Original Research Article

RISK FACTORS FOR ANASTOMOTIC LEAKAGE FOLLOWING BOWEL SURGERY: A CROSS SECTIONAL STUDY

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A B S T R A C T

Background: Bowel anastomosis remains an essential surgical procedure in gastrointestinal surgeries. Despite advances in surgical techniques anastomotic leaks continue to be a significant risk factor for morbidity and mortality. With leak rates reported between 2–5%, Identifying modifiable risk factors for anastomotic leak is important for improving outcomes.
Materials and Methods: A cross-sectional observational study was conducted at the Department of General Surgery, of a tertiary care medical institute. A total of 60 patients undergoing bowel anastomosis, both electively and emergency, were included in this study. Demographic, clinical, laboratory, and intraoperative variables were recorded. Hand-sewn two-layer anastomosis was predominantly employed. Patients were monitored postoperatively for evidence of anastomotic leaks. Statistical analysis was performed using SPSS 23. p-value less than 0.05 considered significant.
Results: The overall anastomotic leak rate was 10%. Significant risk factors identified included age >50 years (P=0.004), diabetes mellitus (P=0.04), clinical pallor (P=0.007), history of smoking (0.006) hypoalbuminemia (<3 g/dl, p=0.001), and total leukocyte count more than 11,000/mm3. Operative factors like contaminated peritoneal cavity (P=0.02), prolonged surgery duration (>2.5 hours, P=0.02) and time to perform anastomosis (> 30 min, P=0.01) were also associated with higher leak rates. Mortality among patients with leaks was 100%.
Conclusion: Anastomotic leaks remain a serious postoperative complication. Advanced age, diabetes, smoking, hypoalbuminemia, emergency surgery and prolonged operative time significantly predispose patients to anastomotic dehiscence. Focused preoperative optimization and meticulous surgical technique are essential strategies to mitigate the risk of leak and improve patient outcomes.
Keywords: Anastomotic Leak, Bowel Anastomosis, Risk Factors, Intestinal Surgery, Hypoalbuminemia.

INTRODUCTION

The restoration of bowel continuity through anastomosis is one of the essential procedures in gastrointestinal surgery.[1] This is performed both electively and emergently across the globe. However, despite advances in surgical techniques, anesthesia and perioperative care the occurrence of anastomotic complications continues to represent a significant challenge. Reported leak rates in the literature vary between 0.5% and 30% with most studies citing a prevalence between 2% to 5%. The consequences of anastomotic dehiscence are grave, including increased postoperative morbidity longer hospital stays, sepsis and increased mortality rates. The early identification and management of risk factors associated with poor anastomotic outcomes remains important for improving surgical results and patient survival. Given the complexity of wound healing in intestinal tissue and the potential for devastating complications bowel anastomosis remains a critical area of focus in gastrointestinal surgery today.[2]

The outcome of bowel anastomosis is influenced by a myriad of patient-related, disease-related, and surgery-related factors. Patient-specific factors such as age, nutritional status, anemia, diabetes mellitus, and immune function have all been implicated in affecting the integrity of anastomosis.[3] Disease-specific variables include the degree of intra-abdominal contamination, location of the anastomosis, and the underlying pathology necessitating the resection. Factors such as surgical technique, anastomotic site tension as well as intraoperative blood supply to the bowel ends are factors which are known to affect the outcome. Studies have shown that even with the use of meticulous technique a breach in fundamental principles can predispose to significant anastomotic leaks. These principles include tension-free, well-perfused and accurately aligned anastomosis. The choice between hand-sewn and stapled anastomosis also remains controversial with each method having its proponents and unique risk profiles. Hand-sewn anastomosis often preferred in resource-limited settings due to cost constraints demands technical expertise and precision to minimize complications.[4] Several modifiable risk factors are reported to be associated with adverse outcomes in cases undergoing bowel surgeries followed by anastomosis. Malnutrition has been identified as a strong predictor of poor healing and increased risk of anastomotic dehiscence. Similarly, patients presenting with anemia and sepsis are reported to be at a higher risk of developing leaks.[5] Operative factors such as prolonged duration of surgery, emergency surgery as opposed to elective settings and intraoperative contamination further increased the risk of complications such as anastomotic leaks. Studies have demonstrated that intraoperative hypoxia and hypotension, longer anastomotic construction time and technical errors during the anastomosis significantly contribute to postoperative leaks. Understanding these risk factors is important from the perspective of a surgeon since it provides an opportunity to intervene preoperatively and intraoperatively to improve the patient outcomes.[6]

Despite extensive research, the rates of anastomotic leaks have remained relatively unchanged over decades. This points toward a gap in effectively translating risk factor management into clinical practice. Most previous studies have either focused on elective surgeries, specific techniques (like stapled versus hand-sewn) or select patient groups, thereby limiting the generalizability of findings. With this background we undertook this study to address these gaps by evaluating factors affecting the outcome of bowel anastomosis in patients undergoing resection and anastomosis.

