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Original Article

Ileostomy Versus Primary Closure in Typhoid Ileal Perforation in Patients with Two or More Poor Prognostic Factors

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Abstract

Background: Typhoid ileal perforation is a life-threatening disease affecting the northwestern Nigeria, with high morbidity and mortality, especially in those with multiple poor prognostic factors. The popular surgical approaches are primary closure of the perforation and ileostomy. It is debatable which approach has better outcomes in our environment. This study compared outcomes of the use of ileostomy to primary closure in patients with two or more poor prognostic factors, assessing 30-day mortality, surgical site infection (SSI), and time to oral intake.

Methodology: The study was conducted at Aminu Kano Teaching Hospital, Nigeria over one year, involving 56 patients randomized into two groups: Group A (ileostomy, n=28) and Group B (primary closure, n=28). Exclusions included moribund patients, non-typhoid ileal perforations, and decompensated systemic diseases. Postoperative complications, mortality, and recovery parameters were analyzed using SPSS version 25, with statistical significance set at $p<0.05$.

Results: Results showed that 64% of patients were aged 12–20 years. SSI was high in both groups (71.9% ileostomy, 82.1% primary closure). Major complications like burst abdomen (32%) and fecal fistula (32%) occurred only in the primary closure group. Patients with ileostomy resumed oral intake earlier (2.30±0.61 days vs. 3.71±0.76 days). Overall mortality was 14.3%, with higher deaths in the primary closure group (21.4% vs. 7.1% in ileostomy).

Conclusions: While SSI and mortality were more frequent in the primary closure group, the difference was not statistically significant. However, ileostomy demonstrated advantages, including fewer severe complications and faster recovery of enteral feeding. The study suggests that individualized surgical approaches, considering patient risk factors, may improve outcomes in typhoid ileal perforation cases. Ileostomy may be preferable in high-risk patients due to its lower complication rates and quicker postoperative recovery.

Keywords: Typhoid Perforation; Ileostomy; Poor Prognostic Factors; Primary Closure.

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Introduction

Typhoid fever is a febrile condition caused by *Salmonella typhi* or *Para typhi* A, B, and C. [1,2] It gains entry via the feco-oral route. Surgical complications of Typhoid fever of surgical importance are still high in tropical countries. Typhoid perforation is one of the most dreaded complications of fever and carries a high mortality.[3–7] It normally occurs in the 3rd week of the infection although early perforation is the norm in most tropical countries, usually occurring at the end of the first week.[8,9] Complications of Typhoid enteric fever of surgical importance are still common in most tropical countries because basic sanitation is still very poor in both rural and peri-urban settings in developing countries.[8]

Typhoid perforation remains a major problem in most 3rd world countries even with advances in Antibiotics agents and surgery in its management.[10] Surgery remains the main treatment for typhoid perforation with options including primary closure, resection and anastomosis, and ileostomy. [7–9] As for which approach is superior, there are conflicting reports in the literature. While primary closure, resection and anastomosis are more popularly practiced no doubt, ileostomy can be a lifesaving procedure in the unstable patient and patients with multiple poor prognostic factors.[10] These patients are at risk of anastomotic/closure breakdown and reperforation which will lead to longer hospital stays for patients who subsequently survive these complications.[10] Adequate resuscitation and stabilization of the patients is key prior to surgery as the outcome of the patient may depend on it irrespective of the type of procedure given.

Typhoid perforation is a very common surgical emergency in our environment. Most of our patients present late to the hospital and with multiple poor prognostic factors due to disease progression.[11] Postoperative complications and mortality remain high after surgical intervention despite decades of understanding the disease. Primary closure of the perforation, segmental resection and anastomosis remain the popular interventions irrespective of the condition of the patient.[11] Ileostomy remains an option and can be a lifesaving procedure in a selected group of patients with typhoid ileal perforation. [11,12]

No study has been made locally to the best of our knowledge even though ileostomy has been offered to some patients who present very unstable, and the procedure is given as part of resuscitation. It is against this background that this study was designed to ascertain whether ileostomy could be used routinely in patients with typhoid perforation despite the limitations in our environment. The study will help in providing information that may help surgical units come up with policies on the most appropriate intervention in Typhoid Ileal Perforation (TIP) patients who present with multiple poor prognostic factors.

