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Original Research Article

Factors influencing intestinal anastomotic leak and their predictive value

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ABSTRACT

Background: Anastomotic leak after intestinal surgery is one of the major reasons behind postoperative morbidity and mortality. This prospective study was undertaken to evaluate various risk factors for anastomotic leakage.
Methods: This study was conducted in B.R.D. Medical College, Gorakhpur, Department of surgery from May 2015 to October 2016. Patients who underwent intestinal anastomosis in emergency settings or routine operation were included in this study. Total of 156 patients were included.
Results: Anastomotic leak was observed in 16.02% cases and was higher in males and in patients from low socioeconomic status. However, age, sex, and socioeconomic status were not found to be significant risk factors for anastomotic leak. Leak rate was higher in patients suffering from chronic diseases such as malignancy; COPD, DM, and patients with chronic corticosteroid use. Leak rate was significantly high in malnourished patients and in cases having sepsis as shown by their blood investigation report. After logistic regression analysis it was observe that various independent predictors for anastomotic leakages are peritonitis ($p<0.05$; odds ratio 2.166), bowel obstructions ($p<0.05$; odds ratio 2.844), blood transfusion>2 u ($p<0.05$; odds ratio 2.354), S. Albumin <3.0 gm/di ($p<0.001$; odds ratio 8.873), corticosteroid therapy ($p<0.001$; odds ratio 4.857), serum creatinine >1.2 mg/dl ($p<0.001$; odds ratio 11.755), duration of surgery (>4 hrs) ($p<0.01$; odds ratio 3.0251) and ASA Grading (III&IV) ($p<0.01$; odds ratio 3.607).
Conclusions: This study has identified the potential risk factors that affect the incidence of anastomotic leakage and the result of this study will be helpful in reducing the incidence of AL after surgeries.

Keywords: Anastomotic leakage, Risk factors, Predictive value, Intestinal surgery, Chronic disease, Blood loss

INTRODUCTION

Anastomotic leakage has been regarded as one of the most common complications encountered after intestinal surgery. In spite of advancement in the surgical procedures, anastomotic leakage remained a dreaded complication over the past century. These leakages are often times difficult to manage and are a significant reason for causing frustration to surgeons.[1]

Anastomotic leaks are often associated with the longer hospital stay, increased mortality and morbidity, and higher rates of readmission. Studies have shown that the mortality rate of anastomotic leak varies from 6% to 39% with a 10% to 100% rise in the permanent stoma. In gastrointestinal cancer patients who have suffered from the anastomotic leak have a higher chance of recurrence. In addition, these patients also experience large delays in receiving chemotherapy after surgery.[2]

Usually, the anastomotic leakage occurs between the 3rd and the 6th postoperative day. The clinical manifestation varies from the presence of low-grade fever and abdominal pain to prolonged ileus or failure to thrive. However, in severe conditions, the spectrum can include sepsis, peritonitis and/or hemodynamic instability.[3] In general, the presentation in a patient depends on the location and the magnitude of the leak and whether the adjacent tissues are affected. Although there is no universal grading system exists for the leak, however, a three-grade scale has been proposed for the leak. In cases where no therapeutic intervention is needed are classified as the grade A, grade bleaks includes the cases where active intervention is needed without laparotomy. Lastly, in leakages where laparotomy is required, the leakage is classified as grade C.[4]

The cause of the anastomotic leakage is multifactorial. Poor surgical procedures can lead to anastomotic leakages; however, even when the operation is done correctly the chances of anastomotic leaks sometimes becomes inevitable. Several pieces of research have been done for the elucidation of the risk factors that influence the anastomotic leakage including, the presence of local sepsis, intestinal ischemia at the suture line, excessive tension across the site of anastomosis, and presence of an obstruction to the distal site to the anastomosis.[5]

In addition to this, old age, male sex, smoking, history of alcohol abuse, obesity, duration of operation, preoperative blood transfusion and timing of the duty doctor also influence the anastomotic leakage. Patients who are malnourished, anemic, patients receiving high doses of steroids and chemotherapy are more prone to develop leak.

