e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2025; 17(6); 1544-1549

Original Research Article

Influence of Perioperative Fluid Therapy on Anastomotic Leak Following Small Intestinal Anastomotic Surgery: A Prospective Observational Study

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Received: 30-04-2025 / Revised: 29-05-2025 / Accepted: 30-06-2025
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Conflict of interest: Nil

Abstract:

Background: Anastomotic leak (AL) after small intestinal surgery is a serious complication with high morbidity and mortality. Perioperative fluid therapy is a modifiable factor influencing anastomotic healing, yet optimal strategies remain unclear, especially in emergency settings.

Materials and Methods: This prospective observational study was conducted at RIMS, Ranchi (Jan 2024–Jan 2025) on 80 patients undergoing small intestinal anastomosis. Data collected included demographics, surgical details, perioperative fluid input (first 72 h), biochemical parameters, hemodynamics, vasopressor use, and leak incidence. AL was diagnosed clinically and radiologically as per ESCP criteria. Statistical analysis used SPSS v25; $p<0.05$ was significant.

Results: AL occurred in 7/80 patients (8.75%), more common in jejunal ($p<0.0001$) and emergency surgeries ($p=0.0002$). Mean perioperative fluid input was higher in leak group (2.65 vs 2.08 ml/kg/h; $p=0.019$). Leaks were associated with lower serum sodium, hemoglobin, hematocrit, plasma osmolarity, and with hypotension and vasopressor use ($p\leq0.003$). Mortality among leak patients was 85.7% ($p<0.0001$).

Conclusion: Excess perioperative fluid, hypotension, vasopressor use, and biochemical derangements significantly increase AL risk. Goal-directed, patient-specific fluid therapy and strict postoperative monitoring may reduce leak-related morbidity and mortality.

Keywords: Anastomotic Leak, Small Bowel Surgery, Perioperative Fluid Therapy, Goal-Directed Fluid Therapy, Morbidity, Mortality.

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Introduction

Anastomotic leak (AL) following small intestinal anastomotic surgery remains one of the most severe postoperative complications, associated with high morbidity, mortality, prolonged hospital stays, and increased healthcare costs. Reported leak rates range from 3–8% in elective cases to over 10% in emergency surgeries [1,2], often leading to sepsis, reoperation, and long-term nutritional deficits [3]. In this context, perioperative fluid management has emerged as a modifiable factor influencing anastomotic integrity [4]. Historically, liberal fluid administration was favored to maintain hemodynamic stability, but concerns over tissue edema and compromised microcirculation have shifted focus towards restrictive and goal-directed fluid therapy (GDFT) approaches [5–8]. Guidelines from ERAS and ASA now recommend individualized strategies to maintain euvolemia intraoperatively and during the first 72 postoperative hours [9,10].

Evidence from recent studies supports this paradigm shift. Johnson et al. (2014) and Larson et al. (2015) reported reduced leak rates with strict fluid control and individualized fluid replacement, respectively [11,12]. Patel et al. (2017) confirmed improved outcomes with GDFT in emergency small bowel surgery [13]. However, inconsistent findings in other studies highlight the need for standardized, prospective research [14,15]. Fluid overload leads to interstitial edema and impaired tissue oxygenation, while under-resuscitation risks hypoperfusion at the anastomotic site [16,17]. Academic centers following strict perioperative protocols have demonstrated reduced complications, although most

data arise from elective procedures, with limited insight into emergency contexts [18].

This study aims to evaluate the influence of perioperative fluid therapy on AL rates in both elective and emergency small bowel surgeries. Objectives include assessing fluid regimens' impact, identifying modifying patient and surgical factors, evaluating guideline effectiveness, and exploring advanced monitoring tools [19,20]. The central hypothesis posits that intraoperative GDFT combined with early postoperative fluid restriction reduces AL risk, morbidity, and hospital stay. Supporting evidence from randomized trials, animal models, and observational studies further underscores the importance of fluid balance on anastomotic healing [21-25]. Additional risk factors such as emergency surgery, malnutrition, anemia, vasopressor use, and preoperative optimization have also been implicated [26-32]. This prospective, multicenter investigation seeks to establish evidence-based perioperative protocols to enhance outcomes in small intestinal surgery.

While literature exists on fluid strategies in colorectal surgery [24], data specifically addressing small bowel anastomosis, especially in emergency cases, are limited. This study investigates the influence of perioperative fluid therapy on leak rates, aiming to establish correlations with fluid volume, type of surgery, patient comorbidities, and clinical outcomes.

Materials and Methods

Study Design: Prospective observational study.

Duration: January 2024 to January 2025.

Setting: Department of General Surgery, RIMS, Ranchi.

Sample Size: 80 patients.

