Alem Mekete, Birhanu Kotisso, Tessema Ersumo, *Ethiop Med J, 2022, Vol. 60 No. 1*

ORIGINAL ARTICLE

GASTROINTESTINAL ANASTOMOTIC LEAKS AND RISK FACTORS IN FOUR UNIVERSITY HOSPITALS, ADDIS ABABA

Alem Mekete[1], Birhanu Kotisso[1], Tessema Ersumo[1]

ABSTRACT

Background: *Studies on the incidence and risk factors for anastomotic leak (AL) related to gastrointestinal (GI) surgery are mainly from the developed world. Incidences of AL range from 1.0% to 41.0%, varying widely according to the site, definition, and type of GI resection. Multiple risk factors have been identified. AL typically manifests clinically around the seventh postoperative day. It increases morbidity, mortality, hospital stay and extra costs irrespective of improvements in surgical techniques.*

Objective: *To identify the pattern, risk factors, and mortality rate related to GI anastomotic leaks after GI resection and anastomosis.*

Methods: *A retrospective descriptive study of medical records of 352 patients for ALs following GI tract resection and anastomosis at four university hospitals in Addis Ababa during January 1, 2017 to December 31, 2018 was done. Data were analyzed using SPSS version 23 package. Descriptive statistics and logistic regressions were used to analyze the data. A p-value of <0.05 was used to define statistical significance.*

Results: *The overall rate of AL was 9.9 %. Low preoperative serum albumin and emergency procedure had statistically significant association. The mean hospital stay was 12 days. Anastomotic leak-associated death rate was 48%.*

Conclusion*: In this study, most patients had elective surgeries involving the colon. Most of them developed enteroenteric ALs with longer hospital stays, and higher death rates, affirming that AL significantly increases morbidity, mortality and cost.*

Key words: *GI resection, anastomotic leak, risk factors, mortality.*

INTRODUCTION

Gastrointestinal (GI) surgery-associated anastomotic leaks (ALs) have been one of the main causes underlying postoperative morbidity and mortality irrespective of the continual improvements in surgical procedures. The frequency and consequences of anastomotic failure (partial or complete disruption of anastomosis with leakage of contents) vary widely according to the sites, definitions, and types of resections within the GI tract **(1, 2)**. Varying rates of ALs are found **(1)** based on the anastomosis site involved: rectum (8-41%), colon (3-29%), small intestine (1-3%), bile ducts (10-16%), pancreas (9-16%), stomach (1-9%), and esophagus (2-16%).

In systematic reviews of 97 studies, a total of 56 separated definitions of AL were identified. Combination of clinical features and radiological investigations were used to define and detect anastomotic leak. However, there is no universally accepted definition of anastomotic leak at any site **(3)**.

Studies conducted to identify the incidence and risk factors for anastomotic leak are from the developed world where patient characteristics and availability and utility of diagnostic tools are different from that in the developing world. Several studies have identified risk factors for GI anastomotic leakage with no general consensus on which risk factors consistently feature **(1)**.

An anastomotic defect in colon causes leakage of colonic content into the abdominal and or pelvic space leading to peritonitis, abscess formation, and sepsis that can be fatal. The incidence of colorectal anastomotic leak (CAL) varies between 3% and 19%, with associated mortality rates ranging from 10 % to 20 %. Moreover, CAL is a risk factor for local recurrence of colorectal cancer **(4)**.

AL typically becomes clinically apparent between the 5 and the 8 postoperative days, but many exceptions exist **(5, 6)**. The occurrence of gastrointestinal AL is associated with significantly increased mortality, morbidity, and prolonged hospital stay as well as considerable extra costs **(4, 7)**. Knowledge on the risk factors may influence procedure related decisions and treatment, and possibly reduce the rate of leakage.

The aims of this study were to evaluate the pattern of AL after GI resection and anastomosis, its perioperative risk factors, morbidity and mortality rates related to AL, and to provide surgical professionals, researchers and hospitals with baseline information for further investigation and guideline development to reduce rate of AL and improve outcome of patients.