The broad objective of this study was to compare the clinical outcome of ileostomy and primary closure of perforation in patients presenting with TIP and two or more poor prognostic factors in Aminu Kano Teaching Hospital (AKTH) Kano. The specific objectives are to compare surgical site infection rates, 30-day mortality rates, and the time to commence oral intake between TIP patients with two or more poor prognostic factors who are treated with ileostomy and those treated by primary closure.

Methodology

Study Area: The study was conducted at Aminu Kano Teaching Hospital (AKTH), which is a public tertiary health institution situated in the ancient city of Kano, North-western Nigeria. Kano, the capital of Kano state is a major commercial center in the North and has a high influx of patients from neighboring states and countries like Niger Republic, Cameroun, and Chad. The hospital has about 700-bed capacity and modern facilities for diagnosis and treatment.

The estimated population of the state is nine million, four hundred and one thousand, two hundred and eighty-eight (9,401,288) based on the official 2006 National Population and Housing Census.[13] One-third of the population lives in Kano city. The state has health centers fairly distributed across all local government areas in addition to a specialist and a newly established state teaching hospital. The hospital receives referrals from all parts of Kano state and its neighboring states including Jigawa, Katsina, Kaduna, and Bauchi. Also, referrals are from far states like; Zamfara, Gombe, Yobe, Borno, Adamawa, Taraba, and Niger state. [13,14]

***Study Design and duration*:** This was an Analytical Prospective, Cohort, and Comparative study done over year (2021-2022).

Study Population: The study population consisted of consecutive patients diagnosed with typhoid perforation who met the inclusion criteria and were randomized into group A (ileostomy) and group B (primary closure of perforation).

Inclusion criteria encompassed all new patients with typhoid ileal perforation presenting to the Accident and Emergency Department who had two or more poor prognostic factors and consented within the one-year study period. The poor prognostic factors, based on studies by Adesunkanmi [15] and Mehdi [16] *et al* included a prolonged perforation operation interval of more than 48 hours, delay of surgery for more than 24 hours due to resuscitation needs (such as anemia, hypokalemia, shock, or uremia), fecal peritonitis exceeding one-liter, multiple perforations, and perforations equal to or larger than one centimeter. The study focused on the first two pre-operative factors to allow for patient randomization before surgery, given their high correlation with the other factors.

Exclusion criteria were patients with a single poor prognostic factor, re-perforation, lack of consent, uncontrolled comorbidities (like cardiac failure, chronic renal failure, or diabetes mellitus), patients who were moribund and unstable at the time of surgery, perforations due to other causes, and patients under 12 years of age.

Sample Size Estimation: Through balloting by an independent assistant, the patients who met the inclusion criteria were randomized into two (2) groups A and B. Using the sample size formula for a comparative study of two population proportions.[17] and the proportion used by Malik M, *et al* in their study on different surgical options vs ileostomy in TIP.[18] The sample size was 28 patients per group with a total of 56 patients recruited.