MATERIALS AND METHODS

This was a cross-sectional observational study conducted in the Department of General Surgery of a tertiary care medical institute. All patients undergoing bowel anastomosis both electively and as emergency procedure were included in this study. Based on the anticipated prevalence of anastomotic complications in previous literature and considering a confidence interval of 95% with an allowable error of 5%, a minimum sample size of 55 patients was calculated using the formula for cross-sectional studies $n = Z^2 \times p \times (1-p) / d^2$. Considering the POSSIBILITY OF dropouts. we included 60 patients in our study. This was a purely observational study and no ethical issues were involved.

All patients undergoing bowel anastomosis during the study period were evaluated prospectively. In cases of elective surgery, detailed preoperative assessments were conducted, including hematological, biochemical and radiological investigations. Patients undergoing emergency surgery were evaluated and optimized as much as possible preoperatively. For each patient demographic details, comorbidities (such as diabetes mellitus, hypertension, tuberculosis), nutritional status, laboratory parameters (hemoglobin, total leukocyte count, serum protein, serum albumin, serum creatinine, liver function tests), operative details (duration of surgery, site of anastomosis, elective vs emergency surgery), and postoperative outcomes were recorded systematically. The method of anastomosis was predominantly hand-sewn, performed in two layers—an inner continuous transmural absorbable suture and an outer interrupted seromuscular non-absorbable suture. Intraoperative contamination was noted and postoperative monitoring included clinical examination, drainage output monitoring and imaging like ultrasonography or computed tomography in suspicious cases. Any anastomotic leak was diagnosed based on clinical signs (peritonitis, altered drain output) and confirmed radiologically or surgically when required.

Data was analyzed using Statistical Package for the Social Sciences (SPSS) version 23. Continuous variables were expressed as mean and standard deviation (SD) , while categorical variables were shown as frequencies and percentages. Comparison between groups (patients with and without anastomotic leaks) was performed using Chi-square test or Fisher's exact test for categorical variables, and Student's t-test or Mann–Whitney U-test for continuous variables, depending on data distribution. A p-value of less than 0.05 was considered statistically significant.

Inclusion Criteria
- Patients aged 18 to 75 years.
- Patients undergoing bowel resection and primary anastomosis (small or large bowel).
- Patients undergoing loop ileostomy or colostomy closure with complete dismantling of stoma.
- Both elective and emergency surgeries included.

Exclusion Criteria
- Patients with a proximal diverting stoma preventing direct evaluation of anastomosis.

- Patients undergoing multiple simultaneous bowel anastomoses.
- Patients with known or histologically proven malignancy.
- Patients lost to follow-up before postoperative day 30.

RESULTS

The analysis of gender distribution of the studied cases showed that ot of 60 patients undergoing anastomosis there were 45 (75%) makes and 15 (25%) females with a M:F ratio of 1:0.33 [Figure 1]. The analysis of the age distribution among the studied cases showed that the most common age group amongst males was 41–50 years (23.3%), followed by 31–40 years (16.7%) and 51–60 years (16.7%). In females, the 41–50 years group was also the most common (8.3%), followed by 51–60 years (6.7%) and 31–40 years (5.0%). The least represented age group in both males and females was 18–30 years (10.0% in males and 1.7% in females). The mean age of males and females was found to be comparable with no statistically significant difference (P = 0.5660) [Table 1].
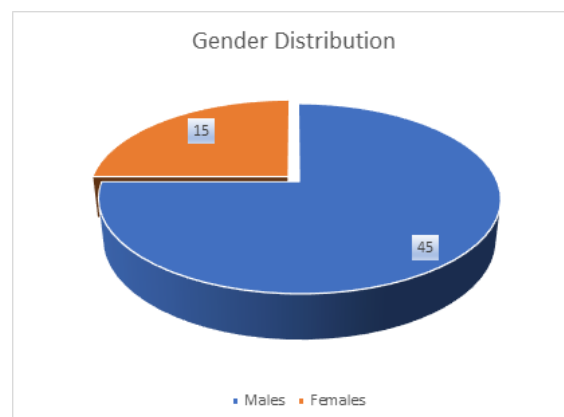
Figure 1: Gender Distribution in studied cases.

Table 1: Gender-wise distribution of age groups in studied cases.

