



Factors influencing outcomes of bowel anastomosis: An analytical observational study at a tertiary care centre

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Abstract

Background: Anastomosis of the bowel is a frequently conducted procedure in gastrointestinal surgery, with anastomotic leakage being one of the most severe postoperative complications. This study assessed the factors affecting outcomes after bowel anastomosis, focusing specifically on anastomotic leakage and postoperative morbidity.

Materials and Methods: This analytical observational study was carried out in the Department of General Surgery at a tertiary care teaching hospital over a period of 18 months. The study included 49 patients who underwent bowel anastomosis. Data collected encompassed demographic details, clinical characteristics, comorbidities, operative variables, serum albumin levels, postoperative complications, duration of hospital stay, and mortality rates. Categorical variables were subjected to analysis using the Chi-square test or Fisher's exact test, as appropriate. A p-value of less than 0.05 was deemed statistically significant.

Results: The mean age of the patients was 50.16 ± 17.46 years, and 28 (57.14%) were males. The mean BMI was 25.88 ± 4.11 kg/m², mean hemoglobin was 11.92 ± 1.84 g/dL, and mean serum albumin was 3.66 ± 0.68 g/dL. Hypoalbuminemia was present in 18 (36.73%) patients. Emergency surgery was performed in 26 (53.06%) patients. Surgical site infection and anastomotic leak were observed in 7 (14.29%) patients each. The mean hospital stay was 9.89 ± 3.13 days, and mortality occurred in 3 (6.12%) patients. Age group, sex, and serum albumin status were not significantly associated with anastomotic leak; however, leak was proportionally more frequent among males, patients above 60 years, and those with hypoalbuminemia.

Conclusion: Anastomotic leak occurred in a clinically significant proportion of patients undergoing bowel anastomosis. Although the evaluated factors did not show statistically significant associations, higher leak proportions among elderly patients, males, and hypoalbuminemic patients indicate the importance of preoperative optimization, nutritional assessment, meticulous surgical technique, and close postoperative monitoring to improve surgical outcomes.

Keywords: Bowel anastomosis, anastomotic leak, hypoalbuminemia, surgical site infection, postoperative outcomes

Introduction

Bowel anastomosis is an essential component of gastrointestinal surgery and is commonly performed after intestinal resection for benign and malignant diseases, trauma, obstruction, perforation, volvulus, and inflammatory or ischemic conditions.^[1] The primary aim of anastomosis is to restore bowel continuity while maintaining adequate luminal patency, vascularity, and tissue healing. Despite advances in perioperative care, anesthesia, antimicrobial prophylaxis, surgical technique, and postoperative monitoring, complications following bowel anastomosis continue to remain a major concern in general surgical practice.^[1] Anastomotic leak is one of the most serious complications following intestinal anastomosis. It is generally understood as a disruption of the bowel wall integrity at the anastomotic site, resulting in communication between the intra-luminal and extra-luminal compartments.^[2] The reported incidence of anastomotic leak varies widely across studies because of differences in patient selection, anatomical site, surgical indication, emergency versus elective setting, operative technique, and diagnostic criteria. Previous reviews have reported leak rates ranging from approximately 1% to 19% after colorectal surgery, with higher rates observed in high-risk patients and technically demanding anastomoses.^[3, 4] The

occurrence of an anastomotic leak has significant clinical consequences. It may lead to intra-abdominal abscess, generalized peritonitis, sepsis, wound infection, prolonged ileus, reoperation, need for diversion stoma, prolonged hospital stays, increased healthcare cost, and mortality.^[1, 5] Severe leaks are particularly associated with increased postoperative mortality, especially among elderly and physiologically compromised patients.^[6] Therefore, early identification of patients at risk and careful postoperative surveillance are important for reducing morbidity and improving surgical outcomes. Several patient-related, disease-related, and operative factors have been implicated in impaired anastomotic healing. Advanced age, male sex, smoking, diabetes mellitus, anemia, hypoalbuminemia, malnutrition, sepsis, peritoneal contamination, emergency surgery, excessive blood loss, perioperative transfusion, prolonged operative duration, distal colorectal anastomosis, and tension or poor vascularity at the anastomotic site have been reported as potential risk factors.^[3, 4, 7] Among these, serum albumin is an important marker of nutritional and inflammatory status. Hypoalbuminemia has been associated with poor wound healing, increased surgical site infection, and higher risk of anastomotic complications following gastrointestinal surgery.^[8]