Data Collection: All patients with Typhoid perforation who met the inclusion criteria were recruited into the study. On presentation, biodata was obtained: Age, sex, tribe, address, living settings, and informant, among others. Also, a detailed history was taken with regards to presenting symptoms, duration of illness before presentation, duration of fever before abdominal pain and distention, medical care prior to presenting to our facility, presence of complications, or any other comorbidity. The patients were also examined for wasting, pallor, facial puffiness, and body temperature. The pulse/heart, blood pressure, and respiratory rate were all recorded. The abdomen was examined for distension, movement with respiration, tenderness, and abdominal aspiration to assess the presence and nature of the peritoneal collection. Blood samples were taken for Full Blood Count, serum urea and electrolyte, erect Chest X-ray, and abdominal ultrasound scan in some of the cases. Patients were resuscitated with intravenous fluid, antibiotics, analgesics, oxygen, and blood as required. A suitable urinary catheter was passed to monitor urine output and an appropriately sized Naso-gastric tube for decompression. All the patients were well-resuscitated and stabilized at the time of surgery. The time between hospital presentation and surgical intervention was noted. Consent was taken and patients were reviewed by the anesthetist. Emergency exploratory laparotomy was done through a long midline abdominal incision. Intra-operative findings noted included the site of perforation, number, and size of each perforation, condition of the gut, volume, and nature of intra-peritoneal collection. For group A, the affected bowel segment was excised

for histology while the two ends were brought out as ileostomy. For group B primary closure of the perforation was done. Patients with Perforation within 12cm of the terminal ileum were given either an Ileostomy or Right hemi-colectomy depending on which group they fell into. The Excised/resected specimens were taken for histology. For group A, Ileostomy care was observed and complications arising from it were recorded. These were to be reversed for 4 to 12 weeks when the patients were considered stable. Thirty (30)-day mortality was recorded. Complications from the two groups were documented and appropriate interventions were instituted. Data was collected into a proforma prepared for the study. The lead researcher/consultant surgeon personally did all the recruitments and 71% (40 of the patients) of the procedures. The rest of the surgical procedures were done by at least a senior registrar.

Sampling Technique: The patients who met the criteria were randomly assigned into either group A or B using simple random techniques. The sampling frame was all eligible TIP patients with ≥2 poor prognostic factors admitted to AKTH within the study period, from which the 56 participants were systematically recruited and randomized. Consecutive patients who met the inclusion criteria were grouped into either group A or B by picking ballot papers at the point of surgery in an envelope containing numbers 1 to 56 until 28 pairs were obtained in total. Odd numbers were placed in group A (ileostomy) while even numbers were placed in group B (primary closure) until 28 participants per group were obtained.

Data Analysis: Data was analyzed using SPSS version 23. Quantitative variables such as age, number of days before presentation, and number of perforations were summarized using mean, standard deviation, median, and range as appropriate. Qualitative variables were described in frequencies and percentages. Outcomes were recorded and compared. The result was displayed in the form of tables and charts. Chi-square and Fischer's test were used to compare between rate of mortality and rate of surgical site infection between the two groups. Independence T-test was used to compare means of length of time to commence oral feed and length of hospital stay. A p value of <0.05 was considered significant.

Ethical Consideration: Ethical approval (NHREC/28/01/2020/AKTH/EC/2928) was obtained from the Aminu Kano Teaching Hospital Health Research Ethics Committee before carrying out the research. A consent form was administered to the respondents after the purpose of the research had been explained to them or to their relatives in the language, they understood better. The patients also reserved the right to withdraw from the study at any time for whatever reason without penalty. All the information gathered remained confidential. Only the initials and serial numbers of the patients were used.

Results

Socio-Demographic Characteristics: In total, 56 patients were recruited in the study. The age range was 12 to 61 with Mean and Standard deviation of 20.53 and 10.65 respectively. The commonest gender was Male accounting for 55.4% (n=31), commonest tribe was Hausa accounting for 98.2% (n=55). All the patients are Muslims. Most of them were students, 64.3% (n=36) attending secondary school (50%). 94.6% of the patients live in a rural setting (n=53). The marital status of the patients showed the majority were single accounting for 80.4% (n=45). These findings are summarized in Table 1, while Figure 1 shows the age group distribution of the subjects.