Age Group (years)	Male Patients (n)	Male (%)	Female Patients (n)	Female (%)
18–30	6	10.0%	1	1.7%
31–40	10	16.7%	3	5.0%
41–50	14	23.3%	5	8.3%
51–60	10	16.7%	4	6.7%
>60	5	8.3%	2	3.3%
Total	45	75.0%	15	25.0%
Mean Age	44.8 +/- 14.2		47.3 +/- 15.5	
P = 0.5660				

The analysis of the type of surgery performed in this study showed that the majority of patients underwent elective surgery, accounting for 34 cases (56.7%), while 26 patients (43.3%) underwent emergency surgery [Table 2].

Table 2: Elective Vs Emergency Surgeries in studied cases.

Variables	Number of Patients (n)	Percentage (%)
Elective Surgery	34	56.7%
Emergency Surgery	26	43.3%

The analysis of co-morbidities among the 60 studied cases showed that the most common associated condition was a history of smoking which was observed in 18 patients (30.0%), followed by alcohol use in 15 patients (25.0%) and hypoalbuminemia in 13 patients (21.7%). Diabetes mellitus was present in 12 patients (20.0%) while hypertension was the least common co-morbidity, seen in 10 patients (16.7%) [Figure 2].

The analysis of surgical indications and site of anastomosis among the studied cases showed that the most common indication for bowel anastomosis was ileostomy reversal, performed in 28 patients (46.7%), followed by ileal perforation repair in 14 patients (23.3%), small bowel obstruction in 10 patients (16.7%), and colonic obstruction or perforation in 8 patients (13.3%). Regarding the site of anastomosis, ileo-ileal anastomosis was the most frequently performed (60%), followed by ileo-colic (30%) and colo-colic anastomosis (10%) [Table 3].
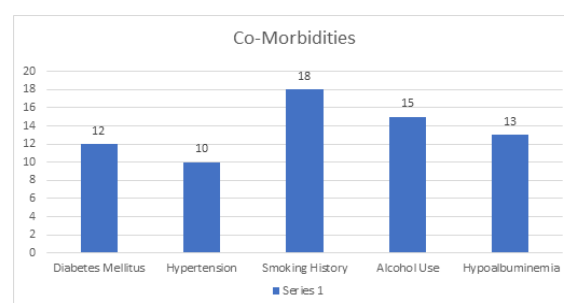
Figure 2:- Co-Morbidities in studied cases.

Table 3: Distribution Based on Type and Site of Anastomosis (n=60)

Variables	Number of Patients (n)	Percentage (%)
Ileostomy Reversal	28	46.7%
Ileal Perforation Repair	14	23.3%
Small Bowel Obstruction	10	16.7%
Colonic Obstruction/Perforation	8	13.3%

Site of Anastomosis		
Ileo-Ileal Anastomosis	36	60%
Ileo-Colic Anastomosis	18	30%
Colo-Colic Anastomosis	6	10%

The analysis of risk factors associated with anastomotic leak among the studied cases showed that patients aged over 50 years had a significantly higher incidence of leak (5 out of 6) compared to those aged 50 or below (1 out of 6), with a statistically significant p-value of 0.004. Males constituted the majority of leak cases (5 out of 6), but the gender difference was not statistically significant (p = 1.00). Diabetes mellitus was present in 3 patients with leaks, showing a statistically significant association (p = 0.04). Pallor was observed in 4 patients with leaks, which was also statistically significant (p = 0.007), and a history of smoking was present in 4 of the 6 patients with leaks, indicating a significant association as well (p = 0.006). Hypertension did not show a statistically significant difference between leak and non-leak groups (p = 0.259) [Table 4].

Table 4: Risk Factors Associated with Anastomotic Leak (n=60)

Risk Factors		Leak Present (n=6)	Leak Absent (n=54)	p-value
Age (years)	=< 50	1	38	0.004*
	> 50	5	16	
Gender	Males	5	40	1.00
	Females	1	14	
Diabetes Mellitus	Present	3	9	0.04*
	Absent	3	45	
Hypertension	Present	2	8	0.259
	Absent	4	46	
Pallor (clinical)	Present	4	10	0.007*
	Absent	2	44	
Smoking History	Present	4	14	0.006*
	Absent	2	40	

The analysis of laboratory parameters in relation to anastomotic leak showed that a total leukocyte count >11,000/mm³ was present in 5 out of 6 patients with leaks compared to 14 out of 54 without leaks, and this association was statistically significant (p = 0.01). Similarly, serum albumin levels <3 g/dl were seen in 5 leak cases versus 8 non-leak cases, also showing a statistically significant correlation (p = 0.001) [Table 5].

