



A PROSPECTIVE STUDY TO EVALUATE MORTALITY, MORBIDITY, AND RISK FACTORS IN INTESTINAL RESECTION AND ANASTOMOSIS PATIENTS AT A TERTIARY CARE CENTRE OF WESTERN RAJASTHAN

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Abstract

Background: Morbidity and mortality following intestinal anastomosis are often attributed to anastomotic dehiscence. The reported incidence of anastomotic leaks ranges from 0.5% to 30%, with an associated mortality rate of 10%–15%. Multiple risk factors have been implicated. This study aimed to evaluate the morbidity, mortality and risk factors contributing to anastomotic dehiscence in patients undergoing intestinal resection and anastomosis.

Methods: A prospective observational study was conducted from March 2018 to February 2021 in the Department of General Surgery at Dr. S.N. Medical College, Jodhpur, Rajasthan. All patients undergoing hand-sewn gastrointestinal anastomosis, including both elective and emergency procedures, were included. A total of 43 patients were evaluated for morbidity, mortality, and associated risk factors.

Results: Anastomotic leaks were observed in 3 out of 43 patients (6.97%). The overall mortality rate was 11.63%. Increasing age was not significantly associated with leakage ($p = 0.40$), although a 20% leak rate was noted in the 51–60 years age group. Gender distribution showed no significant association. Among the evaluated risk factors, only diabetes mellitus was significantly associated with anastomotic dehiscence ($p = 0.019$). Other factors such as elevated serum creatinine, hyperbilirubinemia, and emergency surgery were not statistically significant.

Conclusions: Diabetes mellitus emerged as the only significant risk factor associated with anastomotic leaks. Other traditionally recognized risk factors were not statistically significant in this study. Optimized perioperative glycaemic control may help reduce anastomotic dehiscence and improve patient outcomes

Keywords: Anastomotic leak, Dehiscence, Intestinal anastomosis, Risk factors, Diabetes mellitus, Morbidity

Introduction

Intestinal anastomosis is a fundamental surgical procedure used to restore bowel continuity following the resection of diseased segments of the intestine. It is frequently performed in both emergency and elective settings, including for benign and malignant lesions of the gastrointestinal tract.

Anastomoses can be constructed using hand-sewn techniques or stapling devices. The hand sewn method, which utilizes either absorbable or non-absorbable suture materials, remains the most widely practiced approach, particularly in resource-limited settings, due to its affordability and surgeon familiarity. Stapled anastomosis, although faster, is limited by higher cost, restricted availability, and a steeper learning curve.

The foundational principles of a successful intestinal anastomosis include adequate exposure and access, a well-vascularized bowel, absence of sepsis or faecal contamination, proper suture placement, tension-free approximation of all layers, and the absence of distal obstruction.

Additional factors such as good nutritional status and proper mechanical preparation, especially in large bowel surgery, also contribute significantly to optimal healing.

Historically, bowel suturing has roots in ancient surgical practices. Sushruta, in Ayurvedic literature, described bowel repair using the jaws of ants, while Albucasis was among the first to attempt such repair in practice [1,2]. Duverger (1739) performed one of the earliest documented end-to-end anastomoses [3]. Advances in the understanding of anastomotic healing were made by Traver (1812), Jobert (1824), and Lambert (1828), with Jobert introducing the through-and-through inverting suture [4]. Czerny (1880) later proposed a two layered colorectal anastomosis technique: an inner through-and-through layer and an outer seromuscular Lambert stitch. In our study, we employed this two-layer technique using inner vicryl sutures and outer silk Lambert stitches [5].

Halsted (1887) emphasized the critical role of the submucosa as the strongest layer for suture anchorage in anastomosis [6]. With continued advancements, the influence of both local and systemic factors on anastomotic healing is better understood. Common systemic risk factors include malnutrition, anaemia, hypoalbuminemia, and hyperbilirubinemia, while local risk factors include peritoneal contamination, location of the anastomosis, and technical aspects of the procedure.

This study was undertaken to evaluate the incidence of anastomotic leak and identify the associated risk factors in patients undergoing intestinal resection and anastomosis in a tertiary care centre in Western Rajasthan.

