of the main problems with the current literature is that it is mostly about retrospective studies on single etiologies, primarily typhoid perforation and only a few studies include the whole spectrum of underlying causes. Besides, many of the earlier studies were not uniformly documented, thus making it hard to compare different regions. Therefore, there is an urgent need for new studies that not only include the full spectrum of causes, infectious and non-infectious, but also integrate retrospective and prospective cohorts and reflect the real-world surgical environments where diagnostic doubts are common. The constantly changing etiological spectrum and the geologic assessments that come with NTIP allow for a comprehensive ambispective analysis to be performed, which can aid in understanding the current clinical patterns, operative strategies and outcome determinants. The study, by incorporating a large cohort with diverse etiologies, aims to close the gap in knowledge within the existing literature and, thus, offer insights that might facilitate the process of making surgical decisions based on evidence.

Methodology
This ambispective observational study was conducted in the General Surgery Department of a tertiary care teaching hospital, including both retrospective and prospective patient cohorts diagnosed with non-traumatic ileal perforation. The duration of the study was from September 2024 to July 2025 and all patients who were eligible and underwent surgical treatment for ileal perforation during that time were included. The medical records of the last six months were reviewed to obtain the retrospective data, while the prospective cases were successively recruited during the trial period after signed informed consent was obtained. Those patients who were above twelve years old, diagnosed with non-traumatic ileal perforation through clinical evaluation and imaging, especially contrast-enhanced CT scan of the abdomen, were included in the study. Patient groups excluded from the study were those with traumatic bowel perforations, perforations of duodenum or jejunum, patients younger than twelve years and those who did not consent for the prospective arm of the study.

The sample size of 157 was calculated by using Cochran's formula where the estimated catchment population is 1 million, the presumed prevalence of 38% along with a margin of error of 7.6% and a confidence level of 95%. The clinical data has been collected through a standardized proforma which included patient demographics, comorbidities, duration of symptoms, the nature of presenting complaints like abdominal pain, fever, vomiting and distension and physical findings indicating the possibility of peritonitis. The laboratory tests carried out on all patients were complete blood counts, electrolytes, renal and liver function tests and when sepsis was suspected, blood cultures. Only contrast-enhanced CT scans were done for imaging evaluation, but in addition to that, standing abdominal or chest x-rays were also performed.

The choice of operative procedure, whether ileostomy, segmental resection with anastomosis or primary repair, was guided by several intraoperative factors, including the number and size of perforations, the condition of the surrounding bowel, the extent of contamination within the peritoneal cavity and the overall hemodynamic status of the patient. Postoperative management involved close daily assessment, with laboratory investigations performed as indicated, along with vigilance for complications such as wound infections, anastomotic breakdown, intra-abdominal abscess formation, enterocutaneous fistulae and features of systemic sepsis. Patients were followed through their hospital stay and subsequently reviewed on postoperative days 3, 7, 15 and 30 to evaluate wound recovery, pain levels, nutritional progress and stoma function when relevant. Morbidity and mortality were documented and contributing factors to adverse outcomes-such as delayed presentation, advanced age, associated comorbid conditions and heavy peritoneal contamination were systematically analysed.

All information was entered and analyzed using SPSS version 17.0. Continuous variables were described as means with standard deviations or medians with interquartile ranges, depending on the distribution and categorical variables were shown as frequencies and percentages. The Chi-square test or Fisher's exact test was used for the group comparisons of categorical data and Student's t-test compared continuous variables.

Results

This study included 157 patients with non-traumatic ileal perforation managed at a tertiary care centre. The results are presented in alignment with the study objectives.

1. *Demographic and clinical features of patients with non-traumatic ileal perforation (N=157).*

The mean (SD) age of the participants was 47 (13) years. A slight female predominance was observed, with 88 females (56.1%) and 69 males (43.9%). Table 1 distribution of clinical features of patients with non-traumatic ileal perforation (N=157) (Table 1).

Signs and Symptoms	n (%)
Abdominal pain	157 (100)
Fever	28 (17.8)
Vomiting	128 (81.5)
Constipation	100 (63.7)
Obstipation	25 (15.9)
Loose stools	24 (15.3)
Hematochezia	21 (13.4)
Rigidity	29 (18.5)
Guarding	57 (36.30
Tenderness	157 (100)

Table 1: Demographic features of patients with non-traumatic ileal perforation (N=157).