Table 5: Biochemical Parameters and Anastomotic Outcome

Parameters	Leak Present (n=6)	Leak Absent (n=54)	p-value
Hemoglobin <12 g/dl	5	28	0.2092
	1	26	
Total Leukocyte Count >11,000/mm³	5	14	0.01*
	1	40	
Serum Albumin <3 g/dl	5	8	0.001*
	1	46	
Serum Creatinine >1.2 mg/dl	3	10	0.109
	3	44	

Hemoglobin levels <12 g/dl were observed in 5 patients with leaks and 28 without, but this difference was not statistically significant (p = 0.2092). Elevated serum creatinine (>1.2 mg/dl) was present in 3 patients from each group, with no significant association (p = 0.109). Thus, elevated leukocyte count and low serum albumin were significantly associated with the presence of anastomotic leak [Table 6].

Table 6: Operative Factors and Anastomotic Leak Association

Operative Factors	Leak Present (n=6)	Leak Absent (n=54)	p-value
Emergency Surgery	5	21	0.07
	1	33	
Contaminated Peritoneal Cavity	4	12	0.03*
	2	42	
Duration of Surgery >2.5 hrs	5	18	0.026*
	1	36	
Time to Perform Anastomosis >30 mins	5	16	0.016*
	1	38	

DISCUSSION

Despite meticulous surgical technique intestinal anastomotic leakage remains one of the persistent and dreaded complication. It carries significant morbidity and mortality. In this study an anastomotic leak rate of 10% was observed. These findings mirror the results reported by Hyman et al who documented a leak incidence of 2.7% with high associated mortalit.[7] Similarly Saha et al also reported a 4%

leak rate with a 61.5% mortality rate among cases diagnosed with anastomotic leak.[8] The relatively higher leak rate observed in this study compared to western studies may be attributed to the larger proportion of emergency surgeries in our case. Moreover factors such as malnutrition and limited access to advanced perioperative care facilities may also be reasons for a slightly high anastomotic leakage rate. Early recognition and aggressive management of anastomotic complications is an essential part of management of these patients.

Increasing age was found to be a significant risk factor for anastomotic dehiscence in this study and a higher incidence of leaks observed in patients aged over 50 years. Similar findings have been reported by Turrentine et al who identified advanced age as an independent risk factor for gastrointestinal anastomotic leaks.[9] Irvin et al demonstrated that the incidence of anastomotic leak was significantly higher in patients over the age of 60 years.[10] Age-related factors such as impaired tissue healing and presence of multiple comorbidities may be responsible for this increased susceptibility to anastomotic leak in older patients. Our data further showed that male gender was more commonly associated with leaks. Although the association did not reach statistical significance. Similarly, Trencheva et al also similarly noted a male predominance but with variable significance.[11]

The presence of comorbidities such as diabetes mellitus was significantly associated with anastomotic leaks in our study. Diabetic patients constituted 50% of those who developed leaks. This is similar to findings of Vignali et al who reported diabetes to be an independent predictor of anastomotic leak in rectal surgery.[12] Cooke et al also reported higher leak rates among patients with multiple comorbidities, including diabetes.[13] Poor glycemic control impairs overall wound healing which is critical to the integrity of an intestinal anastomosis. Interestingly, smoking history was also found to be an independent risk factor for development of anastomotic leak. Similar findings had also been reported by Sorensen et al who also identified smoking as a major risk factor for anastomotic failure.[14]

Nutritional status, as indicated by serum albumin levels, emerged as a critical determinant of anastomotic healing. Our study showed that 83.3% of patients with leaks had hypoalbuminemia (<3 g/dl), with a highly significant p-value. Similar results were reported by Yamamoto et al who demonstrated that hypoalbuminemia was strongly predictive of intra-abdominal sepsis post-surgery in Crohn's disease patients.[15] Also Makela et al who found low preoperative albumin levels to be a significant risk factor for leaks after colorectal surgery.[16] Serum albumin, plays an important role in tissue repair and hypoalbuminemia can compromise anastomotic integrity. In addition to hypoalbuminemia, preoperative anemia was another risk factor for anastomotic leak. These findings were consistent with the findings of Hayden et al,[17] and Farghaly et al,[18] who both reported higher leak rates among anaemic patients.

Operative variables such as emergency surgery, prolonged duration of surgery and intraoperative contamination were found to be significantly associated with anastomotic leaks in our study. Emergency surgeries inherently involve compromised bowel conditions and increased contamination. All these factors contribute to poor outcomes. Buchs et al,[19] and Kawada et al,[20] also reported that emergency surgery and prolonged operative time to be independent risk factors of anastomotic leakage.

CONCLUSION

Anastomotic leakage remains a significant complication in cases of bowel anastomosis. In this study, advanced age, diabetes mellitus, history of smoking, anemia, hypoalbuminemia, emergency surgery and prolonged operative time were identified as significant risk factors for anastomotic leak. Preoperative optimization of these factors and adherence to meticulous surgical technique are important in minimize the risk of leakage and improve patient outcomes.

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