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A Study on Risk Factors Associated with Anastomotic Leakage in Gastrointestinal Surgeries

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Authors' contributions

This work was carried out in collaboration among all authors. Author RB designed the study, performed the statistical analysis, wrote the protocol and managed the analysis of the study. Authors NCD and NS managed the analysis and literature searches. Authors JG and AB wrote the first draft of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To study the risk factors associated with anastomotic leakage in Gastrointestinal surgery and to study the measures by which these complications can be minimized and managed in a better way.
Study Design: This was a prospective observational study.

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Place and Duration of Study: Conducted in the Post Graduate Department of Surgery, Government Medical College Jammu, over a period of one year from 1st November 2019 to 31st October 2020.

Methodology: 102 patients who had undergone gastrointestinal anastomosis irrespective of age and gender were included in the study. The patients were thoroughly evaluated and pre operative and post operative details were noted followed by analysis of risk factors associated with those who had anastomotic leaks pos operatively were analysed and results obtained.

Results: Distribution of anastomotic leak was comparable in elective and emergency (5.06% v/s8.70% respectively) .Proportion of anastomotic leak was significantly higher in >25 body mass index as compared to <25 body mass index (27.27% v/s3.30% respectively, significantly higher in anaemic (Hb<10gm%) as compared to non- anemic (Hb>10 gm%) (16.67% v/s2.56% respectively), higher in hypoalbuminemia (<3.5g/dL) as compared to patients with albumin (>3.5g/dL) (17.39% v/s2.53% respectively) .Proportion of anastomotic leak was significantly higher in patients with history of radiotherapy as compared to patients without history of radiotherapy (66.67% v/s 4.04% respectively). Comorbidities also contributed to higher rate of anastomotic leak (diabetes mellitus, hypertension, COPD, bronchial asthma, tuberculosis, malignancy and others) (25% v/s0% v/s33.33% v/s0% v/s16.67% v/s20% v/s0% respectively).

Keywords: Anastomotic leak; risk factors; prevention; management.

1. INTRODUCTION

The word anastomosis comes from the Greek word '*ana*', without, and *'stoma',* a mouth, reflecting the join of a tubular viscus like bowel after a resection. Bowel anastomosis is the procedure done in order to establish communication between two formerly distant portions of the bowel.

Intestinal anastomosis is associated with number of complications like anastomotic leak, bleeding, wound infection, anastomotic stricture and prolonged functional ileus especially in children. Among the postoperative complications, anastomotic leakage is still the most feared complication [1].

Anastomotic leak is defined as a defect at the anastomotic site leading to a communication between intraluminal and extraluminal compartments. This communication can be confirmed radiographically, endoscopically or intra operatively. There is a wide range of clinical features depending on the grade of leak. Gastrointestinal surgery-associated anastomotic leaks have been a major reason behind post-operative morbidity and mortality irrespective of the continual improvements in surgical procedures [2]. Anastomotic leakage leads to increased hospital stay and puts significant burden on the health care providers and patients, besides the possible negative clinical outcomes [3]. The management depends on grade of severity ranging from those requiring laparotomy vs those who do not. Knowledge of various risk factors leading to anastomotic leakage can help the surgeon to adopt measures which would help in bringing down the incidence of the anastomotic leakage and further promote better clinical outcome.

2. MATERIALS AND METHODS

2.1 Aims and Objectives

To study the risk factors associated with anastomotic leakage in Gastrointestinal surgery.

To study the measures by which these complications can be minimized and managed in a better way.

This study was a prospective observational study conducted in the Post Graduate Department of Surgery, Government Medical College Jammu, over a period of one year from 1st November 2019 to 31st October 2020 where in 102 patients who had undergone gastrointestinal anastomosis irrespective of age and gender were included in the study.

2.2 Inclusion Criteria

- All the patients who are undergoing gastrointestinal anastomosis for various indications irrespective of age and gender.
- Both emergency and elective cases.

2.3 Exclusion Criteria

- Patients having tumour recurrence or metastasis

- Patients who underwent palliative stoma
- Patients not giving consent for surgery

Patients fulfilling the inclusion criteria were subjected to complete history, demographic data, physical examination, laboratory and radiological investigations were noted.

The operative details which were noted are as follows:

Emergency v/s elective procedure , presence or absence of sepsis (intra-abdominal contamination), use of vasopressors, peritonitis, type of anastomosis: Hand Sewn v/s stapler, Single v/s double layer, EEA v/s ESA v/s SSA, location of anastomosis ,Intestinal condition presence or absence of Bowel obstruction, Surgical time, Combined organ resection, Quantity of blood loss,Abdominal drainage (insertion of abdominal drains), Drainage location,Curative v/s palliative surgical methods, Operative blood /blood transfusion products and Perioperative use of corticosteroids

In post operative observation the following parameters were studied:

Vitals monitoring and charting , abdominal girth monitored daily.

Nasogastric tube contents and abdominal drains were examined daily for quantity, colour, odour etc.

Routine investigations like CBC, RFT, LFT, PTI, ABG etc. were done on daily basis / alternate basis.

Patients with any of these features like diffuse abdominal tenderness, guarding, rigidity, abdominal distension, absent bowel sounds, fever, leukocytosis, tachycardia, hypotension, diarrhea etc.

were further evaluated by USG abdomen, X-ray abdomen, CECT abdomen, endoscopy etc.

Patients who were diagnosed with anastomotic leaks were managed accordingly.