Abdominal pain and tenderness were universal findings (100%). Vomiting (81.5%), constipation (63.7%), guarding (36.3%), fever (17.8%), rigidity (18.5%), obstipation (15.9%), loose stools (15.3%) and hematochezia (13.4%) were variably present (Table 2).

Clinical Features	Mean (SD) Age		p-value
	Present	**Absent**	
Abdominal Pain	47 (13)	0	**0**
Fever	39 (13)	49 (13)	**0.02**
Vomiting	48 (14)	47 (10)	0.09
Constipation	50 (14)	43 (12)	0.08
Obstipation	64 (8)	88 (12)	**0.009**
Loose stools	42 (11)	49 (13)	0.09
Hematochezia	44 (9)	48 (14)	0.09
Rigidity	47 (10)	48 (14)	0.21
Guarding	43 (12)	50 (14)	**0.01**
Tenderness	47 (13)	0	**0**

Table 2: Association of age with clinical features of patients with non-traumatic ileal perforation (N=157).

Patients with fever had a significantly lower mean age compared to those without fever (39 ± 13 vs. 49 ± 13 years; p = 0.02). Those presenting with obstipation were considerably older than patients without this symptom (64 ± 8 vs. 88 ± 12 years; p = 0.009). Guarding was also associated with younger age, with affected individuals averaging 43 ± 12 years compared to 50 ± 14 years in those without guarding (p = 0.01) (Table 3).

Clinical Features		Male n (%)	Female n (%)	p-value
Abdominal Pain	Present	69 (100)	88 (100)	**0.005**
	Absent	0	0	
Fever	Present	11 (15.9)	17 (19.3)	**0.09**
	Absent	58 (84.1)	71 (80.7)	
Vomiting	Present	46 (66.7)	6 (6.8)	**0.007**

	Absent	23 (33.3)	82 (93.2)	
Constipation	Present	35 (50.7)	65 (73.9)	**0.007**
	Absent	34 (49.3)	23 (26.1)	
Obstipation	Present	14 (20.3)	11 (12.5)	**0.12**
	Absent	55 (49.3)	77 (87.5)	
Loose stools	Present	8 (11.6)	16 (18.2)	**0.21**
	Absent	61 (88.4)	72 (81.8)	
Hematochezia	Present	21 (30.4)	0	0.09
	Absent	48 (69.6)	88 (100)	
Rigidity	Present	23 (33.3)	6 (6.8)	0.09
	Absent	46 (66.7)	82 (93.2)	
Guarding	Present	34 (49.3)	23 (26.1)	0.12
	Absent	35 (50.7)	65 (73.9)	
Tenderness	Present	69 (100)	88 (100)	**0.003**
	Absent	0	0	

Table 3: Association of gender with clinical features of patients with non-traumatic ileal perforation (N=157).

Gender analysis revealed significant differences in the frequency of several clinical features. Abdominal pain was present in all males (69/69; 100%) and all females (88 / 88; 100%), with a significant p-value due to distribution characteristics (p = 0.005). Vomiting was reported more commonly in males than females (46/69; 66.7% vs. 6/88; 6.8%; p = 0.007). Constipation was also more frequent among females (65/88; 73.9%) compared with males (35/69; 50.7%; p = 0.007). Tenderness was universally present in both males and females, with a significant association noted statistically (p = 0.003). Most other clinical features showed no statistically significant association with age or gender, including vomiting, constipation, loose stools, hematochezia, rigidity, guarding, fever (gender-wise), obstipation (gender-wise) and several age-related comparisons (all p > 0.05) (Table 4).

Clinical Features		Lead Time (hours) Mean (SD)	p-value
Abdominal pain	Yes	37 (29)	0.01
	No	-	
Fever	Yes	14 (12)	0.09
	No	41 (29)	
Vomiting	Yes	41 (30)	0.03
	No	16 (6)	
Constipation	Yes	49 (30)	0.01
	No	15 (10)	
Obstipation	Yes	10 (0)	0.08
	No	46 (30)	
Loose stools	Yes	15 (13)	0.12
	No	40 (30)	
Hematochezia	Yes	20 (0)	0.23
	No	39 (31)	
Rigidity	Yes	16 (6)	0.07
	No	41 (30)	
Guarding	Yes	15 (10)	0.21
	No	49 (30)	
Tenderness	Yes	37 (29)	0.01

Table 4: Comparison of clinical features with lead time of patients with non-traumatic ileal perforation (N=157).