Emergency bowel surgery poses an additional challenge because patients often present with obstruction, perforation, contamination, sepsis, dehydration, electrolyte imbalance, anemia, or poor nutritional reserve. In such situations, the opportunity for preoperative optimization may be limited, and the surgeon must balance the need for restoration of bowel continuity against the risk of anastomotic failure. Studies evaluating intestinal anastomosis have identified emergency surgery and low preoperative serum albumin as important predictors of anastomotic leakage.^[7] Hence, assessment of modifiable and non-modifiable risk factors is necessary for planning operative strategy, deciding the need for protective stoma, and guiding postoperative monitoring. Although several studies have evaluated risk factors for anastomotic leak in colorectal surgery, data from mixed bowel anastomosis populations, particularly in tertiary care settings managing both elective and emergency cases, remain clinically relevant. The present study was therefore conducted to evaluate the factors influencing outcomes following bowel anastomosis, with particular emphasis on anastomotic leak, postoperative morbidity, hospital stay, and mortality.

Materials and Methods

Study Design

This was an analytical observational study conducted to evaluate the factors influencing the outcomes of bowel anastomosis and to assess their association with postoperative complications, particularly anastomotic leak.

Study Setting

The study was carried out in the Department of General Surgery at a tertiary care teaching hospital. Patients undergoing bowel anastomosis procedures during the study period and fulfilling the predefined eligibility criteria were included.

Study Duration

The study was conducted over a period of 18 months.

Study Population

The study population consisted of patients undergoing bowel anastomosis for various elective and emergency surgical indications. A total of 49 patients were included in the final analysis.

Inclusion Criteria

Patients undergoing bowel anastomosis procedures were included in the study. Patients of all age groups, those admitted for elective or emergency bowel surgery, and those willing to participate after providing informed consent were considered eligible.

Exclusion Criteria

Patients undergoing bowel surgery without anastomosis were excluded from the study. Patients with contraindications to bowel anastomosis, such as severe bowel ischemia or necrosis, history of previous bowel surgery at the same anatomical site, presence of an intestinal stoma proximal to the planned anastomotic site, or requirement of multiple intestinal anastomoses, were also excluded.

Ethical Considerations

Following approval from the Institutional Ethics Committee, the study commenced. Prior to enrolment, all participants

provided written informed consent. Patient information confidentiality was preserved throughout the study.

Sampling Technique

Eligible patients undergoing bowel anastomosis during the study period were enrolled consecutively according to the inclusion and exclusion criteria.

Data Collection

Data were collected using a structured case record form. Demographic details including age, sex, and body mass index were recorded. Clinical variables such as comorbidities, smoking status, indication for surgery, type of surgery, presence of peritonitis or contamination, and protective stoma formation were documented. Relevant preoperative, intraoperative, and postoperative details were collected and analyzed.

Preoperative Assessment

All patients received a comprehensive preoperative clinical assessment. Standard investigations comprised a complete blood count, kidney and liver function tests, chest X-ray, erect and supine abdominal X-rays, and an electrocardiogram. When clinically warranted, additional investigations such as ultrasonography, endoscopy, computed tomography, magnetic resonance imaging, and tissue biopsy were conducted. Hemoglobin and serum albumin levels were documented to evaluate anemia and nutritional status. Elective cases underwent bowel preparation prior to surgery, and prophylactic antibiotics were administered to all patients.

