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Original Research Article

A study of factors leading to postoperative leaks following bowel anastomosis with special reference to hypoalbuminemia

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ABSTRACT

Background: Bowel anastomosis is a critical surgical procedure performed during gastrointestinal resections, with outcomes influenced by various preoperative, intraoperative, and postoperative factors. This study aims to evaluate the clinical and surgical parameters affecting complications, morbidity, and mortality in patients undergoing bowel resection and anastomosis.
Methods: A prospective observational study was conducted on 50 patients undergoing small or large bowel resection with anastomosis. Data were collected on demographics, comorbidities, serum albumin and hemoglobin levels, type of surgery (elective/emergency), technique of anastomosis (hand-sewn/stapled), and intraoperative contamination. Postoperative complications such as wound infection, anastomotic leak, pelvic collection, and mortality were recorded and statistically analyzed.
Results: The majority of patients were male (66%) and underwent small bowel surgeries (70%). Hand-sewn anastomosis was performed in 66% of cases. Elective procedures accounted for 58% and emergency for 42%. Intraoperative contamination was present in 46% of patients. Postoperative complications occurred in 46%, with surgical site infection (28%) being the most common, followed by ileus (12%) and pelvic collection (6%). Anastomotic leaks occurred in 10%, and the overall mortality was 10%. Emergency surgeries and intraoperative contamination showed a statistically significant association with mortality ($p=0.022$ and $p=0.037$, respectively). Hypoalbuminemia (≤3.5 g/dl) was associated with a higher rate of anastomotic leaks (17.4%) and mortality (17.4%), though the latter was not statistically significant ($p=0.089$).
Conclusions: Emergency surgery, hypoalbuminemia, and intraoperative contamination are significant risk factors for postoperative complications and mortality following bowel anastomosis. Early diagnosis, nutritional optimization, aseptic techniques, and elective intervention when feasible may improve surgical outcomes.

Keywords: Bowel anastomosis, Anastomotic leak, Hypoalbuminemia, Emergency surgery, Intra-operative contamination, Post-operative complications

INTRODUCTION

Intestinal anastomosis is a fundamental surgical procedure used to restore bowel continuity following resection, commonly performed in both emergency and elective settings. Indications for such procedures include trauma, intestinal obstruction, and both benign and malignant gastrointestinal conditions.[1] Despite continuous advancements in surgical techniques and perioperative care, anastomotic leakage remains one of the most feared postoperative complications. It can lead to severe outcomes such as peritonitis, sepsis, prolonged hospitalization, and even death.[2]

The incidence of anastomotic leakage varies and is influenced by multiple factors, including the patient's

general condition, the type of anastomosis performed, and perioperative management strategies. Certain preoperative risk factors—especially hypoalbuminemia, anemia, and comorbidities like diabetes—have been found to significantly increase the risk of anastomotic failure.[3] Hypoalbuminemia is of particular concern as it is associated with delayed wound healing and a heightened risk of infection, making it a critical marker for poor surgical outcomes.

The technique of anastomosis also plays a crucial role in determining patient outcomes. Hand-sewn anastomoses remain widely used due to their accessibility and the surgeon's familiarity, whereas stapled anastomoses offer quicker execution but are more costly and less readily available in resource-limited settings.[4] Moreover, surgeries performed under emergency conditions, especially when there is peritoneal contamination or patient instability, show a higher tendency for postoperative leaks.[5] Successful anastomosis depends on principles such as ensuring good blood supply to the bowel ends, creating a tension-free suture line, and avoiding distal obstruction. Historical contributions—from Duverger's first end-to-end anastomosis in 1739 to Halsted's emphasis on submucosal suturing in 1887—continue to guide modern surgical practice. Anastomotic leakage has been associated with a sharp increase in mortality, with rates reaching up to 22%, compared to 7.1% in non-leak cases.[5] Therefore, identifying and optimizing modifiable risk factors preoperatively is crucial.

Research hypothesis

This study aims to evaluate the risk factors contributing to anastomotic leakage in gastrointestinal surgeries. It will particularly focus on the role of hypoalbuminemia, hemoglobin levels, surgical indications, contamination grade, type of anastomosis, technical aspects, and postoperative care. The study also seeks to assess the variation in morbidity, mortality, and clinical presentation among affected patients.

