To determine the factors that might predict the occurrence of anastomotic leakage in small bowel anastomoses

[1]Govind Singh, [2]Kumar Sharat Chandra Chandan, [3]Gauraw Kumar, [4]Pankaj Kumar Mishra, [5]Ajay Kumar, [6]Binoy Kumar

[1,2,3]Senior Resident, [4,5]Assistant Professor, [6]Professor, Department of General Surgery, PMCH, Bihar, India

Corresponding author
Gauraw Kumar
Senior Resident, Department of General Surgery, PMCH, Bihar, India
Email: gaurawkumarm23@gmail.com

ABSTRACT
Aim: To determine the factors that might predict the occurrence of anastomotic leakage in small bowel anastomoses.
Materials and Methods: The study included patients above the age of 18 years undergoing surgical closure of a full-thickness small intestinal breach. A total of 100 patients who met the inclusion criteria were analyzed and followed up until their discharge from the hospital or death.Patients were divided into two groups: Group 1 (Cases, n=50), which included patients undergoing small bowel surgery with subsequent suture line disruption, and Group 2 (Controls, n=50), which included patients undergoing small bowel surgery without subsequent suture line disruption. **Results:** Postoperative factors also played a role in predicting anastomotic leakage. The use of vasopressor support was more common in the cases group (36%) compared to the controls (24%), although this difference was not statistically significant (p=0.20). Ventilatory support was required by 20% of the cases and 10% of the controls (p=0.16). All patients received antibiotics, so no comparison could be made for this variable. The use of steroids was slightly higher in the cases group (30%) compared to the controls (20%), with a p-value of 0.24.Wound infection was significantly more frequent in the cases group (50%) compared to the controls (20%), with a p-value of 0.003, suggesting a strong association between wound infection and suture line disruption. The timing of starting oral fluids was also delayed in the cases group (5.5 days) compared to the controls (4.8 days), with a p-value of 0.02, indicating that delayed oral intake may be associated with an increased risk of anastomotic leakage.
Conclusion: Overall, these results highlight several factors associated with an increased risk of anastomotic leakage in small bowel anastomoses, including lower serum albumin levels, gross peritoneal contamination, difficulty in surgical closure, wound infection, and delayed initiation of oral fluids. These findings underscore the importance of careful patient management and surgical technique to minimize the risk of this serious complication.
Keywords: Factors, Predict, Anastomotic leakage, Small bowel anastomoses

INTRODUCTION

Anastomotic leakage is a severe and often life-threatening complication following small bowel anastomosis. Understanding the factors that predict anastomotic leakage is critical for improving patient outcomes and reducing postoperative morbidity and mortality. This introduction provides an overview of the key factors influencing anastomotic leakage, encompassing patient-related variables, surgical techniques, intraoperative considerations, and postoperative management.[1] Several patient-related factors significantly impact the risk of anastomotic leakage. Age is a critical factor, as older patients often have reduced physiological reserves and comorbid conditions that can impair healing. Gender may also play a role, although its impact is less clear and may be related to other underlying conditions and physiological differences between men and women.[2] Nutritional status is another crucial determinant. Malnutrition, characterized by low serum albumin levels, has been consistently linked to higher rates of anastomotic leakage. Adequate protein levels are essential for collagen synthesis and wound healing, and malnourished patients are at a greater risk due to their compromised healing capacity. Additionally, patients with a history of smoking, alcohol use, and chronic conditions such as diabetes mellitus and chronic obstructive pulmonary disease (COPD) have an increased risk of postoperative complications, including anastomotic leakage.[3] The technique used during anastomosis plays a significant role in the integrity of the bowel connection. The choice of

sutures, the precision of the surgical technique, and the handling of bowel tissues are critical elements. Surgeons must ensure that the anastomosed ends are well vascularized and that there is minimal tension on the suture line. Proper alignment and the use of appropriate suturing materials are essential to prevent leaks.[4] Hand-sewn anastomoses and stapled anastomoses are the two primary techniques employed. Each method has its advantages and disadvantages, and the choice often depends on the surgeon's preference and the specific clinical scenario. However, both techniques require meticulous attention to detail to ensure a secure and leak-proof connection.[5] Several intraoperative factors influence the risk of anastomotic leakage. The presence of gross peritoneal contamination is a significant predictor, as contamination can lead to local infection and impaired healing. The nature and extent of the contamination, such as fecal or purulent material, can further exacerbate the risk.[6]The site of the anastomosis within the small bowel also matters. Proximal and distal anastomoses may differ in their healing characteristics and risk profiles. The number and size of perforations, the condition of the bowel tissues, and the vascular supply at the site of anastomosis are also critical considerations. Adequate blood flow is essential for healing, and any compromise in vascular supply can lead to ischemia and subsequent leakage.[7]Luminal disparity between the anastomosed ends can pose a technical challenge, and significant size discrepancies must be addressed to ensure a secure connection. The ease of surgical closure, whether the procedure was classified as easy or difficult, can reflect the underlying complexity and potential for postoperative complications.[8] Postoperative care is crucial in mitigating the risk of anastomotic leakage. The use of vasopressor support and ventilatory support can indicate the patient's overall stability and the severity of their condition. Patients requiring these supports may be at higher risk due to their compromised physiological state.The use of antibiotics is standard practice to prevent infections, but the choice and duration of antibiotic therapy can influence outcomes. The presence of wound infection postoperatively is a significant predictor of anastomotic leakage, as infections can impair healing and lead to breakdown of the anastomosis.

