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Anastomotic Leakage After Gastrointestinal Surgery: Risk Factors, Presentation And Outcome

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Abstract

Background: Intestinal anastomosis is one of the most commonly performed surgical procedures, especially in the emergency setting and is also commonly performed in the elective setting when resections are carried out for benign or malignant lesions of the gastrointestinal tract. Anastomotic leak after gastrointestinal anastomosis is one of the important postoperative complication that leads to significant morbidity and adversely affects length of hospital stay.

Objective: To define the risk factors, presentation and outcome of anastomotic leakage after gastrointestinal anastomosis.

Methods: Prospective data collection from patients who underwent small or large bowel resection and anastomosis without fecal diversion in the surgical department in Al Zahraa University Hospital in the period between November 2010 and April 2014. Demographic details of the patients as well as preoperative, intraoperative and postoperative data were recorded. Leak found or not and on which postoperative day leak found. How it was identified (clinical or radiological) and how it was treated. Outcome of patients was recorded as mortality rate and postoperative hospital stay.

Results: There were 70 (63.64%) males and 40 (36.36%) female patients. Mean age was (44.23 ± 15.78) years. Anastomotic leak was occurred in 17 (15.4%) patients group I, while there was no leak in 93 patients (84.6%) group II. The mean postoperative period for diagnosis of anastomotic leakage was 9 days range (5-16) days.

Categorical variable found to be significantly affecting the outcome of anastomosis were age of the patients ($P \leq 0.001$), smoker versus nonsmoker ($P \leq 0.0001$), preoperative chemotherapy, radiation and anti T.B. ($P \leq 0.001$), type of surgery elective versus emergency ($P \leq 0.05$). Bowel preparation done in 73 versus not done in 37 ($P \leq 0.05$), level of anastomosis small bowel and choledocojejunostomy versus gastrojejunstomy and large bowel ($P \leq 0.001$), left versus right side colonic anastomosis ($P \leq 0.05$). Intraoperative blood loss ($P \leq 0.0001$). Blood transfusion >2 unit ($P \leq 0.0001$).

Mortality rate was (29.41%) 5/17 in group I, while it was (3.23%) 3/93 in group II. The postoperative hospital stay was (24.7 ± 5.92) days in group I, while for group II it was (12.83 ± 3.8) days.

Conclusion: Postoperative gastrointestinal anastomotic leak is a very serious complication that has great clinical impact on patients, putting surgeons in dilemmas of detection and management.

There is multiple risk and predictive factors associated with occurrence of leak were suspected in this study such as: older patients, preoperative anemia, hypoalbuminemia, immunosuppressive therapy, smoking, surgery performed in an emergency setting, without adequate bowel preparation, long operative time, intraoperative blood loss and blood transfusion and low pelvic anastomosis, but many factors remain unclear. The presentation of anastomotic leakage varying from severe peritonitis and leakage of bowel content through the wound or from the drain to asymptomatic (small pelvic abscess).

Early detection and expediently treatment is very helpful to improve the patients outcome but death after leak is most often a substitute for a critically ill patients and was infrequently the actual cause of death and so every effort needs to be made to bring down the mortality rates and hospital stay associated with anastomotic leak.

Key Words: Anastomotic leakage, gastrointestinal surgery, risk factors.

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Introduction

Intestinal anastomosis is one of the most commonly performed surgical procedures, especially in the emergency setting and is also commonly performed in the elective setting when resection are carried out for benign or malignant lesion of the gastrointestinal tract.[1]

Leakage from an anastomosis in the gastrointestinal tract that is often associated with increased morbidity, mortality rate[2] and adversely affect length of hospital stay and cost.[3]

The cause of the leakage may be multifactorial, including contribution from faulty technique, ischemia of the intestine at the suture line, excessive tension across anastomosis and mesentery, the presence of local sepsis, presence of obstruction distal to the anastomosis. The old patients, anemia, malnourished with several coexisting diseases, receiving high doses steroids, after chemoradio-therapy is more prone to develop the anastomotic leakage.[4]

Among other factors are male gender, smoking, obesity, alcohol abuse, long duration of operation, preoperative blood transfusion and timing during duty hours.[5]

The frequency and consequences of anastomotic failure vary according to the site within the gastrointestinal tract. Anastomotic leakage is the most important early complication after oesophageal anastomosis: incidences of up to 53% have been reported.[2] Anastomotic leak rates following colorectal anastomosis range from 4 to 26%.[6]

Surgeons are all familiar with potentially devastating consequences of an anastomotic leak. Patients classically develop agonizing abdominal pain, tachycardia, high fever and a rigid abdomen, often accompanied by hemodynamic instability. In these cases urgent return to the operating room for peritoneal washout and fecal diversion is generally required.[7] The mortality rate for an anastomotic leak in the literature typically is in the 6 to 39% range and a 10- 100% rise of permanent stoma.[8] However, a large number of patients ultimately found to have an anastomotic leak develop a more insidious presentation, often low grade fever, prolonged ileus, or failure to thrive.[9] In these patients making the diagnosis may be much more difficult as the clinical course is often similar to other postoperative infectious complications. These patients are often discharged from the hospital without the correct diagnosis in the present environment of cost containment as their nonspecific symptoms (i.e, poor appetite, failure to thrive) are not enough to (justify) continued hospitalization. i.e, he'll do better at home. Radiological imaging is usually required even then, the diagnosis may be elusive or at least uncertain.[7]

So the aim of this prospective study is to define the risk factors, presentation and outcome of anastomotic leakage after gastrointestinal anastomosis.

