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Original Article

Comparison of Outcome of Primary Closure with Ileostomy in Enteric Perforation

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ABSTRACT

Background: Enteric fever remains a significant health problem in low-resource settings, often leading to complications such as ileal perforation that require urgent surgical management. The choice between primary closure and ileostomy remains controversial due to differing outcomes in terms of wound infection and hospital stay. Objective: To compare wound infection rates between primary closure and ileostomy in patients with enteric ileal perforation. Methods: This randomized controlled trial was conducted at Lady Reading Hospital, MTI Peshawar, Pakistan, between October 2024 and March 2025. Eighty-six patients aged 18–75 years with radiologically confirmed ileal perforation and positive typhoid serology were randomized to primary closure (Group A) or ileostomy (Group B). All surgeries were performed by a single experienced surgeon. Postoperative wound infection rates and hospital stay were compared using Chi-square and t-tests, with significance set at $p<0.05$. Results: Group A showed a significantly higher wound infection rate of 34.9% compared to 14.0% in Group B ($p=0.024$; OR 3.29, 95% CI 1.10–9.87). However, Group A had a shorter mean hospital stay (7.23 ± 0.92 days) than Group B (10.20 ± 1.61 days; $p<0.001$). Education level was significantly associated with wound infection ($p=0.04$). Conclusion: Ileostomy significantly reduced wound infections compared to primary closure, suggesting its advantage in managing enteric perforation, particularly for high-risk patients, despite longer hospitalization.

Keywords: *Enteric perforation; wound infection; primary closure; ileostomy; typhoid fever; randomized controlled trial*

INTRODUCTION

Enteric fever continues to pose a significant public health burden in low- and middle-income countries, particularly where sanitation and clean water access remain inadequate, resulting in a high incidence of complications such as intestinal perforation (1,2). Typhoid-related ileal perforation occurs in approximately 2–3% of cases and predominantly affects young adults, leading to severe morbidity and mortality if diagnosis or surgical intervention is delayed (3,4). The underlying pathology involves hyperplasia and necrosis of Peyer's patches caused by Salmonella enterica serovar Typhi, which disrupts intestinal integrity and predisposes to full-thickness perforation, releasing enteric contents into the peritoneal cavity and precipitating peritonitis (5). Clinically, patients often present with persistent fever, abdominal pain, and radiological evidence of pneumoperitoneum, necessitating emergency surgical intervention within a narrow therapeutic window to reduce septic complications (6,7).

While surgical management remains the cornerstone of treatment, the choice between primary closure of the perforation and the creation of a protective ileostomy has generated significant debate, especially in resource-constrained settings where perioperative care may be limited (8). Primary closure, performed by directly suturing the perforation, is appealing due to its technical simplicity, shorter operative time, and the avoidance of stoma-related morbidity and psychosocial distress (9). However, primary closure carries a heightened risk of postoperative wound infection and intra-abdominal sepsis, particularly in patients who present late or with gross peritoneal contamination, which may exacerbate morbidity and prolong hospitalization (9,10). Conversely, ileostomy diverts intestinal contents away from the perforation site, theoretically reducing the risk of wound contamination and facilitating safer postoperative recovery, yet it introduces complications such as electrolyte imbalances, stoma-related skin excoriation, fluid loss, and the eventual need for a second operation for stoma reversal (11,12). Existing literature reflects conflicting evidence regarding wound infection rates between these two surgical strategies. Some studies have reported significantly higher wound infection rates following primary closure compared to ileostomy, suggesting a protective role for diversion in contaminated surgical fields (9). In contrast, other reports indicate increased wound-related morbidity and longer hospital stays associated with ileostomy, highlighting the potential disadvantages of stoma creation and the impact

on patient quality of life (10,11). This inconsistency underscores a critical knowledge gap regarding the optimal surgical approach for enteric perforation in high-risk populations, particularly in regions where patients frequently present late and perioperative resources are variable (12,13). Given these clinical uncertainties, it remains imperative to generate high-quality comparative data to inform surgical decision-making for typhoid ileal perforation. This study was therefore designed to compare the outcomes, specifically postoperative wound infection rates, between primary closure and ileostomy in patients undergoing surgery for enteric perforation. We hypothesized that ileostomy would be associated with a lower incidence of wound infection than primary closure, reflecting its role in minimizing peritoneal contamination and improving surgical outcomes in this vulnerable patient population.