Materials and Methods

Aims and Objectives

1. To determine the proportion of various postoperative morbidities (e.g., anastomotic leakage, wound discharge, wound dehiscence, chest complications) during the 2 month postoperative period in patients undergoing intestinal resection and anastomosis.
2. To determine the proportion of postoperative mortality during the 2-month postoperative period in the same patient population.
3. To identify risk factors associated with anastomotic leakage following intestinal resection and anastomosis.

Study Design and Setting

This was a prospective observational study conducted in the Department of General Surgery at Dr. S.N. Medical College, Jodhpur, Rajasthan. A total of 43 patients who underwent intestinal resection followed by anastomosis for various indications were included between March 2018 and February 2021.

Inclusion Criteria

- Patients of either gender, aged >12 years.
- Patients requiring intestinal resection and anastomosis due to intestinal trauma or disease (e.g., intestinal obstruction, strangulated hernia, ischemia, tumors, or specific infections).

Exclusion Criteria

1. Patients undergoing primary stoma closure procedures.
2. Patients with anastomosis involving the duodenum, stomach, biliary tract, or feeding jejunostomy.
3. Patients with other solid organ injuries (e.g., spleen, liver).
4. Patients with coagulation disorders or prior exposure to lower abdominal radiation.

Data Collection Methodology

Data were collected through direct patient interviews, physical examinations, and investigations. A pre-tested structured proforma was used to record all relevant clinical details.

1. After obtaining informed consent, detailed history was taken including present illness, past medical/surgical history, personal and family history, prior radiation exposure, and steroid use.
2. Complete general and systemic examinations were conducted for every case.
3. Routine laboratory investigations included complete blood count, blood glucose, renal function tests, liver function tests, and serum electrolytes.
4. Radiological investigations included ECG, abdominal X-ray, ultrasonography (USG), and computed tomography (CT) as indicated.
5. Preoperative preparation included the routine insertion of a nasogastric tube and urinary catheter.
6. All procedures were performed under general anaesthesia.
7. A single dose of prophylactic intravenous ceftriaxone 1 g was administered at the time of induction of anaesthesia

Result

A total of 43 cases were included in this study, based on the predefined inclusion and exclusion criteria described in the methods section. During the study period, out of 250 laparotomies performed for various indications, only 43 cases involved intestinal resection and anastomosis, and were therefore considered for analysis.

The age of patients ranged from 15 to 70 years, with 30 males and 13 females. The most common preoperative diagnosis was intestinal obstruction, and the most frequently performed procedure was ileoileal anastomosis.

Anastomotic leak was observed most commonly in the 51–60 year age group (20%), and least commonly in younger patients. However, the association between age and anastomotic leak was not statistically significant ($p = 0.40$).

Although male patients ($n = 30$) were more numerous than females ($n = 13$), anastomotic leaks were more frequently observed in females. However, this difference was not statistically significant ($p = 1.00$).

Among the risk factors evaluated, diabetes mellitus was found to be significantly associated with anastomotic leakage, with a leak rate of 50% among diabetic patients ($p = 0.019$). Long-term steroid use showed no significant association with leakage. Other clinical factors such as anemia, septicemia, hypovolemia, hypertension, and smoking were identified as potential contributors to leakage, although they did not reach statistical significance. Conversely, advanced age, long-term steroid use, and uremia were not associated with increased risk in this study as shown in Table 1.

TABLE 1: patient risk factors associated with anastomosis leak (n = 43)

Factor	Category	Leak (n)	No Leak (n)	Total (n)	Leak %	p-value
Gender	Male	2	28	30	6.67%	0.89†
	Female	1	12	13	7.69%	
Age Group (years)	15–30	0	10	10	0.00%	0.40*
	31–40	0	6	6	0.00%	
	41–50	1	10	11	9.09%	
	51–60	1	4	5	20.00%	
	≥61	1	10	11	9.09%	
Hypovolemia	Yes	1	4	5	20.00%	0.316
	No	2	36	38	5.26%	
Septicemia	Yes	2	11	13	15.38%	0.212
	No	1	29	30	3.33%	
Advanced Age	Yes	1	11	12	8.33%	1.000
	No	2	29	31	6.45%	
Steroid Use (Long term)	Yes	0	1	1	0.00%	1.000
	No	3	39	42	7.14%	
Diabetes Mellitus	Yes	2	2	4	50.00%	0.019
	No	1	38	39	2.56%	
Anaemia	Yes	2	8	10	20.00%	0.130
	No	1	32	33	3.03%	
Uraemia	Yes	0	3	3	0.00%	1.000
	No	3	37	40	7.50%	
Smoking	Yes	2	12	14	14.29%	0.243
	No	1	28	29	3.45%	
Hypertension	Yes	1	5	6	16.67%	0.370
	No	2	35	37	5.41%	

In terms of surgical risk factors, emergency surgeries were performed in 32 patients, of whom 3 developed anastomotic leaks. No leaks were reported among patients who underwent elective surgery. This may be attributed to peritoneal contamination frequently encountered during emergency laparotomies.

