A STUDY OF RISK FACTORS INFLUENCING ANASTOMOTIC LEAKAGE AFTER SMALL BOWEL ANASTOMOSIS

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ABSTRACT

BACKGROUND

Anastomotic leak is an important cause of postoperative morbidity and mortality in patients who have undergone bowel anastomosis. The aim of the study is to know about the significance of various factors influencing anastomotic leak.

MATERIALS AND METHODS

A total of 68 patients who underwent small bowel anastomosis in our study period were followed up and grouped according to the occurrence of anastomotic leak into leak and non-leak groups. The common factors between the two groups were compared to know the significance of each factor in anastomotic leakage.

RESULTS

It has been found out that ASA Score ≥3, low serum total protein, low serum albumin, low haemoglobin, severe peritoneal contamination, perioperative fall in blood pressure and high mean duration of surgery were significantly associated with the occurrence of anastomotic leakage.

CONCLUSION

Adequate attention should be paid to the various preoperative, intraoperative and postoperative factors which influence anastomotic leakage in small bowel anastomosis in order to keep the morbidity and mortality to a bare minimum.

KEYWORDS

Anastomosis, Anastomotic Leak, Anastomotic Dehiscence, Bowel, Peritoneal Contamination, Perforation, Gangrene, Malignancy, Intestinal Obstruction.

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BACKGROUND

Anastomotic leaks are an important and common cause of morbidity and mortality in patients undergoing bowel surgeries. Errors in surgical techniques have been incriminated in cause of such leaks, but studies have found out various other causes, including many that are beyond the immediate control of operating personnel. The healing process in the intestinal tract is rapid when devoid of complications. In cutaneous healing, the healing process can be observed daily on inspection and early intervention could be done wherever necessary. But in intestinal anastomotic site, where it cannot be inspected, it poses a big challenge to the surgeon to judge the success of surgery by assessing patient's parameters of general wellbeing. Due to the same reason, complications necessitate re-exploration, which is associated with morbidity and mortality. Hence, every surgeon has to be aware of all preoperative, intraoperative and postoperative factors influencing anastomotic healing which compromise the healing process. In our institution, we deal with a lot of bowel surgeries. Resection anastomosis is commonly done because of the majority of emergency cases. We have observed that a number of these cases develop anastomotic leaks even in experienced hands. It is therefore evident that factors other than technical aspects should be considered. Knowledge of such factors and awareness of their relative contribution to the occurrence of leaks can help the surgeon to adopt measures which would help in bringing down the incidence of the problem. We analyse factors which contribute to anastomotic leaks in our institution in this study, in order to improve the management of patients undergoing bowel surgeries which in turn will improve the outcome of the operated patients.

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Aims and Objectives

1. To ascertain the contribution of anastomotic leakage to postoperative morbidity and mortality in patients undergoing small bowel surgery.
2. To identify patients who will be at higher risk of anastomotic leak following small bowel surgery.

3. To identify the relative importance of various risk factors contributing to anastomotic leak following small bowel intestinal surgery.
4. To recommend management strategies for prevention of anastomotic leak in high risk groups.

MATERIALS AND METHODS

This prospective analytical study was conducted in the Department of General Surgery, Madurai Medical College and Hospital from June 2014 to August 2015.

Inclusion Criteria

All patients above the age of twelve years undergoing bowel anastomosis in the study period were analysed and followed up until their discharge from hospital or death.

These patients were ultimately divided into two groups-
Group 1: Patients undergoing bowel surgery without anastomotic leak.
Group 2: Patients undergoing bowel surgery with subsequent anastomotic leak.

Our Exclusion Criteria Included

1. Duodenal surgery.
2. Anastomosis between small bowel and stomach or biliary tract.
3. Feeding jejunostomies.
4. Death of patient within 28 days of admission due to causes other than suture line disruption.

Detection of suture line disruption was based on the following-

1. Demonstration by re-laparotomy.
2. Demonstration by dye or contrast studies.
3. Efflux of bowel contents from wound or drain site.
4. Demonstration of any localised collection of bowel contents in the abdominal cavity by ultrasonography or CT-guided aspiration.

