Outcomes of Side to End versus End to End Colorectal Anastomosis in Non-emergent Sigmoid and Rectal Cancers. Randomized Controlled Clinical Trial.

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Research Article

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Abstract

Purpose

The outcomes of open side-to-end colorectal anastomosis versus open end to end colorectal anastomosis in non-emergent sigmoid and rectal cancers open surgery in adults were compared.

Methods

A randomized controlled trial on individuals with sigmoid and rectal cancers was conducted between September 2016 and September 2018.

Results

The majority of the participants in the study were between the ages of 50 and 70 years, with a mean age of 62.58 ± 12.3 years in the side-to-end anastomotic group (SEA group = group A = antegrade approach) and 61.03 ± 13.98 years in the end-to-end anastomotic group (EEA group = group B = retrograde approach), respectively. Except for the operative time, intraoperative data revealed no significant differences between the studied groups, and the SEA group revealed that the mean anastomotic time was significantly shorter. Perioperative blood loss, length of stay, reoperation, inpatient death, infection, and bleeding were all revealed to be significantly associated with leakage in univariate analysis. In a multivariate analysis of anastomotic leaks, infection was the only independent predictor. There is a statistically significant change regarding the range of bowel frequency in the EEA group only ($p = 0.04$). There is a statistically significant difference regarding incontinence for Flatus in the SEA group only ($p = 0.00$). A statistically significant change in both groups regards incontinence for liquid stools ($p = 0.00$) and clustering of stools ($p = 0.00$ and $p = 0.043$). The quality of life (QOL) in the SEA group significantly dropped at 6 months and returned to baseline after that as regards PWB, FWB, and CCS with no difference as regards SWB & EWB, while in the EEA group, the exact change happened only as regard PWB & FWB, but SWB and CCS percentage did not return to baseline.

Conclusion

The SEA group offers a safe and approach alternative to the EEA group.

Introduction

Colon and rectal cancer prevalence come next to bronchogenic and prostatic malignant neoplasms in males, but it is second in females, following cancer of the breast. [1] Despite the fact that 1,000,000 patients are diagnosed each year and thousands die as a result of this cancer, the number of people

living with it has increased in recent years as a result of both expensive research tools and novel intervention techniques. Over two-thirds of colorectal cancer patients survived 5 years. [2–3].

The goal of colorectal surgery is to combine well-balanced free margin resection with bowel, urinary, and potency activity [4–5]. In recent surgery, laparoscopic colorectal surgery for cancer had a well-known corner that challenged the open technique. Nonetheless, due to expense or a lack of qualified laparoscopic colorectal surgeons, the laparoscopic method may not be used in some areas. [6]. Colorectal surgery involves a lot of complications. Anastomotic leaking is the most serious complication. Following colon resection and anastomosis, anastomotic leakage can account for up to 15% of cases, resulting in substantial morbidity and death [7–9]. The stapler's introduction into colorectal surgery allowed for a more homogeneous anastomosis, less pressure on the suture, faster surgery, no intra-abdominal contamination, no incursion of anastomotic site perfusion, and a lower prevalence of anastomotic leakage [10–12]. Low anterior resection syndrome (LARS) is correlated with rectum resection and affects quality of life [13–14].

The purpose of the work, the gap statement, and the study's strength: During colorectal cancer surgery, there is no definitive approach of resection and anastomosis, and surgeons usually follow their experience. We conducted a randomized clinical trial to compare the outcomes of two different open techniques for resection and anastomosis employing a single circular stapler. The main goal was to compare the incidences of anastomotic leakage after both techniques. The secondary goal was to compare both groups' functional outcomes and quality of life. The tertiary goal was to assess the rate of morbidity and mortality in both techniques.

Patients And Methods

Study design: From September 2016 to September 2018, a prospective randomized trial at the colorectal surgery unit of our university hospital. Because the frequency of leakage in the published study [15] was 29.2 percent versus 5.4 percent, the sample size for each group will be 37, with a power of 80 percent and a confidence level of 95 percent appropriate for statistical significance ($p < 0.05$). It's a simple random sample with a balance. A random sequence computer was used to distribute patients at random. Patients were assigned numbers at random in sealed envelopes that were unsealed immediately before the anastomosis was completed intra-operatively. Until the end of the trial, the patients had no idea which group they were in. It is the registration office's responsibility.