The severity of anastomotic leaks is defined on the basis of clinical management required. Grade A leaks are those managed without an invasive intervention, Grade B leaks are those managed with invasive intervention other than a laparotomy (e.g., percutaneous drainage) and Grade C are those requiring laparotomy

Following are the important points that were noted in those with anastomotic leaks:

1. Duration of hospital stay.
2. Post-operative ICU stay.
3.Day of diagnosis of leak
4. Management– Surgical v/s Conservative.
5.Complications other than anastomotic leak. 6. Outcome of anastomotic leak.

2.4 Data Analysis / Statistical Analysis

The presentation of the Categorical variables was done in the form of number and percentage (%). On the other hand, the quantitative data were presented as the means ± SD and as median with 25th and 75th percentiles (interquartile range). The following statistical tests were applied for the results:

1. The association of the variables which were quantitative in nature were analysed using Independent t test.
2. The association of the variables which were qualitative in nature were analysed using Fisher's exact test as atleast one cell had an expected value of less than 5.
3. Univariate and multivariate logistic regression was used to find out significant risk factors of anastomotic leak.

The data entry was done in the Microsoft EXCEL spreadsheet and the final analysis was done with the use of Statistical Package for Social Sciences (SPSS) software, IBM manufacturer, Chicago, USA, ver 25.0.

For statistical significance, p value of less than 0.05 was considered statistically significant.

3. RESULTS AND DISCUSSION

In the study, 67(65.69%) patients were males and 35(34.31%) patients were females. Surgery performed in 79(77.45%) cases was elective and 23(22.55%) cases was emergency. Out of 102 cases, 10(9.80%) cases had malignancy, 6(5.88%) cases had tuberculosis, 4(3.92%) cases had diabetes mellitus, 4(3.92%) cases had hypertension, 3(2.94%) cases had COPD, 2(1.96%) cases had others and 1(0.98%) case had bronchial asthma. ASA score of 69(67.65%) cases was <3, 33(32.35%) cases was >=3.

Table 1. Patient characteristics distribution

Patient characteristics	N(%)	Mean ± SD	Median(25th-75th percentile)
Gender			
Female	35(34.31%)	-	-
Male	67(65.69%)	-	-
Emergency/elective surgery			
Elective	79(77.45%)	-	-
Emergency	23(22.55%)	-	-
Co-morbidity			
No	72(70.59%)	-	-
Bronchial asthma	1(0.98%)	-	-
COPD	3(2.94%)	-	-
Diabetes mellitus	4(3.92%)	-	-
Hypertension	4(3.92%)	-	-
Malignancy	10(9.80%)	-	-
Tuberculosis	6(5.88%)	-	-
Others	2(1.96%)	-	-
ASA score			
<3	69(67.65%)	-	-
>=3	33(32.35%)	-	-
Duration of surgery (minutes)			
60-120	37(36.27%)	143.63 ± 33.07	140(120-150)
121-180	58(56.86%)		
>180	7(6.86%)		
Hand sewn/Stapler			
Hand sewn	94(92.16%)	-	-
Stapler	8(7.84%)	-	-
Type of anastomosis			
End to end	92(90.20%)	-	-
End to side	5(4.90%)	-	-
Side to side	5(4.90%)	-	-
Blood transfusion			
<2	89(87.25%)	-	-
>2	13(12.75%)	-	-
Outcome			
Discharged	97(95.10%)	-	-
Expired	5(4.90%)	-	-
Smoking	38(37.25%)	-	-
Body mass index> 25 kg/m²	11(10.78%)	-	-
Anemia	24(23.53%)	-	-
Hypoalbuminemia	23(22.55%)	-	-
History of radiotherapy	3(2.94%)	-	-
Corticosteroids	9(8.82%)	-	-
Peritonitis	4(3.92%)	-	-
Obstruction	29(28.43%)	-	-
Sepsis	6(5.88%)	-	-
Requirement of vasopressors	6(5.88%)	-	-
Anastomotic leak	6(5.88%)	-	-
Re exploration	4(3.92%)	-	-
Age(years)	-	36.91 ± 21.6	38(20-52)
Hospital duration(days)	-	16.26 ± 6.17	15(14-18)