This prospective study has been undertaken to evaluate the various risk factors associated with anastomotic leakage following elective/emergency open intestinal resection. In addition, this study will also examine the independent predictive factors related to anastomotic leakage and will utilize these predictive values in the future management of the leakage.

METHODS

This present study was conducted in B.R.D. Medical College Gorakhpur, Department of surgery for a period of 15 months from May 2015 to October 2016 on patients with intestinal anastomosis involving small and large intestine. All the patients in whom the intestinal anastomosis was performed either in the emergency settings or in routine OT were included in this study. A thorough history including the age, sex, occupation, socioeconomic background, and history of smoking and alcohol consumption was recorded. In addition thorough clinical information about the presence of any associated disease such as diabetes, hypertension, and renal failure or risk factors which can precipitate these diseases was also taken. History of any other intestinal pathology, TB and any abdominal operation was also elicited.

After the patients were included in the study a thorough general examination was conducted including the pulse, blood pressure, temperature, presence of cyanosis, jaundice, edema, generalized lymphadenopathy, rate of respiration, type of respiration (abdominothoracic/ thoracoabdominal), degree of pallor, dehydration (in terms of dryness of tongue, skin tumor and shrunken eyeball) and all these data was recorded.

A thorough clinical examination of the abdomen was donefor measuring the abdominal distension, peristalsis and its pattern, presence or absence of any previous operation scar or hernial orifices, and bowel sounds were also noted. Detailed clinical examination of the cardiovascular system, respiratory system CNS & Genitourinary system was also done. Routine investigations including Hb%, TLC, DLC, Serum electrolytes, urea, creatinine, serum albumin, liver function test, random blood sugar, and complete urine examination were done in all cases.

Plain X-ray abdomen in erect posture and X-ray chest PA view was taken in every case, USG was done as and when required. During the operation, the fluid and electrolyte balance was maintained. Blood transfusions were done as and when required. The patients were discharged from the hospital and were asked to attend surgical OPD at an interval of 4 weeks for a checkup.

All the variables thus obtained were analyzed by Chi-square test with continuity correction to reduce the numbers of eligible independent variables. Factors that achieved a significance level i.e. p=0.05 were further analyzed with multivariate analysis using forward stepwise logistic regression test.

RESULTS

The present study has shown that a maximum number of anastomotic leaks were observed in the 51-60 yrs age group (23.07%) followed by 0-10 yrs age group (18.18%). Patients in the 10-30 yrs age group had the lowest leakage rate. The youngest patient with anastomotic leak was 3 months old child and oldest was 75 yrs old (Table 1). Males had a higher rate of anastomotic leakage (16.85%) compared to the females (14.92%), however, this difference was statistically insignificant. Survival rate was higher in patients without a leak ($p<0.001$).

Patient with low socioeconomic status showed a high incidence of the leak (18.36%) compared with low and middle group. The maximum number of leakage was present (25%) in patients with peritonitis, followed by patients who were operated for obstruction (15%). The leakage rate was higher in patients (36.36%) with sigmoid volvulus with obstruction. Minimum percentage

of leakage was observed in stoma closure (6.81%) (Table 3C). A high leak rate was seen (19.64%) in cases associated with peritonitis and/or obstruction in comparison to ostomy closure group (06.81%) (p>0.05).

Table 1: Age distribution in cases of intestinal anastomosis.

Age group (years)	Total no. of cases		Cases with leak	
	No.	%	No.	%
0-10	11	07.05	02	18.18
I 1-20	14	08.94	01	07.14
21-30	26	16.66	03	11.53
31-40	39	25.00	06	15.38
41-50	21	13.46	03	14.28
51-60	26	16.66	06	23.07
>60	19	12.17	03	15.76

Sex	Total no. of cases		Cases with leak			
	No.	%	No.	%	x^2 value	P value
Male	89	57.05	15	16.85	0.076	>0.05
Female	67	42.94	10	14.92		

Table 2: Economical status wise incidences.

