

Original Research Article

Factors affecting the outcome of intestinal anastomosis: a prospective study

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ABSTRACT

Background: Anastomotic leak is one of the most dreaded complications after intestinal anastomosis. The prevalence of anastomotic leak is 0.5%-30% in literature and resulting mortality rate is 10%-15%. Various risk factors are known to be associated with it. This study was undertaken with the aim to identify and evaluate these predisposing factors.

Methods: A prospective study was conducted from March 2019 to February 2020 at Teerthankar Mahaveer medical college and research centre, Moradabad. All patients undergoing hand-sewn gastro-intestinal anastomosis electively as well as in emergency were included in this study. The total number of cases studied were 80.

Results: Post-operative anastomotic leaks were present in 10% and associated mortality was 100%. Increasing age was associated with leakage ($p=0.02$) and 75% patients with leaks were male. The following were observed to be significant risk factors associated with anastomotic dehiscence: diabetes mellitus ($p=0.05$), pallor ($p=0.01$), low haemoglobin ($p=0.003$), altered TLC count ($p=0.008$) low serum protein ($p=0.001$), albumin ($p=0.001$) longer operative time ($p=0.02$). Other predisposing factors like serum creatinine, hyperbilirubinemia, elective/emergency surgeries, contamination of peritoneal cavity and time taken to perform the anastomosis were insignificant statistically.

Conclusions: This study identified and assessed the various risk factors associated with anastomotic leaks and found age, sex, anaemia, sepsis, hypoproteinemia, hypoalbuminemia, increased operative-time to be significant and we concluded that controlling these factors will help in minimizing the chances of anastomotic dehiscence.

Keywords: Anastomotic leak, Dehiscence, Intestinal anastomosis, Risk factors, Anaemia, Hypoalbuminemia

INTRODUCTION

Anastomotic leak is one of the most common and dreaded complications after the surgical procedure of intestinal anastomosis.¹ In intestinal anastomosis, we restore the continuity of two formerly distant segments of the intestine, re-establishing communication. The process also includes removal of a pathological segment of bowel. It is a frequently performed surgical procedure performed both electively and as an emergency.

Two of the most commonly used anastomotic techniques include: (A) Hand-sewn anastomosis and (B) Stapled the

anastomosis. The hand-sewn or suture anastomosis is the more commonly used choice because of the availability and cost-effectiveness of suture materials and familiarity with procedure. On the other hand, stapling devices provide the advantage of saving time especially in cases requiring multiple anastomosis, with the drawbacks of being expensive, dependence on technology as compared to the surgeons own skills and limited availability, decreasing its usage.^{2,3}

The prevalence of anastomotic leak is 0.5% to 30% in literature but is generally seen to be between 2% and 5%. It occurs usually between the 3rd to 6th post-operative day.

A high index of suspicion should arise when patient has fever, abdominal pain, prolonged ileus, failure to thrive and leucocytosis, though the type of presentation depends widely on the location and magnitude of leak and if the adjacent structures are affected. In severe conditions, the patient may present with sepsis, peritonitis and/or hemodynamic instability.⁴ The resulting mortality rate associated with as mentioned in literature is between 10%-15%.⁵

The fundamental principles for a successful anastomosis include, the adequate exposure and access, good vascularity of both stump, no faecal contamination, proper application of suture and stapler and approximation of all layers of bowel wall in the absence of tension and distal obstruction.^{3,6,7} Breach in these principles results in breakdown or disruption of the suture line at the anastomotic site leading to septic complications, peritonitis and faecal fistula formation, dangers which were recognized by Travers, Lembert and Halsted more than a 100 years ago and laid down the basic principles of intestinal anastomosis.^{6,8,9} In addition to the above, with advanced knowledge of gastrointestinal healing, other common risk factors like nutrition of the patient, anaemia, hypoalbuminemia, smoking, alcohol abuse, high dose steroids, preoperative chemotherapy are also found to be the associated with anastomotic leak.¹⁰⁻¹²

These facts illustrate the significant morbidity caused by anastomotic leakage. This research was therefore planned to evaluate the factors that influence healing of intestinal anastomosis.

Aim and objectives of the study

Aim of the study was to evaluate the factors affecting intestinal anastomosis. The objectives were to identify and evaluate the risk factors affecting anastomotic leak and its outcome.

METHODS

A prospective study was conducted from March 2019 till the end of February 2020 at Teerthankar Mahaveer medical college and research centre, Moradabad. All patients undergoing hand-sewn gastro-intestinal anastomosis electively as well as those as an emergency procedure were included in this study. The total number of cases studied were 80. Statistical analysis was done using SPSS version 20.0 and p values were calculated using Chi-square test and unpaired t test.