Inclusion Criteria: Patients undergoing small intestinal anastomosis (elective/emergency), including primary repair or stoma closure

Exclusion Criteria: Patients who died intraoperatively, had proximal protective stomas, or underwent anastomosis involving colon, pancreatic duct or biliary tree.

Operational Definitions:

- **Perioperative Period:** For the purposes of this study, the perioperative period is defined as beginning on the day of surgery, including the intraoperative phase, and extending through the first 72 hours postoperatively. This timeframe is consistent with current surgical standards as recommended by the American College of Surgeons (ACS) and Enhanced Recovery After Surgery (ERAS) protocols.
- **Anastomotic Leak:** An anastomotic leak is defined as a defect at the gastrointestinal anastomotic site resulting in leakage of luminal contents. Diagnosis is based on clinical signs—such as fever, tachycardia, abdominal pain, and peritonitis—along with either the presence of intraluminal contents in abdominal drains or surgical sites, or radiological confirmation via extraluminal contrast leakage on imaging. This definition conforms to the criteria established by the European Society of Coloproctology (ESCP).

Data Collection: Data were collected on demographics, comorbidities, intraoperative and postoperative fluid input (first 72 hours), hemodynamic parameters, lab values (Na+, Hb, Hct, and plasma osmolarity), vasopressor use and leak incidence. Readings were noted atleast once every 24 hours and mean was used for final analysis.

Statistical Analysis: SPSS v25, Mann-Whitney U test, Fisher's exact test; $p < 0.05$ considered significant

Results

Demographics:

Parameter	Value
Mean Age	36.2 years
Male:Female	62:18 (77.5% male)

Incidence:

- Anastomotic Leak: 7/80 (8.75%)

Table 1: Leak Association with Site of Anastomosis

Site	Leak	No Leak	p-value
Jejunum	5	2	<0.0001
Ileum	2	71	

Table 2: Leak Association with Type of Surgery

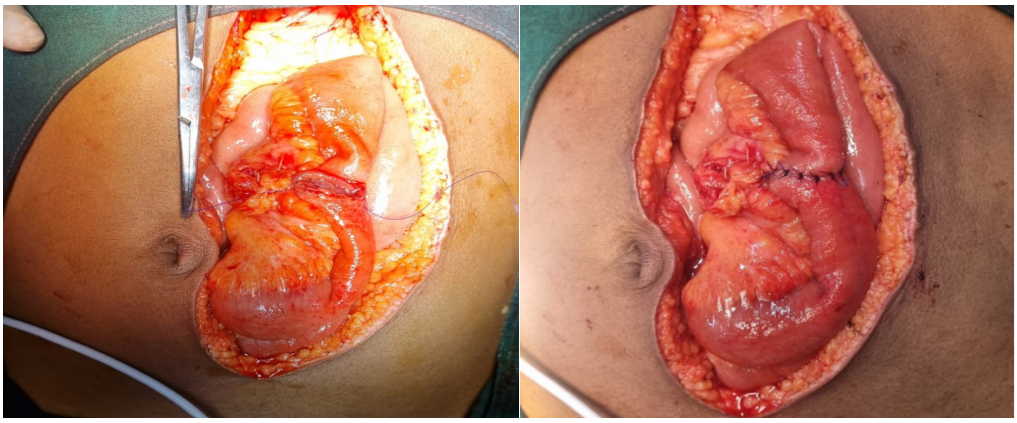
Surgery Type	Leak	No Leak	p-value
Elective	2	68	0.0002
Emergency	5	5	

Table 3: Fluid Input Comparison

Outcome	Mean Fluid Input (ml/kg/hr)	p-value
Leak	2.65	0.019
No Leak	2.08	

Table 4: Other Parameters Significantly Associated with Leak

Parameter (Mean)	Leak	No Leak	p-value
Serum Na+ (mmol/L)	133.0	138.1	0.0001
Hb (g/dL)	8.84	10.89	0.0002
Hct (%)	23.5	35.6	<0.0001
Plasma Osmolarity	262.1	275.6	<0.0001
Systolic BP <90 mmHg	Present in 3/7 leaks	p = 0.003	
Vasopressor use	Present in 3/7 leaks	p = 0.003	
Mortality	6/7 (85.7%)	p < 0.0001	



(A) (B)

Figure 1: Single layer anastomosis (A)Continuous (B) Interrupted sutures using 3-0 polydiaxone

(A) (B)