Operative Procedure

Bowel anastomosis was performed according to standard surgical principles. In open procedures, a two-layer hand-sewn anastomosis was performed. The inner transmural layer was constructed using continuous polyglactin sutures, and the outer seromuscular layer was reinforced with interrupted silk sutures. The surgical approach, type and site of anastomosis, duration of surgery, intraoperative blood loss, blood transfusion requirement, protective stoma formation, and intraoperative complications were recorded.

Postoperative Follow-up

Patients were monitored during the postoperative period for the development of complications. Clinical assessment was performed regularly for fever, abdominal pain, distension, prolonged ileus, drain-site leakage, wound infection, and other signs suggestive of postoperative morbidity. Ultrasonography of the abdomen was performed in patients with abdominal distension, prolonged ileus, or suspected drain-site leakage. Additional investigations were carried out when systemic complications such as pneumonia or sepsis were suspected.

Outcome Measures

The primary outcome was the occurrence of anastomotic leak. Secondary outcomes included surgical site infection, anastomotic stricture, return of bowel function, duration of hospital stay, postoperative morbidity, and mortality.

Definition of Anastomotic Leak

Anastomotic leak was defined as clinical or radiological evidence of disruption at the anastomotic site, including feculent or enteric drain discharge, intra-abdominal collection related to the anastomosis, peritonitis, or need for

re-intervention due to suspected or confirmed anastomotic failure.

Statistical Analysis

Data were input into Microsoft Excel and subsequently analyzed using SPSS software version 26.0. Continuous variables are presented as mean values with corresponding standard deviations, while categorical variables are depicted as frequencies and percentages. The associations between categorical variables were evaluated using the Chi-square test or Fisher's exact test, depending on suitability. A p-value of less than 0.05 was deemed statistically significant.

Result

The study included 49 patients who underwent bowel anastomosis. The patients' ages ranged from 31 to 80 years, with an average age of 50.16 ± 17.46 years. There was a predominance of males, comprising 28 (57.14%) of the participants, while females accounted for 21 (42.86%). The mean body mass index (BMI) was 25.88 ± 4.11 kg/m². The average hemoglobin level was 11.92 ± 1.84 g/dL, and the mean serum albumin level was 3.66 ± 0.68 g/dL. Hypoalbuminemia was present in 18 (36.73%) patients, whereas 31 (63.27%) patients exhibited normal serum albumin levels (Table 1).

Table 1: Baseline demographic and biochemical characteristics of the study participants

Variable	Result
Total patients	49
Age, years, mean $\pm$ SD	50.16 ± 17.46
Age range, years	31–80
Male	28 (57.14%)
Female	21 (42.86%)
BMI, kg/m ² , mean $\pm$ SD	25.88 ± 4.11
BMI range, kg/m ²	18.10–33.00
Hemoglobin, g/dL, mean $\pm$ SD	11.92 ± 1.84
Hemoglobin range, g/dL	8.70–14.80
Serum albumin, g/dL, mean $\pm$ SD	3.66 ± 0.68
Serum albumin range, g/dL	2.30–4.80
Hypoalbuminemia	18 (36.73%)
Normal serum albumin	31 (63.27%)

Among the indications for surgery, malignancy was the most common indication, observed in 10 (20.41%) patients, followed by intestinal obstruction and perforation in 9 (18.37%) patients each. Trauma and volvulus were observed in 8 (16.33%) patients each, while stricture was present in 5 (10.20%) patients. Emergency surgery was performed in 26 (53.06%) patients, whereas 23 (46.94%) patients underwent

elective surgery. Hypertension was present in 15 (30.61%) patients, diabetes with hypertension in 11 (22.45%) patients, and diabetes mellitus alone in 9 (18.37%) patients. A total of 22 (44.90%) patients were smokers. Peritonitis or contamination was present in 27 (55.10%) patients, including generalized contamination in 13 (26.53%) and localized contamination in 14 (28.57%) patients (Table 2).