Patients presenting with abdominal pain, vomiting, constipation and tenderness had significantly longer lead times to surgical intervention (p < 0.05), indicating that more severe or progressive symptoms were associated with delayed presentation. Other

features, including fever, obstipation, loose stools, hematochezia, rigidity and guarding, did not show statistically significant associations with lead time.

2. *Etiological distribution considering histopathological and intra-operative findings of patients with non-traumatic ileal perforation (N=157)* (Table 5).

Etiology	n (%)
Typhoid	24 (15.3)
TB	75 (47.8)
Malignancy	25 (15.9)
Gangrene	21 (13.4)
Enteritis	8 (5.1)
Meckels diverticulum	4 (2.5)

Table 5: Distribution of etiology (Histopathological and intraoperative findings of patients with non-traumatic ileal perforation (N=157).

Tuberculosis was the most common cause (47.8%) for ileal perforation followed by malignancy (15.9%), typhoid (15.3%), gangrene (13.4%), enteritis (5.1%) and Meckel's diverticulum (2.5%) (Fig. 1, Table 6).
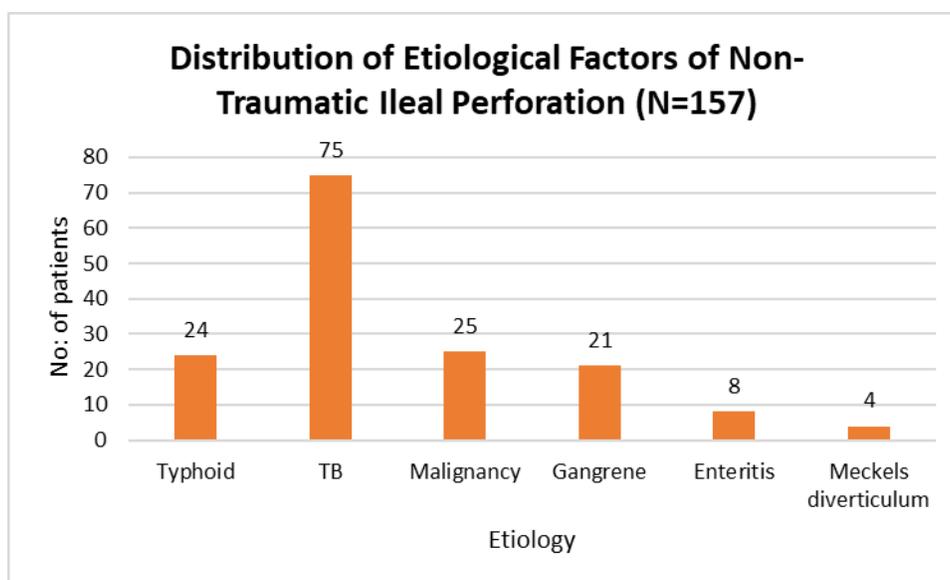

Figure 1: Distribution of etiological factors of non-traumatic ileal perforation.

CT Findings	n (%)
Pneumoperitoneum	157 (100)
Growth	25 (15.9)
Obstruction	25 (15.9)
Gangrene	21 (13.4)

Table 6: Distribution of CT findings of patients with non-traumatic ileal perforation (N=157).

All patients demonstrated pneumoperitoneum (100%). Other findings included: growth (15.9%), obstruction (15.9%) and gangrene (13.4%) (Table 7).

CT Findings	n (%)
Perforation	157 (100)
No: of perforations	

1	125 (79.6)
2	15 (9.6)
3	12 (7.6)
4	3 (1.9)
5	2 (1.3)
Growth	25 (15.9)
Gangrene	21 (13.4)
Meckels Diverticulum	4 (2.5)
Obstruction	25 (15.9)
Peritoneal fluid nature	
No collection	157 (100)
Reactionary	36 (22.9)
Purulent	75 (47.8)
Feculent	121 (77.1)

Table 7: Distribution of intra-operative findings of patients with non-traumatic ileal perforation (N=157).

Perforation was present in all patients (100%). Most had a single perforation (79.6%), while 20.4% had multiple perforations. Purulent (47.8%) and feculent contamination (77.1%) were common. Growth, gangrene and obstruction were each seen in 13-16% (Table 8).