MATERIALS AND METHODS

This was a multicenter retrospective study of medical records of patients with GI resection and anastomosis undertaken at Tikur Anbessa, Menelik II, Yekatit 12 and Zewditu Memorial Hospitals in Addis Ababa during the period of January 1, 2017 to December 31, 2018.

During the study period, a total of 556 patients had GI resection and anastomosis. Of these, charts of 414 patients were retrieved and 62 patients were excluded from the study because four were pediatric patients, 12 patients had insufficient data, and 46 patients had bypass procedures. The documents of 352 patients make the basis for the analysis of this study.

[1]Addis Ababa University College of Health Sciences, School of Medicine, Department of Surgery
*Corresponding author: E-mail: alemkone.12@gmail.com

Structured questionnaires were prepared for data collection and the study proposal was approved by the Institutional Review Board of Addis Ababa University, College of Health Sciences. At the four hospitals, operating room registers, medical charts, discharge summaries, and death certificates of patients were used for data collection. Demographic features, comorbid conditions, diagnoses for which GI resection and anastomosis were performed, and presence or absence of perioperative infection, bowel preparation, antibiotic use, blood transfusion, and serum albumin level were determined. Emphasis was also made on the urgency of the operation, operating professional, and duration and type of the procedure as well as the duration of hospital stay and postoperative complications. The collected data were checked for completeness, and entered into computer and the SPSS version 23 package was used for statistical analysis.

RESULTS

The mean (±SD) age of patients was 48(±17) years; about 75% of patients were ≤ 60 years of age. Majority (72.2%) of patients were male and 257 (73.0%) were urban residents. The most common reasons for gastrointestinal anastomosis were redundant sigmoid colon and sigmoid volvulus (27.8%) followed by small bowel obstruction (SBO) (14.8%). The rest of the diagnoses in decreasing order of frequency included colorectal cancer (12.8%), esophageal cancer (12.2%), and end colostomy for 26 benign and 9 malignant diseases (9.9%), gastric cancer (5.4%), IBD (4.8%), and 10 penetrating and 3 blunt abdominal trauma (3.7%), and others (8.5%) including mesenteric ischemia, ileostomy or abdominal TB (10 each). Cancer accounted for 35.8% of all patients that underwent GI anastomosis (Table 1).

Table 1. Demographic distribution and diagnosis of 352 patients with gastrointestinal Anastomosis in Four University Hospitals in Addis Ababa, January 2017 to December 2018

Variables	No of Patients	Percent
Sex		
Male	254	72.2
Female	98	27.8
Age (Years)		
15-30	80	22.7
31-60	182	51.7
>60	90	25.6
Mean(±SD) 48±17		
Diagnosis		
Esophageal cancer	43	12.2
Gastric cancer	19	5.4
Small bowel obstruction (SBO)	52	14.8
Colorectal cancer	45	12.8
Redundant sigmoid colon & sigmoid volvulus (SV)	98	27.8
End Colostomy	35	9.9
Trauma	13	3.7
Inflammatory bowel disease (IBD)	17	4.8
Other	30	8.5

As is shown in Table 2, most patients (79.9%) underwent elective anastomotic procedures, in 224 (63.6%) procedures related to the colon. GI resection and anastomosis were performed in 41.8% of patients without preoperative mechanical bowel preparation. Serum albumin level was determined in 70.5% of patients, out of which 15.3% had low serum albumin levels. Evidences of infection (pus and GI content in the peritoneum, abscess or fistula) were noted during anastomosis in 6.8% of patients. Blood transfusion was given for 6.8% of patients. The type of operative procedures in decreasing order of frequency were colocolic anastomosis (33.5%), enteroenterostomy (18.2%), ileocolic anastomosis (15.6%), colorectal anastomosis (13.9%), esophagectomy (12.2%), gastrectomy (5.4%), and jejunotransverse (and coloanal anastomoses (0. 3% each).

