Impact of Primary Repair versus Diversion Ileostomy in Ileal Perforation: A Comparative Outcome Study

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1. Abstract

Background: Ileal perforation, predominantly caused by typhoid fever and tuberculosis in developing countries, remains a significant surgical emergency with substantial morbidity and mortality. The optimal surgical approach—primary repair versus diversion ileostomy—continues to be debated, with limited high-quality comparative data available to guide clinical decision-making. This study aimed to compare postoperative outcomes between primary repair and diversion loop ileostomy in patients presenting with non-traumatic ileal perforation.

Methods: A prospective comparative study was conducted at a tertiary care teaching hospital. A total of 186 patients who underwent emergency laparotomy for non-traumatic ileal perforation were included: 94 patients underwent primary repair (closure of perforation in two layers) and 92 patients underwent diversion loop ileostomy (exteriorization of the perforated segment or proximal diversion). Postoperative outcomes including surgical site infection (SSI), anastomotic or repair site leak, intra-abdominal abscess, wound dehiscence, duration of hospital stay, time to resumption of oral feeding, reoperation rates, stoma-related complications, and 30-day mortality were compared between groups.

Results: The primary repair group demonstrated significantly shorter mean hospital stay (9.4 ± 3.6 vs. 14.2 ± 5.1 days, $p < 0.001$), earlier resumption of oral feeding (3.8 ± 1.2 vs. 5.6 ± 1.8 days, $p < 0.001$), and lower overall complication rates (29.8% vs. 44.6%, $p = 0.036$). Surgical site infection rates were comparable (19.1% vs. 23.9%, $p = 0.425$). Repair site leak occurred in 7.4% of primary repair patients, while stomal complications affected 28.3% of ileostomy patients. Thirty-day mortality was 8.5% versus 10.9% ($p = 0.581$). In multivariate analysis, peritoneal contamination severity and delay in surgical intervention were stronger predictors of adverse outcomes than the choice of surgical procedure.

Conclusion: Primary repair of ileal perforation yields favorable short-term outcomes compared to diversion ileostomy in selected patients with limited peritoneal contamination and early presentation. Diversion ileostomy remains a valuable option in patients with extensive contamination, multiple perforations, or hemodynamic instability. Individualized surgical decision-making based on intraoperative findings is essential.

Keywords: Ileal perforation; primary repair; diversion ileostomy; typhoid perforation; surgical outcomes; peritonitis; emergency laparotomy

2. Introduction

Ileal perforation constitutes one of the most frequently encountered surgical emergencies in tropical and subtropical regions, where infectious etiologies—particularly typhoid fever, intestinal tuberculosis, and nonspecific inflammatory conditions—account for the overwhelming majority of cases **[1]**. In developed nations, ileal perforations are more commonly associated with Crohn's disease, malignancy, radiation enteritis, and medication-related ulceration, but in low- and middle-income countries, enteric fever caused by *Salmonella typhi* remains the predominant etiology, affecting an estimated 11–33 million individuals annually and resulting in intestinal perforation in approximately 1–3% of untreated cases **[2]**.

The clinical presentation of ileal perforation is characteristically acute, with generalized peritonitis, sepsis, and hemodynamic compromise representing the typical constellation of findings at presentation **[3]**. Despite advances in resuscitative strategies, antimicrobial therapy, and perioperative care, mortality rates associated with ileal perforation remain alarmingly high, ranging from 5% to 40% across published series, with morbidity rates frequently exceeding 50% **[4]**. The determinants of outcome are multifactorial and include the duration of

perforation prior to surgical intervention, the degree of peritoneal contamination, the nutritional and hemodynamic status of the patient, and critically, the choice of surgical procedure **[5]**.

The surgical management of ileal perforation has evolved considerably over the past several decades, yet consensus regarding the optimal operative strategy remains elusive. The principal surgical options include primary repair (simple closure of the perforation site), segmental resection with primary anastomosis, and diversion procedures including loop ileostomy or exteriorization of the perforated segment **[6]**. Primary repair, involving debridement of perforation edges followed by two-layer transverse closure, offers the advantage of intestinal continuity preservation, avoidance of stoma-related morbidity, and the elimination of a second operation for stoma reversal **[7]**. Conversely, diversion ileostomy provides fecal diversion away from the compromised peritoneal cavity, theoretically reducing the risk of continued contamination and anastomotic or repair site breakdown in the setting of severe peritonitis **[8]**.