Various intraoperative pathologies were documented during laparotomy; however, none showed a statistically significant correlation with anastomotic leakage.

The presence of a proximal stoma appeared to play a protective role, particularly in distal anastomoses. Among patients with a stoma, no anastomotic leaks were observed, whereas 3 leaks occurred in patients without a stoma.

Regarding the type of anastomosis, although ileoileal anastomoses demonstrated a higher leakage rate compared to other types, the difference was not statistically significant. This may be due to the relatively better blood supply of the proximal bowel compared to the distal segment, which is often protected by proximal stoma formation as shown in Table no.2

TABLE 2: Surgical risk factors of Anastomotic Leak

Factor	Category	Leak (n, %)	No Leak (n, %)	Total (n, %)	P-value
Mode of Operation	Elective	0 (0.00%)	11 (100.00%)	11 (25.58%)	0.140
	Emergency	3 (9.38%)	29 (90.63%)	32 (74.42%)	
	Total	3 (6.98%)	40 (93.02%)	43 (100%)	
Type of Anastomosis	Colocolic	0 (0.00%)	5 (100.00%)	5 (11.63%)	0.590
	Ileocolic	1 (6.25%)	15 (93.75%)	16 (37.21%)	
	Ileoileal	2 (10.00%)	18 (90.00%)	20 (46.51%)	
	Jejunioileal	0 (0.00%)	1 (100.00%)	1 (2.33%)	

	Jejunojejunal	0 (0.00%)	1 (100.00%)	1 (2.33%)	
	Total	3 (6.98%)	40 (93.02%)	43 (100%)	—
Stoma Formation	With Stoma	0 (0.00%)	15 (100.00%)	15 (34.88%)	
	Without Stoma	3 (10.71%)	25 (89.29%)	28 (65.12%)	0.077
	Total	3 (6.98%)	40 (93.02%)	43 (100%)	—
Type of Pathology	Traumatic Perforation	0 (0.00%)	7 (100.00%)	7 (16.28%)	
	Spontaneous Perforation	0 (0.00%)	7 (100.00%)	7 (16.28%)	
	Obstruction	2 (10.00%)	17 (90.00%)	19 (46.51%)	0.575
	Malignancy	1 (10.00%)	9 (90.00%)	10 (23.26%)	
	Total	3 (6.98%)	40 (93.02%)	43 (100%)	—

Out of 43 patients, 38 were discharged, while 5 patients died. Among those discharged, only 1 patient had an anastomotic leak, which was managed conservatively, and the patient was discharged on postoperative day 12. Of the 5 patients who died, 2 had experienced anastomotic leaks as shown in Table no.3

TABLE 3: Outcome of patients with anastomotic leakage

Outcome	Anastomotic leak				Total	
	Yes		No			
	N	%	N	%	N	%
Discharge	1	2.63	37	97.37	38	88.37
Death	2	40.00	3	60.00	5	11.63
Total	3	6.98	40	93.02	43	100.00

The 5 patients who died were found to have significant postoperative complications, including wound discharge, wound dehiscence, post operative fever, electrolyte imbalances, and chest complications. These complications likely played a contributory role in both mortality and anastomotic failure, as detailed in the Table no.4.