The participating surgical disciplines included general, colorectal, and cardiothoracic surgery. Majority of the operations (70.8%) were performed by residents and general surgeons. Colorectal and cardiothoracic surgeons operated on 15.9% and 13.4% of patients respectively.

The surgical procedure lasted 90 minutes or more in 94.6%, 2 to 3 hours in 61.4%, more than 3 hours in 9.7%, and more than 5 hours in 0.6% of patients (Table 2).

Table 2. Types of procedures, surgical professionals and perioperative features in 352 patients with gastrointestinal anastomosis, in Four University Hospitals in Addis Ababa, January 2017 to December 2018

Characteristics	N	%
Type of Surgical Procedures		
Esophagectomy and anastomosis	43	12.2
Gastrectomy and anastomosis	19	5.4
Enteroenterostomy	64	18.2
Ileocolic anastomosis	55	15.6
Colocolic anastomosis	118	33.5
Colorectal anastomosis	49	13.9
Ileorectal anastomosis	2	0.6
Other	2	0.6
Operating Professionals		
Surgery residents	137	38.9
Surgeons	215	61.2
Duration of Procedures		
< 90	19	5.4
90-120	83	23.6
>120	250	71.0
Preop Characteristics		
Urgency		
Elective	267	75.9
Emergency	85	24.1
Presence of infection		
Yes	24	6.8
No	328	93.2
Prophylactic antibiotics use		
Yes	352	100.0
No	0	0.0
Preoperative bowel preparation		
Yes	205	58.2
No	147	41.8
Preoperative hematocrit level		
<35 %	50	14.2
> 35%	302	85.8
Preoperative low albumin level (n=248)		
Yes	54	21.8
No	194	78.2
Not done	104	29.5
Pre or intraoperative blood transfusion		
Yes	24	6.8
No	328	93.2

As depicted in Table 3, anastomotic leak was detected in 35 of 352 patients (9.9%) in this study. AL detection day varied from the 2nd to the 14th postoperative days; and majority of the leaks (21, 60%) were detected on the 5th to 8th postoperative days, and (10, 28.6%) on the 7th postoperative day. Majority of leaks (21, 60%) were detected by GI content or fluid discharge via incisional wounds or drainage tubes. Relaparotomy was performed on 8.8% of patients after GI resection and anastomosis, but 71.4% (25/35) of patients that developed anastomotic leak required relaparotomy, and the rest (10/35) were managed conservatively as enterocutaneous fistula whereas only 1.9% (6/311) of patients who did not develop leak required relaparotomy, for wound dehiscence and postoperative collection.

About 60.0% of patients stayed in hospital for one week or more, 54 (15.4%) for more than two weeks, and 34 (9.7%) stayed for more than three weeks. The mean postoperative hospital stay was 12±12.35 days, with a median stay of 8 days and IQR of 7 to 11 days. When conditions of patients on discharge were assessed, 25 patients (7.1%) died in hospital after GI anastomosis (Table 3).

On bivariate analysis (Table 4), emergency procedure, presence of infection, absence of mechanical bowel preparation, and low serum albumin level were significantly associated with AL. AL was significantly high with increase in age and prolonged duration of surgery. Sex, duration of procedure, low preoperative HCT level, and pre or intraoperative blood transfusion was not significantly associated with the development of AL.

Table 3. Anastomotic leak and relaparotomy rates, duration of hospital stay, and outcome of 352 patients with GI anastomosis in Four University Hospitals in Addis Ababa, January 2017 to December 2018

Characteristics	N	%
Presence of Leak		
Yes	35	9.9
No	317	90.1
Postop date leak detected		
5th day	6	17.1
6th day	4	11.4
7th day	10	28.6
2nd day	2	5.7
Other	13	37.1
How was the leak detected?		
Sign of peritonitis	14	40.0
GI content discharge via wound	15	42.9
Abdominal ultrasound	0	0.0
Other	6	17.1
Relaparotomy done		
No	321	91.2
Yes	31	8.8
Duration of hospital stay		
<1 week	140	39.8
1-2 weeks	158	44.9
>2 weeks	54	15.4
Condition on discharge		
Discharged improved	320	90.9
Dead in hospital	25	7.1
Discharged against medical advice	6	1.7
Referred to other hospital	1	0.3

