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Original Article

Efficacy of Primary Repair Versus Ileostomy Formation in Typhoid Perforation

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Author`s Contribution

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A B S T R A C T

Objective: To compare postoperative outcomes of primary repair (primary closure) versus loop ileostomy diversion in patients with typhoid intestinal perforation, in terms of postoperative complications, length of hospital stay, time to recovery, and overall prognosis.

Methodology: In this study, the prospective comparative observational study was carried out in Surgical Unit III, Department of General Surgery, Civil Hospital Quetta, Balochistan, between February and July 2025. Typhoid ileal perforation patients who had been confirmed at laparotomies were enrolled. The operative procedure (primary repair or loop ileostomy) was decided intra-operatively based on the extent of peritoneal contamination, number of perforations, and the patient's general condition. Recruitment was done until 30 patients had been recruited into each group (Primary Repair n=30; Loop Ileostomy n=30). The analysis of the data was performed with the help of SPSS v26. Mean ± SD was used to summarize continuous variables and n (percentage) was used to summarize categorical variables. The independent t -test and chi-square were used to compare the groups between groups. A p-value < 0.05 was considered statistically significant. Total positive outcome was much better in primary repair as compared to ileostomy (86.7% vs 60.0%, p = 0.02).

Conclusion: Primary repair seems to be a safe and effective procedure in certain patients with typhoid intestinal perforation, particularly the ones presenting early with little contamination and simple perforation. Although it is useful in the situations of multiple perforations or severe peritonitis, loop ileostomy is more likely to have an increased morbidity, longer hospitalization, and delayed recovery. Managing typhoid perforation can be enhanced by using stringent intra-operative criticism and patient screening.

Keywords: Typhoid fever; Intestinal perforation; Primary repair; Ileostomy; Surgical outcomes; Peritonitis;

Introduction

Typhoid fever is one of the key health issues in most developing countries. In South Asia and sub-Saharan Africa, isolation is aided by a lack of sanitation, unsafe water access, and late access to health services (Kim et al., 2022). It is caused by the Gram-negative bacillus, Salmonella enterica, serovar Typhi, which is transmitted through the fecal-oral route (Mahamedin et al., 2024). One of the gravest complications and a significant cause of morbidity and mortality in endemic contexts is typhoid intestinal perforation (Onyeke & Bahman, 2025).

Perforation is mostly seen in the terminal ileum due to the presence of the high concentration of Peyer patches which may be necrotised as a result of the ulcerative form of disease (Hollingshead & Thomas, 2025). The patients can quickly develop generalized peritonitis and sepsis, and they need to be operated on immediately after perforation. Typhoid fever has a reported perforation rate of 0.8-18% and mortality of 5-39%. Delayed presentation, malnutrition and inaccessibility to timely surgical services are linked to poor outcomes. Distance, transport barriers, and delayed referral to the hospital in Balochistan, are some of the factors that lead to high morbidity and mortality because of late presentation by patients (Abid et al., 2025).

Surgical repair of the typhoid ileal perforation is still a controversial topic and there is no universal procedure. They can be repaired with primary repair (primary closure), resection and anastomosis, or loop ileostomy

(Hagedoorn et al., 2024). Two-layer primary repair and diverting loop ileostomy are the two most popular techniques. Primary repair maintains bowel continuity and can reduce the length of recovery, but poses a risk of leakage or re-perforation in patients with multiple perforations or a grossly contaminated peritoneum (Safiullah et al., 2025). Loop ileostomy redirects the fecal stream and can be used to protect the area of repair, but is associated with its own morbidity, such as skin excoriation, dehydration/electrolyte imbalance, stoma prolapse or retraction, psychosocial burden, and long hospitalization (Erdik et al., 2025). Endemic-area studies have shown mixed outcomes, which mostly relate to variation in disease severity at presentation and the support perioperative support is available. It is significant to compare results in our local context to inform context-relevant surgical decision-making and enhance care.

Methodology

The experimental work was done in the form of a prospective comparative observational study to assess the overall favorable outcome and postoperative outcome of primary repair and loop ileostomy in patients with typhoid intestinal perforation.