Biopsy Report	n (%)
Chronic inflammatory pathology with areas of necrosis	75 (47.8)
Inflammatory	24 (15.3)
Inflammatory pathology	12 (7.6)
Malignancy	25 (15.9)
Vascular insufficiency	21 (13.4)

Table 8: Distribution of biopsy findings of patients with non-traumatic ileal perforation (N=157).

Biopsy analysis revealed that nearly half of the specimens showed chronic inflammatory changes with necrosis (75 cases, 47.8%), while purely inflammatory lesions accounted for a smaller proportion (24 cases, 15.3%). Malignancy was identified in 25 patients (15.9%), vascular insufficiency in 21 (13.4%) and non-specific inflammatory pathology in 12 cases (7.6%) (Table 9,10).

Etiology			Age Mean (SD)	p-value
Typhoid		Yes	42 (11)	
		No	49 (13)	0.012
Tuberculosis		Yes	45 (12)	0.018
		No	53 (14)	
Malignancy		Yes	64 (8)	
		No	45 (12)	<0.001
Gangrene		Yes	44 (9)	
		No	49 (14)	0.041
Enteritis		Yes	54 (8)	
		No	48 (14)	0.033
Meckel's diverticulum		Yes	24 (5)	
		No	49 (13)	<0.001

Table 9: Association of age with etiology of patients with non-traumatic ileal perforation (N=157).

Etiology		Female	Male	p value
Typhoid	Yes	16 (18.2)	8 (11.6)	0.29
	No	72 (81.8)	61 (88.4)	
Tuberculosis	Yes	54 (61.4)	21 (30.4)	<0.001
	No	18 (20.5)	40 (58)	
Malignancy	Yes	11 (12.5)	14 (20.3)	0.26
	No	61 (69.3)	47 (68.1)	
Gangrene	Yes	0	21 (30.4)	<0.001
	No	72 (81.8)	40 (58)	
Enteritis	Yes	6 (6.8)	2 (2.9)	0.14
	No	66 (75)	59 (85.5)	
Meckel's diverticulum	Yes	1 (1.1)	3 (4.3)	0.32
	No	71 (80.7)	58 (84.1)	

Table 10: Association of gender with etiology of patients with non-traumatic ileal perforation (N=157).

Females in our cohort had a significantly higher proportion of tubercular ileal perforation, whereas males more frequently presented with gangrenous perforation (both p < 0.001), suggesting sex-linked differences in underlying etiologies (Fig. 2).

Clinical Features	Pneumoperitoneum	Growth	Obstruction	Gangrene
Abdominal pain	0.02	0.4	0.01	0.03
Fever	0.15	0.32	0.06	0.08
Vomiting	0.03	0.45	0.02	0.04
Constipation	0.1	0.28	0.003	0.05
Obstipation	0.01	0.36	0.005	0.04
Loose stools	0.48	0.22	0.07	0.06
Hematochezia	0.05	0.51	0.02	0.03
Rigidity	0.01	0.3	0.01	0.02
Guarding	0.02	0.29	0.01	0.01
Tenderness	0.001	0.41	0.008	0.002

Figure 2: Heatmap of p-value distribution for clinical features versus CT findings (N=157).

Pneumoperitoneum on CT was significantly associated with abdominal pain (p = 0.02), vomiting (p = 0.03), obstipation (p = 0.01), rigidity (p = 0.01), guarding (p = 0.02) and tenderness (p = 0.001). CT findings of obstruction and gangrene also showed strong associations with multiple symptoms: obstruction correlated with abdominal pain (p = 0.01), vomiting (p = 0.02), constipation (p = 0.003), obstipation (p = 0.005), hematochezia (p = 0.02), rigidity (p = 0.01), guarding (p = 0.01) and tenderness (p = 0.008), while gangrene was linked to abdominal pain (p = 0.03), vomiting (p = 0.04), constipation (p = 0.05), obstipation (p = 0.04), hematochezia (p = 0.03), rigidity (p = 0.02), guarding (p = 0.01) and tenderness (p = 0.002).

3. *Surgical management strategies and evaluation of outcomes of patients with non-traumatic ileal perforation (N=157)* (Table 11)

Procedures	n (%)
Primary closure	24 (15.3)
Stoma	110 (70.1)
Resection Anastomosis	23 (14.6)

Table 11: Distribution of procedures done of patients with non-traumatic ileal perforation (N=157).