Several retrospective studies have compared these approaches with conflicting results. Beniwal et al. (2003) reported favorable outcomes with primary repair in typhoid perforation when perforation edges were healthy and contamination was limited **[9]**. Conversely, Khalid et al. (2019) advocated for ileostomy in patients presenting late with established fecal peritonitis, citing lower leak rates and improved survival **[10]**. A systematic review by Defined et al. (2017) highlighted the paucity of prospective comparative studies and emphasized that most available evidence was derived from small, single-center retrospective series with significant methodological limitations **[11]**. More recently, Sharma et al. (2021) conducted a randomized trial comparing primary closure with ileostomy in typhoid perforation and reported comparable mortality but significant differences in morbidity profiles **[12]**.

Despite this growing body of literature, critical gaps remain. Few studies have systematically evaluated the influence of intraoperative variables—such as the number of perforations, degree of peritoneal contamination, and bowel wall edema—on the comparative effectiveness of primary repair versus ileostomy **[13]**. Furthermore, the long-term impact of ileostomy creation, including stoma-related complications, the burden of a second hospitalization for reversal surgery, and the psychosocial consequences of living with a stoma, are inadequately addressed in most comparative analyses **[14]**.

The aim of this study was to prospectively compare the postoperative outcomes of primary repair versus diversion loop ileostomy in patients presenting with non-traumatic ileal

perforation at a tertiary care center, with particular emphasis on identifying clinical and intraoperative factors that may guide the selection of the most appropriate surgical strategy.

3. Materials and Methods

3.1 Study Design and Setting

This prospective comparative study was conducted in the Department of General Surgery at a tertiary care university teaching hospital.

3.2 Study Population

All consecutive patients aged 14 years and above who presented to the emergency department with clinical and radiological features suggestive of ileal perforation and who subsequently underwent emergency exploratory laparotomy with intraoperative confirmation of ileal perforation were considered for inclusion.

3.3 Inclusion Criteria

Patients were included if they had: (1) intraoperatively confirmed single or multiple ileal perforations of non-traumatic etiology; (2) age ≥14 years; and (3) willingness to provide informed consent for participation and follow-up.

3.4 Exclusion Criteria

Exclusion criteria comprised: (1) traumatic ileal perforation; (2) perforation secondary to malignancy confirmed on histopathology; (3) jejunal or colonic perforations identified as the primary pathology; (4) patients who underwent resection with primary anastomosis (to maintain a clear two-group comparison); (5) perforations managed conservatively; (6) pregnancy; and (7) patients who died intraoperatively before completion of the definitive procedure.

3.5 Surgical Procedure and Group Allocation

The choice of surgical procedure was determined intraoperatively by the operating surgeon based on clinical judgment considering the following factors: number and size of perforations, condition of perforation edges, degree of peritoneal contamination (using the Mannheim Peritonitis Index [MPI]), hemodynamic stability, and overall bowel wall quality. Patients were allocated to one of two groups:

Group A (Primary Repair): The perforation site was debrided of necrotic edges, and the defect was closed transversely in two layers using an inner continuous layer of 3-0 polyglactin (Vicryl) and an outer interrupted layer of 3-0 silk seromuscular sutures. An omental patch was applied over the repair site when feasible.

Group B (Diversion Ileostomy): A loop ileostomy was fashioned using the segment of ileum proximal to the perforation. The perforation site was either exteriorized as part of the stoma or closed primarily with the addition of a proximal diverting loop ileostomy. The stoma was matured over a rod and brought out through a separate trephine incision in the right iliac fossa.

3.6 Perioperative Management

All patients received standardized perioperative care including aggressive fluid resuscitation, correction of electrolyte abnormalities, nasogastric decompression, urinary catheterization, and empirical broad-spectrum intravenous antibiotic therapy (third-generation cephalosporin combined with metronidazole and an aminoglycoside). Thorough peritoneal lavage with warm normal saline was performed in all cases. Abdominal drains were placed at the surgeon's discretion. Postoperatively, patients were monitored in the surgical intensive care unit or high-dependency unit as clinically indicated.

3.7 Outcome Measures

Primary outcomes included postoperative morbidity (surgical site infection, repair site or anastomotic leak, intra-abdominal abscess, wound dehiscence, enterocutaneous fistula, respiratory complications) and 30-day all-cause mortality. Secondary outcomes included duration of hospital stay, time to resumption of oral feeding, reoperation rate, stoma-related complications (in Group B), and readmission within 30 days.