Table 1: Socio-demographic characteristics of study participants

Variables	Frequency n = 58	Percentage (%)
Age Group		
10-20	36	64.3
21-29	10	17.9
30-39	6	10.7
40-49	2	3.6
50 and above	2	3.6
Religion		
Islam	56	100
Tribes		
Hausa	55	98.2
Fulani	1	1.8
Occupation		
Student	36	64.3
Farmer	8	14.3
Civil Servant	2	3.6
Housewife	6	10.7
Driver	1	1.8
Laborer	1	1.8
Herder	1	1.8
Business	1	1.8
Religion		
Islam	56	100
Educational Status		
None	9	16.1
Primary	15	26.8
Secondary	28	50
Post-Secondary	4	7.1
Living Settings		
Rural	53	94.6
Urban	3	5.4
Marital Status		
Married	11	19.6
Single	45	80.4

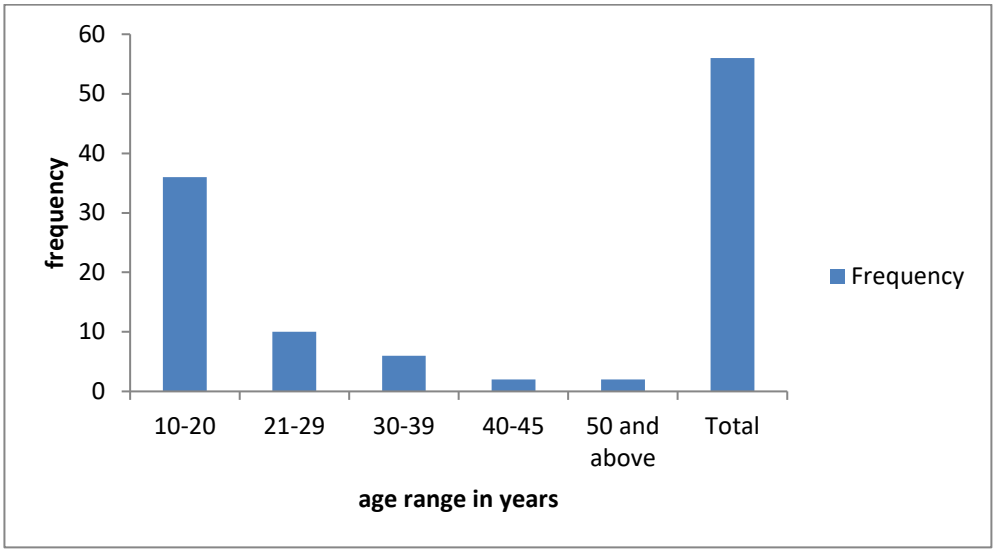

Figure 1: Frequency of age group of patients

Mode of Presentation: The entire patient (100%, n=56) presented with fever, abdominal pain, and abdominal distension. This is followed by constipation in 19 patients (33.9%). Diarrhoea was present in 14 patients (25.0%) while vomiting was present in 13 patients (23.2%). None of the patients presented with rectal bleeding. Forty-six patients (82%) presented with pallor and 37 patients (66.1%) presented with dehydration. Thirteen patients (23.2%) had Pedal Oedema on examination. All 56 patients had generalized abdominal tenderness. Table 2 shows the summary of the signs and symptoms identified in the patients.

Table 2: Mode of presentation (clinical symptoms) of participants

Table 2: Mode of Presentation (Symptoms)		
Symptoms	**Frequency n=56**	**Percentage (100%)**
Fever	56	100
Abdominal pain	56	100
Abdominal distension	56	100
Constipation	19	33.9
Diarrhoea	14	25
Vomiting	13	23.4
Rectal bleeding	0	0

The average fever-abdominal pain interval in this study was 7.82±4.23 days. This is shown in Table 3. The shortest interval is two (2) days while the longest is 20 days. The mean generalized abdominal pain to hospital presentation interval was 4.91±2.69 days. The minimum interval was two (2) days while the maximum was 14 days. All the patients were operated on 24 hours after admission as the majority needed resuscitation from anaemia, electrolyte imbalance, or uraemia. The mean haemoglobin of the patients was 9.41±3.29 which is below the hospital range of 12-16g/dl. The mean white blood cell count was 7.93±4.4×10⁹. The differentials counts were as follows: Neutrophils 47.71±4.71%, lymphocytes 24.27±12.97%, and monocytes 22.93±12.53%. These show a relative Leukocytosis as shown by increased monocyte count. Thirty-eight patients (67.9%) had pre-operative haemoglobin levels of less than 10g/dl.