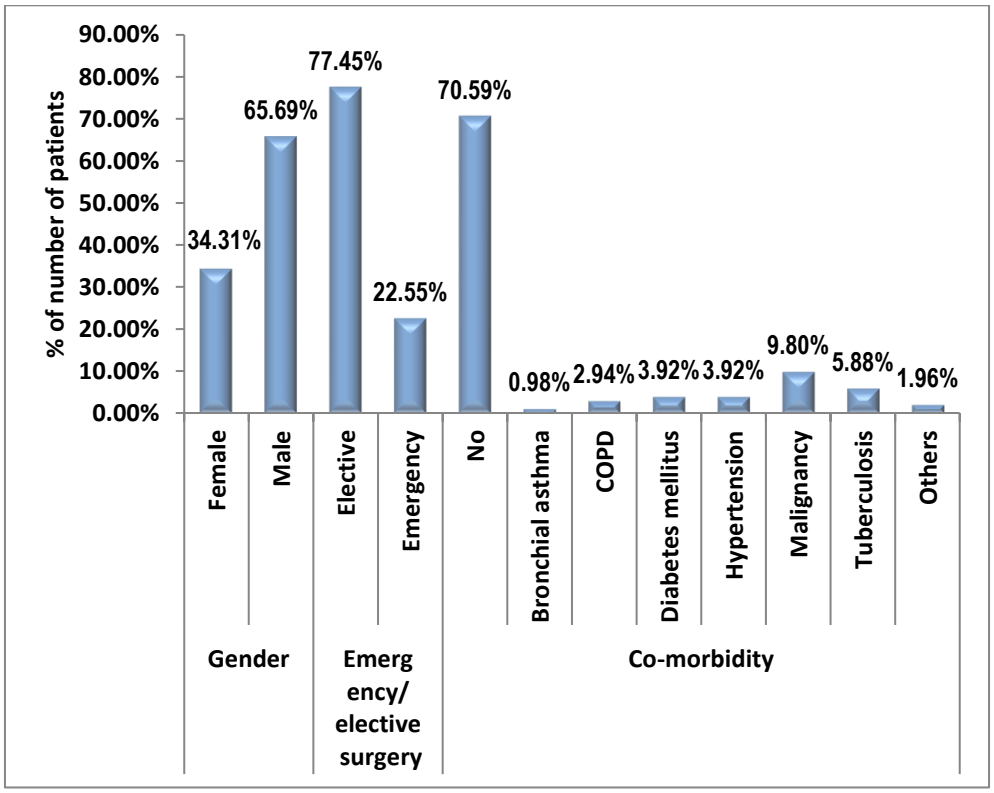

Fig. 1. Patient characteristics distribution

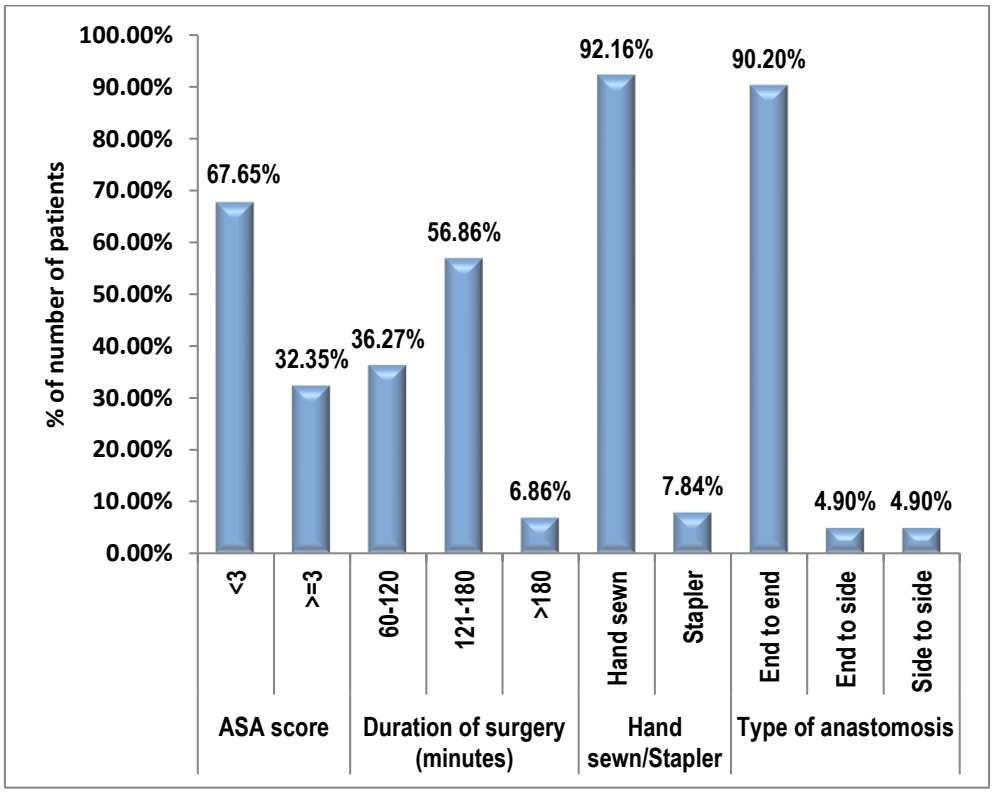

Fig. 2. Patient characteristics distribution

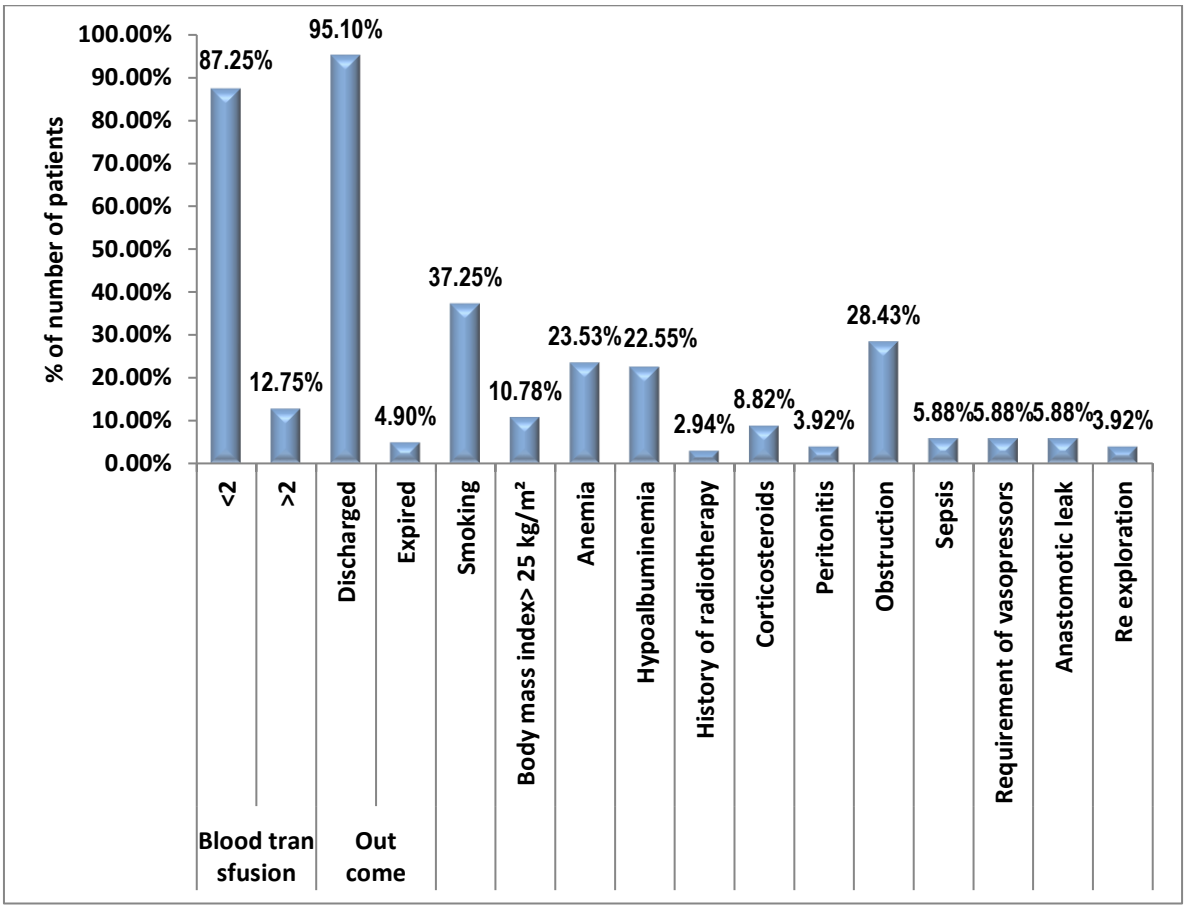

Fig. 3. Patient characteristics distribution

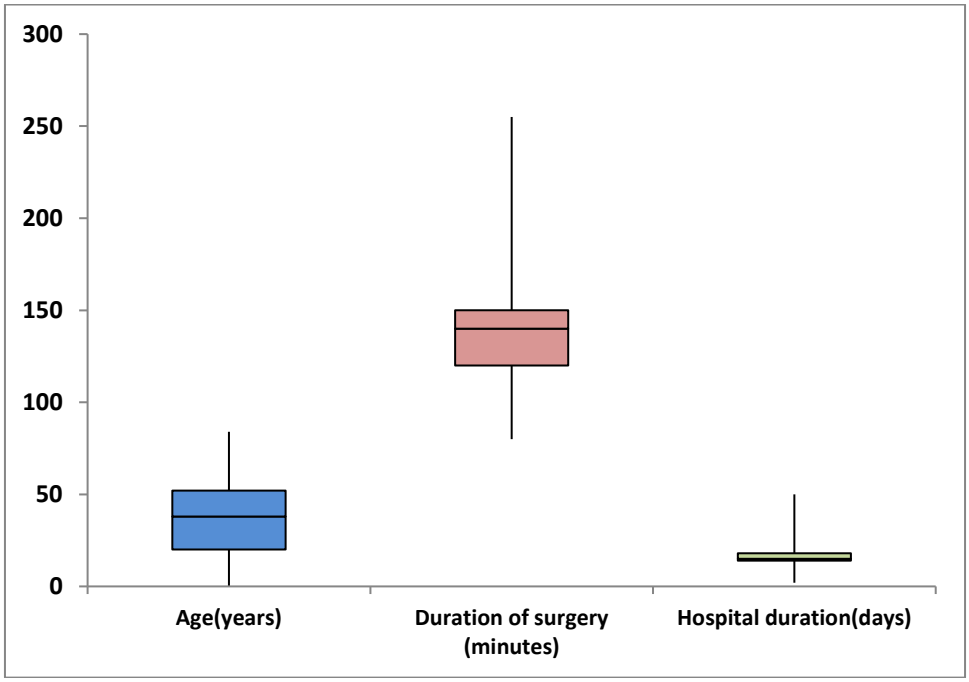

Fig. 4. Descriptive statistics of age(years), duration of surgery (minutes) and hospital duration(days)

Duration of surgery (minutes) of 58(56.86%) cases was 121-180, 37(36.27%) cases was 60-120 and 7(6.86%) cases was >180. Mean value of duration of surgery (minutes) of study subjects was 143.63 ± 33.07 with median(25th-75th percentile) of 140(120-150).

Out of 102 cases, 94(92.16%) cases were hand sewn, 8(7.84%) cases were stapled.

Type of anastomosis of 92(90.20%) cases was end to end, 5(4.90%) cases was end to side and side to side each.

Blood transfusion of 89(87.25%) cases was <2, 13(12.75%) cases was >2. 97(95.10%) cases were discharged, 5(4.90%) cases expired.

In the study, 38(37.25%) cases were smokers, 29(28.43%) cases had obstruction, 24(23.53%) cases had anemia, 23(22.55%) cases had hypoalbuminemia, 11(10.78%) cases had body mass index> 25 kg/m², 9(8.82%) cases were given corticosteroids, 6(5.88%) cases had sepsis, 6(5.88%) cases required vasopressors, 6(5.88%) cases had anastomotic leak, 4(3.92%) cases had peritonitis, 4(3.92%) cases were re explored and 3(2.94%) cases had history of radiotherapy.