Study design: medical records from 2010- 2014 were studied. 110 consecutive patients underwent small or large bowel resection and anastomosis without fecal diversion. The patients were divided postoperatively into 2 groups: those with clinical anastomotic leakage confirmed by laparotomy or radiologicaly (group 1) and those without anastomotic leakage (group II). Preoperative, operative and postoperative clinical and biological findings were compared between the two groups

Inclusion criteria:

All adult patients having a small or large bowel resection with anastomosis and patients need bypass for unresectable diseased bowel.

Exclusion criteria:

i. Patients who underwent primary closure of small perforation
ii. Simple stoma and had their anastomosis protected by a proximal diversion.
iii. Patients who were transferred from outlying hospitals with a leak, abscess or fistula were excluded unless they redeveloped complication after surgery at our institution.
iv. Also patients who underwent anastomosis for bariatric surgery were excluded from this study.

Methods

Medical records of 110 patients who had undergone anastomosis at various levels in the gastrointestinal tract in the surgical department in Al Zahraa University Hospital in the period from November 2010 to April 2014 were

reviewed. To be eligible for this study, all adult patients having a small or large bowel resection and anastomosis either elective or emergency, open or laparoscopic without temporary diverting stoma and patients need bypass for unresectable diseased bowel. The preoperative and operative database include: age, sex, major medical conditions, previous major surgery, preoperative haemoglobin, albumin, blood urea nitrogen, serum creatinine, liver function tests and bowel preparation. Whether the patients were operated upon in an emergency or elective setting were noted, operative time, blood loss during surgery, intraoperative blood transfusion, surgical technique [laparoscopic or open], anastomotic technique [hand- sewn, stapled], anastomotic segment, drain placement, and nasogastric tube was recorded. After surgery, patients were followed up daily in the hospital until discharge. The patients were divided postoperatively into two groups: those with clinical evidence of anastomotic leakage confirmed by laparotomy or radiology (group I) n= 17 and those without anastomotic leakage (group II) n= 93.The definition of anastomotic leakage in the present study was: leakage of bowel content and or gas, pus from the drain or through the wound (fig. 1). Pelvic abscess, peritonitis or discharge of pus per rectum, postoperative pyrexia or septicemia with abdominal tenderness without any evidence of source of infection. All the clinical anastomotic leakage were confirmed by imaging technique, a water soluble contrast enema or CT scan study. Asymptomatic radiological anastomotic leakage was not considered because routine CT or enema was not performed after surgery. The following postoperative clinical and biological findings were recorded: fever, transient disturbances (absence of bowel movement, postoperative ileus and diarrhea), fluid collection by nasogastric aspiration and abdominal drainage, leak found or not and on which postoperative day leak found. How it was identified (clinical or radiological) and how it was treated, postoperative renal failure (blood urea-creatinine), oliguria and leukocytosis, mortality rate and hospital stay were also recorded.

After discharge the patients were followed weekly for the first month and monthly for 6 months postoperatively. Patients with a diverting stoma as a part of the gastrointestinal resection after reoperation for anastomotic leakage were followed up for several months until 45 days after the stoma was closed.

Statistical analysis

The statistical analysis of data was done by using spss program [statistical package for social science version 16] on windows 7 and Microsoft excel 2003

Data was expressed as follows:

1- Frequency and proportion for qualitative data
2- Mean ± SD for normally distributed quantitative data.

The analysis of data was done to test statistical significant between different groups

1- For qualitative data [frequency & proportion] chi-square test was used .
2- For quantitative data normally distributed (mean ± SD), unpaired Student's t test was used to compare the means of different groups

P. value is significant if ≤ 0.05 at confidence interval of 95%.

P. value ≤ 0.01 highly significant.

Results

The medical records of 110 patients who had undergone gastrointestinal anastomosis during the study period were reviewed. There were 70 (63.64%) males and 40 (36.36%) females patients, with a mean ± SD(44.23 ± 10.78) years range (19-69 years).Of 110 patients, 40 (36.36%) had undergone small bowel anastomosis, 55 (50.00%) had undergone large bowel anastomosis,11 (10%) had a gastrojejunostomy and 4 (3.64%) had choledochojejunostomy. 12 (10.91%) patients were diabetic, 10 (9.9%) were ischemic heart disease, 20 (18.18) were smoker, 4 (3.64%) patients were treated by chemotherapy, 2 (1.82%) patients were treated by radiotherapy and 3 (2.73%) patients were on anti-tuberculous drugs. 9 (8.18%) patients was tested positive for Hepatitis C virus and 8 (7.27%) patients had previous abdominal surgery. Table (1).

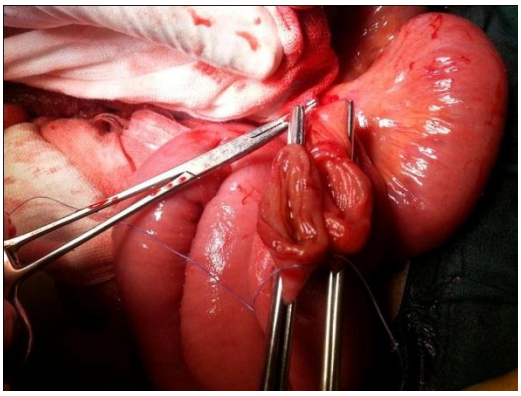
Table (1): Demographic Data

Sex	**Number**	**%**
• **Males**	70	63.64
• **Females**	40	36.36
	Mean	**SD**
Age	44.23	10.78
	(19 - 69)	
Smoking & Addiction	**Number**	**%**
• **Smokers**	20	18.18
• **Addicts**	7	6.36
• **None**	83	75.45
Medical Conditions	**Number**	**%**
• **DM**	12	10.91
• **HCV**	9	8.18
• **IHD**	10	9.09
• **Chemotherapy**	4	3.64
• **Radiotherapy**	2	1.82
• **Anti-TB treatment**	3	2.73
• **Previous abdominal surgery**	8	7.27