Table 4. Bivariate analysis of factors associated with gastrointestinal anastomotic leak (AL)

Risk Factors	Presence of leak		
	Yes N (%)	No N (%)	P-Value
Age			0.098
15-30	5(6.2%)	75(93.8%)	
31-60	16(8.8%)	166(91.2%)	
>60	14(15.65%)	76(84.4%)	
Sex			0.370
Male	23(9.1%)	231(90.9%)	
Female	12(12.2%)	86(87.8%)	
Urgency of Procedure			0.006
Elective	20(7.5%)	247(92.5%)	
Emergency	15(17.6%)	70(82.4%)	
Duration of Procedure			0.150
1.5-2hrs	5(6%)	78(94.0%)	
>2-3hrs	23(10.6%)	193(89.4%)	
3-5hrs	6(17.6%)	28(84.4%)	
Presence of infection during anastomosis			0.011
Yes	6(25.0%)	18(75.0%)	
No	29(8.8%)	299(91.2%)	
Preoperative bowel preparation			0.002
Yes	12(5.9%)	193(94.1%)	0.665
No	23(15.6%)	124(84.4%)	
Preoperative hematocrit level			0.122
<35 %	8(16.0%)	42(84.0%)	
> 35%	27(8.9%)	275(91.1%)	
Low preoperative albumin level			<0.0001
Yes	18(33.3%)	36(66.7%)	
No	10(5.2%)	184(94.8%)	
Pre or intraoperative blood transfusion			0.665
Yes	3(12.5%)	21(87.5%)	
No	32(9.8%)	296(90.2%)	

AL rate following enteroenterostomy (Table 5) was high (17.2%) followed by esophagectomy (16.3%), gastrectomy (10.5%), colorectal anastomosis (10.2%), ileocolic anastomosis (9.1%) and colocolic anastomosis (4.2%), but ileorectal anastomosis did not leak (P=0.019). Majority of the procedures (240 patients) were performed by residents and general surgeons. There were differences in the leak rates among the different surgical professionals, but the differences were not statistically significant (P=0.434).

Anastomotic leakage rate was found to be a little bit higher in malignant conditions than benign conditions. (13/126, 10.3% vs 22/226, 9.73%), but the difference was not statistically significant (P=0.357). AL was associated with significantly increased mortality, morbidity, and prolonged hospital stay (Table 6). The rate of death in patients who developed AL was 48.3% compared to the 3.5% death rate in those who did not develop AL. Most patients (71.4%) with AL had relaparotomy compared to the 1.9% relaparotomy rate in those without AL. Majority of patients (62.9%) with AL stayed more than 3 weeks in hospital, whereas only 3.8% of patients without AL stayed that long.

Table 5. Anastomotic leak rate in comparison to type of operative procedure, surgical professional, and disease category

Characteristics (n=352)	Presence of Leak		
	Yes	No	
	35(9.9%)	317(90.1%))	P-Value
Type of Operative Procedure			0.019
Esophagectomy and anastomosis	7(16.3%)	36(83.7%)	
Gastrectomy and anastomosis	2(10.5%)	17(89.5%)	
Enteroenterostomy	11(17.2%)	53(82.8%)	
Ileocolic anastomosis	5(9.09%)	50(90.91%)	
Colocolic anastomosis	5(4.23%)	113(95.76%)	
Colorectal anastomosis	5(10.2%)	44(89.8%)	
Ileorectal anastomosis	0(0%)	2(100%)	
Other	0(0%)	2(100%)	
Operating Surgeon			0.434
Surgery Resident	13 (9.5%)	124(90.5%)	
General Surgeon	11(10.7%)	92(89.3%)	
Colorectal Surgeon	2 (3.6%)	54(96.4%)	
Cardiothoracic Surgeon	7 (14.9%)	40(85.1%)	
Upper GI surgeon	2 (22.2%)	7(77.8%)	
Diagnosis			0.357
Esophageal Cancer	7(16.3%)	36(83.7%)	
Gastric Cancer	2(10.5%)	17(89.5%)	
Small bowel obstruction (SBO)	9(17.3%)	43(82.7%)	
Colorectal cancer	2(4.4%)	43(95.6%)	
Redundant sigmoid colon & sigmoid volvulus	3(3.1%)	95(96.9%)	
End colostomy	4(11.4%)	31(88.6%)	
Abdominal trauma	1(7.7%)	12(92.3%)	