Table 2: Clinical profile of the study participants

Variable	Frequency (%)
Indication for surgery	
Malignancy	10 (20.41%)
Intestinal obstruction	9 (18.37%)
Perforation	9 (18.37%)
Trauma	8 (16.33%)
Volvulus	8 (16.33%)
Stricture	5 (10.20%)
Type of surgery	
Emergency	26 (53.06%)
Elective	23 (46.94%)
Comorbidities	
Hypertension	15 (30.61%)
Diabetes mellitus with hypertension	11 (22.45%)
Diabetes mellitus	9 (18.37%)
None	14 (28.57%)
Smoking status	
Smoker	22 (44.90%)
Non-smoker	27 (55.10%)
Peritonitis/contamination status	
Generalized	13 (26.53%)
Localized	14 (28.57%)
None	22 (44.90%)

The most common anastomotic sites were colorectal, ileoileal, and jejunojunal anastomoses, each performed in 12 (24.49%) patients. Colocolic anastomosis was performed in 7 (14.29%) patients and ileocolic anastomosis in 6 (12.24%) patients.

A protective stoma was created in 27 (55.10%) patients. The mean duration of surgery was 175.39 ± 47.37 minutes, with a range of 93 to 260 minutes. The mean intraoperative blood loss was 495.45 ± 222.71 mL, ranging from 111 to 878 mL (Table 3).

Table 3: Operative characteristics of the study participants

Variable	Result
Anastomosis site	
Colorectal	12 (24.49%)
Ileoileal	12 (24.49%)
Jejunojejunal	12 (24.49%)
Colocolic	7 (14.29%)
Ileocolic	6 (12.24%)
Protective stoma	
Yes	27 (55.10%)
No	22 (44.90%)
Duration of surgery, minutes, mean $\pm$ SD	175.39 $\pm$ 47.37
Duration of surgery range, minutes	93–260
Intraoperative blood loss, mL, mean $\pm$ SD	495.45 $\pm$ 222.71
Blood loss range, mL	111–878

Postoperatively, surgical site infection was observed in 7 (14.29%) patients. Anastomotic leak occurred in 7 (14.29%) patients, while 42 (85.71%) patients had no evidence of leak.

The mean duration of hospital stay was 9.89 ± 3.13 days, ranging from 5 to 19 days. Mortality was observed in 3 (6.12%) patients, whereas 46 (93.88%) patients survived (Table 4).

Table 4: Postoperative outcomes of the study participants

Outcome	Frequency (%)
Surgical site infection	
Yes	7 (14.29%)
No	42 (85.71%)
Anastomotic leak	
Yes	7 (14.29%)
No	42 (85.71%)
Hospital stays, days, mean $\pm$ SD	9.89 $\pm$ 3.13
Hospital stay range, days	5–19
Mortality outcome	
Survived	46 (93.88%)
Died	3 (6.12%)

The association between age group and anastomotic leak was not statistically significant ($p = 0.863$). Although leaks were proportionally more frequent among patients aged above 60 years, the difference was not statistically significant. Similarly, sex was not significantly associated

with anastomotic leak ($p = 0.683$), although a higher proportion of leak cases occurred among males. Hypoalbuminemia was more common among patients with anastomotic leak; however, the association did not reach statistical significance ($p = 0.398$) (Table 5).

Table 5: Association of selected factors with anastomotic leak

Variable	No leak, n = 42	Leak, n = 7	p-value
Age group			0.863
31–40 years	9 (21.43%)	1 (14.29%)	
41–50 years	8 (19.05%)	2 (28.57%)	
51–60 years	10 (23.81%)	1 (14.29%)	
Above 60 years	15 (35.71%)	3 (42.86%)	
Sex			0.683
Female	19 (45.24%)	2 (28.57%)	
Male	23 (54.76%)	5 (71.43%)	
Serum albumin status			0.398
Hypoalbuminemia	14 (33.33%)	4 (57.14%)	
Normal serum albumin	28 (66.67%)	3 (42.86%)	

Overall, anastomotic leak occurred in 7 (14.29%) patients. Although age group, sex, and serum albumin status were not statistically significant predictors of anastomotic leak in the present study, leak was proportionally more frequent among males, patients aged above 60 years, and patients with hypoalbuminemia.