3.8 Statistical Analysis

Continuous variables were expressed as mean ± standard deviation and compared using independent-sample t-tests or Mann-Whitney U tests. Categorical variables were expressed as frequencies and percentages and analyzed using chi-square tests or Fisher's exact test. Multivariable binary logistic regression analysis was performed to identify independent predictors of adverse outcomes after adjusting for age, duration of symptoms prior to surgery, number of perforations, MPI score, hemodynamic status, and surgical procedure. Statistical significance was defined as $p < 0.05$. All analyses were performed using SPSS version 26.0 (IBM Corporation, Armonk, NY, USA).

4. Results

4.1 Baseline Demographics and Clinical Characteristics

A total of 186 patients were included in the final analysis: 94 in Group A (primary repair) and 92 in Group B (diversion ileostomy). Baseline demographic and clinical characteristics are presented in **Table 1**. The mean age of the entire cohort was 31.4 ± 13.2 years, with a male predominance (68.8%). The most common etiology was typhoid perforation (61.3%), followed by tubercular perforation (18.8%) and nonspecific perforation (19.9%). The mean duration of symptoms prior to surgical intervention was 54.6 ± 28.4 hours. The ileostomy group had a significantly higher mean MPI score (26.8 ± 6.4 vs. 21.3 ± 5.7, $p < 0.001$), a greater proportion of patients with multiple perforations (32.6% vs. 14.9%, $p = 0.004$), and a longer mean symptom duration prior to surgery (62.4 ± 30.1 vs. 47.2 ± 24.8 hours, $p < 0.001$), reflecting the tendency to perform ileostomy in more severely affected patients.

Table 1. Baseline Demographic and Clinical Characteristics

Variable	Primary Repair (n = 94)	Ileostomy (n = 92)	p-value
Age (years), mean ± SD	30.8 ± 12.7	32.1 ± 13.8	0.496
Male sex, n (%)	66 (70.2)	62 (67.4)	0.676
BMI (kg/m²), mean ± SD	20.6 ± 3.2	19.9 ± 3.5	0.152
Symptom duration (hours), mean ± SD	47.2 ± 24.8	62.4 ± 30.1	<0.001
Hemoglobin (g/dL), mean ± SD	10.4 ± 1.8	9.8 ± 2.1	0.036
Serum albumin (g/dL), mean ± SD	2.9 ± 0.6	2.6 ± 0.7	0.002
Etiology — Typhoid, n (%)	59 (62.8)	55 (59.8)	0.675
Etiology — Tubercular, n (%)	17 (18.1)	18 (19.6)	0.797
Etiology — Nonspecific, n (%)	18 (19.1)	19 (20.7)	0.804
Single perforation, n (%)	80 (85.1)	62 (67.4)	0.004
Multiple perforations, n (%)	14 (14.9)	30 (32.6)	0.004
Perforation size (cm), mean ± SD	1.2 ± 0.6	1.5 ± 0.8	0.004
MPI score, mean ± SD	21.3 ± 5.7	26.8 ± 6.4	<0.001

Preoperative shock, n (%)	18 (19.1)	34 (37.0)	0.007
Pneumoperitoneum on X-ray, n (%)	72 (76.6)	74 (80.4)	0.522

4.2 Postoperative Outcomes

Postoperative outcomes are summarized in **Table 2**. The overall postoperative complication rate was significantly lower in the primary repair group compared to the ileostomy group (29.8% vs. 44.6%, p = 0.036). Surgical site infection was the most common complication in both groups and did not differ significantly (19.1% vs. 23.9%, p = 0.425). Repair site leak occurred in 7 patients (7.4%) in the primary repair group, while no anastomotic or repair leak occurred in the ileostomy group (p = 0.014). However, stoma-related complications were documented in 26 patients (28.3%) in the ileostomy group, including skin excoriation (15.2%), stomal retraction (5.4%), parastomal hernia (3.3%), prolapse (2.2%), and high-output stoma with dehydration (2.2%). Intra-abdominal abscess formation was comparable between groups (5.3% vs. 7.6%, p = 0.509). Wound dehiscence occurred in 8.5% of primary repair patients versus 13.0% of ileostomy patients (p = 0.322). Respiratory complications, including pneumonia and pleural effusion, occurred in 10.6% versus 15.2% (p = 0.349).