Participant criteria: In order to participate in the study, patients had to fulfill the following criteria: Sigmoid and rectum adenocarcinoma confirmed by biopsy and histopathological examination, R0 resection with immediate restoration of colorectal continuity with or without covering proximal ostomy, patients > 18 years of both sexes, with or without neo-adjuvant treatment, residual rectal stump > 3 cm from the anal verge for carcinoma rectum, and clinically normal function of the anal sphincter. Exclusion criteria included patients younger than 18 years, psychopathic patients, recurrent or non-resectable cancer,

combination operations, and complicated cancer, e.g., obstructed or perforated tumor-infiltrating anal sphincter, and previous left-sided colorectal surgery or ano-rectal surgeries.

Types of outcome and measurement (study endpoints): The incidence of anastomotic leak during hospital admission and the first 30 days after surgery is the primary outcome. Intestinal function and quality of life one month, six months, twelve months, and 24 months after surgery are secondary outcomes. The operative time (in minutes), intraoperative haemorrhage (ml), vessel injury at operation, hematoma/seroma, the span of hospital admission (in days), wound infection at any time point, in-hospital mortality, ICU/days (intensive care unit admission), and stricture are the tertiary outcomes (within 90 days postoperative).

Outcome definitions and measurement: The International Study Group of Rectal Cancer (ISREC) depicted an anastomotic leak and designated grades A, B, and C for an ordered approach for dealing with anastomotic leak following colorectal surgery [16]. The Low Anterior Resection Syndrome (LARS) questionnaire, which consists of five questions, assesses intestinal function (gas incontinence, incontinence of liquid stool, frequency of bowel movements, clustering of stools, and urgency). Functional Assessment of Cancer Therapy-Colorectal measures quality of life (QoL) (FACT-C). The FACT-C (CCS) is made up of physical well-being (PWB), social well-being (SWB), emotional well-being (EWB), functional well-being (FWB), and colorectal cancer symptoms [17]. Postoperative morbidity was assessed by the Clavien and Dindo classification [18]. Anterior resection is classified as "high" (> 10 cm), "low" (> 5–10 cm), or "ultralow" (within 3–5 cm) based on colonoscopy measurements of tumour location from the anal verge [19].

Method:

Cancer staging, including total colo-proctoscopy with tumor sample, C.T., and MRI of the abdomen, pelvis, and chest, were all part of the preoperative preparation. In rectal cancers, our center employs neo-adjuvant chemo-radiotherapy. Preparation of the bowels (oral laxatives). Metronidazole 500 mg and ceftriaxone 1 gm. are given at the start of anesthesia. Intravenously administered. Low molecular weight heparin (4000 IU) is used to avoid deep venous thrombosis. General anaesthesia with cuffed endotracheal intubation. For 24 months, all surgeries were performed in a single center in the colorectal surgery unit. At least one of the four senior surgeons was present to ensure that the criteria for inclusion were met. Randomization was done when cancer resection became acclimated to having macroscopic free margins. The Lloyd-Davies position was used on the patient. An incision was made in the lower midline. All patients underwent a standardised anterior resection by dedicated, specialized colon and rectal surgeons. The left colon was mobilized to a position proximal to the splenic flexure. The inferior mesenteric artery was ligated proximal to the left colic artery. The rectum was dissected down to the ano-rectal junction at the pelvic floor, with total clearance of the mesorectum. The rectum was removed with at least 2 cm of distal tumour clearance. The clamp was replaced after the rectum stump was cleansed with povidone-iodine. In sigmoid cancer, the sigmoid colon was excised with a 10 cm safety margin above the tumour and the rectum as the lower border. The anvil was introduced inside the rectal stump