Aims and objectives

The aim and objectives of the study were to evaluate the factors affecting outcome in patients undergoing bowel resection and anastomosis, to study the incidence of complications (postop ileus, wound infection), and also to study the mortality rates following intestinal anastomosis.

METHODS

Study design and setting

This hospital-based prospective observational study was conducted in the Department of General Surgery at Murshidabad Medical College and Hospital, Murshidabad. The study was carried out over a period of 18 months, from January 2023 to July 2024.

Sample size and sampling technique

The sample size was calculated using the formula given.

$$N = Z^2 \times P \times (1 - P)/d^2$$

Substituting the values, the calculated sample size was 50.29, approximated to 50. Considering a 10% dropout rate, the final sample size was adjusted to 50.

Inclusion criteria

Patients aged between 20 to 65 years undergoing intestinal resection with primary anastomosis were included.

Exclusion criteria

Patients having sepsis with gross intra-abdominal collection and pus formation due to late presentation in intestinal perforation and obstruction, patients with pre-existing intestinal diseases like inflammatory bowel disease and radiation enteritis, patients who were taking steroids for other diseases, patients having chronic liver diseases, and patients having uncontrolled diabetes mellitus were excluded.

Study variables and data collection

The study employed a prospective data collection approach using structured case record forms. Patient-related parameters included demographic details such as age and sex, along with clinical history covering the date of admission and surgery and presenting symptoms. Laboratory investigations comprised complete hemogram, serum protein and albumin levels, urea, creatinine, and electrolytes. Relevant radiological imaging like X-rays, abdominal ultrasound, and computed tomography (CT) scans were performed as indicated.

Intraoperative data were recorded, including the type and technique of anastomosis (hand-sewn or stapled, end-to-end or end-to-side), the presence or absence of intraoperative contamination, and whether the procedure was elective or emergency. Postoperative outcomes assessed included the occurrence of anastomotic leak, wound infection, wound dehiscence, pelvic collection, and fecal wound discharge. Patient comorbidities such as diabetes mellitus and tuberculosis were also documented.

Types of surgeries included

Surgical procedures covered in the study were categorized into large and small bowel surgeries. Large bowel interventions included right or left hemicolectomy, sigmoid colectomy, anterior resection, abdominoperineal resection (APR), and total colectomy.

Small bowel surgeries comprised resection, stricturoplasty, and bypass procedures.

Surgical techniques

Hand-sewn anastomosis was performed using manual suturing techniques with absorbable or non-absorbable sutures, while stapler anastomosis involved the use of mechanical stapling devices to create the bowel connection.

Complication management

Anastomotic leaks were managed either conservatively or surgically depending on their severity. Wound infections and dehiscence were treated with antibiotics, wound dressings, or re-suturing when required. Pelvic collections were managed through image-guided drainage or surgical intervention. In cases of fecal fistula, re-exploration and stoma formation were undertaken when necessary. Postoperative bowel obstruction was handled conservatively or through adhesiolysis if needed. Stoma-related complications and systemic issues were addressed following standard clinical protocols.

Statistical analysis

Data was analyzed using statistical package for the social sciences (SPSS) software. Categorical variables were presented as frequencies and percentages, continuous variables as mean±standard deviation (SD). The unpaired Student's t-test was used for parametric data and Mann-Whitney U-test for nonparametric data. Chi-square test was applied to categorical variables. A $p<0.05$ was considered statistically significant.

RESULTS

A total of 50 patients undergoing primary bowel resection and anastomosis were included in the study, ranging from 20 to 65 years of age, with a mean age of 50 years. There were 33 males (66%) and 17 females (34%), yielding a male-to-female ratio of approximately 2:1.

Age and gender distribution

The most represented age group among patients was 57–65 years (38%), followed by the 48–56 years group (26%). Younger age groups (21–38 years) accounted for only 12% of the total sample. The gender distribution showed a male predominance (66%), as illustrated in Table 1.