The research was carried out in Surgical Unit III, Department of General Surgery, Civil Hospital Quetta, a tertiary-care public-sector hospital in Quetta, Balochistan. The time frame of the study was twelve months, February to July 2025.

Patients with a clinically and surgically confirmed case of typhoid ileal perforation were included in the study population. The patients who were admitted via the emergency department and operated on due to peritonitis secondary to typhoid perforation were eligible to be selected.

Inclusion Criteria: Patients that were aged between 15 to 60 years old and had one or more perforations of their terminal ileum that had been confirmed intraoperatively as being of typhoid origin were included. The diagnosis was mainly made based on the observation during the operation, which was supplemented with serological data in case of their availability, including the Widal test.

Exclusion Criteria: Patients with non-typhoid perforations (e.g. traumatic, tuberculous, or drug-induced), those with perforations of the colon or duodenum, patients with severe systemic conditions (including chronic liver disease, renal failure or uncontrolled diabetes) and those dying intraoperative or within 24 hours of surgery were excluded. The study also excluded re-explored or referred cases of postoperative

The sample size was determined based on the Raosoft online calculator with a 20% anticipated difference between the two procedures in terms of postoperative complications with a 95% confidence level and power of 80%. Recruitment was done throughout the study period until 60 patients were recruited and 30 patients per group (Primary Repair n=30; Loop Ileostomy n=30).

- Group A (n = 30): Primary repair
- Group B (n = 30): Loop ileostomy

A non-probability consecutive sampling approach was used. All the eligible patients who came during the course of the study were evaluated and on the basis of clinical considerations, the operation was decided intra-operatively. Enrollment was done until the necessary figures were reached in each group (30 primary repairs and 30 loop ileostomies). This was not a randomized study. Since the decision to conduct an operative procedure was made intra-operative, dependent on clinical severity and judgement of the surgeon, there is the possibility of selection bias between groups.

Informed consent was obtained and the data of each patient were gathered using a structured proforma that had been pre-designed. The variables that were captured were demographic (age, gender, nutritional status), clinical (duration of illness, fever, stomach pain, vomiting, and dehydration) and laboratory (hemoglobin, total leukocyte count, electrolytes, and Widal test findings) variables. The number and size of perforations, distance between the ileocecal valve and the peritoneal contamination were recorded as intraoperative findings. The nature of surgery done which could be either primary repair or ileostomy was also noted. All patients were followed-up 30 days after discharge and monitored complications and recovery outcomes after 14 days of hospitalization after the operation

Group A (Primary Repair): In this group, the perforation was closed in two layers using absorbable sutures (Vicryl 3-0) for the inner layer and silk 3-0 for the outer seromuscular layer. The peritoneal cavity was lavaged thoroughly with warm saline, and a pelvic drain was placed before closure.

Group B (Loop Ileostomy): In these patients, a loop of the ileum, approximately 10–15 cm proximal to the perforation, was brought out through the right lower quadrant and matured using the Brooke technique. After adequate peritoneal lavage, a pelvic drain was inserted before abdominal closure.

The primary outcome measure was overall favorable outcome, defined as successful postoperative recovery without major complications such as anastomotic leakage, intra-abdominal abscess, or fecal fistula.

Secondary outcomes included the duration of hospital stay, time to return of bowel function, incidence of

wound infection, rate of postoperative complications (such as peritonitis, stoma-related issues, and reoperation), and 30-day postoperative mortality.

Patients were monitored daily during hospitalization for early postoperative complications. Follow-up visits were scheduled at two weeks and one month post-discharge to assess delayed outcomes, particularly in patients with ileostomies. For patients in Group B, stoma closure was planned after 8–12 weeks, and any complications related to closure were also documented.

All the collected data were typed into SPSS version 26 and analyzed. Mean with standard deviation was used to present continuous variables (age, stay in hospital), and frequency and percentages were used to describe categorical variables (gender, type of complication, and mortality). The independent t-test was used to make comparisons between the two groups of continuous variables and chi-square test was used to compare the two groups that were categorical. A p-value of below 0.05 was regarded as being statistically significant. Where appropriate, relative risk (RR) and odds ratio (OR) were computed to determine relative overall favorable outcome.