Table 3: Clinical examination findings/signs in the participants

Examination	Frequency n=56	Percentage (100%)
Fever	56	100
Abdominal tenderness	56	100
Pallor	46	82.1
Dehydration	37	66.1
Oedema	13	23.2
Jaundice	0	0

The mean pre-operative serum sodium concentration was 129.82±7.54mmol/L which was within the normal hospital range (128-142mmol/L). The mean serum potassium was 4.40±3.81mmol/L. Seven patients (12.5%) presented with hypokalaemia that required correction prior to surgery. The mean serum creatinine and urea were 107.2±59.1mmol/L and 12.67±26.32mmolL respectively. Nineteen of the 56 patients (34%) had plain Chest X-rays among which eighteen (32.2%) showed air under the diaphragm while 1 (1.8%) had a normal chest X-ray. Ten patients (17.9%) had abdominal ultrasound scans, and they were all positive for intra-abdominal collection. A histology report of the excised specimen was obtained for 56 patients. These details are shown in Table 4. Fourty-three histological (76.79%) reports gave the conclusion of Typhoid perforation while 13 (23.21%) reports gave the diagnosis of non-specific perforation.

Table 4: Histological pattern of excised specimens

Histology report	Frequency n=56	Percentage
Typhoid perforation	43	76.79
Non-specific perforation	13	23.21

The operative procedures were Primary closure for 28(50%) of the patients and Ileostomy for the other 28(50%) of the patients.

The number of perforations ranged from 1 to 8 with a mean of 1.95±1.54. Thirty-one patients (55.36%) had single perforation while 25 patients (44.64%) had multiple perforations. The distance of the perforations from the ileoceacal junction ranged from 10cm to 60 cm with a mean of 27.61±13.01. The size of the perforations ranged from 0.3cm to 2cm with a mean of 0.85cm±0.42. The amount of peritoneal exudate ranged from 0.25liters to 4liters with a mean of 1.86±1.02liters. Only 11 patients (19.64%) had a peritoneal collection of less than 1liter while 80.36% of the patients had a peritoneal collection of 1liter or more. The intraoperative findings are depicted in Table 5.

Table 5: Pattern of peri-operative findings

Operative findings		Frequency n=56	Percentage (%)
Peritoneal collection	Less than 1 liter	11	19.64
	1 liter or more	45	80.36
Number of perforations	Single	31	55.36
	Multiple	25	44.64
Size of perforation	<1cm	30	53.57

	≥1cm	26	46.43
Distance from ICJ	Within 60cm	56	100

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The post-operative return to oral feed ranged from one to five days with a mean of 3.02±0.99days. This is shown in Table 6. The patients within the ileostomy and primary closure groups had mean days of return to oral feed of 2.30±0.61 and 3.71±0.76 respectively (p<0.001).

Table 6: Mean days to commencement of oral feeding post operatively

	Type of intervention	N	Mean	Std. Deviation
Return to Oral Feed	Ileostomy	27	2.30	.609
	Primary Closure	28	3.71	.763
p<0.001				

Wound infection was the most common complication in the study. Forty-two (75%) patients had surgical site infection (Table 7). Nineteen (67.9%) of the patients belong to the ileostomy while 23(82.1% were in the primary closure group. (Table 8) within the intervention group) of them belong to the ileostomy group (p-value 0.355). The next commonest complication is wound dehiscence noticed in 16(28.6%) of the patients (Table 7). More serious complications like faecal-fistula and burst abdomen are seen in 9(16.1%) and 4(7.1%) respectively (Table 7). Post-operative Sepsis was observed in 13(23.2%) patients (Table 7). Specific complications for the ileostomy group such as skin excoriation and electrolyte imbalance were seen in 6 and 3(20.14% and 10.14% of the group) patients respectively. The results on complications are shown in Tables 7, 8 and 9.