Nature of surgery and anastomosis technique

Out of the total 50 cases, elective surgeries accounted for 58% (n=29), whereas emergency procedures were performed in 42% (n=21). Small bowel surgeries were more frequent (70%) compared to large bowel surgeries (30%).

Regarding the anastomotic technique, a hand-sewn method was used in 66% of patients (n=33), while 34% (n=17) underwent stapler anastomosis, indicating a preference for the hand-sewn approach in this setting (Table 2).

Biochemical parameters

Serum albumin levels were ≤3.5 g/dl in 46% of patients (n=23), while 54% (n=27) had levels ≥3.5 g/dl. Hemoglobin levels were <10 g/dl in 16% of patients, between 10–12 g/dl in 38%, and >12 g/dl in 46% of patients. Among those with hemoglobin >12 g/dl, the majority were males (n=19) (Table 3).

Table 1: Age and gender distribution.

Age group (years)	Male	Female	Count	Percentage
21-29	1	1	2	4.0
30-38	3	1	4	8.0
39-47	10	2	12	24.0
48-56	7	6	13	26.0
57-65	12	7	19	38.0
Total	33 (66%)	17 (34%)	50	100

Table 2: Nature of surgery and anastomosis technique (n=50).

Parameters	Count	Percentage
Indication		
Elective surgery	29	58
Emergency surgery	21	42
Surgery type		
Large bowel	15	30
Small bowel	35	70
Anastomosis technique		
Hand sewn	33	66
Stapler	17	34

Table 3: Distribution of serum albumin and hemoglobin levels (n=50).

Parameters	Count	Percentage
Serum albumin (g/dl)		
≤3.5	23	46
≥3.5	27	54
Hemoglobin (g/d)		
<10 (female: 5, male: 3)	8	16
10–12 (female: 8, male: 11)	19	38
>12 (female: 4, male: 19)	23	46
Total	50	100

Intra-operative and postoperative observations

Intra-operative contamination was observed in 46% of patients (n=23), while 54% (n=27) had clean operative fields. Postoperative complications occurred in 46% of patients.

Among these, surgical site infection was most common (28%), followed by postoperative ileus (12%) and pelvic collection (6%). Wound infection was seen in 32% of cases, and anastomotic leak in 10% (n=5). Pelvic collections were found in 14% (n=7) (Table 4).

Table 4: Intra-operative contamination, post-operative complications, and outcomes (n=50).

Parameters	Count	Percentage
Intra-operative contamination		
Yes	23	46
No	27	54
Post-operative complications		
None	27	54
Infection	14	28
Ileus	6	12
Pelvic collection	3	6
Wound infection		
Yes	16	32
No	34	68
Anastomotic leak		
Yes	5	10
No	45	90
Pelvic collection (USG/CT)		
Yes	7	14
No	43	86

Table 5: Length of stay and outcome (n=50).

Parameters	Count	Percentage
Length of stay (days)		
≤7	26	52
8–14	16	32
15–21	8	16
Outcome		
Recovered	45	90
Deceased	5	10

Table 6: Key statistical associations in postoperative outcomes (n=50).

Association and groups	Recovered	Deceased	Total (%)
Serum albumin versus leak (g/dl)			
≤3.5	-	-	23 (46)
≥3.5	-	-	27 (54)
Type of surgery versus mortality			
Elective	29	0	29 (58)
Emergency	16	5	21 (42)
Serum albumin versus mortality (g/dl)			
≤3.5	19	4	23 (46)
≥3.5	26	1	27 (54)
Contamination versus mortality			
Contaminated	18	5	23 (46)
Clean	27	0	27 (54)

Statistical associations

A higher incidence of anastomotic leak was observed in patients with hypoalbuminemia (serum albumin ≤3.5 g/dl), where 17.4% developed a leak compared to only 3.7% in those with normal albumin levels. Mortality was significantly associated with the type of surgery: while no deaths occurred in the elective group, emergency surgeries had a mortality rate of 24% (5 out of 21 cases), a statistically significant finding (χ^2=5.25, p=0.022). Although mortality was higher among patients with low serum albumin (17.4%) compared to those with normal levels (3.7%), this association did not reach statistical significance (χ^2=2.89, p=0.089). Importantly, all five deaths occurred in patients with intra-operative contamination, showing a significant association between contamination and mortality (χ^2=4.33, p=0.037) (Table 6).