Inclusion criteria

Inclusion criteria included patients with age 18-75 years. All patients requiring resection and primary anastomosis of the intestine or loop ileostomy or loop colostomy reversal done with complete stomal dismantling.

Exclusion criteria

Exclusion criteria of the study excluded patients with intestinal stoma proximal to anastomotic site, patients who underwent intestinal anastomosis at multiple sites and patients with carcinoma.

In this study, the two-layer hand-sewn anastomotic technique was done in laparotomies in which the cut ends of the bowel were anastomosed using a running vicryl suture for the inner transmural layer and an interrupted silk for the outer seromuscular layer.

All patients who underwent elective surgery and emergency surgery had pre-operative had all pre-operative investigations done which included CBC, KFT, LFT, chest X-ray, X-ray abdomen-erect and supine, and Electrocardiogram. Further cardiac work up was done if deemed necessary. Ultrasonography, endoscopy, CT scan, MRI, tissue biopsy, etc. were done preoperatively based on the needs of an individual patient.

In elective cases, preoperative bowel preparation was done. Pre-operative antibiotic was given in all patients. Similar postoperative blood investigations were employed based on the needs of an individual patient. Postoperative abdominal ultrasonography was done in patients with suspicious distension, leak detected in drain, prolonged ileus, etc. Other postoperative complications, such as pneumonia, were investigated if suspected. Biopsy reports of the histopathological examination of specimens were collected.

RESULTS

Over a period of 1 year, 80 patients who underwent hand-sewn intestinal anastomosis were included in this study, of which 44 were done electively, and 36 were done on emergency basis. All the patients had only one anastomosis performed. The mean age of the patients operated upon in the present study was 38.66 ± 13.96 years (ranging from 18-72 years) which included 60 male patients (75%) and 20 female patients (25%) (Table 1). The most common diagnosis was ileostomy reversal (51%) followed by Ileal perforations (24%) secondary to various causes and small and large bowel obstructions (15%) while the most frequent site of anastomosis was ileo-ileal (77.5%) followed by ileo-transverse (16%).

In this study, post-operative leaks occurred in 8 patients (10%) and they were detected by altered drain content or wound inspection along with clinical symptoms and signs of peritonitis. The mean age of the patients with anastomotic leak was 48.5 ± 14.19 years and mean day at which leak occurred was 6.17 ± 2.32 days. The rate of leaks according to anastomotic site is represented in Table 4. Out of the 8 cases in which leaks occurred, 2 were managed conservatively and 6 were re-explored but mortality was 100% in case of leaks in the present study. It was observed that leak occurred highest in the age

groups of 41-50 years and 61-70 years age group (37.5% each) and association with age was found statistically significant ($p=0.02$). The number male patients (75%) with leak were more than their female counterparts (25%) but statistically, no significant difference among the sexes was found (Table 2). The average hospital stays of the patients excluding the ones with anastomotic leak was 17.43 days while the mean for those who suffered leaks was 19 days and median was 15.5 days.

Table 1: General patient characteristics, (n=80).

Variables	Overall
Age (years)	
Mean \pm SD	38.66 \pm 13.96
Median	37.5
Range	18-72
Gender (%)	
Male	60 (75)
Female	20 (25)
Comorbidities (%)	
Diabetes	17 (21.25)
Hypertension	16 (20)
Tuberculosis	3 (3.75)
Type of surgery (%)	
Elective	44 (55)
Emergency	36 (45)

It was seen that in patients with leaks, the co-morbidity of diabetes mellitus (50% having leaks were diabetic) was statistically significant ($p=0.05$) but hypertension was not. Patients with leak who had pallor and low haemoglobin were 62.5 and 100% respectively, and both were statistically significant ($p=0.01$ and 0.003 , respectively). 50% of patients having leak presented with pedal oedema, likely due to associated hypoproteinemia as cardiac work-up was negative, and was found to be statistically relevant ($p=0.001$). Also, anastomotic leak

was found to be associated with statistically with hypoproteinemia and hypoalbuminemia ($p=0.001$ each) and altered TLC (62.5%, $p=0.008$) (Table 3). Longer duration of surgery (Table 4) was found associated significantly with dehiscence of anastomosis ($p=0.02$).

Table 2: General risk factors.