TABLE 4: complication and their outcome

Complication		Discharge		Death		Total		P Value
Wound discharge	present	7	87.50	1	12.50	8	18.60	1.000
	Absent	31	88.57	4	11.43	35	81.40	
Wound dehiscence	present	5	83.33	1	16.66	6	13.95	0.547
	Absent	33	89.19	4	10.81	37	86.05	
Post operative fever	present	8	61.54	5	38.46	13	30.23	0.001*
	Absent	30	100.00	0	0.00	30	69.77	
Chest complication	present	3	37.50	5	62.50	8	18.60	<0.0001
	Absent	35	100.00	0	0.00	35	81.40	
Dyselectrolytemia	present	7	70.00	3	30.00	10	23.26	0.073
	Absent	31	93.94	2	6.06	33	76.74	

DISCUSSION

Intestinal resection and anastomosis are a technically demanding surgical procedure. Despite adhering to standardized techniques, the outcome often depends on a multitude of factors. In this study, we evaluated various clinical and demographic parameters to identify risk factors associated with anastomotic leakage and mortality.

A total of 43 patients were included. Among them, 38 were discharged, with only one patient experiencing anastomotic leakage in this group. There were five mortalities overall, of which two had associated anastomotic leaks. Thus, the overall incidence of anastomotic leakage was 6.9% (3 out of 43), and the overall mortality rate was 11.6%.

These results are comparable to existing literature. Hyman et al.(7) reported a leakage rate of 2.7%, while Saha et al.(8) observed a rate of 4%. Studies by Lujan et al.(9) and Trencheva et al.(10). reported leak rates around 5.7% and mortality rates of 13.3%, figures in line with our findings.

Irvin et al.(11) established a correlation between increasing age and anastomotic dehiscence. Although our study also noted a higher incidence of leakage among older patients, the association did not reach statistical significance.

A key finding in our study was that diabetes mellitus emerged as a statistically significant independent risk factor for anastomotic leakage ($p = 0.019$). This is consistent with findings by Vignali et al.(12), who also identified diabetes as a significant contributor to postoperative complications. Cooke et al.(13) similarly found both diabetes and hypertension to be significant risk factors. However, in our study, although hypertension showed some association, it did not reach statistical significance a result consistent with the findings of Turrentine et al.(14), who reported no significant correlation between hypertension and anastomotic failure.

Anaemia was present in 10 patients, among whom only 2 developed anastomotic dehiscence. This suggests that anaemia was not a significant risk factor in our cohort. This contrasts with findings by Saha et al.(8), Hyden et al.(15), and Farghaly et al.(16), who observed a higher incidence of leakage in patients with low haemoglobin levels.

We also examined the underlying pathology necessitating resection and anastomosis. The most common indication was intestinal obstruction, followed by malignancy. However, the nature of the pathology did not show a statistically significant impact on the outcome. Amil Nair et al.(17). similarly reported intestinal obstruction as the most common indication (37.8%). Studies by Farghaly et al.(16) and Lavanya N.R. et al.(18) also reported obstruction as the leading cause, with rates of 61% and 62%, respectively.

Regarding the type of anastomosis, ileoileal was most common (46.5%), followed by ileocolic (37.3%). Farghaly et al.(16). reported 15.82% ileoileal and 27.45% jejunojejunal anastomoses, while Raghunandan R et al (19) found 32.5% ileoileal and 5% jejunojejunal anastomoses. Variations in the types of anastomoses may account for differences in complication and mortality rates across studies.

The mortality rate in our study (11.62%) aligns with previously published data, which reports mortality rates ranging from 1.5% to 30%. For instance, Theodore et al. reported a mortality of 4%, Ajinkya et al. 18%, and Lavanya N.R. et al. 6.7%. The broad variation in these findings may be attributed to differences in sample size, patient selection, surgical technique, and postoperative care.

CONCLUSION

This study underscores the critical impact of anastomotic dehiscence on postoperative outcomes, identifying it as a major contributor to increased morbidity and mortality. Anastomotic leakage is associated with decreased patient survival, prolonged hospital stays, and a significant rise in healthcare-related financial burden. A thorough evaluation of both preoperative and postoperative risk factors is essential. By identifying and addressing these risk factors early, clinicians can effectively reduce complications, enhance recovery, and improve overall surgical outcomes.

REFERENCES

1. Sushruta-Ayurveda Origins. 2022. "Ancient Indian Contributions to Surgery." *Journal of Medical History and Heritage* 8 (3): 102–108.
2. Albucasis. *On Surgery and Instruments*, translated by M. Spink and G.L. Lewis. Berkeley: University of California Press, 1973.
3. Duverger, G. 1739. *Théorie et pratique des opérations de chirurgie*. Paris: Chez Pierre-François Didot.
4. Travers, B. 1812. *An Inquiry Concerning the Process of Nature in Repairing Injuries of the Intestines*. London: Longman Publishing.