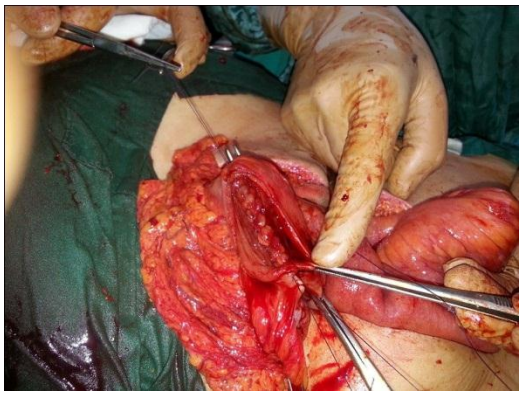
DM: Diabetes Mellitus HCV: Hepatitis C Virus IHD: Ischemic Heart Disease

The haemoglobin level range (8.5-14gm/dL) mean ± SD was (10.65 ± 2.65). The mean serum albumin level range (2.5-4.5gm/dL) mean ± SD was (3 ± 0.75).The serum creatinine level range (0.8- 1.9 mg/dL) mean ± SD was (1.9 ± 0.55). Type of surgery was elective in 73 (66.36%) patients and emergency in 37 (33.64%) patients. No bowel preparation was done on these patients operated on an emergency basis. Bowel preparation was done in 73 (66.36%) patients.

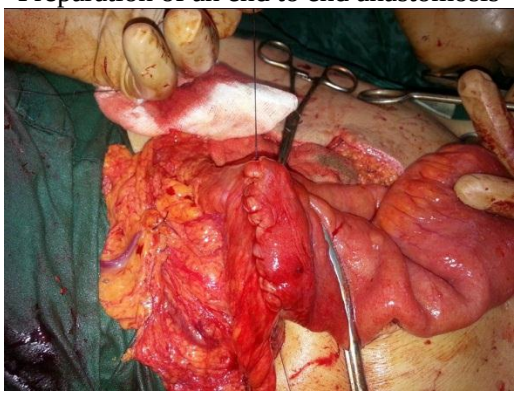
Surgical technique: was open in 90 (81.82%) patients, laparoscopic in 15 (13.64%) patients and converted in 5 (4.54%) patients. The intestinal anastomosis was end to end or end to side in cases of hand-sewn and both end to end and side to side functional end anastomosis in cases of stapled anastomosis depending on the site of anastomosis fig (1). A double layered, inverting either continuous or interrupted, hand sewn anastomosis was performed in 85 (77.27%) patients and stapled anastomosis was done in 25 (22.73%) patients by using gastrointestinal anastomosis (GIA) stapler, contour stapler or current circular stapler depending on location of anastomosis after having confirmed adequacy of blood supply to the cut ends of the bowel fig (2). The operative blood loss range (300- 1400 mL) mean ± SD was (342.93 ± 85.83). The volume of blood transfusion range (1-4unit) mean ± SD was (3.87 ± 0.91). Nasogastric decompression, urinary catheter and drain placement were done routinely in all patients Table (2).



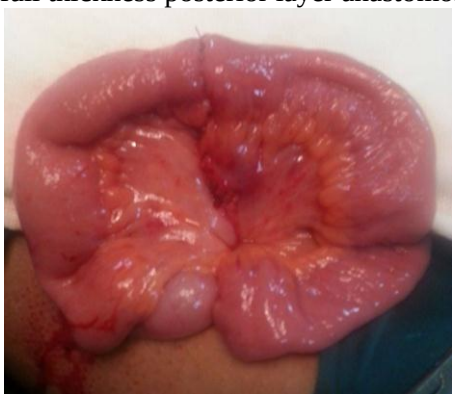
Preparation of an end to end anastomosis



Large intestine
A full thickness posterior layer anastomosis



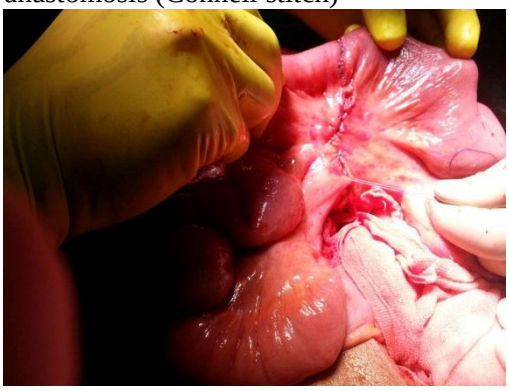
Large intestine



Small intestine

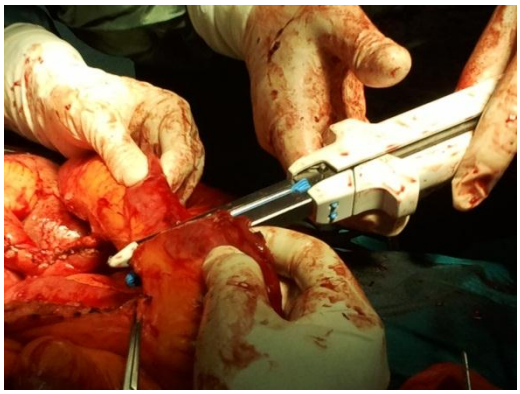
Completed the end to end anterior layer anastomosis (Connell stitch)