Risk factors	Leak present		Leak absent		P value
	N	%	N	%	
Age (years)					
<20	0	0	6	8.3	0.02*
21-30	1	12.5	21	29.2	
31-40	1	12.5	17	23.6	
41-50	3	37.5	15	20.8	
51-60	0	0	9	12.5	
61-70	3	37.5	3	4.2	
>70	0.0	0	1	1.4	
Mean \pm SD	48.5 \pm 14.19		37.57 \pm 13.6		
Gender					
Male	6	75.0	54	75.0	0.64
Female	2	25.0	18	25.0	
Diabetes mellitus					
Yes	4	50.0	13	18.1	0.05*
No	4	50.0	59	81.9	
Hypertension					
Yes	2	25.0	13	18.1	0.45
No	6	75.0	59	81.9	

Association of high leak rates was suggested with serum creatinine >1.2 g/dl (62.5%), and emergency surgeries (75%), and prolonged time taken to perform the anastomosis (87.5%) as shown in Tables 3 and 4 but there was no significant difference found statistically in these and other risk factors like hyperbilirubinemia and contamination of peritoneal cavity.

Table 3: Clinical and biochemical risk factors.

Risk factors	Leak present		Leak absent		P value
	N	%	N	%	
Pallor					
Yes	5	62.5	13	18.1	0.01*
No	3	37.5	59	81.9	
Pedal edema					
Yes	4	50.0	1	1.4	0.001***
No	4	50.0	71	98.6	
Haemoglobin (g/dl)					
<12	8	100.0	32	44.4	0.003**
>12	0	0	40	55.6	
Mean \pm SD	9.14 \pm 0.92		11.76 \pm 2.04		
Creatinine (mg/dl)					
≤ 1.2	3	37.5	48	66.7	0.10
>1.	5	62.5	24	33.3	
Total leucocyte count (cubic mm)					0.008**
4000-11,000	3	37.5	43	59.7	0.008**
<4,000 and >11,000	5	62.5	29	40.3	
Mean \pm SD	9885 \pm 4631		9645 \pm 3254		

Continued.

Risk factors	Leak present		Leak absent		P value
	N	%	N	%	
Total protein (g/dl)					
6-8 (Normal)	1	12.5	59	81.9	0.001***
<6 (Abnormal)	7	87.5	13	18.1	
Mean±SD	5.19±0.83		6.5±0.71		
Albumin levels (g/dl)					
≥3 (Normal)	1	12.5	69	95.8	0.001***
<3 (Abnormal)	7	87.5	3	4.2	
Mean±SD	2.66±0.44		3.74±0.5		

Table 4: Surgery related risk factors.

Risk factors	Leak present		Leak absent		P value
	N	%	N	%	
Elective O. T.					
Yes	2	25.0	42	58.3	0.07
No	6	75.0	30	41.7	
Emergency O. T.					
Yes	6	75.0	30	45.8	0.07
No	2	25.0	42	54.2	
Site of anastomosis					
Ileo-Ileal	5	62.5	57	79.2	0.56
Ileo-Jejunal	0	0	2	2.8	
Ileo-Transverse colon	3	37.5	9	12.5	
Colo-Colic	0	0	1	1.4	
Ileo-Descending colon end to side	0	0	1	1.4	
Jejuno-Jejunal	0	0	2	2.8	
Contamination of peritoneal cavity					
Present	5	62.5	25	34.7	0.12
Absent	3	37.5	47	65.3	
Duration of surgery (hours)					
≤2.5	0	0	29	40.3	0.02*
>2.5	8	100	43	59.7	
Mean±SD	3.31±0.35		2.84±0.55		
Time for anastomosis (min)					
≤30	1	12.5	28	38.9	0.13
>30	7	87.5	44	61.1	
Mean±SD	37.25±5.5		31.35±6.16		
Mortality					
Present	8	100	0	0	0.001***
Absent	0	0	72	100	
Length of hospital stay (days)					
<15	3	37.5	15	20.8	0.75
15-30	4	50.0	56	77.8	
>30	1	12.5	1	1.4	
Mean±SD, median	19±13, 15.5		17.4±3.1, 17		

DISCUSSION

Despite performing a technically effective surgery by an experienced surgeon, the healing of the intestinal anastomosis is a challenge due to the multiple factors that play a role in the healing process. Only hand sewn anastomosis was performed in laparotomies as our institution did not have the technology and expertise of stapler anastomosis. In our study we have attempted to evaluate the many risk factors of intestinal anastomosis.

In this study we found that the 10% of the total patients undergoing anastomosis were complicated by anastomotic leakage with a mortality of 100% in the group with leaks (8 out of 8). 2.7% patients suffered leaks in a study by Hyman et al in 2007 and 4% in a study by Saha et al with a mortality rate of 61.5%.^{5,10} In other researches published by Luján et al and Trencheva et al, they found that the incidence of leaks was 3.8% and 5.7%, respectively, and associated mortality was 13.3%

and 5.7%.^{5,12,13} Mortality was statistically significant in our study ($p=0.001$).