Variables which were statistically significant on bivariate analysis were included in multivariate analysis (Table 6) to see their independent effect on the occurrence of AL. Absence of bowel preparation was strongly associated with AL on bivariate analysis but became out of the range for significance on multivariate analysis. The variable that had strong independent association with AL was a low serum albumin level ($p<0.0001$).

Patients who had low serum albumin were 19 times more likely to develop AL compared to those who had normal serum albumin. The other variable which was independently associated with occurrence of AL was emergency procedures ($p=0.018$) where patients were 4.6 times more likely to develop AL than those who underwent elective procedures.

Table 6. The effect of AL on postoperative outcomes and multivariate analysis of variables with occurrence of AL in GI anastomosis

Characteristic		Presence of leak				P value
		Yes		No		
		N	%	N	%	
Condition on discharge	Improved	15	51.7	305	96.5	<0.0001
	Died	14	48.3	11	3.5	
Hospital stay	<1 week	2	5.7	138	43.5	<0.0001
	1-2 weeks	7		151	47.6	
	2-3 weeks	4	11.4	16	5.0	
	> 3 weeks	22	62.9	12	3.8	
Relaparotomy	No	10	28.6	311	98.1	<0.0001
	Yes	25	71.4	6	1.9	

Multivariate analysis of factors significantly associated with AL on bivariate analysis

Characteristic	B	P value	AOR	95% C.I	
				Lower	Upper
Urgency (emergency)	1.527	0.018	4.606	1.306	16.242
Infection (yes)	0.513	0.444	0.599	0.161	2.226
Bowel prep (No)	0.300	0.554	1.349	0.500	3.642
Albumin (low)	2.979	<0.0001	19.670	5.629	68.733

DISCUSSION

Anastomotic leak is perhaps the most dreaded complication following intestinal surgery and is one of the leading causes of postoperative morbidity and mortality despite improvements in surgical care. The rates and complications of AL vary considerably depending on the definition, risk factors, site, and type of GI tract resection (1,2).

Majority of studies used a combination of clinical features and radiological investigations to define and detect anastomotic leak. The diagnostic methods commonly used when a leakage is suspected are CT scan, contrast enema, endoscopic examination, and reoperation (8). In our series, except one patient who developed wound dehiscence and the leak was detected on re-operation, all ALs were detected and defined clinically only. There is no universally accepted definition of anastomotic leak at any site (3, 9).

In this study, the rate of AL increased with increase in age of patients and pronged duration of surgery, but the increase was not significant and congruent to the findings by others (4, 7, 10, and 11). In our study, female patients developed AL more frequently than males (12.2% vs. 9.1%) even though the variation was not statistically significant (P=0.370). In other studies, AL occurred more commonly in male patients (12, 13). The variation could be due to small sample size of female patients in our study.