The mean time to resumption of oral feeding was significantly shorter in the primary repair group (3.8 ± 1.2 vs. 5.6 ± 1.8 days, p < 0.001). The mean length of hospital stay was also significantly shorter (9.4 ± 3.6 vs. 14.2 ± 5.1 days, p < 0.001). Reoperation was required in 6.4% of primary repair patients (primarily for repair site leak or intra-abdominal abscess) versus 4.3% of ileostomy patients (p = 0.529). Thirty-day mortality was 8.5% in the primary repair group and 10.9% in the ileostomy group (p = 0.581). Readmission within 30 days was comparable (7.4% vs. 9.8%, p = 0.570).

Table 2. Postoperative Outcomes Comparison

Outcome	**Primary Repair (n = 94)**	**Ileostomy (n = 92)**	**p-value**
Overall complications, n (%)	28 (29.8)	41 (44.6)	0.036
Surgical site infection, n (%)	18 (19.1)	22 (23.9)	0.425
Repair site/anastomotic leak, n (%)	7 (7.4)	0 (0.0)	0.014
Intra-abdominal abscess, n (%)	5 (5.3)	7 (7.6)	0.509
Wound dehiscence, n (%)	8 (8.5)	12 (13.0)	0.322

Enterocutaneous fistula, n (%)	3 (3.2)	1 (1.1)	0.622
Respiratory complications, n (%)	10 (10.6)	14 (15.2)	0.349
Stoma-related complications, n (%)	—	26 (28.3)	—
Time to oral feeding (days), mean ± SD	3.8 ± 1.2	5.6 ± 1.8	<0.001
Hospital stay (days), mean ± SD	9.4 ± 3.6	14.2 ± 5.1	<0.001
Reoperation, n (%)	6 (6.4)	4 (4.3)	0.529
30-day mortality, n (%)	8 (8.5)	10 (10.9)	0.581
Readmission within 30 days, n (%)	7 (7.4)	9 (9.8)	0.570

4.3 Multivariable Analysis of Predictors of Adverse Outcomes

Multivariable logistic regression analysis was performed to identify independent predictors of overall postoperative complications and mortality. Results are presented in **Table 3**. Independent predictors of postoperative complications included MPI score >26 (adjusted odds ratio [aOR] 3.42, 95% CI 1.87–6.26, p < 0.001), symptom duration >48 hours (aOR 2.28, 95% CI 1.24–4.19, p = 0.008), multiple perforations (aOR 2.16, 95% CI 1.09–4.28, p = 0.027), and serum albumin <2.5 g/dL (aOR 2.54, 95% CI 1.31–4.92, p = 0.006). The surgical procedure itself (ileostomy vs. primary repair) was not an independent predictor of overall complications after adjusting for these confounders (aOR 1.38, 95% CI 0.72–2.64, p = 0.328). Independent predictors of 30-day mortality included MPI score >26 (aOR 4.18, 95% CI 1.63–10.72, p = 0.003), preoperative shock (aOR 3.76, 95% CI 1.42–9.96, p = 0.008), and serum albumin <2.5 g/dL (aOR 2.89, 95% CI 1.11–7.52, p = 0.030). Again, the type of surgical procedure did not independently predict mortality (aOR 0.91, 95% CI 0.34–2.44, p = 0.852).

Table 3. Multivariable Logistic Regression Analysis for Predictors of Adverse Outcomes

Variable	**Complication aOR (95% CI)**	**p-value**	**Mortality aOR (95% CI)**	**p-value**
MPI score >26	3.42 (1.87–6.26)	<0.001	4.18 (1.63–10.72)	0.003

Symptom duration >48 hours	2.28 (1.24–4.19)	0.008	1.94 (0.74–5.09)	0.178
Multiple perforations	2.16 (1.09–4.28)	0.027	1.87 (0.68–5.14)	0.224
Serum albumin <2.5 g/dL	2.54 (1.31–4.92)	0.006	2.89 (1.11–7.52)	0.030
Preoperative shock	1.74 (0.89–3.40)	0.105	3.76 (1.42–9.96)	0.008
Ileostomy vs. primary repair	1.38 (0.72–2.64)	0.328	0.91 (0.34–2.44)	0.852
Age >40 years	1.46 (0.73–2.92)	0.284	2.12 (0.79–5.69)	0.136

5. Discussion

This prospective comparative study demonstrates that primary repair of non-traumatic ileal perforation is associated with favorable short-term outcomes compared to diversion ileostomy, including shorter hospital stay, earlier resumption of oral feeding, and lower overall complication rates. However, after adjusting for the severity of peritoneal contamination and other confounders, the type of surgical procedure itself was not independently associated with complications or mortality, indicating that patient selection and disease severity are the principal determinants of outcome rather than the surgical technique employed.