Mean value of age(years) and hospital duration(days) of study subjects was 36.91 ± 21.6 and 16.26 ± 6.17 with median(25th-75th percentile) of 38(20-52) and 15(14-18) respectively (Table 1, Figs. 1 to 4).

On performing univariate regression, smoking, body mass index> 25 kg/m², anemia, hypoalbuminemia, history of radiotherapy, co-morbidity: COPD, diabetes mellitus, malignancy, tuberculosis, ASA score: >=3, corticosteroids, sepsis, duration of surgery (minutes): >180, blood transfusion: >2, requirement of vasopressors were significant risk factors of anastomotic leak.

Patients with smoking, body mass index> 25 kg/m², anemia, hypoalbuminemia, history of radiotherapy, co-morbidity: COPD, diabetes mellitus, malignancy, tuberculosis, ASA score: >=3, corticosteroids, sepsis, duration of surgery (minutes): >180, blood transfusion: >2, requirement of vasopressors had significantly high risk of anastomotic leak with odds ratio of 6.975(1.073 to 45.347), 10.414(1.927 to 56.266), 6.79(1.32 to 34.92), 6.578(1.222 to 35.397), 36.964(2.928 to 466.616), 28.929(1.686 to 496.251), 20.314(1.385 to 297.864), 13.88(1.541 to 124.995), 12.832(1.011 to 162.872), 8.847(1.355 to 57.77), 13.941(2.445 to 79.485), 26.861(3.91 to 184.522), 18.959(2.04 to 176.244), 16.634(2.98 to 92.855), 11.388(1.666 to 77.861) respectively (Table 2).

Re exploration was significantly higher in patients with anastomotic leak as compared to patients without anastomotic leak. (50% vs 1.04% respectively). (p value=0.0005).

Mortality was significantly higher in patients with anastomotic leak as compared to patients without anastomotic leak. (Expired:- 33.33% vs 3.13% respectively). (p value=0.027).

Mean ± SD of hospital duration(days) in patients with anastomotic leak was 32.67 ± 11.43 which was significantly higher as compared to patients without anastomotic leak (15.24 ± 3.94).(p value=0.013) (Table 4, Figs. 5 and 6).

3.1 Discussion

The history of gastrointestinal surgery has undergone various revisions and changes through time encompassing studying different techniques and their associated pros and cons, study of risk factors and timely prevention and management forming the foundation for us today to achieve excellence and provide highest quality healthcare.

Main principles of intestinal anastomosis include: 1. Good blood supply to both bowel ends. 2. Anastomosis is under no tension. 3. Avoid injury to mesenteric vessels. 4. Use atraumatic bowel clamps. 5. Well nourished patient. 6. No distal obstruction. 7. Meticulous surgical technique.

The vascularity of the bowel is the most important factor in the anastomotic healing. The stomach and small bowel are more vascular than the colon and they heal more rapidly. The increased vascularity of the bowel wall is the reason why gastric and small bowel anastomoses heal more rapidly in comparison with those involving the oesophagus and large bowel.

Indications of intestinal anastomosis can be broadly divided into two categories:1. Restoration of bowel continuity following resection of diseased bowel 2. Bypass of unresectable diseased bowel (mostly malignancies).

Table 2. Univariate logistic regression to find out significant risk factors of anastomotic leak

Variable	Beta coefficient	Standard error	P value	Odds ratio	Odds ratio Lower bound (95%)	Odds ratio Upper bound (95%)
Age(years)	0.027	0.019	0.169	1.027	0.989	1.067
Gender						
Female				1.000		
Male	0.000	0.886	1.000	1.000	0.176	5.682
Emergency/elective surgery						
Elective				1.000		
Emergency	0.902	0.792	0.255	2.464	0.521	11.640
Smoking	1.942	0.955	0.042	6.975	1.073	45.347
Body mass index> 25 kg/m²	2.343	0.861	0.006	10.414	1.927	56.266
Anemia	1.915	0.836	0.022	6.790	1.320	34.920
Hypoalbuminemia	1.884	0.859	0.028	6.578	1.222	35.397
History of radiotherapy	3.610	1.294	0.005	36.964	2.928	466.616
Co-morbidity						
No				1.000		
Bronchial asthma	2.660	2.511	0.289	14.295	0.104	1961.026
COPD	3.365	1.450	0.020	28.929	1.686	496.251
Diabetes mellitus	3.011	1.370	0.028	20.314	1.385	297.864
Hypertension	1.651	1.868	0.377	5.213	0.134	202.654
Malignancy	2.630	1.121	0.019	13.880	1.541	124.995
Tuberculosis	2.552	1.296	0.049	12.832	1.011	162.872
Others	2.237	2.078	0.282	9.366	0.160	549.542
ASA score						
<3				1.000		
>=3	2.180	0.957	0.023	8.847	1.355	57.770
Corticosteroids	2.635	0.888	0.003	13.941	2.445	79.485
Peritonitis	0.000	2.168	1.000	1.000	0.014	70.040
Obstruction	1.620	0.831	0.051	5.053	0.991	25.758
Sepsis	3.291	0.983	0.001	26.861	3.910	184.522
Duration of surgery (minutes)						
60-120				1.000		
121-180	0.074	1.067	0.944	1.077	0.133	8.723