Table 7: Complications seen within the study group

Complications	Frequency n=56	Percentage (%)
Wound infection	42	75
Wound dehiscence	16	28.6
Sepsis	13	23.2
Faecal Fistula	9	16.1
Chest infection	7	12.5
Burst abdomen	4	7.1
Intra-abdominal abscess	6	10.7

Table 8: Comparison of complications between the study groups

Complications	Ileostomy group	Primary closure	*p*-value
Wound infection	19(76.9%)	23(82.1%)	0.217
Wound dehiscence	3(10.7%)	13(46.4%)	0.03
Burst abdomen	0(0%)	4(14.3%)	0.111
Faecal fistula	0(0%)	9(32%)	0.02
Sepsis	4(14.3%)	9(32%)	0.114
Chest infection	2(7.1%)	5(17.9%)	0.422

Table 9: Complications specific to the ileostomy group

Complications	Frequency n=28	Percentage (100%)
Skin excoriation	6	21.41
Prolapse	3	10.71
Electrolyte imbalance	3	10.71
Stenosis/retraction	3	10.71
Bleeding	1	3.57

Of the total patients in the study, eight died (14.3%). This is shown in Table 10. Six patients died in Group B making up 21.4% of the intervention group while two patients died in Group A making up 7.1% of the intervention group (*p*-value 0.252). Six of the eight patients (75%) died of overwhelming sepsis while the other two died of entero-cutaneous fistula complications.

Forty-eight patients were discharged after the initial admission for both the ileostomy group and the primary closure group. The mean hospital stay is 15.58±11.18 days for the study ranging from four to 52 days. The mean hospital stay for the ileostomy group is 10.58±6.33 days (ranging from 4-28days) while the mean hospital stay for the primary closure group is 21.50±12.79 days (ranging from 5-52days) with the level of significance of $p<0.01$.

Table 10: Mortality among the study participants

	Ileostomy	primary closure	*p*-value
Mortality	2(7.1%)	6(21.4%)	0.252

Discussion

Typhoid ileal perforation remains a public health problem in the developing world. Mortality remains high in these environments despite several surgical options. This has largely been attributed to delayed presentation by the patients. Typhoid perforation affects mainly male young adults as reported by Adesunkanmi.[15] This study shows a mean age of 20.53±10.65. 64.3% are less than 20 years of age

attending secondary school. This is similar to earlier study findings in this centre by Sheshe *et al* where the median age was 17 years.[1] Ninety-four percent of the patients are from the rural area and the majority are students. Access to good drinking water is difficult in this group of people in addition to poor sanitary conditions and habits irrespective of gender. This may explain the low male-female ratio.

Perforation following typhoid fever usually occurs within the 3rd week. In this study, however, the perforation mostly occurred within the second week (mean 7.82±4.27days). This agrees with an earlier study in this centre by Edino *et al* where they found more than 54.7% of the patients perforated within 2nd week of the illness.[11] This is possibly attributed to the hypersensitivity of the payer's patches in the West African population.[19]

The majority of the perforations in the study were single perforations (55.36%). This is lower than earlier studies in this centre by Sheshe and Edino *et al* whose study found a single perforation in 87.2% and 71.7% respectively. [1,11] This is probably because all the patients included in this study have a late presentation of at least 48hours after perforation. Only 19.6% of the study population had peritoneal exudate of less than one liter while 80.36% had one liter or more of the peritoneal collection intra-operatively. This can also be explained by the fact that the patients recruited in this study have a late presentation.