Economical status	Total no. of cases		Cases with leak		x^2 value	P value
	No	%	No.	%		
Low	98	68.82	18	18.36		
Middle	40	25.64	05	12.50	0.803	>0.05
High	18	11.53	02	11.11		

Table 3: Relationship of various abdominal conditions with incidence of anastomotic leaks.

Obstruction		Total cases		Cases with leak		x^2 value	P value
		No.	%	No.	%		
Patients with obstruction							
Present	Ileal	31	51.66	02	06.45		
	Colonic	18	30.00	03	16.66		
	Sigmoicl volvulus	11	18.33	04	36.36	5.769	<0.05
	Total	60	41.02	16	26.66		
Not present		96	60.25	09	09.37		
Patients with peritonitis							
Present		52	33.33	13	25.00	3.862	<0.05
Not present		104	66.66	12	11.52		
Patients in stoma closure							
Ostomy closure	Ileoilia	21	47.72	01	09.52		
	lIleocolicc	13	29.54	01	07.69		
	Colocolic	10	22.72	01	10.00		
		44		03	06.81		

Table 4: Relationship of associated systemic chronic diseases with the incidence of anastomotic leaks.

Chronic disease		Total no. of cases		Cases with leak		x^2 value	P value
		No.	%	No.	%		
Present	Malignancy	13	08.33	03	23.07		
	COPD	20	12.82	06	30.00		
	DM	24	15.38	04	16.66	2.171	>0.10
	Total	57	36.53	13	22.80		
Not present		99	63.47	12	12.12		

Table 5: Association of chronic corticosteroid therapy with a leak rate.

Chronic steroid intake	Total no. of cases		Cases with leak		x^2 value	P value
	No.	%	No.	%		
Yes	54	34.61	18	66.66	12.571	<0.001
No	102	65.38	07	06.80		

Table 6: Physical and general examination and radiological findings.

Physical and general examination					
Sign anti. symptoms		Total cases		Cases with leak	
		No.	%	No.	%
Pulse rate	<100	128	82.05	18	14.06
	>100	28	17.94	07	25.00
Temperature	N	138	88.46	20	14.49
	>100	18	11.53	05	27.77
Respiratory rate	16-24	96	61.53	06	06.25
	>24	60	38.46	19	31.66
Abdominal examination	Desterttioll	118	75.64	18	15.25
	Rigidity	52	33.33	12	23.02
	Guarding	44	28.20	10	22.72
	BS(-)	67	42.94	11	16.41
	BS	74	47.43	1	21.62
Respiratory system	Crypts	32	20.51	12	37.50
	Wheeze	37	23.71	13	35.13
	Air entry	46	29.48	16	34.78
Radiological findings	Pleural effusion	12	07.69	05	41.66
X rays chest	Pneumonitis patch	10	06.41	03	31.00
	Gas Rt dome of diaphragm	48	30.76	08	33.33
X-ray abdomen with both dome of diaphragm	Fluid level	66	42.30	16	24.24
	Distended bowel loop	15	09.61	05	6.00
Normal Examination		38	24.35	05	13.15

Table 7: Blood investigations.

Investigation		Total cases		Cases with leak		x^2 value	P value
		No.	%	No.	%		
Hb	>10	105	67.73	10	09.52	6.935	<0.05
	<10	51	32.69	15	29.41		
TLC	<11000	131	83.97	11	08.31	33.20	<0.001
	>11000	25	16.02	14	56.00		
Serum creatinine	<1.2	128	82.04	07	05.46		
	>1.2	28	17.94	18	64.28	33.20	<0.001
Serum albumin	>3	135	86.53	11	08.14		
	<3	21	13.46	14	66.66	24.99	<0.001

Table 8: Association of preoperative ASA grading with leak incidence.

ASA grade	Total no. of cases		Cases with leak		x^2 value	P value
	No.	%	No.	%		
I	54	34.61	06	11.11	7.1405	<0.01
II	84	53.84	11	13.09		
Total	138	88.46	17	12.31		
III	12	07.69	05	41.66		
IV	06	03.89	03	50.00		
V	-	-	-	-		
Total	18	11.53	08	44.44		

Table 9: Duration of surgery and mortality rate.