MATERIALS AND METHODS

This study aimed to identify factors predicting anastomotic leakage in small bowel anastomoses. The study included patients above the age of 18 years undergoing surgical closure of a full-thickness small intestinal breach. A total of 100 patients who met the inclusion criteria were analyzed and followed up until their discharge from the hospital or death.

Methodology

Patients were divided into two groups: Group 1 (Cases, n=50), which included patients undergoing small bowel surgery with subsequent suture line disruption, and Group 2 (Controls, n=50), which included patients undergoing small bowel surgery without subsequent suture line disruption.The following patients were excluded from the study: those undergoing duodenal surgery, those with anastomoses between the small intestine and stomach or biliary tract, those with feeding jejunostomies, and those who died within 28 days of admission due to causes other than suture line disruption.Suture line disruption was detected through relaparotomy demonstration, dye or contrast studies, efflux of bowel contents from the wound or drain, and ultrasonography-guided aspiration demonstrating localized collection of bowel contents in the abdominal cavity.Patients were initially interviewed regarding factors important in the etiology of disruption, including age, sex, and duration of symptoms before hospital presentation (for emergency cases). The use of tobacco, alcohol, and steroid medications was noted, and the presence of chronic obstructive pulmonary disease (COPD), diabetes mellitus, and systemic hypertension was recorded. The attending surgeon's preoperative diagnosis was also noted from patient records.Patients' weight, height, mid-arm circumference, and triceps skinfold thickness were recorded. Laboratory tests included hemoglobin, serum total protein, albumin, urea, creatinine, and electrolytes. Blood cultures and enteric fever serology (Widal) were performed where indicated.During surgery, the following variables were studied: presence of gross peritoneal contamination and the nature of the contaminant, site of pathology in the small bowel, presence, number, and size of perforations, vascular supply at the surgical closure region, luminal disparity between anastomosed ends of the bowel, suture material used, presence of any distal obstruction, ease of surgical closure, amount and nature of intraoperative fluids given, presence of any adverse intraoperative hemodynamic event, use of drains, grade of the operating surgeon, and intraoperative diagnosis.Postoperatively, the following factors were considered: use of vasopressor support, use of ventilatory support, antibiotics used, use of steroids, presence of wound infection, and timing of starting oral fluids. Patients who had documented suture line disruption and underwent relaparotomy were considered fresh cases, and data were recorded again as described above. Patients with suture line disruption (test group) were compared with patients whose anastomoses did not leak (control group).

Statistical analysis was performed using Fisher's exact test and chi-square test for discrete variables, and the student's t-test for continuous data. SPSS software version 25.0 was used for the analysis. A p-

value of less than 0.05 was considered significant for the purpose of this study.

RESULTS

The study aimed to identify factors predicting anastomotic leakage in small bowel anastomoses by analyzing 100 patients. The patients were divided into two groups: Group 1 (Cases) with 50 patients who experienced suture line disruption, and Group 2 (Controls) with 50 patients who did not.

Demographic Data

The demographic data analysis revealed no significant differences between the cases (patients who experienced suture line disruption) and the controls (patients who did not). The average age of patients in the cases group was 55.2 years, compared to 52.8 years in the controls, with a p-value of 0.32, indicating no statistical significance. Gender distribution was also similar, with 60% males in the cases group and 56% in the controls, and 40% females in the cases group versus 44% in the controls, both with p-values of 0.68.

Clinical and Laboratory Parameters

Clinical and laboratory parameters showed some differences between the two groups. The duration of symptoms before hospital presentation was slightly longer in the cases group (6.5 days) compared to the controls (5.8 days), though this difference was not statistically significant (p=0.21). Tobacco use was reported by 50% of the cases and 40% of the controls (p=0.31), and alcohol use was reported by 36% of the cases and 30% of the controls (p=0.52). Chronic obstructive pulmonary disease (COPD) was present in 24% of the cases and 20% of the controls (p=0.62), while diabetes mellitus was observed in 20% of the cases and 16% of the controls (p=0.60). Systemic hypertension was slightly more common in the cases group (30%) compared to the controls (24%), with a p-value of 0.50.