METHODOLOGY

The patients in the study were initially interviewed with specific regard to certain factors known to be of importance in the aetiology of disruption. These included age, sex and duration of symptoms before presentation to hospital (in emergency cases). The use of tobacco, alcohol and steroid medications if any was noted, and the presence of chronic obstructive pulmonary disease (COPD), diabetes mellitus and systemic hypertension was looked for. The attending surgeon's preoperative diagnosis was also noted as per the patient's record. The vital parameters of each patient viz pulse rate, blood pressure, and respiratory rate were recorded at admission. Laboratory data obtained in each patient included haemoglobin, serum total protein, serum albumin, urea, creatinine and serum electrolytes. Blood was sent for culture and sensitivity for further antibiotic treatment. Intraoperative variables studied included the presence of gross peritoneal contamination, the nature of peritoneal contaminant, the site of pathology in small bowel, the vascular supply at the region of surgical closure, presence of any distal obstruction. The amount and nature of intraoperative fluids given, the presence of any adverse intraoperative haemodynamic event, and intraoperative diagnosis was noted. Postoperatively, several factors were taken into account such as use of vasopressor support, ventilator support, antibiotics used, use of steroids and time of starting oral fluids. All data were recorded using structured proforma (appendix 1). The end of the study was the time of discharge of the patient from hospital or at the time of the patient's death. Patients who had anastomotic leak (test) were compared with patients whose anastomosis which did not leak (control). Results were tabulated and the statistical analysis was done using Chi square test.

OBSERVATION AND RESULTS

This study was conducted over a period of 15 months, from June 2014 to August 2015. A total of 68 patients were included in the study, the majority of them being emergencies (80.9%). As per the inclusion criteria, all enteroenteric and enterocolic anastomoses were analysed for the factors that could predispose to anastomotic leakage. Of the 68 patients, 46 were male and 22 were female, out of which 55 cases were operated on emergency basis and 13 were operated as elective cases. Among the 68 cases, 6 patients had Chronic Obstructive Pulmonary Disease, 17 patients had Diabetic Mellitus and 33 patients were found to have Hypertension. There were 29 alcoholics and 33 smokers. There were 52 small-to-small bowel anastomoses and 16 small-to-large bowel anastomosis among 9 in former and 4 in the later (leaked). All anastomoses were hand sewn and constructed in two layers using 3-0 Vicryl for inner layer (interrupted or continuous) and 3-0 silk for outer interrupted seromuscular layer. In this study, there were totally 13 anastomotic leaks among the 68 (19.1%) cases. Among the 13 cases of anastomotic leak, five patients were managed conservatively and eight patients had undergone re-laparotomy, in which seven patients of the latter had undergone surgical exteriorisation of the leak site and the remaining one patient had undergone re-anastomosis. There were totally four deaths in our study, and all of them belonged to the leak group.

Patient Variables

Variables	Leak	No Leak	P value
Age	49.92 ± 12.	44.34 ± 14.27	0.59
Duration of Symptoms	47.3 ± 26.3	25.43 ± 26.1	0.092