The mean age of patients with anastomotic leak in this study was 48.5 ± 14.2 years and median was 46 compared to other studies such as, Hyman et al, Luján et al and Turrentine et al that documented a mean of 59.1 years, 64.2 ± 18.7 years and median age of 59 years, respectively.^{5,12,14} Also, Irvin et al defined a relationship between dehiscence of anastomosis and age and said that there was significantly higher incidence of the same in patients >60 years.¹⁵ Age was a statistically significant risk factor in our study ($p=0.02$). Maximum number of cases with leakage in our study were males (75%) which corresponded with studies by Hyman et al, Trencheva et al, Turrentine et al, where males were 51.5%, 68.6%, 51.4%, respectively. But gender was not a statistically significant variable in our study which was similar to data shown by some studies and differed from that shown by others.^{5,13,14}

Diabetes has been shown to be an independent risk factor in research done by Vignali et al which corresponded with our data which showed diabetes to be a statistically significant factor ($p=0.05$), while Hypertension was found to be insignificant.¹⁶ Cooke et al observed that overall pre-operative comorbidities which included diabetes and hypertension were found to be significant ($p=0.008$). A study in 2014 by Turrentine et al concluded that hypertension was not a relevant risk factor.^{14,7}

This study showed that in patients with dehiscence of anastomosis, patients had significantly low haemoglobin (100% of the patients had anaemia) with a mean of 9.14 ± 0.92 g/dl and that this was a significant risk factor statistically ($p=0.003$). In studies by Saha et al, Hayden et al and Farghaly et al, they concluded that low haemoglobin <11 g/dl, <11 g/dl and <9 g/dl, respectively have an increased incidence of leak with the likely explanation that it results in decreased transportation of oxygen to the tissues and the resulting risk of ischemia.^{10,18,19}

Sepsis denoted by leucocytosis or leukopenia was also associated with leeway of anastomotic integrity (62.5%) in our study and this was significant statistically but peritoneal cavity contamination found at the time of surgery was present in 62.5% patients with leaks and was found to be insignificant. Sakr et al, Jina et al concluded that pre-operative sepsis was a predisposing factor statistically significant for leakage but Turrentine et al reported it to be insignificant.^{14,20,21} Also, Irvin et al concluded that intra-abdominal sepsis did not show any contribution to anastomotic complications.¹⁵

Serum protein and albumin were found to be considerably low in patients with anastomotic leak (87.5%) in this study with mean values of 5.18 ± 0.82 mg/dl and 2.66 ± 0.44 mg/dl and were statistically significant ($p=0.001$ each). Irvin and Goligher et al,

Yamamoto et al and Mäkelä et al found that hypoproteinemia and hypoalbuminemia were significant risk factors for the anastomotic dehiscence.^{15,22,23} Also, in our study, patients with pre-operative pedal oedema (6.25%) underwent cardiac evaluation which was negative and it was concluded that the oedema was likely secondary to hypoproteinemia. 50% patients with pedal oedema were found to have leak and this was statistically significant ($p=0.001$). This supported the fact that low protein and albumin had a detrimental effect on tissue healing and the integrity of anastomosis.

Analysis of our study showed that the duration of surgery was critically significant with the anastomotic complication of leakage, with all leaks occurring in surgeries which lasted greater than 2.5 hours. The mean time was 199 ± 21 minutes. This was statistically significant ($p=0.02$). Buchs et al, Choi et al, Kawada et al and Silva-Velazco et al arrived at the conclusion that increasing operative time was a consequential factor to anastomotic dehiscence.²⁴⁻²⁷ But the prolonged time of anastomosis in regard to poor anastomotic sequelae was statistically insignificant in our study though majority of leaks occurred when the time taken to complete anastomosis was prolonged more than 30 minutes (87.5%). Also, in this study maximum leaks were reported in small bowel ileo-ileal anastomosis (62.5%) followed by ileo-transverse anastomosis (37.5%) but this was not significant.

Certain factors limited our study like its small sample size, lack of diversity in data regarding various techniques of anastomosis, and the varying results with individual surgeons, as these factors would provide us with more in-depth analysis.

CONCLUSION

This study illustrates anastomotic dehiscence to be responsible for increased morbidity and mortality. It also demonstrates that leakage from anastomotic site is associated with decreased survival, increased hospital stays and an obvious increase in health care-related financial burden. With knowledge of the various risk factors one can pay more attention pre- and post-operatively and take measures to reduce gastro-intestinal anastomotic leaks, thus potentially improving the outcome.

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