In terms of laboratory parameters, hemoglobin levels were similar between the two groups (11.8 g/dL in cases vs. 12.1 g/dL in controls, p=0.36). Serum albumin levels, however, were significantly lower in the cases group (3.1 g/dL) compared to the controls (3.4 g/dL), with a p-value of 0.01. This indicates a potential association between lower serum albumin levels and an increased risk of anastomotic leakage. Serum urea and creatinine levels were comparable between the groups, with p-values of 0.14 and 0.22, respectively. Electrolyte levels, including sodium, potassium, and chloride, showed no significant differences between the two groups.

Intraoperative Factors

Several intraoperative factors were analyzed to identify their association with suture line disruption. Gross peritoneal contamination was significantly more common in the cases group (60%) compared to the controls (40%), with a p-value of 0.04. The site of pathology in the small bowel was similarly distributed between the proximal and distal sections in both groups, with no significant differences. The number of perforations and their size were slightly higher in the cases group, but these differences were not statistically significant (p=0.09 and p=0.35, respectively). Vascular supply at the closure site was adequate in both groups (90% in cases vs. 94% in controls, p=0.49).

Luminal disparity between anastomosed ends of the bowel was observed in 30% of the cases and 20% of the controls (p=0.24). The type of suture material used was similar between the groups, with silk used in 60% of the cases and 56% of the controls, and Vicryl used in 40% of the cases and 44% of the controls (p=0.68). Distal obstruction was present in 16% of the cases and 10% of the controls (p=0.37). The ease of surgical closure was significantly different between the groups; 60% of the cases were classified as difficult closures compared to 40% in the controls, with a p-value of 0.04.

Postoperative Factors

Postoperative factors also played a role in predicting anastomotic leakage. The use of vasopressor support was more common in the cases group (36%) compared to the controls (24%), although this difference was not statistically significant (p=0.20). Ventilatory support was required by 20% of the cases and 10% of the controls (p=0.16). All patients received antibiotics, so no comparison could be made for this variable. The use of steroids was slightly higher in the cases group (30%) compared to the controls (20%), with a p-value of 0.24.

Wound infection was significantly more frequent in the cases group (50%) compared to the controls (20%), with a p-value of 0.003, suggesting a strong association between wound infection and suture line disruption. The timing of starting oral fluids was also delayed in the cases group (5.5 days) compared to the controls (4.8 days), with a p-value of 0.02, indicating that delayed oral intake may be associated with an increased risk of anastomotic leakage.

Table 1: Demographic Data

Variable	Cases (n=50)	Controls (n=50)	p-value
Age (years)	55.2 ± 12.1	52.8 ± 13.4	0.32
Male (%)	30 (60%)	28 (56%)	0.68
Female (%)	20 (40%)	22 (44%)	0.68

Table 2: Clinical and Laboratory Parameters

Variable	Cases (n=50)	Controls (n=50)	p-value
Duration of symptoms (days)	6.5 ± 2.4	5.8 ± 2.7	0.21
Tobacco use (%)	25 (50%)	20 (40%)	0.31
Alcohol use (%)	18 (36%)	15 (30%)	0.52
COPD (%)	12 (24%)	10 (20%)	0.62
Diabetes Mellitus (%)	10 (20%)	8 (16%)	0.60
Systemic Hypertension (%)	15 (30%)	12 (24%)	0.50
Hemoglobin (g/dL)	11.8 ± 1.4	12.1 ± 1.5	0.36
Serum albumin (g/dL)	3.1 ± 0.4	3.4 ± 0.5	0.01*
Serum Urea (mg/dL)	32.8 ± 8.6	30.5 ± 7.9	0.14
Serum Creatinine (mg/dL)	1.1 ± 0.3	1.0 ± 0.3	0.22
Sodium (mmol/L)	137.5 ± 3.6	138.1 ± 3.4	0.44
Potassium (mmol/L)	4.3 ± 0.5	4.4 ± 0.4	0.25
Chloride (mmol/L)	101.2 ± 4.1	102.3 ± 4.0	0.21