Variable	Beta coefficient	Standard error	P value	Odds ratio	Odds ratio Lower bound (95%)	Odds ratio Upper bound (95%)
>180	2.942	1.138	0.010	18.959	2.040	176.244
Hand sewn/Stapler						
Hand sewn				1.000		
Stapler	1.271	1.021	0.214	3.563	0.481	26.380
Type of anastomosis						
End to end				1.000		
End to side	1.325	1.221	0.278	3.764	0.344	41.236
Side to side	0.168	1.819	0.926	1.183	0.033	41.855
Blood transfusion						
<2				1.000		
>2	2.811	0.877	0.001	16.634	2.980	92.855
Requirement of vasopressors	2.433	0.981	0.013	11.388	1.666	77.861

Table 3. Multivariate logistic regression to find out significant risk factors of anastomotic leak

Variable	Beta coefficient	Standard error	P value	Odds ratio	Odds ratio Lower bound (95%)	Odds ratio Upper bound (95%)
Smoking	0.166	1.215	0.891	1.181	0.109	12.778
Body mass index> 25 kg/m²	1.450	1.379	0.293	4.262	0.285	63.616
Anemia	0.307	1.341	0.819	1.359	0.098	18.805
Hypoalbuminemia	1.107	1.263	0.381	3.025	0.254	35.982
History of radiotherapy	1.918	2.358	0.416	6.805	0.067	691.712
Co-morbidity						
No				1.000		
Bronchial asthma	2.703	3.811	0.478	14.920	0.009	26183.813
COPD	3.639	2.026	0.072	38.064	0.718	2017.670
Diabetes mellitus	-0.267	2.135	0.901	0.766	0.012	50.283
Hypertension	1.002	1.857	0.589	2.724	0.072	103.698
Malignancy	0.093	2.032	0.964	1.097	0.020	58.913
Tuberculosis	2.757	1.439	0.055	15.745	0.938	264.223
Others	2.536	2.334	0.277	12.627	0.130	1225.076

ASA score						
<3				1.000		
>=3	0.738	1.551	0.634	2.093	0.100	43.749
Corticosteroids	-0.923	2.071	0.656	0.397	0.007	23.032
Sepsis	1.594	2.013	0.428	4.924	0.095	254.581
Duration of surgery (minutes)						
60-120				1.000		
121-180	-0.631	1.199	0.599	0.532	0.051	5.582
>180	0.648	2.897	0.823	1.911	0.007	559.177
Blood transfusion						
<2				1.000		
>2	0.968	1.627	0.552	2.632	0.108	63.910
Requirement of vasopressors	0.115	2.603	0.965	1.122	0.007	184.572

Table 4. Association of outcome with anastomotic leak

Outcome	With anastomotic leak(n=6)	Without anastomotic leak(n=96)	Total	P value
Re exploration				
No	3 (50%)	95 (98.96%)	98 (96.08%)	0.0005*
Yes	3 (50%)	1 (1.04%)	4 (3.92%)	
Mortality				
Discharged	4 (66.67%)	93 (96.88%)	97 (95.10%)	0.027*
Expired	2 (33.33%)	3 (3.13%)	5 (4.90%)	
Hospital duration(days)	32.67 ± 11.43	15.24 ± 3.94	16.26 ± 6.17	0.013†