Figure 2: Bilious bowel content (A) from surgical site (B) in abdominal drain

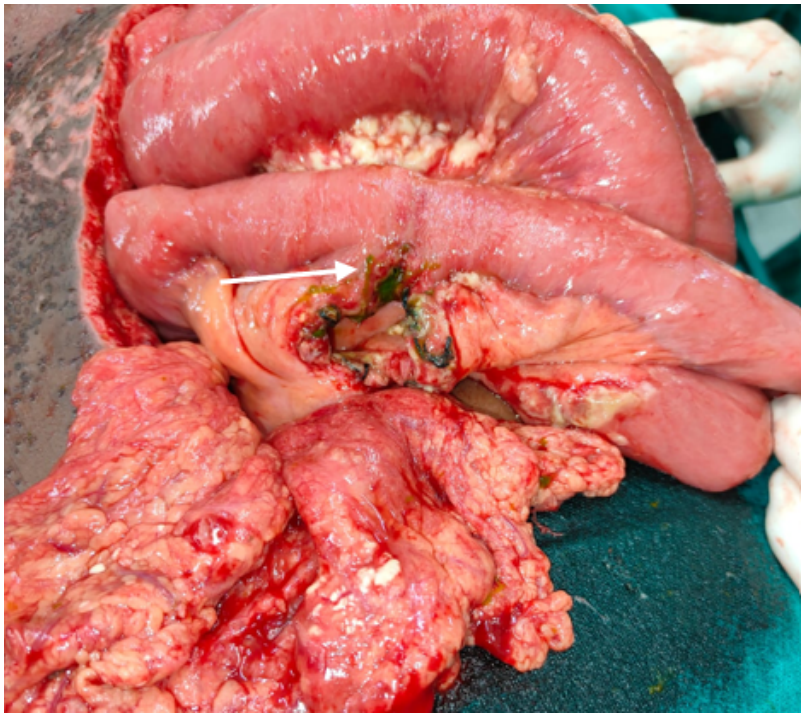


Figure 3: Anastomotic leak on re-exploration (white arrow)

Discussion

This study demonstrates that increased perioperative fluid input is significantly associated with anastomotic leaks following small bowel surgery. The findings support previous studies in colorectal surgery by Brandstrup et al. [21], Marjanovic et al. [22], and Alvarez-Villasenor et al. [26], but uniquely extend the evidence to small intestinal procedures.

The higher leak rates observed in jejunal anastomosis may be attributed to increased enzymatic activity and fragile mucosal integrity in this segment compared to the ileum. Emergency procedures inherently present higher physiological stress, delayed optimization, and limited time for intraoperative planning, explaining the higher leak incidence [27,30]. Low serum sodium and plasma osmolarity values suggest dilutional hyponatremia and fluid overload, compromising microcirculatory perfusion and oxygen delivery at the anastomotic site. Similarly, low hemoglobin and hematocrit reflect inadequate tissue oxygenation, which impairs collagen synthesis and delays healing. Vasopressor use, while often necessary, also emerged as a predictor of leak, likely due to microvascular vasoconstriction [32].

These findings reinforce the evolving paradigm in perioperative care: shifting from a one-size-fits-all fluid administration approach toward individualized, goal-directed therapy. This approach considers dynamic parameters and patient-specific factors to maintain perfusion without causing fluid overload. The ERAS and ASA guidelines emphasize maintaining euvolemia, guided by measurable hemodynamic markers, and minimizing both hypotension and excess fluid administration.

The high mortality observed among patients with anastomotic leaks highlights the clinical significance of prevention. In our study, 85.7% of patients with leaks succumbed to sepsis and multi-organ failure, underscoring the need for early identification and aggressive management of risk factors.

This study also brings attention to the value of close postoperative monitoring. Parameters such as urine output, vital signs, and early warning scores may help identify patients at higher risk of leak. Incorporating bedside monitoring tools like lactate trends and dynamic preload indicators can further enhance fluid titration.

Limitations: Being a single-center study, the generalizability of our findings is limited. The absence of advanced hemodynamic monitoring and lack of implementation of GDFT protocols also restricts the ability to attribute causal relationships. Additionally, the modest sample size may underpower detection of smaller effect sizes in multivariate analysis.

Future multicentric trials incorporating real-time fluid optimization tools and larger patient cohorts are warranted to confirm our findings and refine fluid therapy protocols.

Conclusion

Anastomotic leak after small intestinal surgery is a devastating complication with high mortality. This study identifies increased perioperative fluid input,

hypotension, vasopressor use, and biochemical disturbances such as hyponatremia, anemia, and hypo-osmolarity as significant contributors to leak incidence.

These results highlight the urgent need for perioperative fluid strategies that are patient-specific, goal-directed, and evidence-based. Surgeons and anesthesiologists must collaborate to ensure fluid therapy not only supports circulation but also avoids tissue edema and impaired healing.

Standardizing protocols for fluid restriction, timely detection of hypoperfusion, and judicious use of vasopressors—especially in emergency settings—may significantly reduce leak-related morbidity and mortality. Incorporating these principles into ERAS-based care pathways can improve outcomes in patients undergoing small intestinal anastomosis.

Ethics Approval: Approved by Institutional Ethics Committee, RIMS Ranchi

Informed Consent: Obtained from all participants

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