Studies have identified risk factors for GI anastomotic leakage, but there is no universal agreement on which risk factors consistently feature (1). Amrika Seshadri (7) reported that serum albumin, need for blood transfusion and others as strongly associated factors for AL. In a retrospective study, male sex, perioperative transfusion, presence of cardiovascular disease and proximal tumor location were predictive factors of anastomotic leakage after gastrectomy for gastric cancer and the leakage rate was 1.9% (13). In a prospective study, Nair et al (14) reported a 35.0% rate of anastomotic disruption in patients undergoing emergency small bowel anastomosis, a much higher rate than our finding. There are clearly many patient and disease factors that contribute to anastomotic leak. AL has been associated with a 6% to 39% mortality rate (15). In this study, emergency procedure, the presence of infection, the absence of bowel preparation, and low serum albumin were significantly associated with anastomotic leak, but on multivariate analysis only emergency procedures (P=0.018) and low serum albumin(P<0.0001) remained significantly associated with anastomotic leakage. This is because of the fact that patients were operated on without bowel preparation on emergency bases which possibly is a confounding variable. This finding is in line with the findings in several other studies (7, 14, and 16).

DISCUSSION

Anastomotic leak is perhaps the most dreaded complication following intestinal surgery and is one of the leading causes of postoperative morbidity and mortality despite improvements in surgical care. The rates and complications of AL vary considerably depending on the definition, risk factors, site, and type of GI tract resection **(1,2)**.

Majority of studies used a combination of clinical features and radiological investigations to define and detect anastomotic leak. The diagnostic methods commonly used when a leakage is suspected are CT scan, contrast enema, endoscopic examination, and reoperation **(8)**. In our series, except one patient who developed wound dehiscence and the leak was detected on reoperation, all ALs were detected and defined clinically only. There is no universally accepted definition of anastomotic leak at any site **(3, 9)**.

In this study, the rate of AL increased with increase in age of patients and pronged duration of surgery, but the increase was not significant and congruent to the findings by others **(4, 7, 10, and 11)**. In our study, female patients developed AL more frequently than males (12.2% vs. 9.1%) even though the variation was not statistically significant (P=0.370). In other studies, AL occurred more commonly in male patients **(12, 13)**. The variation could be due to small sample size of female patients in our study.

Studies have identified risk factors for GI anastomotic leakage, but there is no universal agreement on which risk factors consistently feature **(1)**. Amrika Seshadri**(7)** reported that serum albumin, need for blood transfusion and others as strongly associated factors for AL. In a retrospective study, male sex, perioperative transfusion, presence of cardiovascular disease and proximal tumor location were predictive factors of anastomotic leakage after gastrectomy for gastric cancer and the leakage rate was 1.9% **(13)**. In a prospective study, Nair et al **(14)** reported a 35.0% rate of anastomotic disruption in patients undergoing emergency small bowel anastomosis, a much higher rate than our finding. There are clearly many patient and disease factors that contribute to anastomotic leak. AL has been associated with a 6% to 39% mortality rate **(15)**. In this study, emergency procedure, the presence of infection, the absence of bowel preparation, and low serum albumin were significantly associated with anastomotic leak, but on multivariate analysis only emergency procedures (P=0.018) and low serum albumin (P<0.0001) remained significantly associated with anastomotic leakage.This is because of the fact that patients were operated on without bowel preparation on emergency bases which possibly is a confounding variable. This finding is in line with the findings in several other studies **(7, 14, and 16)**.

In general, the rate of AL varies depending on the tissue anastomosed, and the rates include, stomach, 1.1-3.3%, small intestine, 1.0-3.8%, ileocolic, 2.0-6.5%, colocolic, 3.0-5.4%, colorectal, 4.0-26%, and ileorectal, 5.0-19%. AL is known to be correlated with worse prognosis after curative resection for colorectal cancer **(15)**. In the present study, the rates of AL were 16.3% in esophagogastrostomy, 10.5% in gastrectomy and gastrojejunostomy, 17.2% in enteroenterostomy, 9.1% in ileocolic anastomosis, 4.2% in colocolic anastomosis, and 10.2% in colorectal anastomosis. Compared to the preceding report, AL rates in gastric, small bowel and ileocolic anastomosis were higher in our study probably due to nutritional deficiencies or emergency procedures. Contrary to our finding where ileorectal anastomosis did not leak, higher incidences of AL, probably related to disease or patient factors, were found in other reports **(1,15)**. The overall AL rate of 9.9% observed in this study is similar to the reported rates that ranged from 1.8% to 15.4% in many studies **(2, 10, 16-19)**. Esophagogastrostomy, ileocolic, colocolic and colorectal AL rates were comparable with the findings in other series **(2, 4, 10, 11, 15, 16, 20, 21)**. In our series, anastomotic leakage rate was slightly higher in malignant than benign conditions (10.3 % vs 9.73%), but the difference was not statistically significant (P=0.357).