Duration		Total no. of cases		Cases with leak		x^2 value	P value
		No.	%	No.	%		
	<2 hr	37	23.71	05	02.70	5.5036	<0.01
<4 hr	2-4 hr	98	62.82	12	12.24		
	Total	135	86.53	17	12.59		
>4 hr		21	13.46	08	38.09		
Mortality rate after surgery							
Result							
Survived		142	91.02	16	11.26	14.187	<0.001
Expired		14	08.97	09	64.26		

Table 10 (A): Variable of group I & II with p<0.05 after univariate analysis by using Chi-square (x^2) test with continuity correction.

Variable versus cases with leak	P value
Age	-
Male sex	>0.05
Low socioeconomic status	>0.05
Obstruction	<0.05
Peritonitis	<0.05
Associated chronic diseases	>0.10
Corticosteroid therapy	<0.001
Hematocrit (<30%)	<0.05
S. Albumin (<3.0 gm/dl)	<0.001
TLC (> 11,000/cu.mm)	<0.001
Serum creatinine > 1.2 mg/dl	<0.001
ASA status	<0.01
Blood transfusion >2 units	<0.05
Emergency surgery	>0.05
TPN given (4 days)	>0.50
Estimated blood loss (>1000 ml)	>0.05
Site of anastomosis	>0.05
Suture technique	>0.05
Duration of surgery (>4 hours)	<0.01
Experience of the surgeon (>15 years)	<0.02

Table 10 (B): Significant variables after multivariate analysis with forwarding stepwise logistic regression tests (n=156).

Variables	Cases with leak		Total cases		Odds ratio	P value
	No.	%	No.	%		
Peritonitis (+)	13	25.00	52	33.30	2.166	-0.05
Peritonitis (-)	12	11.52	104	66.66		
Bowel obstructions(+)	16	26.66	60	41.00	2.844	0.05
Bowel obstructions (-)	09	09.37	96	60.20		
Blood transfusion >2u (+)	07	33.33	22	14.10	2.354	<0.05
Blood transfusion >2u (-)	18	13.43	134	85.90		
S. Albumin <3.0 gm/di (+)	14	66.66	21	13.46	8.873	<0.001
S. Albumin <3.0 gm/dl (-)	11	08.14	135	86.53		
Corticosteroid therapy (+)	18	66.66	54	34.61	4.857	<0.001
Corticosteroid therapy (-)	07	06.80	102	65.38		
S. Creatinine >1.2 mg/d1(+)	18	64.28	28	17.94	11.755	<0.001
S. Creatinine >1.2 mg/dl (-)	07	05.46	128	82.04		
Duration of Surg.(>4 H) (+)	08	38.09	21	13.46	3.0251	<0.1)1
Duration of Surg.(>4 Hrs) (-)	17	12.59	135	86.53		
ASA Grading (>II) (+)	08	44.44	18	11.53	3.607	<0.01
ASA Grading (>11) (-)	17	12.31	138	88.46		

52% leaks were reported in patients with chronic diseases. Leak rate was higher in cases associated with chronic diseases as malignancy; COPD, diabetes mellitus (22.80%) and chronic corticosteroid use (66.66%) ($p<0.001$), whereas in patients without any chronic disease leak rate was 12.12%. Leak rate was significantly high in malnourished patients and in cases having sepsis. High leak rates were associated with low hemoglobin level (<10 gm%) (29.41%), TLC >11000/cu.mm. (56%), low serum albumin levels (<3 gm/di) (66.66%) and increased serum creatinine (>1.2 mg/dl) (64.28%).