MATERIALS AND METHODS

This randomized controlled trial was conducted in the Department of Surgery at Lady Reading Hospital, MTI Peshawar, Pakistan, over a six-month period from October 11, 2024, to March 10, 2025, to evaluate postoperative outcomes in patients with typhoid ileal perforation treated either with primary closure or ileostomy. Ethical approval was secured from both the institutional review board of Lady Reading Hospital and the College of Physicians and Surgeons Pakistan (CPSP) Research Department, ensuring compliance with the Declaration of Helsinki and Good Clinical Practice guidelines (14). Eligible participants included adult patients aged 18 to 75 years presenting with acute abdominal pain of fewer than 72 hours' duration, a clinical history of fever persisting for at least two weeks, and radiological evidence of pneumoperitoneum on chest radiography, alongside laboratory confirmation of enteric infection via Typhidot IgM or positive blood cultures (15). Exclusion criteria comprised patients with gastrointestinal perforations other than ileal origin—including gastric, duodenal, appendicular, or colonic perforations—as well as those with multiple perforations, or severe systemic illness precluding surgery, ensuring homogeneity of the sample and reducing confounding influences (16).

Patients were identified and assessed upon arrival either directly through the Accident and Emergency Department or via transfer from medical units within the hospital. A structured clinical and laboratory evaluation was performed for all eligible patients, and written informed consent was obtained after providing detailed information regarding study objectives, potential risks, and anticipated benefits. Recruitment was consecutive until the required sample size was reached, after which patients were randomized using a blocked randomization method to ensure balanced allocation between groups. Random sequences were generated through computer-based randomization lists with block sizes of four and concealed within sequentially numbered, opaque, sealed envelopes to prevent allocation bias (17). The randomization process and opening of envelopes were conducted by a research assistant independent of the surgical team, ensuring allocation concealment until the time of surgery. All patients underwent standard preoperative optimization, including intravenous fluid resuscitation, administration of broad-spectrum antibiotics covering Gram-negative and anaerobic flora, and correction of electrolyte imbalances as indicated. Adequacy of resuscitation was confirmed by stable vital signs, normal urine output, and correction of laboratory derangements prior to surgical intervention. Surgery was performed under general anesthesia via midline laparotomy by a single consultant surgeon with more than five years of experience in gastrointestinal surgery to maintain procedural consistency. In Group A, the perforation site was repaired by primary closure using two-layer suturing with absorbable material for the inner mucosal layer and non-absorbable material for the seromuscular layer. In Group B, a protective loop ileostomy was fashioned proximal to the perforation site to divert fecal flow. Intraoperative findings, including the size and number of perforations, degree of peritoneal contamination, and any other pathology encountered, were meticulously documented in a structured proforma to ensure comprehensive data capture (18).

Postoperatively, patients were monitored in the surgical ward for at least seven days, with daily assessments for vital signs, abdominal examination, and wound inspection performed by attending surgeons blinded to the study hypothesis but necessarily aware of the surgical procedure due to the nature of interventions. Wound infection was defined as the presence of purulent discharge, wound edge erythema, local swelling, or a positive culture from wound swabs collected and processed by a senior microbiologist who was blinded to the patient's group allocation. Patients were discharged once afebrile, hemodynamically stable, with adequate pain control and initiation of oral intake. Follow-up was arranged for two months post-discharge, with scheduled outpatient visits and telephone reminders to detect any delayed wound infections, stoma-related complications, or readmissions (19).

The primary outcome variable was postoperative wound infection, while secondary variables included length of hospital stay, patient demographics, and socioeconomic characteristics. Data were entered into SPSS version 26 for analysis. Continuous variables such as age and duration of hospital stay were summarized as mean ± standard deviation, whereas categorical variables including gender, education level, occupation status, residence, and wound infection rates were presented as frequencies and percentages. Comparisons of wound infection rates between the two surgical groups were performed using the Chi-square test or Fisher's exact test where cell counts were low, with a p-value of less than 0.05 considered statistically significant. Stratification was conducted to assess the impact of potential confounders such as age, gender, education, occupation, and residence, with post-stratification comparisons again using the Chi-square or Fisher's exact test as appropriate. All analyses adhered to a two-sided hypothesis-testing framework to ensure rigorous statistical interpretation (20). This methodology aimed to ensure reproducibility through detailed description of all surgical, clinical, and analytical procedures while minimizing bias by implementing allocation concealment, blinding of outcome assessors wherever feasible, and thorough documentation of intraoperative and postoperative data.