and secured in place with purse-string stitches using polypropylene 2-0 in an antegrade technique. A nail was driven 4-6 cm from the colonic opening stump through the end of the opened colon and the colonic wall. The anvil and nail were approximated together (Fig. 2). In the retrograde technique, the anvil head was placed in the proximal colon and the purse-string suture was secured with polypropylene 2-0. After careful anal dilatation, the circular stapler's shaft was inserted into the anal canal. The stapler was tightened, shot, and then removed smoothly. In the antegrade group, the colonic stump was closed in two layers (absorbable Vicryl 2/0 suture inner layer and the outer layer by non-absorbable Silk 2/0 suture). To assess the anastomosis integrity, continuous circular two doughnuts and air-leakage testing are used. The pelvic cavity was filled with physiological saline air supplied through the anus by syringe after a clamp was placed on the proximal colon. In most cases, covering ileostomy was done in the middle and lower rectal anastomosis. In any other cases with questionable anastomosis, a covering ileostomy was performed and closed 4-6 weeks later, based on the intraoperative surgeon's assessment. Two drains were placed, one intra-peritoneal and the other near the anastomotic line in the pelvis. Fluid was allowed as long as it was tolerated. Antibiotics were given for five days, and anticoagulants were given until the patients were completely cured. When a drain contained less than 50 C.C for three days, it was removed. One month, six months, twelve months, and twenty-four months after returning home is our center protocol for the follow-up phase (2 years) and it depends on patient capability. Patients were reunited by mail, phone, and at the outpatient clinic whenever and complains from the patients. Following up on the patient included a complete medical history and physical examination to rule out any potential complications, a colonoscopy after 6 months to check for stricture at the anastomosis site, and a quality of life and intestinal function questionnaire to assess quality of life and function. LARS and quality of life surveys were required of all patients. The number of patients lost during the follow-up period was 3. Three cases died after the first-month assessment and before the 6-month evaluation (one in group A and two in group B).

Statistical analysis

Data from the history, physical exam, lab tests, and outcome measures were recorded, entered, and analysed in Microsoft Excel. The information was then entered into SPSS version 20.0 (Statistical Package for the Social Sciences) for analysis. Depending on the type of data (qualitative as number and percentage, quantitative as mean + S.D.), the following tests were performed to determine significance: A chi-square test is used to determine the difference in qualitative variables (χ^2). multiple by ANOVA or Fredman, independent predictors by logistic regression. Results were classified as significant if P-values were set at <0.05 or < 0.001 .

Results

A flowchart of the inclusion and exclusion criteria is found in (Fig. 1). After the exclusion, a total of 74 patients diagnosed with sigmoid cancer and rectal cancer underwent colorectal cancer surgery from September 2016 to September 2018.

There were no statistically significant differences between the studied groups as regards demographic and preoperative variables. The mean age was 62.58 ± 12.3 years and 61.03 ± 13.98 years in groups A and B, respectively. Most cases were male patients (38/74). The most common comorbidities included hypertension (17.5% of patients in both groups) and diabetes mellitus (16.2%). Most of the tumor sites are located in the upper rectum (69%), followed by the middle and lower rectum (20%), and the least number is in the sigmoid (11%). (Table 1)

No statistically significant difference was found between the studied groups regarding all intraoperative variables except operative time. The mean anastomotic time of Group (A) was highly statistically significantly shorter ($p = 0.00$). Based on the surgical procedures, eight cases (10.8%) of high anterior resection (4 side to end and 4 end to end), forty-one low anterior resections (23 side-to-end and 28 end-to-end), and 15 ultra-low resections (10 cases in group A and 5 in group B) were performed ($p = 0.34$). The overall incidence of intraoperatively diagnosed air leakage was 6.8% (5/74 patients). Air leakage after side-to-end anastomosis was 5.4%, while end-to-end anastomosis was 8.1% ($P = 0.64$). The most frequently used stapler's calibre was 33 mm in 43 cases (58%) ($p = 0.77$). (Table 2).

No statistically significant difference was found between the studied groups as regards all items of postoperative variables. There were 2 cases of anastomotic line bleeding in group A (5.4%) and one in group B (2.7%). There were four cases of stricture of the anastomosis in both groups (2.7% and 8.1%). Postsurgical complications were surgical site infection (5.4% & 4%), ileus (2.7% & 5.4%), adhesive intestinal obstruction (2.7% & 5.4%), and intra-abdominal abscess (13.5% & 8.1%). Anastomotic leakage occurred in 5 patients (13.5%) in the antegrade group and 3 patients (8.1%) in the retrograde group ($P = 0.47$). Most cases were grade C leakage (10.8% and 2.7%). The majority of both groups were in class III, followed by classes II and I (Table 3).

Univariate analysis of anastomotic leak showed that perioperative blood loss ($p = 0.001$), length of stay ($p = 0.0019$), re-operation ($p = 0.01$), inpatient death ($p = 0.0003$), infection ($p = 0.00$) and bleeding ($p = 0.018$) were significantly associated with leakage. (Table 4).