Table 1. Age Distribution

Variables	Leak	No Leak	P value
Male	7	39	0.24
Female	6	16	

Table 2. Gender Distribution

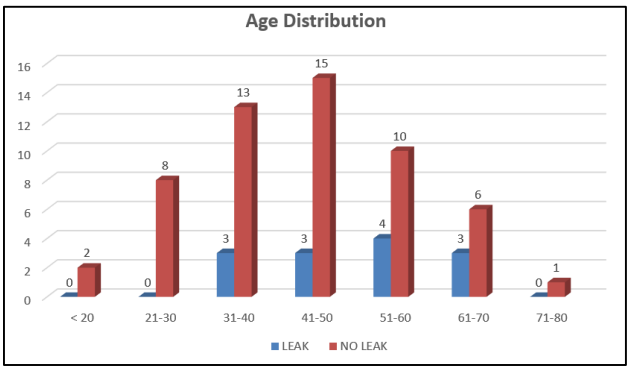

Figure 1. Age Distribution

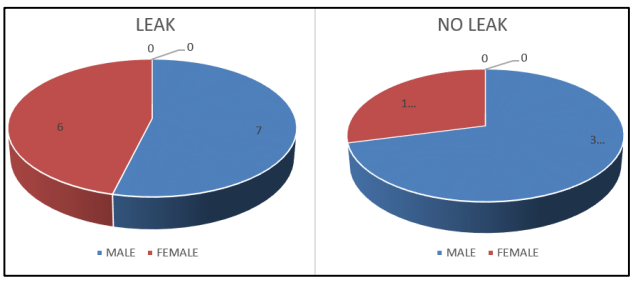

Figure 2. Gender Distribution

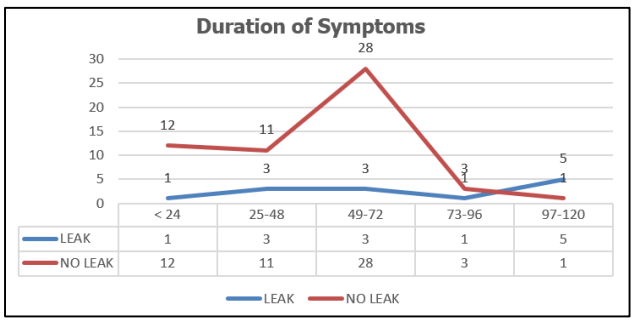

Figure 3. Duration of Symptoms

Variables	Leak	No leak	P value
Hypertension	9/13	26/55	0.15
Diabetes Mellitus	4/13	13/55	0.59
COPD	1/13	5/55	0.87
Smoking	5/13	26/55	0.56
Alcoholism	8/13	31/55	0.73

Table 3. Comorbid Factors

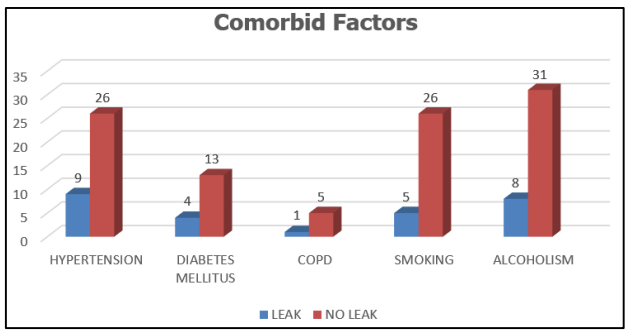

Figure 4. Comorbid Factors

Variables	Leak	No leak	P value
ASA < 3	5	42	0.08
ASA ≥ 3	8	13	
Total	**13**	**55**	

Table 4. ASA Grading

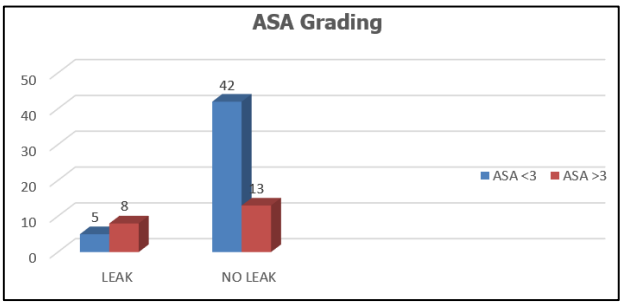

Figure 5. ASA Grading

Variables	Leak	No leak	P value
Haemoglobin (g/dL)	9.9±1.4	11.32±0.9	0.001
Serum total (g/dL)	4.98±0.32	5.3±0.39	0.006
Serum albumin (g/dL)	2.9±0.42	3.23±0.29	0.002