Increase in leak rate was seen with the increase in ASA grading (Table 10). Patients with grade I had 11.11% leak incidence whereas in grade IV patients leak rate was 50% ($p<0.01$). Patients with radiological findings suggestive of intestinal obstruction (66.66%), pleural effusion (41.66%) and pneumonitic patch (30%) are also found to be linked with high leak rates. Higher incidence of leakage rate was observed in cases in which emergency surgery was done (17.59%) and parenteral nutrition was not given (18.75%), colorectal anastomosis (26.66%) with double-layer technique (16.66%) was done or in those patients with more than one litre of blood loss happened either preoperatively or postoperatively (36.36%).

Out of the total 156 anastomoses done, the ileoileal anastomosis was done in 69 cases (44.23%), Jejunojejunal anastomosis in 19 patients (12.17%), Ileocolic anastomosis in 17 cases (10.89%), colocolic anastomosis in 36 cases (23.07%) and colorectal anastomosis in 15 (09.61%). Maximum no. of leaks were seen in colorectal anastomosis 4 (26.66%) whereas no significant difference was seen in rest of cases.

DISCUSSION

Despite the advancement in surgery anastomotic disruption is a feared and serious complication of intestinal surgery. The vast amount of research has identified factors favoring successful healing of anastomosis as well as risk factors for anastomotic disruption. In our study, a total of 156 patients were evaluated over a study period of 15 months.

The incidence of leakage was relatively higher in this study (16%) with the highest incidence rate was reported in (23.07%) 51- 60 years of age group, followed by 0-10 yrs age group (18.18%). Similarly, Makela et al have shown that age does not affect the incidence of anastomotic leakage in patients.[6] The present study has also shown about three-fold higher hospital stay and increased morbidity inpatients suffering from anastomotic leakage.

In our study, the incidence of the leak was slightly higher in males but this result was not statistically significant ($p>0.05$). A similar observation was made in another study conducted in 2003 by Makela et al.[6] This result is in contrast with studies that have shown the male gender is an independent risk factor for developing a colonic anastomotic leak.[7,8] It may be because of the presence of multiple risk factors and more number of male patients in our study.

Patients with colorectal anastomosis (26.66%) had the maximum number of leaks. ($p>0.05$) and the majority of anastomosis (150) were constructed using a double layer, inverting technique (96.15%). out of these leaks occurred in 16.66%, and there was no statistically significant difference when comparing double layer with single layer technique (however; single layer technique was used only in 6 cases).

Previously studies have shown that low socioeconomic status adversely affects the prognosis as well as the final outcome after surgery. Patients who are from low socioeconomic status are generally malnourished, anemic, immunosuppressed and also more exposed to various infections and inflammatory conditions. All of these factors have an unfavorable effect on wound healing. [9] In the present study also approximately 2/3rd of the study population was from low socioeconomic status with Hb level less than 10 gm/dl (29.41%) ($p<0.05$). Choudhury et al have shown that hemoglobin level less than 8 gm/dl is independently associated with a higher incidence of anastomotic leakage.[10]

In addition, patients who were having signs of peritonitis, sepsis or obstruction in preoperative examination or at the time of admission, developed more leaks (28.45%) in comparison to those with normal vitals (13.15%). Golub et al reported a 16% anastomotic leak in the presence of infection, while 3% in cases where the infection was not present. Similarly, in this study, high TLC level was found to be associated with an increased occurrence of the leak (56%) ($p<0.001$).[11] In addition, uremia (s. creatinine >1.2 mg/dl), and decreased serum albumin level below 3.0 gm/dl was found to be an independent risk factor for anastomotic leak.

A considerably higher rate of leakage was reported in patients on corticosteroid therapy (66.66%, $p<0.001$). Eriksen et al have reported an increased anastomotic leak rate in patients receiving corticosteroid therapy.[12] The present study also revealed a high but not significant association of chronic diseases with anastomotic complications. About half of the total cases with leak were having associated chronic diseases including chronic obstructive pulmonary disease (30%) and malignancy. However, no significant association was observed with diabetes and anastomotic leakage.