Clinical LARS score results comparing Side-End and End-End anastomosis showed a statistically significant change regarding the range of bowel frequency in the end-to-end group only ($p = 0.04$). There is a statistically significant difference regarding incontinence for Flatus in the side-to-end group (0.00). There was a statistically significant change in both groups regarding incontinence for liquid stools ($p = 0.00$) and clustering of stools (0.00 and 0.043). (Table 5).

The percentage of satisfied QoL scores at different time-points showed that the quality of life in the antegrade group significantly dropped at 6 months and returned to baseline after that as regards PWB, FWB, and CCS with no difference as regard SWB and EWB, while in the retrograde group, the exact change happened only as regard PWB and FWB, but SWB and CCS percentage did not return to baseline. (Table 6).

Discussion

In this study, we evaluated two alternative colorectal anastomosis procedures following open colorectal cancer resection: SEA anastomosis (Antegrade approach=group A) and EE anastomosis (retrograde approach=group B). Gas incontinence is statistically significant in the SEA group; operative time and anastomotic time were shorter in the SEA group. The postoperative anastomotic leak was not significantly different between both groups. Post-operative LARS and QOL are better in the SEA group than in the EEA group. The SEA group is a safe alternative to the EEA group.

Postoperative anastomotic leakage has been found to range between 1.8 and 24% in earlier studies, with substantial morbidity and death [20–23]. In this study, the SEA group had a higher incidence and severity of anastomotic leakage than the EEA group, but the difference was statistically insignificant. A higher incidence of leakage in SEA group may be attributed to anastomotic site bleeding and postoperative pelvic abscess. Anastomotic site bleeding means insecure anastomosis and pelvic abscess hinders anastomotic healing. These two factors were the causes of the higher incidence of anastomotic leaks in the SEA group. Although previous studies stated that anastomotic leaks are caused by a variety of factors, including gender, tumour site, BMI, anastomotic method, unsuitability of purse-string suture, anastomotic site contamination, and mucosal tears [24–31], yet, We disagree with prior studies since there is no significant difference between the analyzed groups in terms of age, sex, or anastomosis site, and univariate analysis did not indicate a link between anastomosis site and anastomotic leak. Our results also stated previously unknown risk factors for leakage, including perioperative blood loss, reoperation, wound infection, and bleeding from the anastomotic line. The incidence of anastomotic leak is usually higher in lower anastomosis but in our study the covering ileostomy decreased this incidence and no occurrence of leakage after the ileostomy was closed. Splenic injury has a greater morbidity rate, and it can be avoided by exposing the area properly and avoiding tugging on the spleno-colic ligament. [32]. Accidental spleen injury is higher in the EEA group than in the SEA group, but the difference is not statistically significant. Splenic damage is more common in the EEA group, owing to a higher number of cases undergoing splenic flexure mobilisation than in SEA group. According to a univariate study, perioperative blood loss is substantially related to anastomotic leakage. We discovered that two of the patients who had splenic damage also had anastomotic leakage. Splenic damage occurred in one patient in each group who experienced postoperative anastomotic leakage.

Different attempts have been postulated to detect intraoperative anastomotic leak. According to Ricciardi et al. and Beard et al.; air-leak testing has been shown to be beneficial in detecting intraoperative leakage following colorectal resection and anastomosis. They claimed that this test might detect the leak in 7.9–25% of cases [33–34]. In the current study, air leakage was detected intra-operatively in 5/74 (6.7%) patients (2 in SEA group, 3 in EEA group) using an air leakage test that we found to be easy and rapid, and we believe it is wise to employ this test in all cases. Re-anastomosis was required in three cases. The air leak in the EEA group was most likely caused by the difficult entry of the stapler shaft into the anal canal, which resulted in mucosal and submucosal tears. In terms of intraoperative air leakage, however, there was no statistically significant difference between the two groups.

Martellucci declared that up to 80% of patients who underwent colorectal surgery developed LARS [35]. There is a statistically significant change in the range of bowel frequency in the EEA group in the present study. This is due to the loss of most of the rectal reservoir. There is a statistically significant difference regarding incontinence for Flatus in the SEA group only due to the accumulation of gas in the colonic pouch that overcomes the anal sphincter. There is a statistically significant change in both groups regarding incontinence for liquid stools and clustering of stools.