Table 5. Haematological and Biochemical Parameters

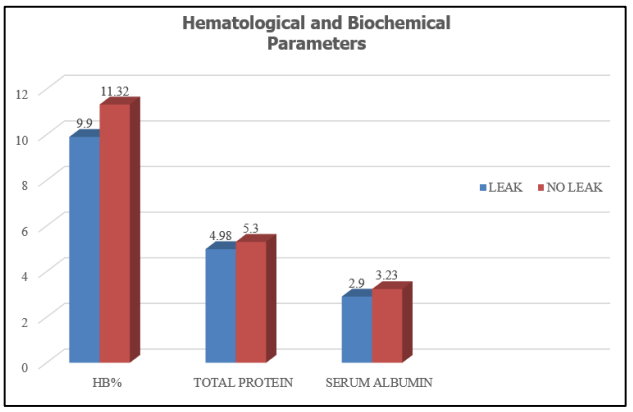

Figure 6. Haematological and Biochemical Parameters

Variables	Leak	No leak	P value
Yes	1	12	0.25
No	12	43	

Table 6. Bowel Preparation

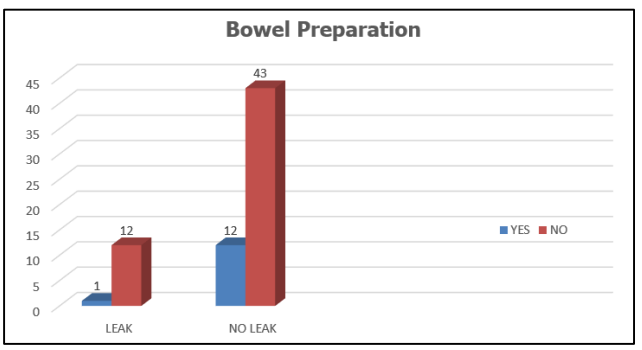

Figure 7. Bowel Preparation

Diagnosis	Leak	No leak	Total
Obstruction	4	17	21
Gangrene	1	15	16
Perforation	7	11	18
Malignancy	1	12	13
Total	**13**	**55**	**68**

Table 7. Indication for Bowel Surgery

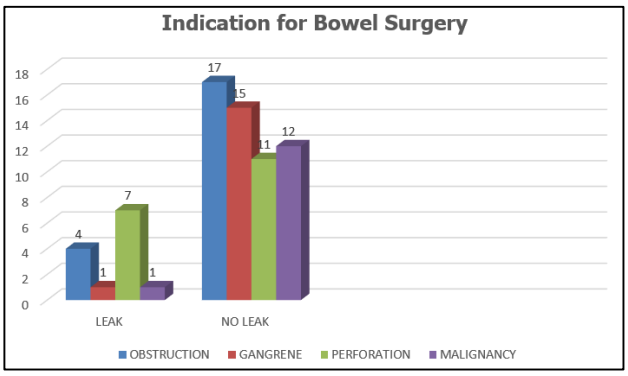

Figure 8. Indication for Bowel Surgery

Variables	Leak	No leak	P value
Duration of Surgery	167.69±16.9	144±20.61	0.003
Peritoneal Contamination	9/13	17/55	0.025

Table 8. Intraoperative Variables

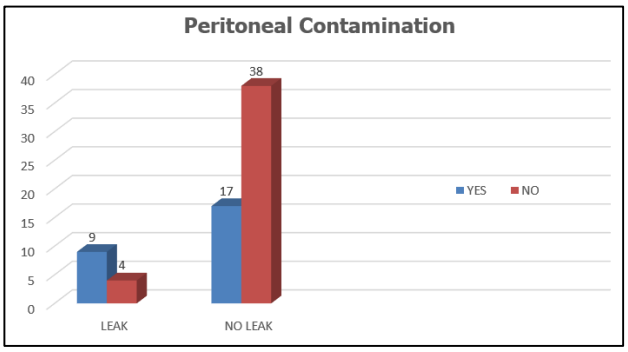

Figure 9. Peritoneal Contamination

Variables	Leak	No leak	Total
Ileocolic	4	12	16
Ileoileal	7	33	40
Jejuno-jejunal	2	10	12
Total	**13**	**55**	**68**

Table 9. Level of Anastomosis

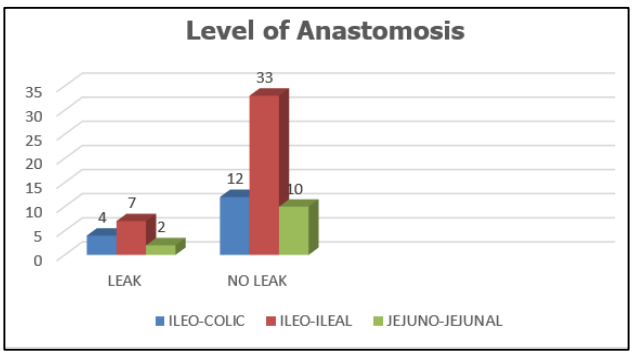

Figure 10. Level of Anastomosis

Variables	Leak	No leak	P value
End-to-end anastomosis	9	43	0.49
End-to-side anastomosis	4	12	
Total	**13**	**55**	