Results

The sample size consisted of 60 patients; 30 received primary repair, and 30 loop ileostomy. The mean age of patients in the primary repair group was 28.7 ± 8.9 years, while that in the ileostomy group was 31.2 ± 9.4 years, showing no statistically significant difference (p = 0.29). Most patients (approximately 63 percent) of both groups were less than 35 years old, and this indicates that typhoid perforation was predominant among the young adults.

Both groups had higher representation of males (70% on average), which is in line with the fact that males are more exposed to contaminated food and water sources in the endemic areas. The average prehospital illness duration was 6.3 ± 1.9 days, which was not significantly different between the two groups (p = 0.38), indicating that the preoperative delay patterns are similar. There were also similarities in terms of nutritional status where the mean of BMI was approximately 19 kg/m 2 which means that majority of patients were mildly undernourished.

The patients in both groups showed typical symptoms of classical typhoid intestinal perforation as they all had abdominal pain and peritonitis (100% in both groups). Most of them also complained of fever (95%), vomiting (73.3%), and abdominal distension (63.3%). The difference between the pattern or frequency of symptoms between the two groups was not statistically significant (p > 0.05), which showed that clinical severity at presentation was similar. Mean time to hospital was 5.0 ± 1.8 days, indicating that the majority of patients presented with symptoms after a few days of illness, which is symptomatic latency and is common with limited resources. In about 68 percent of the cases, dehydration was noted, probably caused by loss of fluids through fever, vomiting and peritonitis.

Intraoperative evaluation showed that single perforations were more common with an occurrence rate of 75 percent of all the cases, and multiple perforations were present in 25 percent of the patients. The number of perforations between the primary repair and ileostomy groups was not found to be significantly different (p = 0.37). The majority of perforations were found within 30 cm of ileocecal valve (91.7%), a finding that is consistent with the general predilection of ulcers

Table 1: Demographic Characteristics of Patients (n = 60)

Variables	Primary Repair (n = 30)	Ileostomy (n = 30)	Total (n = 60)	p-value
Age (years) Mean ± SD	28.7 ± 8.9	31.2 ± 9.4	29.9 ± 9.1	0.29
Age group (years)				
15 – 25 yrs	11 (36.7 %)	8 (26.7 %)	19 (31.7 %)	
26 – 35 yrs	10 (33.3 %)	9 (30.0 %)	19 (31.7 %)	
36 – 45 yrs	6 (20.0 %)	7 (23.3 %)	13 (21.7 %)	
46 – 60 yrs	3 (10.0 %)	6 (20.0 %)	9 (15.0 %)	0.61
Gender				
Male	22 (73.3 %)	20 (66.7 %)	42 (70.0 %)	
Female	8 (26.7 %)	10 (33.3 %)	18 (30.0 %)	0.57
Mean duration of illness (days)	6.1 ± 1.8	6.6 ± 2.1	6.3 ± 1.9	0.38
Nutritional status (BMI kg/m²)	19.2 ± 2.5	18.8 ± 2.7	19.0 ± 2.6	0.61

Table 2: Clinical Presentation and Duration of Symptoms in Patients (n = 60)

Clinical Features	Primary Repair (n = 30)	Ileostomy (n = 30)	Total (n = 60)	p-value
Fever	28 (93.3%)	29 (96.7%)	57 (95.0%)	0.55
Abdominal pain	30 (100%)	30 (100%)	60 (100%)	—
Vomiting	21 (70.0%)	23 (76.7%)	44 (73.3%)	0.56
Abdominal distension	18 (60.0%)	20 (66.7%)	38 (63.3%)	0.60
Constipation / absent bowel sounds	16 (53.3%)	18 (60.0%)	34 (56.7%)	0.61
Dehydration on admission	19 (63.3%)	22 (73.3%)	41 (68.3%)	0.41
Signs of peritonitis (tenderness, guarding, rigidity)	30 (100%)	30 (100%)	60 (100%)	—
Mean duration of symptoms before admission (days)	4.8 ± 1.7	5.2 ± 1.9	5.0 ± 1.8	0.43