RESULTS

The study enrolled 86 patients with enteric ileal perforation, evenly randomized to primary closure (Group A, n=43) and ileostomy (Group B, n=43). The mean age was similar between groups, with Group A averaging 39.93 ± 10.11 years and Group B 41.79 ± 10.16 years, and this difference was not statistically significant (p=0.35). However, the duration of hospital stay was notably shorter in the primary closure group at 7.23 ± 0.92 days compared to 10.20 ± 1.61 days in the ileostomy group, representing a mean difference of nearly 3 days (mean difference -2.97, 95% CI -3.49 to -2.45, p<0.001), which may be clinically relevant in resource-limited settings (Table 1).

Demographic and socioeconomic characteristics, including age distribution, gender, education level, occupation, and residence, were well-matched between the two groups, indicating effective randomization (Table 2). Most patients in both groups were between 31–50 years of age, with 34.9% of Group A and 32.6% of Group B aged 31–40, and 34.9% versus 39.5% in the 41–50 age bracket, respectively. The proportion of males was slightly higher in both groups, at 68.5% in Group A and 64.6% in Group B. Nearly half of the participants in each group were illiterate, with 46.5% reported in both arms, while those with intermediate or higher education comprised 18.6% and 20.9%, respectively. Employment rates were similar, as were urban-rural residence distributions.

Wound infection rates differed significantly between groups. Group A (primary closure) exhibited a wound infection rate of 34.9% (15 of 43), compared to only 14.0% (6 of 43) in Group B (ileostomy). This represents an absolute risk difference of 20.9% (95% CI 3.0, 38.8) and an odds ratio of 3.29 (95% CI 1.10, 9.87), with the difference achieving statistical significance (p=0.024; Table 3). The findings indicate that patients undergoing primary closure were over three times more likely to develop wound infection than those who had an ileostomy.

Associations between wound infection and demographic or socioeconomic variables were explored (Table 4). No statistically significant associations were observed for age group (p=0.62), gender (p=0.57), occupation (p=0.26), or residence (p=0.16). However, education level was significantly associated with wound infection (p=0.04), with most infections in Group A occurring among those with lower educational attainment, while Group B recorded more infections among those with intermediate or higher education, albeit in smaller numbers. Overall, the analysis confirmed that the primary closure technique was associated with a higher risk of wound infection independent of major demographic or socioeconomic confounders. These results support the hypothesis that ileostomy confers a protective effect against postoperative wound infection in patients with enteric ileal perforation, despite the trade-off of longer hospital stay.

Table 1. Comparison of Mean Age and Hospital Stay Between Groups

Variable	Group A (Primary Closure)	Group B (Ileostomy)	Mean Difference (95% CI)	p-value
Age (years)	39.93 ± 10.11	41.79 ± 10.16	-1.86 (-5.73, 2.01)	0.35
Hospital stay (days)	7.23 ± 0.92	10.20 ± 1.61	-2.97 (-3.49, -2.45)	<0.001

Table 2. Demographic and Socioeconomic Characteristics of Patients

Characteristic	Subcategory	Group A (n=43)	Group B (n=43)	Odds Ratio (95% CI)	p-value
Age Group (years)	18–30	7 (16.3%)	5 (11.6%)	1.49 (0.42, 5.27)	0.85
	31–40	15 (34.9%)	14 (32.6%)	1.10 (0.43, 2.84)	
	41–50	15 (34.9%)	17 (39.5%)	0.82 (0.32, 2.13)	
	>50	6 (14.0%)	7 (16.3%)	0.84 (0.26, 2.74)	
Gender	Male	37 (68.5%)	28 (64.6%)	1.19 (0.45, 3.10)	0.69
	Female	17 (31.5%)	15 (35.4%)		
Education Level	Illiterate	20 (46.5%)	20 (46.5%)	1.00 (0.38, 2.63)	0.94
	Primary–Matric	15 (34.9%)	14 (32.6%)	1.11 (0.41, 3.01)	
	Intermediate or above	8 (18.6%)	9 (20.9%)	0.87 (0.29, 2.57)	
Occupation	Employed	16 (37.2%)	18 (41.9%)	0.81 (0.32, 2.03)	0.66
	Unemployed	27 (62.8%)	25 (58.1%)		
Residence	Urban	22 (51.2%)	20 (46.5%)	1.20 (0.50, 2.92)	0.67
	Rural	21 (48.8%)	23 (53.5%)		