AL presents in a dramatic fashion early or more often in a far subtler fashion, often relatively late in the postoperative period **(22)**. In majority of our patients (60.0%), in agreement with another report **(6)**, AL was detected between the 5^{th} and 8^{th} postoperative days, and on the 14^{th} postoperative day in one patient.

The consequences of AL are peritonitis, fistula or abscess formation, postoperative infection, and increased hospital costs and mortality **(20, 23, 24)**. It causes considerable morbidity and mortality to the patient, and it doubles the length of hospital stay **(7)**.

In this study, 40.0% of patients developed peritonitis, and the death rate in patients who developed AL was 48.3% compared to the 3.5% in those who did not develop AL. Previous reports showed a 3% to 39% and 8 to 10-fold mortality rates after AL **(2, 4, 7, 20)**. In our series, the mortality rate was higher than the above reported rates, which may be explained by lack of early suspicion, late clinical detection and or delayed intervention since this study could not find usage of diagnostic imaging techniques for the detection of leakage.

In our study, the risk of relaparotomy was high in patients with AL; most patients (71.4%) with AL had relaparotomy compared to the 1.9% relaparotomy rate in those without AL. Compared to a 3.8% of patients without AL, 62.9% of patients with AL stayed more than 3 weeks in hospital. AL is associated with significantly prolonged hospital stay as well as considerable extra costs **(4,7)**.

Conclusion and recommendation:

The incidence of AL in gastrointestinal anastomosis in our series was 9.9%. Low serum albumin and emergency procedures are strong risk factors for AL. The occurrence of AL significantly increases the rate of relaparotomy, sepsis, postoperative mortality and duration of hospital stay.

Awareness of the risk factors, suspicion of AL, and thorough evaluation of patients may impact perioperative decision-making, surgical technique and patient care.

Optimization of nutrition prior to elective GI anastomosis may prevent AL and its far-reaching consequences.

Emergency GI resection and anastomosis should be handled with utmost care. Prospective studies should be conducted to identify determinant factors for AL. We also recommend the four hospitals to have better patient record keeping.

ACKNOWLEDGMENT

We would like to thank the administrations of Tikur Anbessa, Menelik II, ZM, and Yekatit 12 Hospitals for cooperation during data collection. We also thank the Addis Ababa University College of Health Sciences for funding the study.