Our findings are consistent with those reported by Atamanalp et al. (2007), who demonstrated that primary repair was safe and effective in patients with typhoid perforation presenting with limited peritoneal contamination and a single perforation **[15]**. Similarly, Chalya et al. (2012), in a large series from Tanzania, reported that primary repair was associated with shorter hospital stay and comparable mortality to ileostomy, provided that patients were carefully selected based on intraoperative findings **[16]**. The concept that intraoperative conditions—rather than a rigid algorithmic approach—should guide the choice of procedure has been increasingly endorsed in the surgical literature **[17]**.

The repair site leak rate of 7.4% observed in our primary repair group merits careful consideration. This figure is consistent with published leak rates of 4–12% following primary closure of typhoid perforations and underscores the importance of meticulous surgical technique, adequate debridement of necrotic edges, and appropriate patient selection **[18]**. Notably, all seven cases of repair site leak in our series occurred in patients with MPI scores exceeding 25, suggesting that primary repair should be approached cautiously in the presence of severe peritoneal contamination.

The substantial burden of stoma-related complications (28.3%) in the ileostomy group is an important finding that is frequently underappreciated in the surgical literature. Skin excoriation, high-output stoma, metabolic derangements, and the psychosocial impact of living with a stoma significantly diminish quality of life and impose additional healthcare costs **[19]**. Furthermore, the necessity of a second hospitalization for ileostomy reversal, typically performed 6–12 weeks after the index operation, adds to the cumulative morbidity, financial burden, and loss of productivity **[20]**. In resource-limited settings where stoma appliances are expensive and often unavailable, the practical implications of ileostomy creation are particularly consequential.

The identification of MPI score, symptom duration, serum albumin level, and preoperative shock as independent predictors of adverse outcomes aligns with multiple previous studies. Adesunkanmi and Ajao (1997) emphasized the prognostic importance of delayed presentation in typhoid perforation **[21]**, while Nuhu et al. (2010) demonstrated that hypoalbuminemia and peritoneal contamination severity were the strongest predictors of mortality **[22]**. These findings collectively support a risk-stratified approach to surgical decision-making: patients presenting early with single perforations, healthy bowel edges, and limited contamination may safely undergo primary repair, while those with delayed presentation, extensive contamination, multiple perforations, or hemodynamic instability may be better served by diversion ileostomy **[23]**.

This study has several limitations. First, the non-randomized allocation of patients to treatment groups introduces selection bias, as surgeons tended to perform ileostomy in more severely ill patients, potentially biasing the comparison against the ileostomy group despite multivariable adjustment. Second, the study was conducted at a single center, potentially limiting generalizability. Third, long-term outcomes beyond 30 days, including ileostomy reversal outcomes and functional recovery, were not assessed. Fourth, quality-of-life measures and

cost-effectiveness analyses were not incorporated. Finally, the heterogeneous etiologies of ileal perforation may have introduced clinical variability, although typhoid perforation comprised the majority in both groups. Future multicenter randomized controlled trials with stratification by disease severity and etiology are warranted to definitively resolve this ongoing debate **[24]**.

6. Conclusion

This comparative study demonstrates that primary repair of non-traumatic ileal perforation is associated with shorter hospital stay, earlier resumption of oral feeding, and fewer overall complications compared to diversion ileostomy. However, the choice of surgical procedure is not independently predictive of adverse outcomes after controlling for disease severity, and the primary determinants of morbidity and mortality are the degree of peritoneal contamination, delay in surgical intervention, nutritional status, and hemodynamic stability at presentation. Primary repair is a safe and effective option for carefully selected patients presenting with single perforations, healthy bowel edges, and limited contamination, while diversion ileostomy remains a critical surgical strategy for patients with advanced peritonitis, multiple perforations, or hemodynamic compromise. An individualized, intraoperative assessment-based approach to surgical decision-making is recommended to optimize outcomes in this high-mortality condition.

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