Interrupted anastomosis for the anterior layer
(Small intestine)



Anastomosis completed with closure of the mesentery

Fig (1): Hand-sewn anastomosis



Linear cutting stapler

Contour stapler

Circular stapler

Fig (2): Staplers used in our study

Table (2): Preoperative, operative and postoperative data

Preoperative Data	**Mean**	**SD**
Preoperative Hb level	10.65	2.65
Preoperative albumin level	3.1	0.75
Preoperative creatinine level	1.09	0.55
Preoperative Bowel Preparation	Number	%
Yes	73	66.36
No	37	33.64
Type Of Surgery	Number	%
Elective	73	66.36
Emergency	37	33.64
Surgical Technique	Number	%
Open	90	81.82
Laparoscopic	15	13.64
Converted	5	4.55
Level Of Anastomosis	Number	%
Small Bowel	40	36.36
Gastrojejunostomy	11	10.00
Choledochojejunostomy	4	3.64
Large Bowel	55	50.00
Colicocolic	25	22.73
Rt Ileocolic	8	7.27
Lt Ileocolic	6	5.45
Colicorectal	8	7.27
Colicoanal	4	3.64
Ileorectal	2	1.82
Ileoanl	2	1.82
Type Of Anastomosis	Number	%
Hand Sewn	85	77.27
Stapled	25	22.73
	Mean	**SD**
Operative blood loss	342.93	85.83
Volume of blood transfusion	3.87	0.91
	Number	%
Drain placement	110	100.00
Nasogastric decompression	110	100.00

Hb = Hemoglobin

Anastomotic leakage was occurred in 17 of 110 patients (15.4%) group I, no anastomotic leakage was found in 93 patients (84.6%) group II. On postoperative day 3 significantly more patients in group I had fever above 38^{o}C than in group II 8/17 (47.06%) versus 13/93 (13.98%) ($P \leq 0.01$). More in group I patients than in group II patients also had transient disturbances, they included the absence of bowel movement on postoperative day 4, 7/ 17 (41.18%), versus 10/93 (10.75%) ($P \leq 0.01$). and diarrhea before postoperative day 6 5/17 (29.41%) versus 8/93 (8.60%).From postoperative day 2 to 4, amount of drainage fluid exceeding 500ml were collected significantly more from group I patients than group II patients 9/17 (52.74%) versus 12/93 (12.90%) ($P \leq 0.01$). No significant difference was noted between the two groups for nasogastric fluid aspiration 1.200 mL on 3rd postoperative day. On postoperative day 4 significantly more from group I than group II patients had oliguria urine output less than 400CC/ day 6/17 (35.29%) versus 15/93 (16.13%) ($P \leq 0.01$). Renal failure on postoperative day 3-5 affected significantly more patients in group I than group II 3/17 (17.65%) versus 5/93 (5.38%) ($P \leq 0.01$). After postoperative day 6, significantly more group I patients than group II had leukocytosis (WBC) over 12, 000/mm^{3}/ 14/17 (82.35%) versus 23/ 93 (24.73%) ($P \leq 0.01$). Table (3).

Table (3): Predictive factors for anastomotic leak.

	Leakage n = 17		No Leakage n = 93		
	Number	**%**	**Number**	**%**	**P value**
Postoperative					
Fever	8	47.06	13	13.98	
Absence of bowel movement	7	41.18	10	10.75	< 0.01
Diarrhea	5	29.41	8	8.60	
Amount of drainage					
> 500 cc	9	52.94	12	12.90	< 0.01
< 500 cc	8	47.06	7	7.53	
Postoperative renal failure	3	17.65	5	5.38	< 0.01
Postoperative oliguria	6	35.29	15	16.13	< 0.01
Postoperative leukocytosis	14	82.35	23	24.73	< 0.001

The mean postoperative period for diagnosis of anastomotic leakage was 9 days range (5- 16 days). In 7 patients, it was identified by drain output and 4 patients were clinically diagnosed at a mean of 8 days (5-12 days) postoperatively fig (3). The remaining 6 patients were diagnosed radiologicaly at a mean 16 day's postoperatively. Contrast enema was obtained in 4 cases, the leak was observed in one case, but in 3 cases the test was falsely negative. CT scan were obtained in 5 cases, the leak was correctly diagnosed in 4 cases, but one scan was falsely negative fig (4).

Out of the 17 patients from group I with anastomotic leakage, 9 patients required fecal diversion after another exploratory laparotomy and washout of peritoneal cavity and repair of the leak fig (5). 5 patients were able to be managed non-operatively (typically with radiologic drainage and antibiotics) fig (6). 2 patients had conservative management of the leak done and one patient died before reoperation and anastomotic leakage was confirmed by (autopsy). No permanent diverting stoma was observed in this study.