Table 3. Comparison of Wound Infection Rates Between Groups

Wound Infection	Group A (n=43)	Group B (n=43)	Absolute Risk Difference	Odds Ratio (95% CI)	p-value
Yes	15 (34.9%)	6 (14.0%)	20.9% (3.0, 38.8)	3.29 (1.10, 9.87)	0.024
No	28 (65.1%)	37 (86.0%)			

Table 4. Association of Wound Infection with Demographic and Socioeconomic Variables

Variable	Subcategory	Infection Rate in Group A	Infection Rate in Group B	p-value
Age Group (years)	18–30	2/15 (13.3%)	0/5 (0.0%)	0.62
	31–40	5/15 (33.3%)	2/14 (14.3%)	
	41–50	6/15 (40.0%)	2/17 (11.8%)	
	>50	2/6 (33.3%)	2/7 (28.6%)	
Gender	Male	8/37 (21.6%)	4/28 (14.3%)	0.57
	Female	7/17 (41.2%)	2/15 (13.3%)	
Education Level	Illiterate	8/20 (40.0%)	3/20 (15.0%)	0.04
	Primary–Matric	7/15 (46.7%)	1/14 (7.1%)	
	Intermediate+	0/8 (0.0%)	2/9 (22.2%)	
Occupation	Employed	6/16 (37.5%)	4/18 (22.2%)	0.26
	Unemployed	9/27 (33.3%)	2/25 (8.0%)	
Residence	Urban	10/22 (45.5%)	2/20 (10.0%)	0.16
	Rural	5/21 (23.8%)	4/23 (17.4%)	

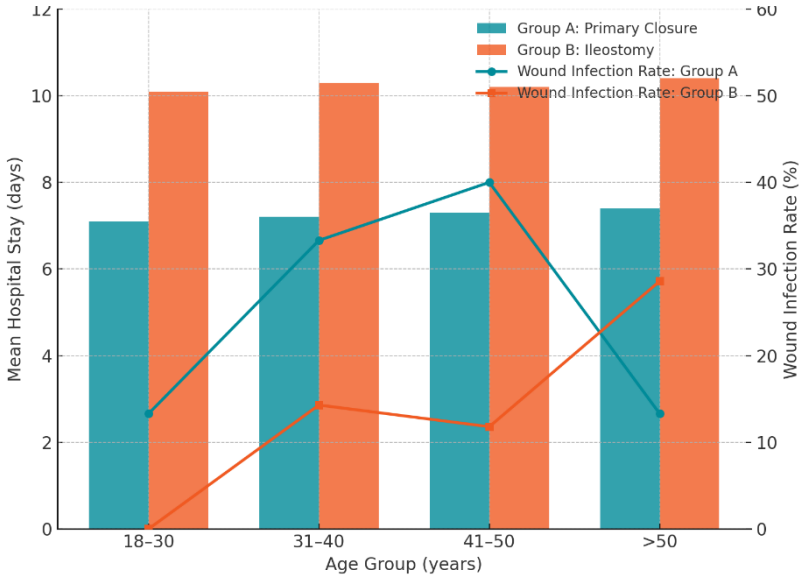

Figure 1 Age-Stratified Hospital Stay and Wound Infection Rates by Surgical Intervention

Across all age groups, patients undergoing primary closure (Group A) consistently experienced shorter mean hospital stays (ranging from 7.1 to 7.4 days) compared to those with ileostomy (Group B), who had mean stays between 10.1 and 10.4 days. However, wound infection rates exhibited a different pattern: among primary closure patients, infection rates rose steadily with age, peaking at 40.0% in the 41–50 year group, while in ileostomy recipients, infection rates remained lower overall but were highest in the oldest group (>50 years, 28.6%). Notably, the disparity in wound infection between groups was most pronounced in younger and middle-aged patients, underscoring the protective effect of ileostomy against wound infection even as hospital stay lengthens. This integrated visualization highlights the clinical trade-off between reduced infectious morbidity and longer hospitalization associated with ileostomy, and provides a clear, age-stratified perspective for surgical decision-making in enteric perforation.