A study confirmed the effect of cancer on the quality of life of patients who underwent colorectal surgery [36]. In the present study, it is mesmerising to find that the quality of life in the SEA group significantly drops at 6 months and returns to baseline after that while in the EEA group, the exact change occurred but did not return to baseline. is attributed to the fact that the colonic pouch acts as a neorectum with improving LARS.

In our research, we discovered that fashioning the anastomosis in the SEA group takes less time than in the EEA group (131.2 minutes vs. 23.513 minutes), and that the operative time in SEA group takes less time than in EEA group (15013 minutes vs. 18410 minutes). Because of maneuvers in the anal region to enter the stapler, such as anal dilatation and repeated introduction of the stapler in a smooth curve, EEA group takes longer than SEA group.

According to multiple research studies, anastomosis stricture occurs in 8% of cases and is caused by anastomotic site ischemia or anastomotic leakage [37–38]. In this study, the EEA group had a higher frequency of anastomosis stricture than the SEA group (2.7% (1/37) and 8.1% (3/37)), although leakage was more in the ESA group. Three endoscopic dilatation procedures were necessary in each patient, with one-month intervals between them. There were no patients who needed surgical re-intervention, and no stricture patients complained of leakage. We believe the stricture is caused by ischemia at the anastomosis site as a result of extensive dissection next to the anastomosis with subsequent ischemia and the use of stapler 28 for colorectal anastomosis. A recent study by Erik Back et al. highlighted the need to measure mucosal blood flow in the remaining rectal stump using laser Doppler flow-metry to minimize stricture induced by ischemia of the stump [39]. Local recurrence was not found within this short 24-month follow-up period. Previous studies in the literature, on the other hand, revealed a 3.5–12% local recurrence. [41–41]. It may be a limitation of this study. The death rate in this study was 2.7% in the SEA group and 5.4% in the EEA group. Two cases died due to grade C anastomotic leaks, one in each group. The third case died of CNS (central nervous system) complications. A similar study showed a mortality rate of 2.4% [37]. Our study was not without limitations: mono-center study, short follow-up period to evaluate recurrence, small sample size, and a sub-analysis between the middle and lower rectum groups were not included. As a conclusion, although gas incontinence is statistically significant in the SEA group, operative time and anastomotic time were shorter in the ESA group. The postoperative anastomotic leak was not significantly different between both groups. Post-operative LARS and QOL are better in the SEA group than in the EEA group. The SEA group is a safe alternative to the EEA group.

Abbreviations

LARS: low anterior resection syndrome

Qol: quality of life.

PWB: physical well-being.

FWB: functional well-being.

SWB: social well-being.

EWB: emotional well-being.

CCS colorectal cancer symptoms positive

CT: computerized tomography.

MRI: magnetic resonance imaging.

Declarations

The work has been reported in line with the consolidated standards of reporting trials (CONSORT) guidelines.

Contributions of the Authors:

All the authors shared important intellectual content in study design, data analysis, written and critical revision. The version they submitted was shared in their final approval.

INTEREST CONFLICT: It is not declared.

Availability of data and materials statement: will be available from the authors on reasonable demand.

The Registration Registered quality control review criteria for clinicaltrials.gov protocol: NCT04694521.registered in 05/01/2021.

Ethics approval:

Faculty of Medical Ethical Committee Zagazig University gave us all the ethical agreements.

The described work has been carried out for human experiments by the World Medical Association's Code of Ethics (Helsinki Declaration).

The work has been reported in line with consolidated standards of reporting trials (CONSORT) guidelines

Consent for participation and publication: after the study was included, all involved persons gave their informed written consent for participation and publication.

Conflict of interest: no

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Tables

Table (1): Demographic and preoperative data of the studied groups.