Table 10. Type of Anastomosis

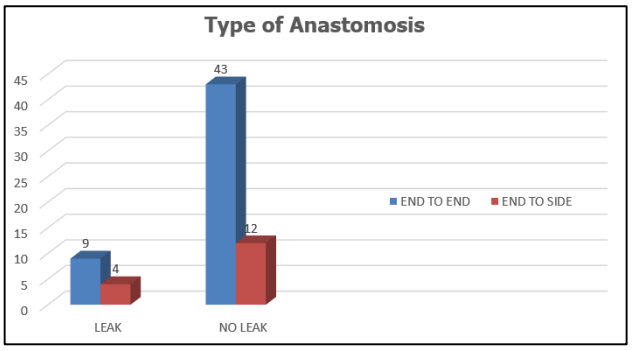

Figure 11. Type of Anastomosis

Variables	Leak	No leak	P value
Yes	8	1	9
No	5	54	59
P value	0.00		

Table 11. Intraoperative Hypotension

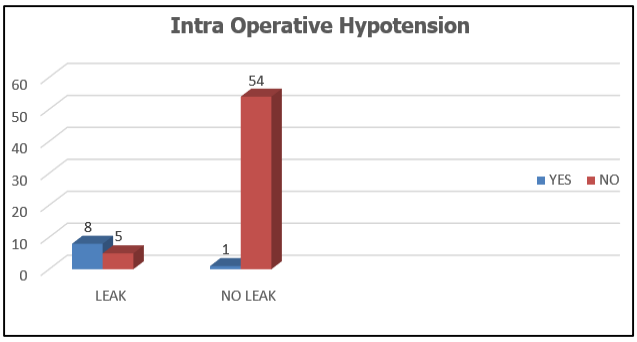

Figure 12. Intraoperative Hypotension

Variables	Leak	No leak	P value
Junior resident	5	32	0.19
Senior resident	8	23	
Total	**13**	**55**	

Table 12. Grade of the Surgeon

Postoperative Variables

Eight out of fifteen patients who developed postoperative hypotension developed anastomotic leak which is evident by a significant p value of 0.0001 hereby indicating that postoperative hypotension plays a significant role in the development of anastomotic leak.

DISCUSSION

The construction of anastomosis is fraught with potential problems for the surgeon, who realises that anything short of meticulous attention to it can have devastating consequences. However, it is seen that anastomotic disruption occurs frequently despite the greatest attention to technical detail. This has stimulated many workers to

search for other causative factors that although not readily apparent, may be amenable for correction in the preoperative, thus lessening the incidence of problem.

This prospective study spanning 15 months had 68 patients. Our present effort was conducted to clarify issues causing small bowel anastomotic leakage with specific reference to emergency surgeries, as the majority of cases (80.9%) we analysed were emergency.

Age Distribution

The age of the subjects in this study ranged from 15 to 80 years, with a mean of 45.41 ± 14.01 years. The mean in the leak group was 49.92 ± 12.23 years whereas the corresponding value for the non-leak group was 44.34 ± 14.27 years. This difference between groups was found to be significant (P=0.59). (Table 1 and Figure 1).

The mean age of subject in our study was 45.41 ± 14.01 years. Other studies have reported higher mean ages, but none have conclusively stated that advanced age is a risk factor for anastomotic leak. Hesp[1] and co-worker subdivided the bowel anastomoses into 4 groups based on aetiology. Those patients forming the 'inflammatory' group of intra-abdominal infections and inflammatory bowel disease had a mean age of 41 years. 'Vascular' cases comprised mainly by strangulated hernias and mesenteric vascular occlusions had a higher mean age of 53 years. Stoop[2] and co-workers found from their animal studies that advanced age is not an independent risk factor for the breakdown of intestinal anastomoses. The lower mean age we encountered could be due to the higher prevalence of specific and nonspecific small bowel perforations in our series, which is usually seen to affect individuals in the prime of their lives. Chaikof[3] noted a mean age of 51.8 ± 21.8 years in his work in non-traumatic small bowel perforations, which pertained mainly to non-infective causes. Higher mean ages have been reported in other studies on large bowel anastomoses, but this could be a reflection of the higher incidence of colorectal malignancies in those series. Ashok Kumar[4] and co-workers found that advanced age is a risk factor for anastomotic leak in colonic anastomoses with a median age of 47 years in their study group.