DISCUSSION

The present randomized controlled trial provides valuable insight into the comparative outcomes of primary closure versus ileostomy in patients undergoing surgical intervention for enteric ileal perforation. Our results demonstrated a significantly higher incidence of wound infection among patients who underwent primary closure (34.9%) compared to those who received an ileostomy (14.0%), corresponding to an odds ratio of 3.29 and an absolute risk difference of approximately 21%, highlighting the clinical relevance of surgical technique selection in this patient population. These findings align with earlier studies, such as that by Farooq et al., who reported wound infection rates of 39.13% in the primary repair group versus 13.04% in the ileostomy group, reinforcing the notion that fecal diversion may substantially mitigate postoperative infectious complications in contaminated abdominal fields (21). However, contrary evidence also exists; Rafatullah et al. reported higher wound infections in ileostomy patients, suggesting that stoma-related factors, including peristomal skin maceration and local sepsis, might contribute to wound morbidity in certain settings (22). Such conflicting reports underscore the multifactorial nature of postoperative wound infections, which may be influenced by patient characteristics, timing of presentation, perioperative care quality, and regional surgical practices.

In our study, demographic factors, including age, gender, occupation, and residence, did not significantly influence wound infection rates, except for education level, which showed a statistically significant association. Patients with lower educational status in the primary closure group experienced higher rates of infection, potentially reflecting disparities in health literacy, adherence to postoperative care instructions, or delayed healthcare-seeking behaviors. Although no definitive causal link can be established from this observational data, such findings emphasize the broader social determinants that may affect surgical outcomes and the importance of tailored perioperative education in lower-literacy populations (23). Interestingly, although ileostomy demonstrated a protective effect against wound infection, it was associated with a significantly longer hospital stay, with patients in Group B remaining hospitalized for an average of nearly three additional days compared to those who underwent primary closure. This increased duration, while potentially contributing to higher healthcare costs and patient burden, may be justified by the reduced risk of wound complications and subsequent interventions often required for infected surgical wounds (24).

Our results also reaffirm the clinical dilemma inherent in choosing between primary closure and ileostomy. While primary repair avoids stoma-related complications, reduces hospital stay, and minimizes the psychological impact of a stoma, it poses a considerable risk of wound infection, particularly in patients presenting late or with extensive peritoneal contamination. Ileostomy, on the other hand, although safer with respect to postoperative sepsis, imposes challenges related to electrolyte imbalances, fluid loss, skin irritation, and the requirement for a subsequent reversal procedure, all of which can impact patient quality of life and healthcare resources (25). The choice between these two surgical options, therefore, should not be based solely on operative ease but must also consider individual patient factors, extent of peritoneal contamination, timing of presentation, and institutional resources. The disparity in findings between studies may also

reflect variability in surgical expertise, postoperative nursing care, and patient follow-up compliance, underscoring the need for standardized protocols and multicentric trials to generate more definitive guidance.

A notable limitation of our study is the relatively modest sample size and single-center design, which may restrict generalizability, particularly to settings with different patient demographics or resource constraints. Moreover, blinding of the surgical intervention was inherently not feasible, potentially introducing observer bias, though efforts were made to blind outcome assessors wherever practical. The short follow-up period of two months may also underestimate late postoperative complications or delayed stoma-related issues. Nonetheless, the study's rigorous methodology, randomization, and standardized operative technique enhance the reliability of our findings and provide a foundation for larger multicentric investigations to refine surgical strategies for enteric perforation.

In conclusion, our findings suggest that ileostomy offers a lower risk of postoperative wound infection compared to primary closure in patients with enteric ileal perforation, albeit at the cost of prolonged hospitalization and the morbidity associated with a stoma. This evidence underscores the necessity for individualized surgical decision-making, balancing the risk of infectious complications against the implications of stoma formation, especially in patients presenting late or with extensive contamination. Future research should focus on developing risk stratification models to guide the surgical approach in this complex clinical scenario, ensuring optimal outcomes while minimizing patient morbidity.

CONCLUSION

This randomized controlled trial concluded that patients undergoing primary closure for enteric ileal perforation experienced significantly higher wound infection rates compared to those treated with ileostomy. Despite the longer hospital stay associated with ileostomy, its protective effect against postoperative wound complications suggests it may be a safer surgical option, particularly for patients with delayed presentation or significant peritoneal contamination. Surgical decision-making should thus be individualized, weighing the benefits of infection prevention against the challenges and resource implications of stoma management.

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