Table 3: Intraoperative Factors

Variable	Cases (n=50)	Controls (n=50)	p-value
Gross peritoneal contamination (%)	30 (60%)	20 (40%)	0.04*
Site of pathology in small bowel (%)			
- Proximal	20 (40%)	18 (36%)	0.68
- Distal	30 (60%)	32 (64%)	0.68
Number of perforations	2.1 ± 0.8	1.8 ± 0.6	0.09
Size of perforations (cm)	1.2 ± 0.5	1.1 ± 0.4	0.35
Vascular supply at closure site (%)	45 (90%)	47 (94%)	0.49
Luminal disparity (%)	15 (30%)	10 (20%)	0.24
Suture material used (%) - Silk	30 (60%)	28 (56%)	
- Vicryl	20 (40%)	22 (44%)	0.68
Distal obstruction (%)	8 (16%)	5 (10%)	0.37
Ease of surgical closure (%) - Easy	20 (40%)	30 (60%)	
- Difficult	30 (60%)	20 (40%)	0.04*

Table 4: Postoperative Factors

Variable	Cases (n=50)	Controls (n=50)	p-value
Use of vasopressor support (%)	18 (36%)	12 (24%)	0.20
Use of ventilatory support (%)	10 (20%)	5 (10%)	0.16
Antibiotics used (%)	50 (100%)	50 (100%)	-
Use of steroids (%)	15 (30%)	10 (20%)	0.24
Presence of wound infection (%)	25 (50%)	10 (20%)	0.003*
Timing of starting oral fluids (days)	5.5 ± 1.3	4.8 ± 1.1	0.02*

*Significant at p < 0.05

DISCUSSION

The study's findings offer insights into the factors predicting anastomotic leakage in small bowel anastomoses. The demographic data, clinical and laboratory parameters, intraoperative factors, and postoperative factors were analyzed to identify significant associations with suture line disruption. The results were compared with existing literature to validate and contextualize the findings.The demographic analysis indicated no significant differences between the cases (patients with suture line disruption) and the controls (patients without suture line disruption). The average age and gender distribution were similar between the two groups, suggesting that demographic factors alone do not significantly predict anastomotic leakage. This aligns with studies by Alves et al. and Law et al., which also found that age and gender are not significant predictors of anastomotic leakage.[9,10]The duration of symptoms before hospital presentation was slightly longer in the cases group, but this was not statistically significant. Similarly, the use of tobacco, alcohol, and the presence of comorbidities such as COPD, diabetes mellitus, and systemic hypertension were not significantly different between the two groups. This is consistent with findings from studies by Vignali et al. and Bellows et al., which reported that lifestyle factors and comorbidities have limited predictive value for anastomotic leakage in small bowel surgeries.[8,11]However, serum albumin levels were significantly lower in the cases group, indicating a potential association between lower serum albumin and an increased risk of anastomotic leakage. This finding is supported by research from Gibbs et al. and

Hirst et al., which identified hypoalbuminemia as a significant risk factor for anastomotic complications. Low serum albumin may reflect poor nutritional status or underlying chronic illness, both of which can impair wound healing and increase the risk of leakage.[5,12]Intraoperative factors showed that gross peritoneal contamination was significantly more common in the cases group. This is consistent with the work of Alves et al. and Law et al., who identified peritoneal contamination as a significant risk factor for anastomotic leakage. The presence of contamination can lead to local infection and impaired healing, increasing the likelihood of suture line disruption.[9,10]The number and size of perforations, vascular supply at the closure site, luminal disparity, and type of suture material used did not show significant differences between the groups. These findings are similar to those reported by Hirst et al. and Vignali et al., indicating that while these factors are important to consider, they may not be strong independent predictors of leakage.The ease of surgical closure was significantly different between the groups, with difficult closures being more common in the cases group. This suggests that technical challenges during surgery can contribute to the risk of leakage, which is in line with the findings of Bellows et al.Postoperative factors also played a crucial role in predicting anastomotic leakage. The use of vasopressor and ventilatory support was more common in the cases group, though not statistically significant. The presence of wound infection was significantly more frequent in the cases group, highlighting a strong association with suture line disruption. This is supported by the work of Hirst et al., who reported that postoperative infections are a significant predictor of anastomotic complications.The timing of starting oral fluids was delayed in the cases group, suggesting that early enteral nutrition may play a protective role in anastomotic integrity. This finding is consistent with studies by Alves et al. and Law et al., which emphasized the importance of early nutritional support in enhancing postoperative recovery and reducing complications.[9,10]

CONCLUSION

Overall, these results highlight several factors associated with an increased risk of anastomotic leakage in small bowel anastomoses, including lower serum albumin levels, gross peritoneal contamination, difficulty in surgical closure, wound infection, and delayed initiation of oral fluids. These findings underscore the importance of careful patient management and surgical technique to minimize the risk of this serious complication.

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