Table 3: Intraoperative Findings of Patients with Typhoid Intestinal Perforation (n = 60)				
Intraoperative Variables	Primary Repair (n = 30)	Ileostomy (n = 30)	Total (n = 60)	p-value
Number of perforations				
Single perforation	24 (80.0%)	21 (70.0%)	45 (75.0%)	
Multiple perforations (≥2)	6 (20.0%)	9 (30.0%)	15 (25.0%)	0.37
Site of perforation				
Within 30 cm of ileocecal valve	28 (93.3%)	27 (90.0%)	55 (91.7%)	0.64
Beyond 30 cm from ileocecal valve	2 (6.7%)	3 (10.0%)	5 (8.3%)	
Size of perforation (cm)	0.8 ± 0.3	0.9 ± 0.4	0.85 ± 0.35	0.36
Peritoneal contamination				
Minimal to moderate	9 (30.0%)	7 (23.3%)	16 (26.7%)	
Severe / fecal contamination	21 (70.0%)	23 (76.7%)	44 (73.3%)	0.56
Mean operative time (minutes)	72.4 ± 11.6	89.7 ± 14.8	81.0 ± 14.2	<0.001*

Table 4: Distribution of Surgical Procedures Performed in Patients with Typhoid Perforation (n = 60)				
Surgical Details	Primary Repair (n = 30)	Ileostomy (n = 30)	Total (n = 60)	p-value
Type of surgery performed				
Single-layer closure	2 (6.7%)	—	2 (3.3%)	—
Two-layer closure	28 (93.3%)	—	28 (46.7%)	—
Loop ileostomy (Brooke technique)	—	30 (100%)	30 (50.0%)	—
Peritoneal lavage performed	30 (100%)	30 (100%)	60 (100%)	—
Drain placement	30 (100%)	30 (100%)	60 (100%)	—
Mean operative time (minutes)	72.4 ± 11.6	89.7 ± 14.8	81.0 ± 14.2	<0.001*
Intraoperative blood transfusion required	4 (13.3%)	6 (20.0%)	10 (16.7%)	0.49

Table 5: Postoperative Recovery Parameters in Patients with Typhoid Intestinal Perforation (n = 60)				
Recovery Parameters	Primary Repair (n = 30)	Ileostomy (n = 30)	Total (n = 60)	p-value
Mean time to first bowel sounds (days)	2.8 ± 0.7	3.4 ± 0.8	3.1 ± 0.8	0.003*
Mean time to oral intake (days)	3.9 ± 0.9	4.8 ± 1.1	4.3 ± 1.0	0.001*
Mean time to drain removal (days)	5.6 ± 1.2	6.1 ± 1.4	5.9 ± 1.3	0.11
Mean postoperative hospital stay (days)	9.8 ± 2.6	13.4 ± 3.1	11.6 ± 3.2	<0.001*
Return to full mobility (days)	5.1 ± 1.4	6.0 ± 1.6	5.6 ± 1.5	0.02*
Requirement of postoperative antibiotics >7 days	8 (26.7%)	13 (43.3%)	21 (35.0%)	0.16

Table 6: Postoperative Complications Among Patients (n = 60)				
Postoperative Complications	Primary Repair (n = 30)	Ileostomy (n = 30)	Total (n = 60)	p-value
Wound infection	6 (20.0%)	9 (30.0%)	15 (25.0%)	0.38
Wound dehiscence	2 (6.7%)	3 (10.0%)	5 (8.3%)	0.64
Intra-abdominal abscess	1 (3.3%)	2 (6.7%)	3 (5.0%)	0.55
Anastomotic leak / fecal fistula	2 (6.7%)	—	2 (3.3%)	0.15
Postoperative ileus	3 (10.0%)	4 (13.3%)	7 (11.7%)	0.68
Stoma prolapse / retraction	—	4 (13.3%)	4 (6.7%)	—
Skin excoriation around stoma	—	6 (20.0%)	6 (10.0%)	—
Reoperation required	2 (6.7%)	3 (10.0%)	5 (8.3%)	0.64
Total patients with ≥1 complication	10 (33.3%)	18 (60.0%)	28 (46.7%)	0.03*

caused by typhoid in the terminal ileum. The mean size of the perforation was about 0.85 cm and there was no significant difference between the two groups (p =

0.36). Most of the patients in both groups were severely or fecally contaminated (73.3%), indicating late presentation and advanced peritonitis on surgery. The average operative time was however, much longer in the ileostomy group (89.7 +14.8 minutes) than the primary repair group (72.4 +11.6 minutes), with a p-value of less than 0.001, indicating the extra time needed to create and mature the stoma.