Fig (3): Pictures of leakage of bowel content though the wound

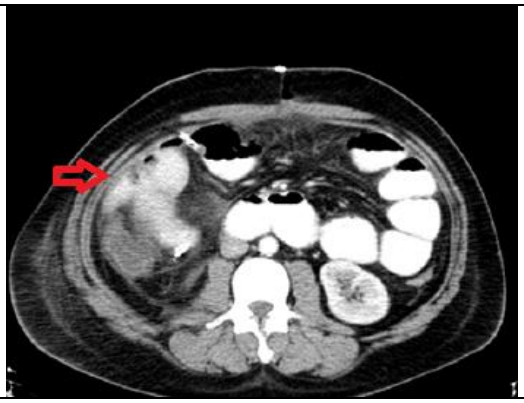


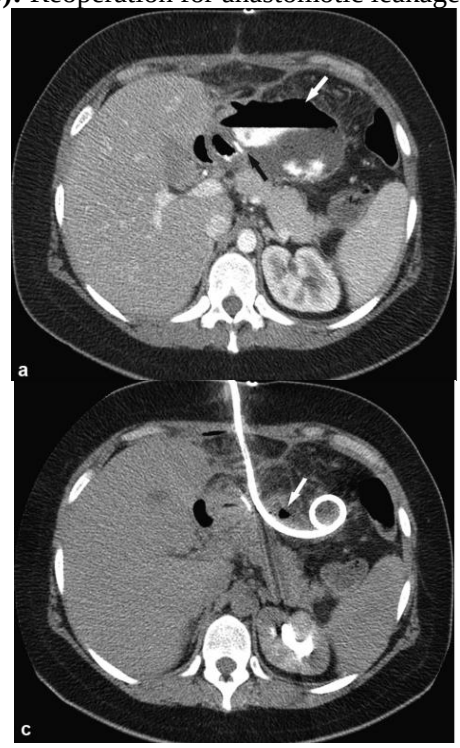
Fig (4): Oral and IV contrast axial CT, of a male patient postoperative follow up, revealed: mild amount of free pelvi-abdominal fluid extending from right iliac fossa lateral to ascending colon with dense fluid collection.....denoting contrast leakage.

Anastomotic dehiscence during re-exploration

Repair of the leak

Temporary diverting stoma after repair of the leak (Ileostomy)

Fig (5): Reoperation for anastomotic leakage.



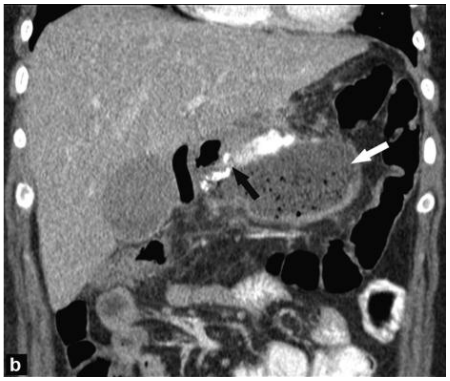


Fig (6): Abscess at the lower part of the staple line due to a leak. a: axial CT of the upper part of the abdomen showing a large collection with a fluid level (white arrow) containing contrast material adjacent to the staple line; b: coronal CT showing the leak between two staples and the abscess (black arrow); c: axial CT showing resolution of the abscess after drainage.

Categorical variable found to be significantly affecting the outcome of anastomosis were age of the patients ($P \leq 0.001$), smoker versus nonsmoker ($P \leq 0.0001$), preoperative chemotherapy, radiation and anti T.B. ($P \leq 0.001$), type of surgery elective versus emergency ($P \leq 0.05$). Bowel preparation done

in 73 patients versus not done in 37 patients ($P \leq 0.05$), level of anastomosis small bowel and choledocojejunostomy versus gastrojejunstomy and large bowel ($P \leq 0.001$), left versus right side colonic anastomosis ($P \leq 0.05$). Intraoperative blood loss ($P \leq 0.0001$). Blood transfusion >2 unit ($P \leq 0.0001$).

Certain factors were not significant in our study for their impact on the anastomotic leak: they include: gender of the patients, diabetes mellitus, ischemic heart disease, HCV ($P > 0.05$). Surgical technique, type of anastomosis, drain placement, nasogastric decompression ($P > 0.05$) Table (4).

Table (4): Comparison between data of both groups (those with leakage and those without leakage)

	Leakage n = 17		**No Leakage n = 93**		
	Number	**%**	**Number**	**%**	**P value**
Age					
Above 65	6	**35.29**	15	**16.13**	
Below 65	11	**64.71**	78	**83.87**	< 0.001
Gender					
Males	5	**29.41**	35	**37.63**	
Females	12	**70.59**	58	**62.37**	> 0.05
Comorbid conditions					
DM	3	**17.65**	9	**8.60**	
IHD	4	**23.53**	6	**6.45**	> 0.05
HCV	5	**29.41**	4	**4.30**	
Smoking					
Smokers	8	**47.06**	12	**12.90**	< 0.0001
Addicts	3	**17.65**	4	**4.30**	
None	6	**35.29**	77	**82.80**	
Other Treatment					
Chemotherapy	2	**11.76**	2	**2.15**	
Radiation	1	**5.88**	1	**1.08**	< 0.001
Anti-TB treatment	1	**5.88**	2	**2.15**	
None	13	**76.47**	88	**94.62**	

Cont. Table (4)