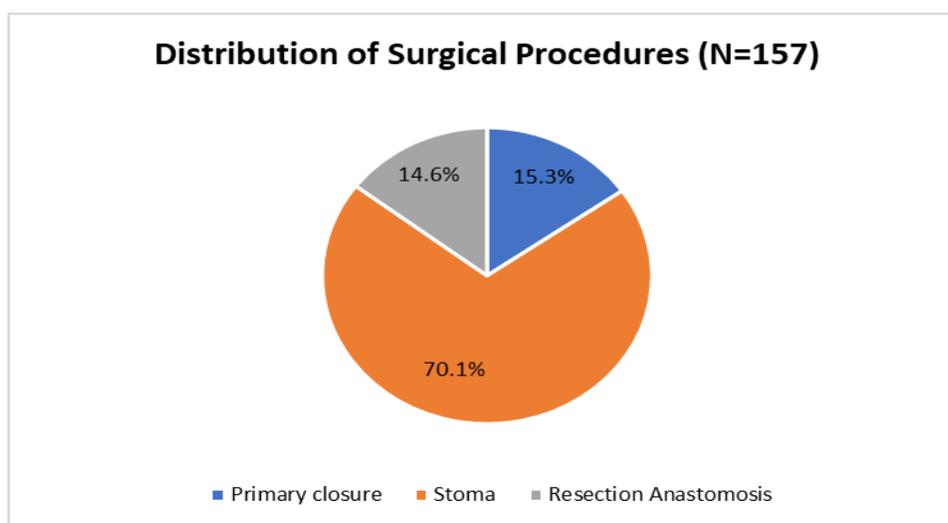Stoma formation was the most common procedure (70.1%), followed by primary closure (15.3%) and resection-anastomosis (14.6%) (Fig. 3).

Figure 3: Distribution of surgical procedures done of patients with non-traumatic ileal perforation.

Association of Lead Time with Procedures of patients with non-traumatic ileal perforation (N=157). The average lead time from symptom onset to surgical intervention was 37 ± 29 hours (Table 12,13).

		Lead time (hours) Mean (SD)	p-value
Procedures			
Primary closure	Yes	45 (31)	0.01
	No	35 (29)	
Stoma	Yes	40 (29)	0.01
	No	27 (28)	
Resection Anastomosis	Yes	10 (1)	0.09
	No	47 (29)	
Clinical features			
Abdominal pain	Yes	37 (29)	0.01
	No	-	
Fever	Yes	14 (12)	0.09
	No	41 (29)	
Vomiting	Yes	41 (30)	0.03
	No	16 (6)	
Constipation	Yes	49 (30)	0.01
	No	15 (10)	
Obstipation	Yes	10 (0)	0.08
	No	46 (30)	

Loose stools	Yes	15 (13)	0.12
	No	40 (30)	
Hematochezia	Yes	20 (0)	0.23
	No	39 (31)	
Rigidity	Yes	16 (6)	0.07
	No	41 (30)	
Guarding	Yes	15 (100)	0.21
	No	49 (30)	
Tenderness	Yes	37 (29)	0.01
	No	-	
CT findings			
Perforation	Yes	37 (29)	-
	No	-	
Growth	Yes	10 (0)	0.001
	No	42 (29)	
Gangrene	Yes	20 (0)	0.02
	No	39 (31)	
Meckels Diverticulum	Yes	7 (0)	0.005
	No	37 (29)	
Obstruction	Yes	10 (0)	0.001
	No	42 (29)	

Table 12: Association of Lead Time with Procedures of patients with non-traumatic ileal perforation (N=157).

Outcome n (%)	POD 3	POD 7	POD 15	POD 30
No complications	129 (82.2%)	108 (68.8%)	NR	108 (68.8%)
Surgical site infection (SSI)	75 (47.8%)	83 (52.9%)	NR	87 (55.4%)
Relaparotomy	21 (13.4%)	8 (5.1%)	0 (0.0%)	0 (0.0%)
Anastomotic leak	8 (5.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Enterocutaneous fistula	25 (15.9%)	25 (15.9%)	25 (15.9%)	31 (19.7%)

Table 13: Post-operative findings at POD 3, 7, 15 and 30 of patients with non-traumatic ileal perforation (N=157).