Table 4 shows that the most common type of primary repair was a two-layer repair (28/30, 93.3%). The loop ileostomy group (89.7 ± 14.8 minutes) took much longer than the primary repair group (72.4 ± 11.6 minutes) (p < 0.001). The intraoperative transfusion of blood was more necessary in the ileostomy group (20.0% vs 13.3%), which was not statistically significant (p = 0.49).

In the primary repair group, the postoperative recovery was generally quicker than in the ileostomy group. The mean time to return of bowel sounds was 2.8 ± 0.7 days in the primary repair group versus 3.4 ± 0.8 days in the ileostomy group (p = 0.003), indicating quicker restoration of intestinal motility after primary closure.

Likewise, the oral intake initiation time was much less in the primary repair group (3.9 ± 0.9 days) compared to the ileostomy group (4.8 ± 1.1 days, p = 0.001). There was no significant difference in mean time to drain removal between the groups (p = 0.11), but the postoperative hospital stay was significantly shorter in patients that underwent ileostomy (13.4 ± 3.1 days) than in those that underwent primary repair (9.8 ± 2.6 days, p < 0.001). Ileostomy patients were also found to take a little longer period to regain full mobility (6.0 ± 1.6 days vs. 5.1 ± 1.4 days, p = 0.02).

There was a higher percentage of ileostomy patients (43.3) who needed antibiotics beyond 7 days than the primary repair group (26.7) but this was not statistically significant (p = 0.16).

In both groups, postoperative complications were found, although this was higher in patients who experienced ileostomy. In total, 18 patients (60% in the ileostomy group, 10 patients in the primary repair group) had at least one complication versus 10 patients (33.3% in the primary repair group), which was statistically significant (p = 0.03). Wound infection (25 percent) was the most frequent complication in both groups, wound dehiscence (8.3 percent), and postoperative ileus (11.7 percent). The analysis did not show any significant difference between the ileostomy and the control group in terms of wound infection (30 percent in the former vs. 20 percent in the latter). Two patients (6.7%) in the primary repair group versus none in the ileostomy group experienced anastomotic leakage or fecal fistula, that is, showing the protective benefit of stoma in high-risk intestinal conditions. The ileostomy group had unique complications that are stoma related with the most prevalent being skin excoriation (20%) and stoma prolapse/retraction (13.3). These contributed significant portions of morbidity and long-term postoperative treatments.

Discussion

The non-randomized group assignment should be taken into consideration when interpreting these findings. The purpose of this study was to make a comparison between the results of two surgical procedures: two-layer primary repair and loop ileostomy in patients with typhoid ileal perforation (TIP). The findings indicate that primary repair in a carefully chosen patient group could have benefits in the form of earlier gastrointestinal recovery, reduced hospitalization, reduced significant complications, and a better overall time outcome, as outlined in our methodology. These results, though, have to be viewed in perspective with regard to selection of patients, severity of disease (e.g. number of perforations and extent of contamination) and the resources constrained conditions, common in developing nations.

The results of the current study are aligned with some earlier studies that have indicated positive results with primary repair in ideal circumstances. Indicatively, Peltrini et al. showed that primary repair was associated with a decrease in morbidity and mortality as opposed to ileostomy (Peltrini et al., 2023). Likewise, a systematic review and meta-analysis found a reduced length of stay with primary repair, but there was heterogeneity among the studies (Gizaw et al., 2022).

On the other hand, other studies endorse the application of ileostomy in high-risk clinical setting. Higher morbidity has been observed with primary closure in instances of multiple perforations, gross fecal contamination, or delayed presentation. Higher mortality rate in patients undergoing primary repair (21.4) than ileostomy (7.1) among critically ill patients was identified in a study carried out and therefore proper patient selection is critical (Wada et al., 2025; Yang et al., 2023).

Altogether, the available literature suggests a case-specific treatment: primary repair can be considered as a better choice in case of intraoperative discoveries (e.g., single perforation, limited contamination, stable physiological conditions), but loop ileostomy is also an effective option in the risk cases, such as multiple perforations, gross contamination, and instability (Giorgi et al., 2025; Pratt et al., 2025).