Gender Distribution

Seven men (15.2% of all males) and six women (27.3% of all females) had anastomotic leak. There was no significant difference between men and women for the occurrence of leak (P=0.24). (Table 2 and Figure 2).

Forty six male (67.6%) and 22 female patients (32.4%) constituted our study group. No significant association with leakage was noted in either group. Golup et al[5] made similar observations, noting no gender association for leakage.

Duration of Symptoms

The duration of symptoms ranged from 2 to 120 hours, with an overall mean of 29.61 ± 26.10 hours. The mean duration in the leak group was 47.3 ± 26.38 hours as compared to 25.43 ± 26.10 hours in the non-leak group. This mean duration of symptom between the groups was not statistically significant (P=0.092). (Figure 3).

Since our series focused mainly on emergency cases, we felt the need to highlight the possible importance of duration of preoperative symptoms in association with leakage. However, our data failed to reveal any significance between both groups in this regard (p=0.09). A scrutiny of previous studies did not reveal any observation in this regard, although one does mention that the number of preoperative hospital days was not significantly associated with disruption.

Comorbid Factors

In the leak group, nine patients had hypertension, whereas in the non-leak group twenty six patients had hypertension. This difference has no significant association with the occurrence of anastomotic leak (P=0.15). (Table 3 and Table 4).

In the leak group, four patients had diabetes mellitus, as compared to non-leak group where the corresponding values were 13 patients. This difference was found to be statistically not significant (P=0.59).

In the leak group, one patient had chronic obstructive pulmonary disease, as compared to non-leak group where 5 patients had COPD. This difference was found to be statistically not significant (P=0.87).

In the group, there were eight alcoholics and in the non-leak group, there were thirty one alcoholics. There were five smokers as compared to twenty six smokers in non-leak group. This difference in regards to smoking (P=0.56) and alcoholism (P=0.73) were found to be statistically insignificant for anastomotic leak.

The presence of Diabetes Mellitus, Chronic Obstructive Pulmonary Disease (COPD) or Systemic Hypertension were found to have no association with the occurrence of leaks in our sample populations, though the numbers were small. Similar results were obtained when analysing history of smoking and alcohol intake in our patients.

Fawcett[6] and colleagues noted that smoking and hypertension were significantly associated with the occurrence of suture line disruption in colonic anastomoses. This was attributed to the increased incidence of microvascular diseases in the anastomotic region caused by these risk factors, it is unclear to us whether such factors affect small bowel vascularity too, our sample size did not allow us to make any relevant conclusions in this regard. Pickleman et al also found that hypertension was a risk factor in the development of small intestinal anastomotic leakage. Diabetes has been shown in many studies not to have a significant association with disruption. COPD was noted to be an independent predicator of leakage in one study.

Patient Parameters

The haemoglobin values between leak and non-leak group showed a significant difference (p=0.001), the mean values for the leak group being 9.9 ± 1.4 g/dL as compared to the non-leak group being 11.32 ± 0.9 g/dL.

Serum albumin values showed a significant difference between the leak and non-leak groups which is lower in the leak group (p=0.002), the mean values in the leak group being 2.90 ± 0.42 g/dL and in the non-leak group being 3.23 ± 0.29 g/dL.

Total protein was significantly lower in the leak group (4.98 ± 0.32 g/dL) as compared to the non-leak group (5.3 ± 0.39 g/dL). This difference has significant association with anastomotic leak (p=0.006).

No significant association between baseline haemodynamic measurements at admission in emergency cases and the occurrence of leak or death was noted in our study. As most of the existing literature focuses on a rather uniformly mixed patient population of elective and emergency cases, related observations were lacking in them.