† *Independent t test,* * *Fisher's exact test*

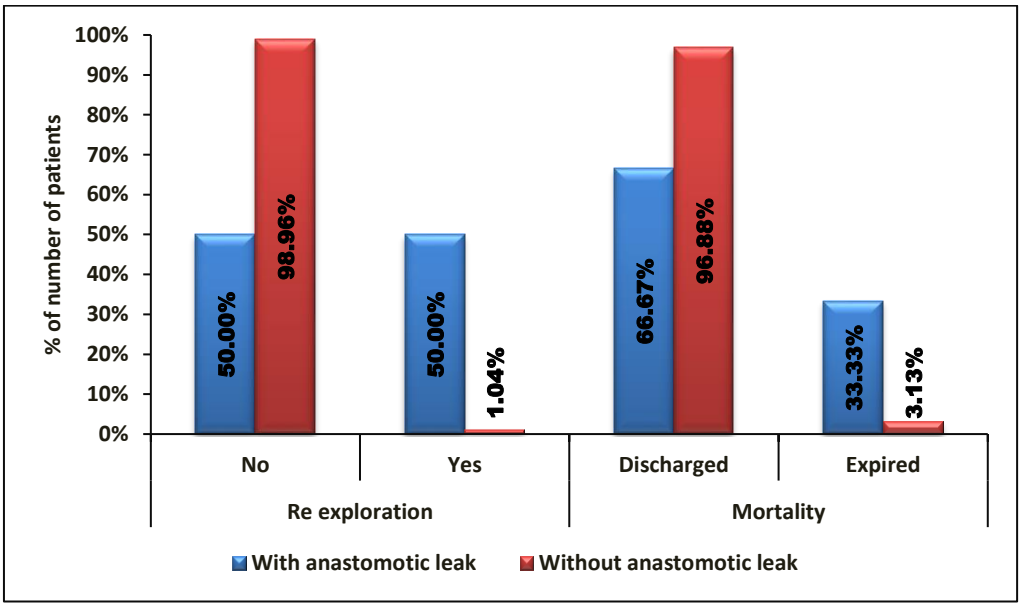

Fig. 5. Association of outcome with anastomotic leak

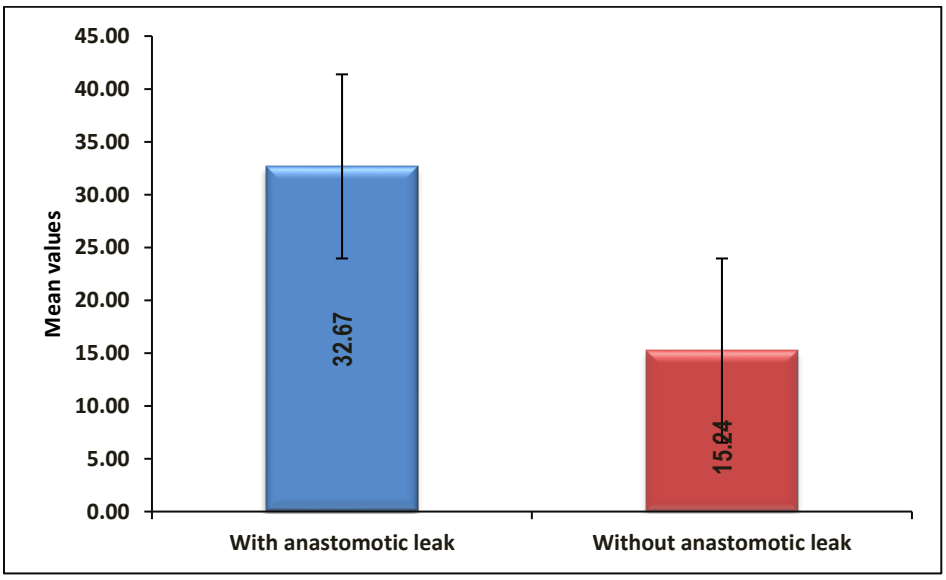

Fig. 6. Association of hospital duration(days) with anastomotic leak

On performing multivariate regression, none of the variable was independent significant risk factor of anastomotic leak. (p value>.05)

This study intends to find risk factors associated with anastomotic leakage in GI surgery.

Mean age of patients in our study was 37 years. The highest incidence of anastomotic leak rate was reported in (21.05%) 31–40 years of age group, followed by more than 60 years age group (6.25%).

Due to a lack of large sample size, our study couldn't prove any association of age with anastomotic leak.

In our study, the incidence of the leak was slightly higher in males but this result was not statistically significant (p value > 0.05). Jina A et al. reported a 16.85% association of anastomotic leaks with male gender. Kryzauskas M et al. in their study reported that male sex is associated with anastomotic leaks in as high as 11.59% of cases.

Komen N et al. reported that high BMI was associated with anastomotic leaks in around 29% while Buchs NC et al. reported this association in around 25% of the cases.

Our results are comparable with other studies done on the said criteria.

In our study, anemic patients had anastomotic leak in around 16% of cases as compared to 29.41% as seen in study done by Jina A et al. 40% reported by Kshirsagar AY et al. and around 61% seen in the study of Farghaly AE et al.

The results of our study are different from other studies in reporting a lower incidence of anastomotic leaks in anaemic patients as compared to data reported in other studies as seen in Table 8.

Hypoalbuminemia is one of the important risk factors for anastomotic leak seen in 17.39% in this study. Kshirsagar AY et al. reported that 40% of the cases with hypoalbuminemia had anastomotic leaks while Farghaly AE et al. reported this number as 92.3%, Telem DA et al. as 51% and Jina A et al. as 66.6%.

Table 5. Advanced age association comparison

Study	Year	Advanced age as a risk factor	P value
Kumar A et al. [4]	2011	>35%	<0.005
Kshirsagar AY et al. [5]	2020	>27.77	<0.005
Present Study	2020	6.25%	>0.05(0.163)

Table 6. Gender association comparison

Study	Year	Male association	P value
Jina A et al. [6]	2019	16.85%	>0.05
Kryzauskas M et al. [7]	2020	11.59%	<0.05
Present study	2021	6.06%	>0.05

Table 7. BMI association comparison

Study	Year	BMI association	P value
Buchs NC et al. [8]	2008	25%	<0.05
Komen N et al. [9]	2009	29.32%	<0.05
Present study	2021	27.27%	<0.05(0.016)

Table 8. Association of anemia comparison

Study	Year	Anemic patients with anastomotic leak (%)	P value
Jina A et al. [6]	2019	29.41%	<0.05
Kshirsagar AY et al. [5]	2020	40%	<0.05
Farghaly AE et al. [10]	2019	61. 5%	<0.05
Present study	2021	16.67%	<0.05(0.026)

Table 9. Hypoalbuminemia association comparison

Study	Year	Patients with hypoalbuminemia (%)	P value
Telem DA et al. [11]	2010	51%	<0.05
Farghaly AE et al. [10]	2019	92.3%	<0.05
Jina A et al. [6]	2019	66.66%	<0.05
Kshirsagar AY et al. [5]	2020	40%	<0.05
Present study	2021	17.39%	<0.05(0.022)

Our study confirmed the association of hypoalbuminemia with anastomotic leak but the number of cases reported were lower than other studies as reported in Table 9.

In our study, the association of smoking with anastomotic leak was seen in 13.16% patients which correlates with study done by Baucom RB et al where it was 17% as represented in Table 10.

In our study the association with an ASA score of >/=3 in patients with anastomotic leak was found to be 15.15% which correlates with 12.68% seen in the study done by Kryzauskas M et al. as shown in Table 11.

In our study, 33.33% patients with anastomotic leak in this study had a history of steroid use which strongly correlates with the study done by Daele EV et al. in which it was 33%. Jina A et al. reported a higher incidence while Eriksen TF et al., reported a much lower incidence in their studies as shown in Table 12.