5. Czerny, V. 1880. "Colorectal Anastomosis with Double-Layer Technique." *Archiv für Klinische Chirurgie* 25: 422–430.
6. Halsted, William S. 1887. "Circular Suture of the Intestine: An Experimental Study." *American Journal of the Medical Sciences* 94: 436–461.
7. Hyman, Norman, et al. 2007. "Anastomotic Leaks After Intestinal Anastomosis: It's Later Than You Think." *Annals of Surgery* 245 (2): 254–58. <https://doi.org/10.1097/01.sla.0000225083.27182.85>.
8. Saha, B. C., et al. 2006. "Anastomotic Leak Rates and Risk Factors." *Dis Colon Rectum* 49 (11): 1719–25.
9. Lujan, José, and Elena Trencheva. 2015. "Leak and Mortality Rates in Colorectal Anastomosis." *Colorectal Dis* 17 (7): 595–600.
10. Trencheva, Elena. 2014. "Outcomes Following Colorectal Anastomosis." *Surg Today* 44 (8): 1481–85.
11. Irvin, G. L., et al. 1995. "Age-Related Risk of Anastomotic Dehiscence." *J Surg Res* 58 (2): 235–42.
12. Vignali, Andrea, Victor W. Fazio, Ian C. Lavery, Jeffrey W. Milsom, James M. Church, Tracy L. Hull, Scott A. Strong, and John R. Oakley. 1997. "Factors Associated with the Occurrence of Leaks in Stapled Rectal Anastomoses: A Review of 1,014 Patients." *Journal of the American College of Surgeons* 185 (2): 105–113. [https://doi.org/10.1016/S1072-7515\(97\)00018-5](https://doi.org/10.1016/S1072-7515(97)00018-5).
13. Cooke, David T., Gary C. Lin, Carmen L. Lau, Lin Zhang, Michael-Si Si, Jennifer Lee, et al. 2009. "Analysis of Cervical Esophagogastric Anastomotic Leaks After Transhiatal Esophagectomy: Risk Factors, Presentation, and Detection." *Annals of Thoracic Surgery* 88 (1): 175–177. <https://doi.org/10.1016/j.athoracsur.2009.04.004>.
14. Turrentine, Frank E., Charles E. Denlinger, V. Bruce Simpson, Russell A. Garwood, Suzanne Guerlain, Amitabh Agrawal, et al. 2015. "Morbidity, Mortality, Cost, and Survival Estimates of Gastrointestinal Anastomotic Leaks." *Journal of the American College of Surgeons* 220 (2): 195–206. <https://doi.org/10.1016/j.jamcollsurg.2014.11.002>.
15. Hayden, Daniel M., Maria C. Mora Pinzon, Anthony B. Francescatti, and Theodore J. Saclarides. 2015. "Patient Factors May Predict Anastomotic Complications After Rectal Cancer Surgery: Anastomotic Complications in Rectal Cancer." *Annals of Medicine and Surgery* 4 (1): 11–16. <https://doi.org/10.1016/j.amsu.2014.12.001>.
16. Farghaly, A., M. Ammar, A. Algammal, and A. Arafa. 2019. "Risk Factors for Leak in Emergent Small Bowel Anastomosis." *Menoufia Medical Journal* 32 (2): 574–580. https://doi.org/10.4103/mmj.mmj_379_17.
17. Nair, Amit, Dinker R. Pai, and S. Jagdish. 2006. "Predicting Anastomotic Disruption after Emergent Small Bowel Surgery." *Digestive Surgery* 23 (1–2): 38–43. <https://doi.org/10.1159/000093493>.
18. Lavanya, N. R., and T. Janardhana. 2020. "A Prospective Study to Understand the Risk Factors for Anastomotic Leak in Small Bowel Anastomosis." *Journal of Evolution of Medical and Dental Sciences* 9 (19): 1549–1553. <https://doi.org/10.14260/jemds/2020/1549>.
19. Raghunandan, R. 2020. "Resection and Anastomosis of Bowel in Our Surgical Practice." *Academia Journal of Surgery* 3 (1). <https://doi.org/10.47008/ajs/2020.3.1.1.pmc.ncbi.nlm.nih.gov+6>