Malnutrition

The implications of malnutrition on anastomotic healing have been well established in previous studies. A low serum albumin was noted to be predictive of anastomotic leak in our series (p=0.002). Our findings corroborate the conclusion of other workers who noted the association between hypoalbuminaemia and deranged wound healing. Irvin.[7,8] Golub and their colleagues also noted the deleterious effects on low serum albumin levels on anastomotic healing.

In our study, it was observed that low haemoglobin level was also associated with significant occurrence of anastomotic leak with the mean haemoglobin percentage in the leak group being 9.9 ± 1.4 g%. The mechanism through which malnutrition affect anastomotic healing is not fully understood and may be due to lack of essential amino acids for collagen synthesis or deterioration in the patient's immunocompetence. The majority of the well-nourished gastrointestinal surgery patients do not require special nutritional regimens.

The American Society of Anesthesiologists' (ASA) grade of III or more was seen in 8 out of 13 patients in leak group whereas 13 out of 55 patients had as ASA grade of ≥ III in non-leak group. This was significantly associated with the occurrence of anastomotic leak (p=0.08). (Table 4 and Figure 5).

An ASA grade of III or more was associated with increased risk of leakage in our study (p=0.008). Our findings corroborate the conclusion of other workers, Golub.[5] Albes and co-workers who reported the association of increasing ASA grade with anastomotic complication.

Aetiological Factors

Of the 68 cases we studied, intestinal obstruction was found in twenty one cases (30.9%), small bowel gangrene in sixteen cases (23.5%), small bowel perforation in eighteen cases (26.5%) and thirteen cases (19.1%) were operated for malignancy. No single group has a significant association with the occurrence of anastomotic leak (p=0.062).

The patients in our study were grouped into four main categories based on intraoperative findings via intestinal obstruction, small bowel perforation, gangrene gut and those with malignancy. Some studies have underlined the importance of intestinal obstruction as a determinant of anastomotic leak although we were not able to arrive at similar conclusions. Hesp and co-workers had opined the re-anastomotic were prone for subsequent re-leak, and our study validated their findings but with only one case.

Intraoperative Factors

Out of 13 patients who underwent bowel preparation one developed leak and out of 55 patients who did not undergo bowel preparation 12 developed leak. This difference between two groups were not significant (p=0.25). (Table 6 and Figure 7)

We noted that the mean duration of surgery in the leak group was significantly higher than in the non-leak group (p=0.03). This is most probably reflective of the difficulties faced intraoperatively which might later predispose to anastomotic leakage. Alves et al[9] found/difficulties encountered during the construction of large bowel anastomosis to be predictive of subsequent anastomotic leak.

The duration of surgery in the study ranged from 100 to 190 minutes with a mean of 148.67 ± 21.97 minutes. The mean in leak group is 167.69 ± 16.9 minutes as compared to the non-leak group where the mean was 144±20.61 minutes, which showed significant difference (p=0.003).

The presence of gross peritoneal contamination, as evidenced by the finding of bile, food, pus or faecal matter in the peritoneal cavity, was showed a significant association with the occurrence of anastomotic leak (p=0.025).

We found that the presence of peritoneal contamination had an association with the occurrence of anastomotic leakage (p = 0.01). This factor was also found to be independently predictive of anastomotic leakage by investigator in two other studies.

A total of 40 ileoileal, 16 ileocolic and 12 jejunojejunal anastomoses were constructed in the study period of which 7, 4 and 2 leaked respectively. Therefore type anastomosis has no significant association with the occurrence of anastomotic leak (p=0.78).

The level of anastomosis (i.e. enteroenteric or enterocolic) did not have a significant association with the occurrence of anastomotic leak (0.49). (Table 9 and Figure 10).

End-to-end anastomoses were performed in 52 patients and end-to-side anastomoses were performed in 16 patients of which 9 in the former and 4 in the later leaked. This difference was statistically not significant (p=0.49). (Table 10 and Figure 11).

The level of anastomotic construction had no bearing on the leak in our study. Hesp[1] and co-workers remarked that jejunojejunal anastomoses were less prone to leakage than those constructed distally, but no significant difference were observed in this regard in their study. Golub, Pickelman.[10] and colleagues had reported that they found no difference between end-to-end, end-to-side or side-to-side anastomoses in their studies.