REFERENCES

1. Chunsheng Li, Yakun Zhao, Zhenqi Han et al. Anastomotic leaks following gastrointestinal surgery: updates on diagnosis and interventions. Int J ClinExp Med. 2016; 9 (3):7031-7040.
2. Lipska MA, Bissett IP, Parry BR et al. Anastomotic Leakage after Lower Gastrointestinal Anastomosis: Men are at a higher Risk. ANZ J Surg. 2006 Jul;76(7):579-85.
3. J Bruce, Z H Krukowoski, G Alkhairz et al. Systematic Review of the Definition and measurement of anastomotic leak after GI Surgery. BJS. 2001;88:1157-168.
4. Neils Komen. New Approach towards risk assessment, diagnosis and preventive strategies of colorectal anastomotic leakage, Rotterdam 2014.
5. Theodore R. Schrock., Clifford W. Deveney, J E Dunphy . Factors Contributing to Leakage of Colonic Anastomoses. Ann Surg. 1973 May;177(5): 513–518.
6. Freek Daams, Misha Luyer, Johan F Lange. Colorectal anastomotic leakage: Aspects of prevention, detection and treatment. World J Gastroenterol. 2013 Apr 21;19(15): 2293–2297.
7. Amrika Seshadri. Clinical Factors Influencing Bowel Anastomotic Leak. International Journal of Biomedical Research 2016;7 (6):350-355.
8. Hirst NA, Tiernan JP, Millner PA et al. Systematic review of methods to predict and detect anastomotic leakage in colorectal Surgery. Colorectal Dis.2016;16 (2):95–109.
9. Stefanus J van Rooijen, Audrey CHM Jongen, Zhou-Qiao Wu et al. Definition of colorectal anastomotic leakage: A consensus survey among Dutch and Chinese colorectal surgeons. World J Gastroenterol. 2017 Sep 7;23(33):6172–6180.
10. Andre L Moreir, Pokala R Kiran, Matthew Kalady et al. Anastomotic Leak After Ileocolic Anastomosis: Risk Factor Analysis, SSAT.2007 Posters.
11. Rizwan Sultan, Tabish Chawla, Masooma Zaidi. Factors affecting anastomotic leak after colorectal anastomosis in patients without protective stoma in tertiary care hospital. JPMA. 2014; 64:166-170.
12. Koianka Trencheva, Kevin P Morrissey, Martin Wells et al. Identifying Important Predictors for Anastomotic Leak After Colon and Rectal Resection: Prospective Study on 616 Patients. Ann Surg.2013;257:108–113.
13. Sung-Ho Kim, Sang-Yong So, Young-Suk Park et al. Risk Factors for Anastomotic Leakage: A Retrospective Cohort Study in a Single Gastric Surgical Unit. J Gastric Cancer 2015;15(3):167-175.
14. Nair A, Pai DR, Jagdish S. Predicting anastomotic disruption after emergent small bowel surgery. Dig Surg. 2006;23 (1-2):38-43.
15. Benjamin R Phillips. Reducing gastrointestinal anastomotic leak rates: review of challenges and solutions. Open Access Surgery 2016;9:5–14.
16. Ahmad Sakr, Sameh Hany Emile, Emad Abdallah et al. Predictive Factors for Small Intestinal and Colonic Anastomotic Leak: a Multivariate Analysis. Indian Journal of Surgery.2017;79(6):555–562.
17. Pickleman J, Watson W, Cunningham J et al. The failed gastrointestinal anastomosis: an inevitable catastrophe?. *J Am Coll Surg*. 1999;188 (5):473-82.
18. Hamed Ahmed Abd, El Hameed El-Badawy. Anastomotic Leakage After Gastrointestinal Surgery: Risk Factors, Presentation And Outcome. The Egyptian Journal of Hospital Medicine. 2014;57: 494-512.
19. Bodil Gessler, Olle Eriksson, Eva Angenete. Diagnosis, treatment and consequence of anastomotic leakage in colorectal surgery. Int J Colorectal Dis. 2017;32 (4): 549–556.
20. Mark A. Boccola, Joshu Lin, Warren M. Rozen et al. Reducing Anastomotic Leakage in Oncologic Colorectal Surgery: An Evidence-Based Review. Anticancer Res. 2010;30 (2):601-607.
21. Jones CE, Watson TJ: Anastomotic leakage following esophagectomy. ThoracSurgClin. 2015; 25:449-459.

22. Neil Hyman, Thomas L. Manchester, Turner Osler et al. Anastomotic Leaks after Intestinal Anastomosis:It's Later than You Think. Ann Surg.2007;245: 254–258.
23. Bielecki K, Gadja A. The causes and Prevention of Anastomotic Leak after Colorectal Surgery. Klin Onkol. 1999;12: 25-30.
24. Jeffrey Hammond, Sangtaeck Lim, YinWan et al. The Burden of Gastrointestinal Anastomotic Leaks: an Evaluation of Clinical and Economic Outcomes. J Gastrointest Surg. 2014;18(6): 1176–1185.