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A prospective observational study of factors affecting the outcome of intestinal anastomosis

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Abstract

Introduction: Intestines form a major part of human digestive system. Both in terms of length as well as surface area, the small and large intestines constitute about 90% of the digestive system. They play a major role in absorption of nutrients, water and other micro nutrients. Thus they play a major role in growth and proper functioning of the human body. Any pathological condition of the bowel leads to disturbance in the homeostasis of the human body. **Materials and Methods:** A prospective study was conducted from March 2019 to February 2020 at Department of General Surgery, Shivamogga Institute of Medical Sciences, Shivamogga, India. 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 160. Statistical analysis was done using SPSS version 20.0 and p values were calculated using Chi-square test and unpaired t test. **Results:** Over a period of 1 year, 160 patients who underwent hand-sewn intestinal anastomosis were included in this study, of which 88 were done electively, and 72 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 120 male patients (75%) and 40 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%). **Conclusion:** 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.

Key Words: Homeostasis, anastomosis, Ileal perforations, ileo-ileal, by ileo-transverse.

Introduction

Intestines form a major part of human digestive system. Both in terms of length as well as surface area, the small and large intestines constitute about 90% of the digestive system. They play a major role in absorption of nutrients, water and other micro nutrients. Thus they play a major role in growth and proper functioning of the human body. Any pathological condition of the bowel leads to disturbance in the homeostasis of the human body[1].

Timely intervention and correction of the pathologies affecting the bowel is of utmost importance in providing a healthy functional life to the patient[2].One of the most common surgeries done on the intestines is resection and anastomosis. It is the surgical procedure of removing the diseased portion of the bowel and joining the normal viable disease free bowel ends[3]. History of bowel anastomosis goes back to early 17th and 18th century. Galen was the first person to coin the term "Anastomosis". From the 17th century to the modern times intestinal resection and anastomosis remains one of the most common yet very challenging

surgeries the surgeon faces. This is the significance of the following study[4].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[5].

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.

Materials and methods

Study design

Prospective study

Study Duration

March 2019 to February 2020 (1 year).

Study Location

Department of General Surgery, Shivamogga Institute of Medical Sciences, Shivamogga, India.

A prospective study was conducted from March 2019 till the end of February 2020 at Department of General Surgery, Shivamogga Institute of Medical Sciences, Shivamogga, India. 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 160. Statistical analysis was done using SPSS version 20.0 and p values were calculated using Chi-square test and unpaired t test.

Inclusion criteria

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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, 160 patients who underwent hand-sewn intestinal anastomosis were included in this study, of which 88 were done electively, and 72 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 120 male patients (75%) and 40 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 16 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 16 cases in which leaks occurred, 4 were managed conservatively and 12 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: Patient Characteristics

Variables	Overall
Age (years)	
Mean±SD	38.78±13.99
Median	37.5
Range	18-72
Gender (%)	
Male	120 (75)
Female	40 (25)
Comorbidities (%)	
Diabetes	34 (21.25)
Hypertension	32 (20)
Tuberculosis	6 (3.75)
Type of surgery (%)	
Elective	88 (55)
Emergency	72 (45)

Table 2: General risk factors

Risk factors	Leak present N	Leak present %	Leak absent N	Leak absent %	P Value
Age (years)					
<20	0	0	12	8.3	
21-30	2	12.5	42	29.2	
31-40	2	12.5	34	23.6	
41-50	6	37.5	30	20.8	0.02
51-60	0	0	18	12.5	
61-70	6	37.5	6	4.2	
>70	0	0	2	1.4	
Mean ± SD	48.5±14.19		37.57±13.6		
Gender					
Male	12	75.0	108	75.0	
Female	4	25.0	36	25.0	0.64
Diabetes Mellitus					
Yes	8	50.0	26	18.1	
No	8	50.0	118	81.9	0.05
Hypertension					
Yes	4	25.0	26	18.1	0.45
No	12	75.0	118	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	10	62.5	26	18.1	0.01
No	6	37.5	118	81.9	
Pedal edema					
Yes	8	50.0	2	1.4	
No	8	50.0	142	98.6	0.001
Haemoglobin (g/dl)					
<12	16	100.0	64	44.4	
>12	0	0	80	55.6	0.03
Mean±SD	9.14±0.92		11.76±2.04		
Creatinine (mg/dl)					
≤1.2	6	37.5	96	66.7	0.10
>1	10	62.5	48	33.3	
Total leucocyte count (cubic mm)					
4000-11,000	6	37.5	86	59.7	
<4,000 and >11,000	10	62.5	58	40.3	0.008
Mean±SD	9885±4631		9645±3254		
Total protein (g/dl)					
6-8 (Normal)	2	12.5	118	81.9	
<6 (Abnormal)	14	87.5	26	18.1	0.001
Mean±SD	5.19±0.83		6.5±0.71		
Albumin levels (g/dl)					
≥3 (Normal)	2	12.5	138	95.8	
<3 (Abnormal)	14	87.5	6	4.2	0.001
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	4	25.0	84	58.3	**0.07**
No	12	5.0	60	41.7	
Emergency O. T.					
Yes	12	75.0	60	45.8	0.07
No	4	25.0	84	54.2	
Site of anastomosis					
Ileo-Ileal	10	62.5	114	79.2	
Ileo-Jejunal	0	0	4	2.8	
Ileo-Transverse colon	6	37.5	18	12.5	0.56
Colo-Colic	0	0	2	1.4	
Ileo-Descending colon end to side	0	0	2	1.4	
Jejuno-Jejunal	0	0	4	2.8	
Contamination of peritoneal cavity					
Present	10	62.5	50	34.7	
Absent	6	37.5	96	65.3	0.12
Duration of surgery (hours)					
≤2.5	0	0	56	38.9	
>2.5	14	87.5	88	61.1	0.02
Mean±SD	3.31±0.35		2.84±0.55		
Time for anastomosis (min)					
≤30	2	12.5	56	38.9	0.13
>30	14	87.5	88	61.1	
Mean±SD	37.25±5.5		31.35±6.16		
Mortality					
Present	16	100	0	0	0.001
Absent	0	0	72	100	
Length of hospital stay (days)					
<15	6	37.5	30	20.8	
15-30	8	50.0	112	77.8	0.75
>30	2	12.5	2	1.4	
Mean±SD, median	19±13, 15.5		17.4±3.1, 17		

Discussion

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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%. 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)[6].

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. 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[7]. 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[8].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. 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[9].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. 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[10].

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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