Intraoperative hypertension (taken as a drop of the systolic blood pressure to 80 mmHg or less) occurred in 9

patients out of whom 8 had anastomotic leak. This difference was found to be statistically significant (p=0.00). (Table 11 and Figure 12).

The occurrence both intraoperative hypertension (systolic blood pressure below 80 mmHg) and postoperative hypertension in the initial few days was found to be important predictor of anastomotic leak. The presence of this variable might explain the higher mean total fluid infused in the leak group. On the contrary, Golub.[5] and associates had noted that intraoperative hypotension (taken as less than 90 mmHg) was not a significant factor in their study.

Majority of surgeons who operated on the patients were those having more than three year of surgical experience. Neither the anastomoses constructed by this group nor those done by surgical trainees (having less than three years of experience) were significantly associated with anastomotic leak (p=0.19). (Table 12).

The grade of the operating surgeon did not have a bearing on the anastomotic outcome in our analysis (p=0.19). A senior hand was always present during surgery, either assisting the trainee or performing the anastomosis himself. The result of the other support our findings, although it has been noted before that even senior surgeons may have a lack of consistency in producing secure anastomoses, the frequency of their leakage ranging from 0.5 to 30% in one study.

Postoperative Factors

Tissue perfusion and decreased oxygen tension at the anastomotic site are known to adversely affect its healing. Golub and colleagues[4] mentioned COPD as a predictor of leakage, and stated that the low tissue oxygen levels seen in COPD might be the causative factor of leak. Postoperative hypotension may reduce the tissue perforation because in these circumstances, the gastrointestinal tract shuts its own blood supply to support perfusion of other vital organs. Adequate oxygen delivery is a prerequisite to the hydroxylation of lysine and proline during collagen synthesis. Thus, postoperative hypotension by affecting tissue oxygen supply affects anastomotic healing.

Management of Anastomotic Leak

In patients who died, all of whom belonged to anastomotic leak group, no significant difference was observed between those who were managed conservatively and those who had a surgical exteriorisation of leak site. With this study we recommend that anastomotic leak should be treated by exteriorisation leak site whenever re-laparotomy is done for the same. In our study, there was one mortality in the case that had undergone re-anastomosis. With this one case we could not identify the significant association between the re-anastomosis and re-leakage. But similar studies revealed that re-anastomosis after anastomotic leak was associated with poor healing.

SUMMARY

This study was conducted in our hospital between September 2010 to November 2011 in order to define factors contributing to small bowel anastomotic leak, and to suggest measures which might lessen their impact. We also wished to propose the ideal line of management for patients who have had anastomotic disruption.

The overall anastomotic leak rate in our study was 19.1% (13 out of 68). We encountered anastomotic leakage in 17.3% (9 out of 52 cases) of small-to-small bowel anastomoses. The corresponding figure for small-to-large bowel anastomoses was 25% (4 out of 16 cases). Emergency cases made up the majority in our group (80.9%). All the four deaths in our study occurred in the anastomotic leak group. Factors found to have a significant association with anastomotic leak by univariate analysis included ASA grade of III or above, low haemoglobin, low serum albumin, low total protein, and higher mean duration of surgery, presence of gross peritoneal contamination, intraoperative hypotension and postoperative hypotension.

Re-anastomosis after anastomotic leak was shown to be associated with re-leakage, but the significance of which could not be made out with the less number of cases which had undergone re-anastomosis.

CONCLUSION

Small anastomotic leak remains a major problem in an emergency surgery setting. Many of the factors causing disruption may not be amenable to immediate correction in the preoperative period. A patient who has risk factors for anastomotic dehiscence may be a candidate for an enterostomy rather than an anastomosis to help tide over the crisis. Patients undergoing re-laparotomy for anastomotic leakage should have exteriorisation of the leak site done.

Hence, adequate attention should be paid to the various preoperative, intraoperative and postoperative factors which influence anastomotic leakage in small bowel anastomosis in order to keep the morbidity and mortality to a bare minimum.

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