DISCUSSION

Bowel anastomosis in older males suggests that age and gender may be risk factors for surgical complications. This could be due to age-related physiological changes and comorbidities, as well as potential gender-specific differences in disease presentation or access to care.

Surgical techniques and outcomes

Hand-sewn anastomosis was more commonly performed (66%) and associated with fewer complications in our study. However, this contrasts with findings from the American Journal of Surgery, which reported lower leak rates with stapled anastomosis.[6] Another study found that stapled anastomosis resulted in fewer postoperative complications and shorter hospital stays.[7] The preference for hand-sewn or stapled techniques varies across institutions and regions, likely due to surgeon experience, resource availability, and patient-specific factors. The lack of consensus highlights the need for standardized guidelines based on robust evidence from randomized controlled trials (RCTs).

Elective versus emergency surgery outcomes

Elective procedures had a 0% mortality rate, while emergency surgeries had a significantly higher mortality rate (24%, p=0.022). This is consistent with previous studies, which reported higher mortality rates in emergency bowel resections compared to elective cases.[8] The stark difference in outcomes underscores the importance of timely surgical intervention and preoperative optimization. Delayed presentations in emergency cases often involve advanced disease, sepsis, or hemodynamic instability, contributing to poorer outcomes.

Serum albumin and anastomotic leak

Hypoalbuminemia (≤3.5 g/dl) was associated with higher anastomotic leak rates (17.4%) and mortality (17.4%),

though the association with mortality was not statistically significant (p=0.089). This aligns with a study published in Cureus, which identified serum albumin levels below 3.0 g/dl as a risk factor for anastomotic failure.[9] Nutritional optimization before surgery is critical to reduce postoperative complications. Preoperative albumin supplementation or dietary interventions could improve outcomes in malnourished patients.

Intra-operative contamination and mortality

Intra-operative contamination was significantly associated with higher mortality (22% versus 0%, p=0.037). This is supported by studies emphasizing that contamination increases postoperative infections and prolongs hospital stays.[10]

Strict adherence to aseptic techniques and contamination control protocols is essential to minimize postoperative complications. Enhanced training and standardized operating room practices could further reduce contamination risks.

Postoperative complications and wound infections

The most common postoperative complication was infection (28%), followed by ileus (12%), pelvic collection (6%), and anastomotic leak (10%). Wound infections occurred in 32% of cases. These findings are comparable to previous studies, which reported infection rates of 15% and anastomotic leaks in 7% of cases.[11]

Infection control measures, such as prophylactic antibiotics, proper wound care, and early mobilization, should be prioritized to reduce complications. Standardized postoperative care protocols may contribute significantly to better patient outcomes.

Length of stay and recovery

The majority of patients (52%) had a hospital stay of ≤7 days, but 16% required 15–21 days of care. The total recovery rate was 90%, with a mortality rate of 10%. While most patients recover within a week, a significant proportion requires extended care, highlighting the need for tailored postoperative management plans. Early identification of high-risk patients and targeted interventions could reduce prolonged hospital stays.

Mortality and risk factors

Emergency surgeries and intra-operative contamination were strongly linked to increased mortality. Hypoalbuminemia also showed a trend toward increased mortality, though it was not statistically significant. Addressing modifiable risk factors, such as nutritional status and contamination, could significantly reduce mortality rates. Future studies should explore the role of preoperative optimization in improving survival outcomes.

CONCLUSION

This study of 50 patients undergoing bowel resection and anastomosis highlighted key clinical findings. Most patients were older males, with small bowel surgeries (70%) and hand-sewn anastomosis (66%) being predominant. Elective surgeries (58%) had better outcomes compared to emergency procedures (42%), which showed a higher mortality rate (24%). Hypoalbuminemia (≤3.5 g/dl) was associated with increased anastomotic leaks and mortality, while intra-operative contamination (46%) significantly correlated with mortality. Common postoperative complications included infections (28%), ileus (12%), and pelvic collections (6%). Overall recovery was 90%, with mortality at 10%.

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