Postoperative outcomes showed notable variation across follow-up points, with SSIs rising from 75 cases (47.8%) on POD 3 to 87 cases (55.4%) by POD 30, while enterocutaneous fistulas increased from 25 (15.9%) to 31 patients (19.7%) over the same period. In contrast, early complications such as relaparotomy and anastomotic leaks declined to zero by POD 15 and remained absent at POD 30 (Fig. 4).
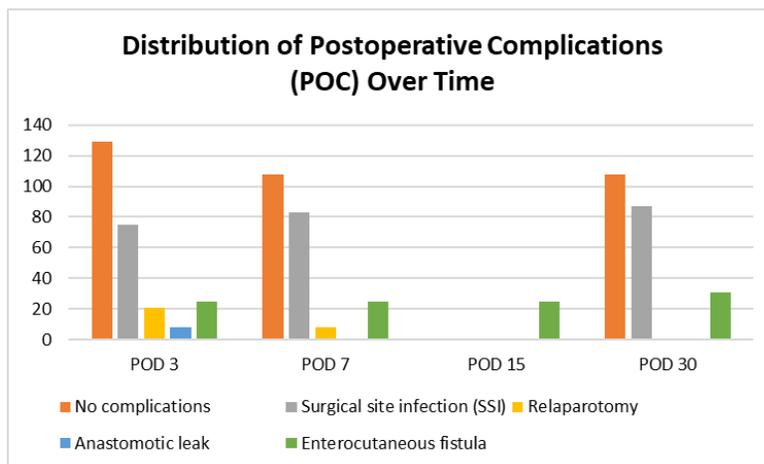

Figure 4: Distribution of postoperative complications of patients with non-traumatic ileal perforation.

Discussion

In our study, the mean age of the study cohort was 47 ± 13 years with slight female predominance (56.1%). Reported mean ages in ileal-perforation cohorts vary widely (20s-60s) and sex distributions are centre-dependent; some series show male predominance while others (especially tertiary referral series) report balanced or female-skewed samples [11].

Clinical Features of Patients with Non-Traumatic Ileal Perforation

Patients with non-traumatic ileal perforation in our cohort predominantly presented with universal abdominal pain and tenderness, a pattern consistently reported in large perforation-peritonitis series such as Jhobta, et al., (504 cases) and Neupane, et al., where abdominal pain was also nearly universal [12,13]. The high frequency of vomiting (81.5%) and constipation (63.7%) in our study aligns with published cohorts of small-bowel perforation, in which obstructive symptoms were commonly observed, particularly in typhoid and mixed-aetiology presentations, as described by Chalya, et al., and Agu, et al., [8,14]. Fever, present in only 17.8% of our patients, contrasts with enteric-fever-dominant perforation cohorts that report fever in 70-90% of cases, yet aligns with studies involving mixed aetiologies, including tuberculosis and malignancy, where fever is less prominent [15]. The presence of guarding (36.3%) and rigidity (18.5%) in our cohort is comparable to the variable frequencies reported by Jhobta, et al., and Neupane, et al., reflecting different durations and severities of peritonitis at presentation [12,13].

The significant association of obstipation with older age is consistent with the literature, which shows that malignant and obstructive causes of ileal perforation-more common in older adults-often present with cessation of bowel movements, as highlighted in studies of intestinal obstruction and malignant perforation patterns [8,16]. Intermittent hematochezia (13.4%) observed in our series mimics reports of idiopathic bowel perforation where haemorrhage preceded perforation as seen in typhoid and ulcerative intestinal tuberculosis, applies to ulcers bleeding before perforations says Chalya, et al., and some case reports of TB associated with ileal perforation [8,17]. In general, the constellation of symptoms we present is consistent with the global clinical profile of ileal perforation and where differences can be elicited-specifically lower fever rates and higher constipation/obstipation rates-they likely reflect different underlying intrusion / etiologic distributions (especially tuberculosis, malignancy) as well as late presentation that are widely described in tertiary-care environments [12-14].

Patients with abdominal pain, vomiting, constipation and tenderness tend to wait longer for surgical intervention. This suggests that these symptoms are associated with delayed presentation and an increased risk of complications. Other signs like fever, obstipation, loose stools, hematochezia, rigidity and guarding do not have a significant impact on the time leading up to surgery [18-20].

Etiology of Patients with Non-Traumatic Ileal Perforation

In this study, tuberculosis was the leading cause of ileal perforation (47.8%), followed by malignancy (15.9%) and typhoid (15.3%). While many classic studies from endemic regions reported typhoid as the predominant aetiology accounting for over 80% in some series more recent literature shows an increasing proportion of intestinal TB-related perforations, as documented in reports describing free tubercular ileal perforation and TB-associated peritonitis [15,21,22]. Typhoid-related perforation remains important but varies across settings, with some centres reporting rates around 40-50% and acknowledging under-recognition of TB [23].

