

## Original Research Article

# Incidence and threat factors of anastomotic leak following emergency abdominal surgery: a retrospective analysis

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## ABSTRACT

**Background:** Anastomotic leakage (AL) represents a critical postoperative complication that is linked to considerable morbidity and mortality in the context of abdominal surgery.

**Methods:** This retrospective (RTS) analysis assessed a cohort of 2,563 patients who underwent emergency abdominal surgery involving bowel resection and anastomosis at two tertiary centres in India over the period from 2015 to 2023.

**Results:** The total occurrence of AL was recorded at 3.47%. Univariate analysis revealed multiple clinical and operative variables that are significantly correlated with AL. Analysis using multivariate logistic regression identified hypoalbuminemia, the perioperative transfusion of two or more units of blood, peritoneal contamination and male sex as independent threat factors. Patients diagnosed with AL exhibited an elevated incidence of reoperation, extended durations of hospitalization and a heightened rate of in-hospital mortality.

**Conclusions:** Identifying these threat factors is essential for enhancing perioperative management and informing surgical decision-making in patients at high threat who are undergoing emergency abdominal procedures.

**Keywords:** Anastomotic leak, Abdominal surgery, Bowel anastomosis, Hypoalbuminemia, Retrospective study, Threat factors

## INTRODUCTION

AL stands as a technically challenging complication after bowel resection and anastomosis; these further affect postoperative morbidity, extend hospitalization and increase mortality rates.<sup>1</sup> In investigations, the incidence of AL shows wide variation, being reported from 0.5% to as high as 30%, with mortality rates ranging between 10 and 15%.<sup>2</sup> The threat of AL in emergency abdominal surgery is further increased by delayed patient presentation, sepsis and poor nutritional status. These factors are common in the scenario of Indian healthcare, characterized by delayed presentations and limited resources.<sup>3</sup> Threat factors related to the patient as well as the procedure are implicated in the development of AL. Some of these comprise age, male sex, diabetes mellitus (DM), cardiovascular and pulmonary comorbidities,

hypoalbuminemia, anemia and A.S.A. score.<sup>4</sup> Similarly, peritoneal contamination, excessive blood loss, prolonged operative time, emergency surgery and the need for perioperative blood transfusion during surgery elevate the threat of AL.<sup>3,4</sup> Smoking and the use of alcohol tend to delay wound healing and compromise anastomotic integrity.<sup>5</sup>

Indian studies have emphasized malnutrition, anemia and infectious comorbidities. A three-tier scale for leaks has been suggested, but a universal grading system is lacking. Grade A cases require no therapeutic intervention, whereas grade B cases necessitate active intervention without laparotomy. In instances of leakages requiring laparotomy, the leakage is classed as grade C.<sup>7</sup> Anastomotic leakage involves several contributing factors. Suboptimal surgical techniques can lead to

anastomotic leaks, but even with proper methods, these leaks may still occur. Multiple studies have examined the threat factors linked to AL, such as local sepsis and intestinal ischemia at the suture line and excessive tension at the anastomosis site and distal obstruction at the anastomosis.<sup>8</sup> Given the substantial clinical and economic effects of AL, especially in resource-limited settings, spotting modifiable along with non-modifiable threat factors is crucial for improving surgical outcomes. This study assesses the incidence, threat factors and clinical outcomes of AL following emergency abdominal surgery with bowel resection and anastomosis at a tertiary care center in India. This study examines a substantial patient cohort to determine independent predictors of AL, with the goal of guiding targeted strategies to minimize postoperative complications and improve patient care in India.

## METHODS

### *Study design and setting*

This RTS observational study was carried out at two tertiary care centers under Ahalia Hospital Branch-1, Abu Dhabi, UAE namely, the Ahalia Central Hospital and the Ahalia Medical Center. It involved patients who underwent emergency abdominal surgery with bowel resection and primary anastomosis from January 2015 to December 2023. The Institutional Ethics Committees of both centers granted approval for the study.

### *Patients*

All adult patients aged 18 years or over who got done emergency abdominal surgery that included bowel anastomosis were considered eligible. Individuals who underwent procedures that did not involve bowel resection or the creation of a primary stoma were excluded from the study.