Discussion

Anastomotic leak is one of the most serious complications after bowel anastomosis because it increases postoperative

morbidity, hospital stay, need for re-intervention, sepsis, and mortality. In the present study, anastomotic leak occurred in 7 (14.29%) patients, while surgical site infection was also observed in 7 (14.29%) patients. This leak rate is comparable with previously reported rates, where anastomotic leakage after intestinal and colorectal surgery has ranged widely from approximately 1% to 19%, depending on patient factors, anastomotic site, emergency status, contamination, and diagnostic criteria.^[3, 4] The relatively higher leak proportion in the present study may be

attributed to the large number of emergency surgeries 26 (53.06%) and the presence of peritonitis or contamination in 27 (55.10%) patients.

Age group was not significantly associated with anastomotic leak in this study ($p = 0.863$). However, leaks were proportionally more frequent among patients aged above 60 years. Elderly patients often have reduced physiological reserve, associated comorbidities, impaired tissue healing, and higher susceptibility to infection, which may adversely affect anastomotic integrity. Previous studies have shown variable findings regarding age as an independent predictor of leak, suggesting that anastomotic failure is usually multifactorial rather than dependent on a single risk factor.^[3]

⁹¹ Therefore, the lack of statistical significance in the present study should be interpreted cautiously because of the small sample size and limited number of leak events.

Male sex was also not significantly associated with anastomotic leak ($p = 0.683$), although 5 (71.43%) of the leak cases occurred among males. Similar observations have been reported in earlier studies, particularly in colorectal and rectal surgery, where male sex has been considered a potential risk factor due to anatomical and technical factors.^[4, 9] In the present study, however, different anastomotic sites were included, such as colorectal, ileoileal, jejunojejunal, colocolic, and ileocolic anastomoses. This heterogeneity may have reduced the ability to identify sex as an independent predictor of leak.

Serum albumin status is an important marker of nutritional status and wound healing capacity. In the present study, hypoalbuminemia was present in 18 (36.73%) patients, and leak was proportionally more frequent among hypoalbuminemic patients than those with normal albumin, although the association was not statistically significant ($p = 0.398$). Previous studies have reported low serum albumin as an important predictor of anastomotic leak after intestinal and colorectal surgery.^[5, 7, 10] Telem *et al.* reported that preoperative albumin below 3.5 g/dL significantly increased the risk of anastomotic leakage^[10], while Awad *et al.* also found that low albumin and emergency surgery were associated with postoperative leak.^[7] These findings support the need for preoperative nutritional assessment and correction of hypoalbuminemia whenever feasible.

Overall, the present study shows that anastomotic leak occurred in a clinically significant proportion of patients undergoing bowel anastomosis. Although age group, sex, and serum albumin status were not statistically significant predictors, higher leak proportions among elderly patients, males, and hypoalbuminemic patients indicate their clinical relevance. In addition, emergency surgery, contamination, operative duration, blood loss, and protective stoma formation are important contextual factors that may influence outcomes.^[11, 13] The findings emphasize the importance of careful patient selection, preoperative optimization, control of sepsis and contamination, meticulous tension-free and well-vascularized anastomotic technique, selective use of protective stoma, and close postoperative monitoring for early detection and management of complications.^[2, 14, 16]

Conclusion

Anastomotic leak was observed in a clinically significant proportion of patients undergoing bowel anastomosis, contributing to postoperative morbidity and prolonged recovery. Although age, sex, and serum albumin status were

not statistically significant predictors, higher leak proportions among elderly patients, males, and hypoalbuminemic patients suggest their clinical importance. Careful preoperative optimization, nutritional assessment, control of contamination, meticulous surgical technique, selective protective stoma formation, and close postoperative monitoring are essential to improve outcomes after bowel anastomosis.

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