	Leakage n = 17		No Leakage n = 93		
	Number	**%**	**Number**	**%**	**P value**
Previous abdominal surgery					
Yes	6	35.29	2	2.15	**<0.0000**
No	11	64.71	91	97.85	**1**
Preoperative Hb level					
> 11 g	11	64.71	15	16.13	**<0.0000**
< 11 g	6	35.29	78	83.87	**1**
Preoperative ALB level					
> 3 g	7	41.18	81	87.10	**<0.0000**
< 3 g	10	58.82	12	12.90	**1**
Elective	9	**52.94**	64	**68.82**	
Emergency	8	**47.06**	29	**31.18**	**< 0.05**
Bowel preparation					
Yes	9	**47.06**	64	**68.82**	
No	8	**52.94**	29	**31.18**	**< 0.05**
Surgical technique					
Open	14	**82.35**	76	**81.72**	
Lap	2	**11.76**	13	**13.98**	**> 0.05**
Converted	1	**5.88**	4	**4.30**	
Type of anastomosis	**Number**	**%**	**Number**	**%**	
Hand Sewn	12	**70.59**	73	**78.49**	**> 0.05**
Stapled	5	**29.41**	20	**21.51**	
Level of anastomosis					
Small bowel	3	**17.65**	37	**39.78**	**< 0.0001**
Gastrojejunostomy	1	**5.88**	10	**10.75**	**< 0.05**
Choledochojejunostomy	1	**5.88**	3	**3.23**	**> 0.05**
Large bowel					
Colicocolic	3	**17.65**	22	**23.66**	**> 0.05**
Rt Ileocolic	1	**5.88**	7	**7.53**	**> 0.05**
Lt Ileocolic	2	**11.76**	4	**4.30**	**< 0.05**
Colicorectal	2	**11.76**	6	**6.45**	**> 0.05**
Colicoanal	2	**11.76**	2	**2.15**	**< 0.05**
Ileorectal	1	**5.88**	1	**1.08**	**> 0.05**
Ileoanl	1	**5.88**	1	**1.08**	**> 0.05**
Intraoperative blood loss					
< 500 cc	8	**47.06**	5	**5.38**	
> 500 cc	9	**52.94**	8	**8.60**	< 0.0001
Blood transfusion					
< 2 units	8	**47.06**	7	**7.53**	
> 2 units	9	**52.94**	4	**4.30**	< 0.0001
No blood transfusion	0	**0.00**	82	**88.17**	
Operative time					
< 240 min	4	**23.53**	1	**1.08**	< 0.0001
> 24 min	13	**76.47**	92	**98.92**	

ALB: Albumin Level ***P is significant if ≤0.05*** ***P is highly significant if <0.001***

The overall mortality rate was 8/110 (7.2%) it was significantly higher in group I than group II. 5/17 (29.41%) in group I versus 3/93 (3.23%) in (group II) ($P \leq 0.001$). Causes of death in group I: was multiple organ dysfunction n=3, gastrointestinal bleeding in one patient and disseminated intravascular coagulation (DIC) in one patient and in group II cardiac dysfunction in one patient, liver failure in 2 patients.

The mean postoperative hospital stay was (20 days) range (8-35 days), for group I it was (17-35 days) mean ± SD was (24.7 ± 5.92), while for group II it was (8-16 days) mean ± SD was (12.83 ± 3.8), ($P \leq 0.001$).

According to our study results the rate of anastomotic leak during the study period was 15.4%. Beside there was statistically significant mortality ($P \leq 0.001$).

Table (5): Mortality rate and hospital stay in our study.

	Leakage n = 17		**No Leakage n = 93**		
	Number	**%**	**Number**	**%**	**P value**
Mortality	5	29.41	3	3.23	< 0.001
	Mean	SD	Mean	SD	
Hospital Stay	24.67	5.92	12.83	3.8	< 0.001

Discussion

Anastomotic leakage is the most serious complication specific to intestinal surgery and range from 2.9% to as high as 15.3%.[10] However, there is lack of a clear definition for what constitutes an anastomotic leak [radiological proven, clinically relevant, with or without abscess].[11] But the definition of anastomotic leakage in our study was leakage of bowel content and or gas or pus from the drain or through the wound, pelvic abscess, peritonitis or discharge of pus per rectum, postoperative pyrexia or septicemia with abdominal tenderness without any evidence of source of infection.

The definition of leak after bowel surgery usually included peritonitis (localized or generalized), fecal or purulent drainage from the wound and / or drain, presence of an abscess and fever.[2] Numerous risk factors have been implicated as predisposing for anastomotic leaks. Factors that were found to correlate with an increased leakage rate were older age, anemia, prior radiation therapy, intraperitoneal infection and anatomic level of anastomosis.[12]In our study we found that there is a statistically significant increase of anastomotic leak in patients above 65 years 6/21 versus 11/89 in patients below 65 years old P< 0.001.

In general the postoperative mortality rate in geriatric surgical patients over 70 years is low. Despite the increased prevalence of preoperative chronic medical conditions, most patients do well postoperatively. However the ASA classification (III + IV) emergency surgery, a history of hypertension, pulmonary, neurologic and coronary artery diseases increases the odds of developing any postoperative adverse events in elderly patients.[13] Among patient related factors, male gender is generally accepted as a risk for anastomotic leakage.[14,15] Some recent studies showed that male patients, have a high risk of complications in open and laparoscopic surgery.[16]We also found there is increase of anastomotic leakage in male patients but were not of significance statistical value. Systemic conditions were associated with increased risk of anastomotic leakage in our study are anemia and hypoalbuminemia ($P< 0.001$). The assessment of nutritional status were done based on two biochemical parameters, namely haemoglobin, hematocrit and serum albumin estimation. The mean value of serum albumin in these patients was 3.71%, anemia Hb 11g and hematocrit below 33%. However many studies reveal that both prolonged and short term malnutrition diminish anastomotic healing.[4,11,17] 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 patients

immuno-competence.[18] Diabetes, ischemic heart disease and Hepatitis C virus is another causes of anastomotic leakage in this study, but it did not have statistical significant effect. In this study out of 17 patients who developed anastomotic leak 3 of them were diabetic, 5 were HCV and 4 were ischemic heart diseases. Little evidence indicates that diabetes affects GI healing. A direct effect of the diabetic state of the healing process is difficult to separate from an impairment caused by increased abscess formation**.**[19]Smoking and addiction were the independent risk factors associated with anastomotic leak in our study ($P< 0.0001$). We agree with ***Sultan et al.[3], Daams et al.[20], Trencheva et al.[21]***. These investigators found that there is highly significant anastomotic leak in smoking patients.