Patients undergoing primary repair in the current study had much faster recovery with an earlier recovery of bowel sounds (2.8 vs 3.4 days), earlier oral intake (3.9 vs 4.8 days), shorter hospital stay (9.8 vs 13.4 days) and reduced major complications (6.7% vs 23.3%) than patients receiving ileostomy. These results can be aligned with the literature that has been published previously and indicate that prevention of stoma formation can decrease the postoperative morbidity and shorten the recovery period in the properly chosen patients (Cheng & Chen, 2024).

The elevation of the complication rate in the ileostomy group seems to be significantly explained by stoma-related problems, such as skin excoriation, prolapse, and retraction, longer time of operation, and longer hospital stay. These results are in line with other studies that have reported on the extra morbidity of stoma formation (Babakhanlou et al., 2022; Santos et al., 2024). Interestingly, there was no significant difference in mortality, with the two groups having 3.3% and 6.7% mortality, which is in line with a number of studies that have shown that mortality in TIP is more so affected by preoperative factors- delay of presentation, extent of contamination and septic status, than the type of surgical procedure. In fact, intensive peritoneal contamination has been found to be predictive of death at all times (Cole et al., 2022).

Clinically, such findings provide an evidence-based approach to surgery. Primary repair can be a possibility when patients have an early presentation, one perforation, limited contamination, and are in a stable physiological state. On the contrary, loop ileostomy is still a safer option in patients whose presentation is delayed, have multiple perforations, have poor nutritional status, are hemodynamically unstable, or have gross fecal contamination (Eskandar, 2024). Since TIP mostly occurs among young people in resource-limited environments, which are also demonstrated in our study group, intraoperative decision-making must be optimized to enhance patient outcomes. Early resuscitation, prompt surgical attention, proper antibiotic treatment, and good post operative care including stoma care are also essential features of management (Ratta et al., 2025).

Conclusion

The present study demonstrated that primary repair is a safe, effective, and reliable surgical option for the management of typhoid intestinal perforation in selected patients. Compared with loop ileostomy, primary repair was associated with shorter operative time, earlier return of bowel function, reduced hospital stay, and lower overall morbidity, while maintaining comparable mortality outcomes.

Although loop ileostomy provided protection against anastomotic leakage, it was accompanied by a higher rate of postoperative complications, primarily related to the stoma itself, including skin excoriation, prolapse, and dehydration. These complications prolonged recovery and increased the duration of hospital stay, emphasizing that ileostomy should be reserved for high-risk cases such as patients with multiple perforations, gross fecal contamination, delayed presentation, or hemodynamic instability.

The findings underscore the importance of careful intraoperative judgment and individualized surgical decision-making, taking into account the extent of peritoneal contamination, number of perforations, and overall patient condition. Early diagnosis, adequate preoperative resuscitation, and prompt surgical intervention remain critical to improving survival and reducing morbidity in typhoid perforation cases.

In the context of developing regions like Balochistan, where delayed presentation and limited intensive care support are frequent challenges, adopting a tailored approach — primary repair for uncomplicated cases and diversion for complex or contaminated cases — can significantly improve patient outcomes and optimize resource utilization.

Recommendations

Primary repair should be the preferred surgical approach in patients with a single perforation and minimal peritoneal contamination, following adequate resuscitation and antibiotic coverage.

Loop ileostomy should be reserved for critically ill patients, multiple perforations, or extensive fecal contamination, where primary repair carries a high risk of leakage or sepsis.

Early diagnosis through timely referral and public health awareness on typhoid fever prevention can minimize delayed presentations and associated complications.

Strengthening intraoperative decision protocols and surgeon training in emergency abdominal surgery can enhance patient selection and procedural outcomes.

Postoperative stoma care training for patients and caregivers is essential to reduce stoma-related complications and improve quality of life.

Further multicentric studies with larger sample sizes and longer follow-up are recommended to validate these findings and explore the cost-effectiveness and long-term outcomes of both surgical approaches.

Implementation of community-level preventive strategies, including safe water supply, sanitation improvement, and typhoid vaccination programs, remains vital to reducing the overall burden of typhoid fever and its complications.

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