In our study 16.67% patients had an associated comorbidity which strongly correlates with study done by Jina A et al.where it was found to be 16.66% while Daele EV et al. reported this number as 25% as shown in Table 13.

In our study 8.7% patients with anastomotic leak had an emergency surgery which correlates with the study done by Damen N et al. where it was found to be 7%. Jina A et al. reported a 17.6% association while Kshirsagar AY et al. reported an association of 23.25% as shown in Table 14.

In our study the association of sepsis with anastomotic leak was found to be 50% correlating with the study done by Jina A et al., where it was found to be 56% as seen in Table 15.

Table 10. Association of smoking with anastomotic leak

Study	Year	Smoking (%)	P Value
Baucom RB et al. [12]	2015	17%	<0.05
Daele EV et al. [13]	2016	67%	<0.05
Present study	2021	13.16%	<0.05(0.026)

Table 11. Association of ASA score (>/=3) with anastomotic leak

Study	Year	ASA score >/=3(%)	P value
Daele EV et al. [13]	2016	3. 59%	>0.05
Jina A et al. [6]	2019	44.44%	<0.05
Kryzauskas M et al. [7]	2020	12.68%	<0.05
Present study	2021	15. 15%	>0.05(0.013)

Table 12. Association of steroids with anastomotic leak

Study	Year	Steroids (%)	P value
Eriksen TF et al. [14]	2014	6.77%	<0.05
Daele EV et al. [13]	2016	33%	<0.05
Jina A et al. [6]	2019	66.66%	<0.05
Present study	2021	33.33%	<0.05 (0.009)

Table 13. Association of comorbidity with anastomotic leak

Study	Year	Comorbidity(%)	P value
Daele EV et al. [13]	2016	25%	>0.05
Jina A et al. [6]	2019	16.66%	>0.05
Present study	2021	16.67%	<0.05(0.008)

Table 14. Association of emergency surgery with anastomotic leak

Study	Year	Emergency surgery (%)	P Value
Damen N et al. [15]	2014	7%	<0.05
Jina A et al. [6]	2019	17. 59%	>0.05
Kshirsagar AY et al. [5]	2020	23.25%	<0.05
Present study	2021	8.7%	>0.05(0.615)

Table 15. Association of sepsis with anastomotic leak

Study	Year	Sepsis(%)	P value
Jina A et al. [6]	2019	56%	<0.05
Farghaly AE et al. [10]	2019	69.2	<0.05
Kshirsagar AY et al. [5]	2020	37. 5%	<0.05
Present study	2021	50%	<0.05(0.002)

Table 16. Association of duration of surgery with anastomotic leak

Study	Year	Duration of surgery (%)	P value
Telem DA et al. [11]	2010	54%	<0.05
Jina A et al. [6]	2019	38.09%	<0.05
Present study	2021	42.86%	<0.05

Table 17. Association of blood transfusion with anastomotic leak

Study	Year	Percentage association	P value
Telem DA et al. [11]	2010	50%	<0.05
Jina A et al. [6]	2019	33.33%	<0.05
Present study	2021	30.77%	<0.05(0.002)

Table 18. Association of vasopressors with anastomotic leak

Study	Year	Percentage association	P value
Telem DA et al. [11]	2010	29.62%	<0.05
Zakirson T et al. [16]	2017	37.87%	<0.05
Present study	2021	33.33%	<0.05(0.039)

In our study the association of duration of surgery (>180 mins) with anastomotic leak was found to be 42.86% correlating with the study done by Jina A et al. where it was found to be 38.09% while Telem DA et al*.* reported their number as 54% as shown in Table 16.

In our study the association of blood transfusion (>2 units) with anastomotic leak was found to be 30.77% correlating with the study done by Jina A et al*.* where it was found to be 33.33% as seen in Table 17.

In our study, vasopressor use was associated with anastomotic leak in 33.33%. Our reported numbers are consistent with studies done by Telem DA et al*.* which reported their number as 29.62% and Zakirson T et al*.* reported their association as 37.87% as shown in Table 18.

4. CONCLUSION

Bowel anastomosis is one of the commonest surgical procedures done to establish a

connection between two portions of the bowel. It is a common procedure done in both elective and emergency settings. The technique depends on various factors such as site, quality of bowel, underlying disease process etc. It is indicated in various conditions such as gangrene of the bowel, infections, benign and malignant conditions, trauma, inflammatory bowel disease.

Despite taking adequate care, few complications can occur, most importantly anastomotic leak which is the core of this study.

This study is aimed at studying the risk factors associated with anastomotic leakage and the measures by which this complication can be reduced by early diagnosis (radiologically, endoscopically and intraoperatively) and corrections of various modifiable risk factors. Various risk factors like smoking, anemia, emergency surgeries, presence of sepsis etc. were seen to contribute to a higher incidence of anastomotic leaks (5.88%).

Further, risk factors such as hypoalbuminemia, use of >2 blood transfusions and presence of comorbidity also played a significant role in causing higher rates of anastomotic leaks in patients with these risk factors.

Comorbidities like diabetes, tuberculosis, bronchial asthma were also seen to act as risk factors for anastomotic leaks in this study. Patients in whom corticosteroids/ radiotherapy earlier were used were also more prone to develop anastomotic leak.

Based on our study, it is emphasized that it is of utmost importance to identify these risk factors having a strong association with anastomotic leak and plan the line of management to prevent and reduce the rate of anastomotic leaks seen in day to day surgical practice and provide a hassle free postoperative care for patients undergoing gastrointestinal surgeries.

CONSENT

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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