### *Data collection*

Data pertaining to patients were acquired from electronic medical records maintained by the hospital. The variables collected encompassed demographic information, including age, sex and BMI, as well as comorbid conditions such as DM, cardiovascular disease (CVD) and COPD. Additionally, laboratory parameters, specifically albumin levels, were recorded. Intraoperative findings included the site of anastomosis, blood loss, along with the surgery duration, alongside postoperative outcomes. Details of the operative procedure, encompassing the indications for surgical intervention, the necessity for blood transfusion and the status of peritoneal contamination, were meticulously documented.

### *Definition of anastomotic leakage*

Anastomotic leak (AL) is characterized by clinical manifestations such as fever, abdominal pain, peritonitis

or purulent drain output and is validated through imaging techniques including contrast-enhanced CT or dye studies or during reoperation.

### *Statistical analysis*

Descriptive statistics were utilized to summaries patient characteristics. Univariate analysis involved the chi-square test for categorical variables and either the independent t-test or the Mann-Whitney U-test for continuous variables. Variables with a p value below 0.05 in univariate analysis were entered into a multivariate logistic regression model to determine independent predictors of AL. The statistical significance threshold was set at  $p < 0.05$ . Analyses were done utilizing SPSS version 25.0 (IBM Corp., Armonk, NY, USA).

## RESULTS

### *Patient demographics and clinical characteristics*

A total of 2,563 patients who underwent emergency abdominal surgery involving bowel resection and anastomosis were included in this RTS analysis. The clinicopathological and operative characteristics at baseline are presented inside table 1 below. The average age of the cohort was 61.8 years, with a higher proportion of males at 59.4%. The average body mass index (BMI) was 23.1 kg/m<sup>2</sup>. Cardiovascular disease was identified in 15.5% of the patient population, DM in 12.2% and chronic obstructive pulmonary disease (COPD) in 6.1%. It is noteworthy that 19% of patients exhibited preoperative hypoalbuminemia, defined as an albumin level of less than 3.0 g/dl.

In the cohort studied, a history of prior laparotomy was observed in 16.4% of patients, while 26.7% presented with an ASA score of 3 or above, indicating a considerable burden of comorbid conditions. Peritoneal contamination was noted in 24.2% of the cases, while 15.3% of patients necessitated the administration of two or more units of blood transfusion during the perioperative period. Preoperative administration of steroids was documented in 5.0% of cases. Operative variables indicated that 27.8% of surgeries extended beyond three hours, while intraoperative blood loss surpassed 500 mL in 20.8% of instances. Bowel obstruction served as the surgical indication in 26.8% of the patient cohort. The allocation of anastomosis sites was observed to be 44.3% in the small bowel and 55.7% in the colorectal region.

### *Incidence and sites of anastomotic leakage*

AL was observed in 89 patients, leading to an overall incidence rate of 3.47%. Table 2 presents the distribution of leakage sites. The ileocolic anastomosis emerged as the predominant site, succeeded by colorectal, small bowel, gastrojejunostomy and jejunojejunostomy anastomoses.

### Management and clinical outcomes of anastomotic leakage

Of the 89 patients experiencing AL, 34 underwent reoperation, whereas the remaining 55 were treated non-operatively through percutaneous drainage and conservative management strategies. The average duration of hospitalization for patients with leakage was significantly extended and the mortality rate during hospitalization for these individuals was markedly higher in comparison to those without leakage.

### Univariate analysis of threat factors for anastomotic leakage

Univariate analysis revealed multiple variables that are significantly correlated with the occurrence of AL. Individuals who experienced leakage exhibited a higher likelihood of being older, male and having hypoalbuminemia, CVD, DM, COPD, peritoneal contamination, increased transfusion requirements, extended operative durations, greater intraoperative blood loss, steroid utilization, bowel obstruction and a colorectal site of anastomosis. The identified associations highlight the complex interplay of factors

contributory to the threat of anastomotic failure in emergency surgical scenarios. Table 3 delivers the comprehensive outcomes of the univariate analysis.