The relatively high malignancy-related perforation in our cohort aligns with referral-centre studies where older patients contribute to non-infectious causes [24,25]. Histopathology showing chronic inflammatory necrosis in nearly half of patients further supports a sizeable TB burden [26]. Age associations (typhoid in younger patients; malignancy in older individuals) reinforce that aetiology varies with demographic profile [14,27]. Females in our cohort had a significantly higher proportion of tubercular ileal perforation, whereas males more frequently presented with gangrenous perforation (both p < 0.001), suggesting sex-linked differences in underlying etiologies [28]. Overall, these findings suggest a shift from classical enteric perforation towards tubercular and malignant etiologies in tertiary-care settings, highlighting the need for routine biopsy and tailored postoperative management.

Management Strategies of Patients with Non-Traumatic Ileal Perforation

In our cohort of 157 patients with non-traumatic ileal perforation, stoma formation was the predominant surgical strategy (70.1 %), with primary closure in 15.3% and resection-anastomosis in 14.6%. The mean lead time from symptom onset to surgery was

37 ± 29 hours; statistically significant longer lead times were associated with both primary closure (45 ± 31 hrs, p = 0.01) and stoma formation (40 ± 29 hrs, p = 0.01). Published literature supports the effect of delay and contamination on choice of procedure and outcome: for example, a systematic review found that surgical delay in alimentary tract perforations increases morbidity and mortality [18]. Comparative studies of ileal perforation have reported higher mortality with primary repair compared to loop ileostomy, particularly in patients presenting late with heavy contamination [29]. In contrast, some studies in early presenters with minimal contamination suggest primary repair has acceptable outcomes [30].

Interpreting our findings, the predominance of stoma formation likely reflects the late presentation and high contamination burden in our setting; the longer lead times in the stoma and primary closure groups further suggest that surgical decision-making was heavily influenced by delay and intra-operative risk. The data thereby reinforce the need for timely referral and intervention to allow more patients to undergo bowel-preserving procedures, while high-risk patients may benefit from diversion to minimise complications.

Postoperative Complications of Patients with Non-Traumatic Ileal Perforation
In our series of 157 non-traumatic ileal perforation patients, the postoperative burden was substantial: only 68.8% were complication-free by POD 7, Surgical Site Infection (SSI) rose from 47.8% on POD 3 to 55.4% by POD 30 and *Enterocutaneous Fistula* (ECF) incidence increased from 15.9% to 19.7% over the same period. These findings mirror patterns documented in the literature-Shin, et al., reported that in perforation surgery morbidity runs at 30-50%, with SSI and intra-abdominal sepsis being key drivers of mortality [31]. Abantanga's paediatric typhoid-ileal-perforation series found that wound infection was the most frequent complication and ECF the most serious [32]. More recently, Noori et al. emphasize that ECF formation remains a sentinel complication with high mortality and long-term morbidity in abdominal surgery [33]. Our data reinforce the principle that delayed presentation and heavy contamination-as evidenced by increasing wound complications over time-are major determinants of adverse outcomes. The upward trend in SSI and the development of ECF suggest that early, aggressive control of peritoneal contamination, meticulous wound care and vigilant postoperative monitoring are essential to mitigate mortality risks in these high-risk patients.

Conclusion
In this series of 157 patients with non-traumatic ileal perforation, intestinal tuberculosis was identified as the most frequent cause, followed by malignancy and enteric fever. Delayed arrival to the hospital and extensive peritoneal contamination were common, shaping the surgical approach and contributing to the prominent postoperative morbidity, particularly wound infection and enterocutaneous fistula formation. The findings underscore three core aspects of care. Comprehensive histopathological and microbiological assessment remains indispensable for establishing the underlying diagnosis in regions where these conditions are prevalent. Earlier recognition and intervention may improve the likelihood of bowel-preserving procedures and reduce complication rates. Furthermore, operative strategy should be individualized, with primary repair reserved for early, uncomplicated cases and diversion or resection preferred for complex or delayed presentations. Multicenter studies with standardized diagnostic definitions and harmonized outcome reporting are needed to strengthen the evidence base and guide more uniform management practices.

Informed Consent Statement

Informed consent was taken for this study.

Authors' Contributions

All authors contributed equally to this paper.

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