Studies have shown that ASA grading more than III acts as an independent risk factor for the development of anastomotic leakage.[13] Similarly, in the present study maximum number of leaks was reported in patients with ASA grade IV (50%) and ASA grade III (41.66%). In addition, the incidence of anastomotic leak was higher in

patients who were operated in the emergency set up by less experienced surgeons. In our study, we found a consistent increase in the leak rate with the length of the surgery. However, no such significant association was found between excess blood loss and leakage (p>0.05).

In agreement with studies by Golub et al, Kim et al and Jannasch et al, this study have also shown that preoperative or intraoperative blood transfusion significantly increased the incidence of intestinal anastomotic leakage. Patients who received more than 2 units of whole blood intra-operatively had a high rate of anastomotic leakage (33.33%) (p<0.05).[11,13,14]

CONCLUSION

This study has pointed out several factors including malnourishment, malignancy, diabetes, steroids, and duration of surgery, blood transfusion, and experience of the surgeon that affects the incidence of anastomotic leakage. In addition, this study has also pointed out several predictors for anastomotic leakage and these predictors can be used for the reduction of the incidence of leakage in the future.

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REFERENCES

1. Phillips B. Reducing gastrointestinal anastomotic leak rates: review of challenges and solutions. Open Access Surg. 2016: 5-14.
2. Krarup PM, Nordholm-Carstensen A, Jorgensen LN, Harling H. Anastomotic leak increases distant recurrence and long-term mortality after curative resection for colonic cancer: a nationwide cohort study. Ann Surg. 2014;259:930-8.
3. Pickleman J, Watson W, Cunningham J, Fisher SG, Gamelli R. The failed gastrointestinal anastomosis: an inevitable catastrophe? J Am Coll Surg. 1999;188:473-82.
4. Rahbari NN. Definition and grading of anastomotic leakage following anterior resection of the rectum: a proposal by the International Study Group of Rectal Cancer. Surgery. 2010;147:339-51.
5. Bruce J, Krukowski ZH, Al-Khairy G, Russell EM, Park KG. Systematic review of the definition and measurement of anastomotic leak after gastrointestinal surgery. Br J Surg. 2001;88:1157-68.
6. Mäkelä JT, Kiviniemi H, Laitinen S. Risk Factors for Anastomotic Leakage After Left-Sided Colorectal Resection With Rectal Anastomosis. Dis Colon Rectum. 2003;46:653-60.
7. Zhou C, Wu X, Liu XH, Chen YF, Ke J, He XW, et al. Male gender is associated with an increased risk of anastomotic leak in rectal cancer patients after total mesorectal excision. Gastroenterol Rep. 2018;6:137-43.
8. Park JS, Huh JW, Park YA, Cho YB, Yun SH, Kim HC. Risk Factors of Anastomotic Leakage and Long-Term Survival After Colorectal Surgery. Medicine (Baltimore). 2016;95(8):e2890.
9. Daams F, Luyer M, Lange JF. Colorectal anastomotic leakage: aspects of prevention, detection and treatment. World J Gastroenterol. 2013;19:2293.
10. Choudhuri AH, Uppal R, Kumar M. Influence of non-surgical risk factors on anastomotic leakage after major gastrointestinal surgery: Audit from a tertiary care teaching institute. Int J Crit Illn Inj Sci. 2013;3:246-9.
11. Golub R, Golub RW, Cantu JR, Stein HD. A multivariate analysis of factors contributing to leakage of intestinal anastomoses. J Am Coll Surg. 1997;184:364-72.
12. Eriksen TF, Lassen CB, Gögenur I. Treatment with corticosteroids and the risk of anastomotic leakage following lower gastrointestinal surgery: a literature survey. Colorectal Dis. 2014;16:O154-O160.
13. Kim SH, Son SY, Park YS, Ahn SH, Park DJ, Kim HH. Risk Factors for Anastomotic Leakage: A Retrospective Cohort Study in a Single Gastric Surgical Unit. J Gastric Cancer. 2015;15:167-75.
14. Jannasch O, Klinge T, Otto R, Chiapponi C, Udelnow A, Lippert H, et al. Risk factors, short and long term outcome of anastomotic leaks in rectal cancer. Oncotarget. 2015;6:36884-93.

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