Smoking and alcohol abuse are important predictive factors for anastomotic leakage after colonic and rectal resection**.**[20,22] Preoperative chemotherapy, radiotherapy and anti-tuberculous drugs are associated with highly significant risk factors for anastomotic leak in this study. Chemoradiation may predispose to anastomotic problem in patients having colon surgery, particularly in patients with anastomosis in the pelvis. Anastomotic leak and radiation therapy may contribute to the formation of pelvic abscess, rendering the neorectum stiff and noncompliant. After reconstruction, patients may suffer from tenesmus and fecal incontinence.[12]

Previous abdominal surgery was independent risk factor in anastomotic leak in our study. After open lower abdominal surgery adhesion related problems and readmission rates were mostly influenced by the initial site of surgery: colon and rectal resection having the highest relative risk of problems directly related to adhesion.[23]

Type of surgery and bowel preparation were independent risk factors of anastomotic leakage in this study. We found that there is increase of anastomotic leak in patients who operated in emergency 8/37 versus 9/73 in elective cases and in patients who are not attending bowel preparation versus the prepared cases. Several well designed prospective randomized trials have shown that preoperative bowel cleaning does not prevent anastomotic leakage or wound infection in patients undergoing open or laparoscopic colorectal surgery.[14,24]However, some randomized trial have reported significant differences in outcomes with use of oral antibacterial agents and mechanical preparation.***Irvin and Goligher,***[25]:reported significant decrease in anastomotic dehiscence with use of mechanical preparation than that without mechanical bowel preparation. ***Burke et al.***[26]have provided further evidence that question the use of bowel preparation showing no difference in outcome after colon surgery between prepared and unprepared patients**.**[3]

Surgical technique, either open, laparoscopic, or converted were not associated with significant difference of anastomotic leakage in our study. Laparoscopic colon surgery was first described by ***Redwine and Sharpe***[27] and multiple level I studies show the advantages include less intraoperative trauma, reduction in postoperative adhesions, decreased postoperative pain, decreased length of ileus, better cosmesis, early discharge from hospital and early return to work**.**[28,29]Operating room costs are significantly higher, but the difference in overall hospital charges has not been found to be statistically significant.[30]

The available data comparing the anastomotic leakage rate in laparoscopic or open operated patients showed no difference regardless of the level of the anastomosis.[31]

We reported that patients whose surgery converted from laparoscopic to open tended to have longer operating time, higher morbidity and more prolonged hospital stay.We agree with ***Tjandra and Chan,***[28]about this point. Also, there is no significant difference in anastomotic leakage was noted between hand sewn and stapling procedures. In relation to efficacy, applicability and safty, it has been demonstrated that the use of surgical stapling instruments is comparable to that of conventional suturing methods. In certain situation, staplers offer the facility to achieve reconstructions that would be difficult to be accomplished manually and their popularity in that setting seen justifiable**.**[32]

A meta- analysis, concluded that there is no difference between hand-sewn and stapled anastomosis for the majority of outcome measures including mortality, leak rates, local

cancer recurrences and wound infection.[20,33,34,35,36] However, in a recent coherence review ileocolic stapler anastomosis were associated with fewer leaks than hand sewn anastomosis.[37]

On contrary: ***Cheng et al.***[38]concluded that: stapled anastomosis showed a trend to a higher leakage rate, but the difference did not reach statistical significance.

We noted that prolonged operative time was associated with highly significant rate of anastomotic leaks ($P< 0.0001$). In a series of 541 colorectal anastomosis between 1999 and 2004 at a single colorectal unit, univariate analysis show that a prolonged operating time had a odd ratio of 2.8 for developing anastomotic leakage.[39] Many studies showed that prolonged operating time correlated with higher anastomotic leak.[11,20,29]

A highly statistically significant relation was found between intra operative blood loss, intra operative blood transfusion and anastomotic leak. ($P< 0.0001$) we agree with ***Kirchhof et al.,[11]; Kiran et al., [40]*** about this point.

Blood transfusion are known to have an immuno- suppressive effect. As a result tumor growth may be enhanced, the incidence of tumor recurrence may be high, there can be prolonged allograft survival in transplantation procedures and increased susceptibility to infection.[41,42]In the peritoneal cavity there could be delayed healing of anastomosis and increased incidence of intraperitoneal sepsis.[43]

Routine nasogastric decompression and abdominal drains in patients undergoing a procedure involving an intestinal anastomosis remain controversial. Abdominal drains and nasogastric tubes were routinely inserted in all patients in this study. In retrospective and prospective randomized, controlled trial, routine use of a nasogastric tube conferred no significant advantage.[44,45] In fact, there was a trend toward an increased incidence of respiratory tract infections after routine gastric decompression.[17] Nonetheless, one study found that nearly 20% of patients required insertion of gastric tube in the early postoperative period.[44]