### Multivariate analysis of independent threat factors

The analysis using multivariate logistic regression revealed that hypoalbuminemia, the transfusion of two or more units during the perioperative period, peritoneal contamination and male sex serve as independent predictors of AL. The odds ratio for hypoalbuminemia was notably elevated, suggesting a significant correlation with the threat of leakage. Blood transfusion and peritoneal contamination were associated with significantly elevated odds, as was male sex, though to a lesser degree. The results are presented in table 4.

A median follow-up exceeding two years revealed significantly increased mortality rates among patients who suffered from AL. Multivariate survival analysis demonstrated that leakage, higher age, higher ASA score and malignant pathology are all independent predictors of death. The findings highlight the major consequences of AL in emergency abdominal surgery for both immediate postoperative results and long-term survival rates.

**Table 1: Patient's clinicopathological and operative characteristics.**

| Variable                                | Value        |
|-----------------------------------------|--------------|
| Age (years), mean±SD                    | 61.8±13.9    |
| Male sex, N (%)                         | 1,523 (59.4) |
| BMI (kg/m <sup>2</sup> ), mean±SD       | 23.1±3.6     |
| Albumin <3.0 g/dl, N (%)                | 487 (19.0)   |
| Cardiovascular disease, n (%)           | 398 (15.5)   |
| Diabetes mellitus, N (%)                | 312 (12.2)   |
| COPD, N (%)                             | 156 (6.1)    |
| Previous laparotomy, N (%)              | 421 (16.4)   |
| ASA score≥3, N (%)                      | 683 (26.7)   |
| Peritoneal contamination, N (%)         | 621 (24.2)   |
| Blood transfusion≥2 units, N (%)        | 392 (15.3)   |
| Preoperative steroid use, N (%)         | 129 (5.0)    |
| Operation time>3 hours, N (%)           | 712 (27.8)   |
| Intraoperative blood loss>500 ml, N (%) | 534 (20.8)   |
| Bowel obstruction, N (%)                | 687 (26.8)   |
| Site of anastomosis                     |              |
| Small bowel, N (%)                      | 1,134 (44.3) |
| Colorectal, N (%)                       | 1,429 (55.7) |

**Table 2: Anastomotic leakage sites.**

| Site                 | N (%)     |
|----------------------|-----------|
| Ileocolic            | 38 (42.7) |
| Colorectal           | 27 (30.3) |
| Small bowel          | 13 (14.6) |
| Gastrojejunostomy    | 7 (7.9)   |
| Jejunojunctionostomy | 4 (4.5)   |
| Total                | 89 (100)  |

**Table 3: Univariate analysis of threat factors for anastomotic leakage.**

| Variable                         | Leak (n=89) | No leak (n=2,474) | P value |
|----------------------------------|-------------|-------------------|---------|
| Age≥65 years                     | 52 (58.4%)  | 1,016 (41.1%)     | 0.008   |
| Male sex                         | 63 (70.8%)  | 1,460 (59.0%)     | 0.003   |
| Albumin <3.0 g/dl                | 37 (41.6%)  | 450 (18.2%)       | <0.001  |
| Cardiovascular disease           | 22 (24.7%)  | 376 (15.2%)       | 0.028   |
| Diabetes mellitus                | 18 (20.2%)  | 294 (11.9%)       | 0.015   |
| COPD                             | 9 (10.1%)   | 147 (5.9%)        | 0.041   |
| Peritoneal contamination         | 38 (42.7%)  | 583 (23.6%)       | 0.012   |
| Blood transfusion≥2 units        | 32 (36.0%)  | 360 (14.6%)       | <0.001  |
| Operation time>3 hours           | 41 (46.1%)  | 671 (27.1%)       | 0.023   |
| Intraoperative blood loss>500 ml | 27 (30.3%)  | 507 (20.5%)       | 0.006   |
| Preoperative steroid use         | 8 (9.0%)    | 121 (4.9%)        | 0.032   |
| Bowel obstruction                | 28 (31.5%)  | 659 (26.7%)       | 0.018   |
| Colorectal anastomosis           | 54 (60.7%)  | 1,375 (55.6%)     | 0.001   |