Complications are evenly distributed among the study groups except for ileostomy-related complications. Surgical site infection is the most common complication occurring in 75% of the patients. It's slightly higher in the primary closure group occurring in 23 out of 28 patients (82.1%) while 19 patients out of 28 (76.9%) were affected in the ileostomy group. The difference is, however, not statistically significant (p=0.217). Wound dehiscence and faecal fistula are two more serious complications that were statistically significantly higher in the primary closure group (p=0.03 and p=0.02 respectively).

It is important that the patients return to enteral feeding as soon as possible so they can commence on high high-calorie high-protein diet. Parenteral nutrition is not readily available and unaffordable to many in this environment. In this study, the patients in the ileostomy group had earlier return to oral intake in comparison to those that had primary closure. The commencement of oral feeding is within 2.3±0.61 and 3.71±0.73 for the ileostomy and primary closure groups respectively. This was shown to be statistically significant with a p-value <0.001.

Mortality was found to be unrelated to the number of perforations, amount of peritoneal aspiration, and the time of invention (p=0.59,0.73 and 0.70 respectively). This does not support the findings by Sheshe and Edino *et al* in which mortality was linked to the amount of peritoneal aspiration of one litre and above. [1,11] Mortality is also unrelated to high serum urea levels. Out of the eight mortalities, four patients had elevated serum urea. However, this was found to be statistically not significant (p= 2.58). This goes in contrast with the findings of Atoyebi *et al* in Lagos who reported a relation between elevated levels of urea and mortality.[20] Mortality is higher in the primary closure group owning up to five out of the eight mortalities. This, however, is found to be statistically not significant (p=0.25). A study by Malik *et al* in Pakistan showed a significantly lower mortality of 1.85% as opposed to 12.5% in the primary closure group.[18] Tahir *et al* found a similar low mortality of 3.45% in patients with late presentation.[21] Mishra *et al,* however, showed non-significant higher mortality in the ileostomy group in a relatively smaller sample size (19 patients).[22] There is a significantly shorter hospital stay in the ileostomy group that survived (10.58±6.33 days ranging from 4-28days) as opposed to 21.50±12.79 days (ranging from 5-52days) with a level of significance of p<0.01. Major morbidities that are more common in the primary closure group like post-operative entero-cutaneous fistula and wound dehiscence are partly responsible for the big difference. However, the ileostomy group will require a second admission for ileostomy reversal and that should be considered.

Limitations

This was a single-center cohort study**,** with unmeasured confounders, like surgeon skills, and residual imbalances post-balloting may have influenced the results. A randomized controlled trial (RCT) is recommended to strengthen the recommendation of preference for any method over the over. In addition non-significant in mortality rates makes the need for larger randomized studies and metanalysis necessary.

Conclusion:

This prospective cohort study compared outcomes of ileostomy versus primary closure in typhoid ileal perforation (TIP) patients with ≥2 poor prognostic factors. While the study design limits causal inferences, the findings suggest that ileostomy is associated with significantly lower rates of fecal fistula and wound dehiscence compared to primary closure. Although mortality was lower in the ileostomy group, this difference was not statistically significant. Similarly, surgical site infection rates did not differ significantly. However, ileostomy patients had earlier return to oral intake and shorter hospital stays (p<0.01), highlighting its potential advantages in high-risk settings.

Based on our findings, we recommend prioritizing ileostomy for high-risk typhoid perforation cases given its significant reduction in major complications. Multicenter randomized trials are needed to validate these outcomes and clarify mortality benefits. Hospitals should establish high-dependency units for postoperative monitoring and consider implementing total parenteral nutrition protocols, particularly for primary closure patients. A cost-effectiveness analysis encompassing ileostomy reversal expenses would provide important policy guidance. We advocate standardized preoperative resuscitation protocols and evidence-based surgical selection criteria. Future research should also evaluate long-term quality-of-life outcomes to better inform clinical decision-making for this challenging surgical emergency in resource-limited settings.

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