The value of prophylactic drainage in intestinal anastomosis has been studies extensively currently available data from randomized controlled trials point out that a routine prophylactic drainage provides no benefit after uncomplicated major colon and rectal surgery.[46] On contrary, a no drain policy was associated with less and a fewer anastomotic leaks, these studies underscore the low sensitivity of drains in detecting leakage and bleeding, which questions the putative warning function of a prophylactic drain. In summary, there is sufficient evidence showing that routine drainage colorectal anastomosis does not prevent leaks or other complications.[47,48] This finding to the contrary, many surgeons elect to place an intra-abdominal drain to the pelvis after an anterior resection or a coloanal anastomosis because of the higher than unusual risk that a fluid collection will develop. Drainage is rarely helpful, indeed easy, after a gastric or small bowel anastomosis. Drains are indicated, however, after emergency operations for peritonitis or trauma in which it was necessary to close or anastomose damaged or inflamed bowel.[17] Left side anastomosis, colorectal and ileoanal anastomosis were the independent risk factors associated with anastomotic leak in our study. Most studies comparing high and low anterior resections have shown that the level of anastomosis is the most predictive factor for leakage. Higher leak rate are typically reported for low pelvic anastomosis or anastomosis to the anal canal.[3,7,21,49]

The present study found a clinical leakage rate of 15.4%. This rate is at the higher level of incidence reported by several investigators which range from 2.8%-15%.[7,38,50,51,52,53] ***Sultan et al***[3] reported 15% anastomotic leakage in their study in agree with our results. The reason behind the higher rate of leakage in our study were not proximally diverted while in rest of the studies patients population was mixed i.e. proximally diverted as well as not diverted.

The mean postoperative period for diagnosis of anastomotic leakage was a 9 days range [5-16 days] in our study. Anastomotic leakage typically becomes clinically apparent between the 5^{th} and 8^{th} postoperative day, but many exceptions exist, with one study even reporting a mean of the 12^{th} postoperative day for the diagnosis of anastomotic leakage.[7] Interestingly in recent study anastomotic leaks

were more often after hospital discharge.[54] Clinical signs of systemic inflammatory response syndrome, fever, ileus and pain are frequent but have low positive predictive value for anastomotic leak, when observed separately. In a study by ***Dendulk et al.***[55] these clinical features were combined into a clinical scoring system (Dutch leakage score), with patients were scored daily in a systematical and uniform way. Points are attributed to certain clinical criteria i.e. fever, heart rate, nutritional status, signs of ileus, gastric retention, type of intake and laboratory findings i.e. C- reactive protein (CRP) level, leucocytes, kidney function. In our study we also recorded the fluid collected by nasogastric aspiration and abdominal drainage and urine output. After applying the score system retrospectively on a historical cohort, the score was used prospectively: it was shown that patients with a high score were prone to anastomotic leakage requiring intensive clinical observation or radiological evaluation. This scoring system reduced delay in diagnosis of anastomotic leak from 4 to 1.5 days, decreasing false negative diagnostic imaging representing a major factor of delay in diagnosis.[56]

Water soluble enemas or CT scans are widely used for diagnosis of anastomotic leak, CT scanning appear to be far more helpful than contrast enema in the radiologic diagnosis of the leak. CT scan were obtained in 5 cases, the leak was correctly diagnosed in 4 cases but one scan was falsely negative. On contrary contrast enema was obtained in 4 cases, the leak was observed in one case, but in 3 cases the test was falsely negative. CT scan does appear to be the radiologic procedure of choice to diagnose an anastomotic leak after intestinal surgery when clinical finding alone insufficient.[7]

When facing and treating patients with anastomotic leak, surgeons have to take into account many different aspects i.e, age, health status and current clinical condition of the patient, extent of dehiscence, time between operation and reoperation, indication of primary resection and localization of the anastomosis. These variable lead to individualization of treatment strategies and in comparable outcome. However: few studies, showing that surgeons believe that the anastomosis can be repaired rather than dismantled, have paved the way for a trial in which next to mortality and morbidity, preservation of the anastomosis could be one of the endpoints.[20,57]

The overall mortality rate in our study was 8/110 (7.2%). It was significantly higher in patients with anastomotic leak 5/17 (28.41%) versus 3/93 (3.23%) in patients without anastomotic leak ($P< 0.001$). In comparison with other studies we approximate with the study of ***Sultan et al.***[3], they reported 15.79% mortality rate of their patients with anastomotic leak and high in comparison with the study of ***Hyman et al.***[7], they found mortality rate 5.7% of their patients, ***Cheng et al.***[38] the mortality rate 1.4%, ***Trenchval et al.***[21] the mortality rate 0.9% ***Alves et al.***[50] the mortality rate 12% and ***Buch et al.***[58] the mortality rate was 12.9% of their patients with anastomotic leakage. In four of five deaths, leaks occurred in very ill patients undergoing emergency procedure and appeared to be premorbid events.

There was no case with permanent diverting stoma in this study. On contrary ***Brisinda et al.***[8] reported that anastomotic leakage has been associated with a 6-39% mortality rate and a 10-100% risk of permanent stoma.

Morbidity of dramatically increased opposed patients without colonic anastomotic leakage and leads to reoperations, radiological intervention and permanent stoma in 56%.[59]

Conclusion

Postoperative gastrointestinal anastomotic leak is a very serious complication that has great clinical impact on patients, putting surgeons in dilemmas of detection and management.

There is multiple risk and predictive factors associated with occurrence of leak were suspected in this study such as: older patients, preoperative anemia, hypoalbuminemia, immunesuppressive therapy, smoking, surgery performed in an emergency setting, without adequate bowel preparation, long operative time, intraoperative blood loss and blood transfusion and low pelvic anastomosis, but many factors remain unclear.

The presentation of anastomotic leakage varying from severe peritonitis and leakage of bowel content through the wound or from the drain to asymptomatic (small pelvic abscess).

Early detection and expediently treatment is very helpful to improve the patients outcome but death after leak is most often a substitute for a critically ill patients and was infrequently the actual cause of death and so every effort needs to be made to bring down the mortality rates and hospital stay associated with anastomotic leak.

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