**Table 4: Multivariate analysis of independent threat factors for AL.**

| Variable                  | Odds ratio (OR) | 95% Confidence interval (CI) | P value |
|---------------------------|-----------------|------------------------------|---------|
| Albumin<3.0 g/dL          | 4.8             | 2.1–10.9                     | <0.001  |
| Blood transfusion≥2 units | 3.2             | 1.5–6.8                      | 0.002   |
| Peritoneal contamination  | 2.7             | 1.2–6.1                      | 0.015   |
| Male sex                  | 2.4             | 1.3–4.7                      | 0.009   |

## DISCUSSION

In an RTS study conducted on 2,563 patients who underwent emergency abdominal surgeries involving bowel resection and anastomosis, the overall incidence of AL was 3.47%. This rate agrees with rates depicted in previous Indian and international studies, varying between 2% and 19% based on patient demography and surgical conditions.<sup>9,10</sup>

Among the cases of leakage, ileocolic anastomosis issued the highest rates of leakage, followed by leakage through colorectal and small bowel anastomoses. This distribution illustrates the technical challenges and physiological fragilities that these sites have in emergency situations.<sup>4,10</sup> Univariate analysis revealed the following as significant threat factors for developing AL: advanced age, male gender, hypoalbuminemia, CVD, DM, COPD, peritoneal contamination, higher transfusion requirements, longer operative duration, higher intraoperative blood loss, use of steroids, bowel obstruction and colorectal anastomosis. The findings correspond with multiple Indian studies and meta-analyses, indicating that both patient-related and intraoperative factors significantly affect anastomotic integrity.<sup>2,9,11</sup> Hypoalbuminemia emerged as the key independent predictor in multivariate analysis, underscoring the critical role of nutritional status in anastomotic healing. Hypoalbuminemia correlates with impaired tissue repair and increased postoperative complications, especially in resource-limited settings where malnutrition is prevalent. Our study found that perioperative transfusion of two or more units and

peritoneal contamination were independently associated with AL. Blood transfusion may signal intraoperative hemodynamic instability or significant blood loss, potentially compromising tissue oxygenation and impairing healing.<sup>11</sup> Peritoneal contamination, often observed in Indian emergency surgery from delayed presentation and perforative peritonitis, is a known AL threat factor, increasing local inflammation and bacterial load.<sup>13</sup> Male sex was linked with a risen AL threat level, supported by other large studies and likely due to anatomical and hormonal differences.<sup>11</sup> In our cohort, the clinical outcomes of AL were significant, with a substantial percentage of patients requiring reoperation and a notably high in-hospital mortality rate among those with leakage.

The findings correspond with current studies identifying AL as a key factor in postoperative morbidity and mortality after gastrointestinal surgery.<sup>3</sup> Survival analysis revealed that AL, advanced age, high ASA score and malignant pathology are independent mortality predictors, stressing the necessity for aggressive perioperative optimization and early intervention in high-threat patients. The results have important implications for clinical practice in India. They highlight the essential role of preoperative nutritional assessment and optimization, especially given the high rates of malnutrition and hypoalbuminemia in surgical patients in India. Secondly, strategies to reduce intraoperative blood loss and the judicious utilization of blood transfusions may lower AL rates.<sup>3</sup>

This study's RTS design may be subject to selection and information biases. Data from only two centers may limit the generalizability of findings to other populations or healthcare settings. Additionally, some potential confounding variables could not be fully controlled due to incomplete documentation in medical records.

## CONCLUSION

AL is a significant complication post emergency abdominal surgery, occurring in 3.47% of cases in this study. Identified independent threat factors hypoalbuminemia, perioperative blood transfusion, peritoneal contamination and male sex underscore the necessity for thorough preoperative evaluation and informed intraoperative choices. Timely detection of high-threat patients and the application of focused preventive measures could decrease leakage rates and enhance clinical outcomes. The findings highlight the necessity for enhanced perioperative optimization, particularly in emergency surgical contexts where patient comorbidities and physiological stress are frequently significant.

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