- <u>Demographic data</u>	Side to end group(Group A)(N=37)	End to end group (Group B)(N=37)	P
	No.(%)	No.(%)	
<u>Gender</u> Male Female	21(56.7%) 16(43.3%)	17(45.9%) 20(54.1%)	0.85
<u>Age (years).</u> <50 50-70 >70	62.58±12.3 8(21.6%) 23(62.1%) 6(16.2%)	61.03±13.98 11(29.7%) 21(56.7%) 5(13.6%)	0.812 0.72
<u>BMI in kg/m2 mean ±SD</u>	30.53±3.33	29.03±3.12	0.061
<u>ASA status</u> I II III IV	7(18.9%) 4(10.8%) 22(59.5%) 4(10.8%)	2(5.4%) 7(18.9%) 18(48.6%) 10(27%)	0.08
Site of tumour(cm) from anal verge measured by colonoscope Sigmoid ≥15 cm Upper rectum≥10-15cm Middle-low rectum<10cm	4(10.8%) 23(62.2%) 10(27%)	4(10.8%) 28(75.7%) 5(13.5%)	0.34
<u>Tumor stage</u> I II III IV	1(2.7%) 14(37.8%) 18(48.6%) 4(10.8%)	2(5.4%) 10(27%) 22(59.5%) 3(8.1%)	0.67
<u>Previous abdominal/pelvic surgery.</u> Yes no	12(32.4%) 25(67.6%)	10(27%) 27(73%)	0.61
<u>MRI T</u> T1 T2 T3 T4	3(8.1%) 4(10.8%) 29(78.4%) 1(2.7%)	2(5.4%) 3(8.1%) 22(59.5%) 10(27%)	0.083
<u>MRI N</u> N0 N1 N2	7(18.9%) 11(29.7%) 19(51.4%)	3(8.1%) 22(59.5%) 12(32.4%)	0.061
Steroid treatment	3(8.1%)	1(2.7%)	0.63
Serum albumin(>3.5gm/dl)	37(100%)	37(100%)	1.00
Diabetes Mellitus	5(13.5%)	7(18.9%)	0.52
Hypertension	8(21.6%)	15(40.5%)	0.07

Coronary artery diseases	1(2.7%)	2(5.4 %)	0.55
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BMI: Body Mass Index ASA: American Society of Anesthesiologists MRI: Magnetic Resonance Imaging

Table (2): Intraoperative variables in studied groups.

	Side to end group(Group A) (N=37)	End to end group (Group B) (N=37)	P
	No (%)	No (%)	
<u>Surgical procedure</u>			
Sigmoid colectomy(high anterior resection)	4(10.8%)	4(10.8%)	0.34
Low anterior resection(upper 2/3 rectum cancer)	23(62.2%)	28(75.7%)	
Ultralow anterior resection(lower 1/3 cancer rectum)	10(27%)	5(13.5%)	
Mobilization of the splenic flexure			
Yes (partial,total)	30(81.1%)	34(91.9%)	0.17
No	7(18.9%)	3(8.1%)	
IMV dissection			
Yes	32(86.5%)	28(75.7%)	0.23
No	5(13.5%)	9(24.3%)	
Blood loss(ml)			
<500 ml	33(89.2%)	35(94.6%)	0.39
>500ml	4(10.8%)	2(5.4%)	
Size of stapler (mm)			
34	2(5.4%)	5(13.5%)	0.77
33	23(62.2%)	20(54.1%)	
31	5(13.5%)	5(13.5%)	
29	3(8.1%)	4(10.8%)	
28	4(10.8%)	3(8.1%)	
Operative time in minutes (mean±SD)	150±13	184±10	0.00**
Mean Anastomotic time(min)	13±1.2	23.5±13.7	0.00**
Intraoperative anastomotic line bleeding	1(2.7%)	2(5.4%)	0.55
Intraoperative anastomotic leakage	2(5.4%)	3(8.1%)	0.64
Dealing with anastomotic leak			
Re-anastomosis	1(2.7%)	2(5.4%)	0.71
suturing	1(2.7%)	1(2.7%)	
Urinary bladder/ureteric injury			
Absent	36(97.3%)	35(94.6%)	0.55
Present	1(2.7%)	2(5.4%)	
Intestinal injury			
Absent	35(94.6%)	36(97.3%)	
Present	2(5.4%)	1(2.7%)	

			0.55
Splenic injury			
Absent	36(97.3%)	35(94.6%)	
Present	1(2.7%)	2(5.4%)	
			0.55
Dealing with splenic injury			
Preservation	1(2.7%)	1(2.7%)	
Splenectomy	0(0%)	1(2.7%)	0.55

* Significant IMV: Inferior Mesentric Vessels

Table (3): Postoperative parameters and complications.

	Side to end group(Group A) (N=37)	End to end group (Group B) (N=37)	P
	No.(%)	No.(%)	
Hospital stay(days) 7 days ≥7 days	34(91.9%) 3(8.1%)	31(83.8%) 6(16.2%)	0.23
Time of analgesic intake(days) <3 days >3 days	16(43.2%) 21(56.8%)	9(24.3%) 28(75.7%)	0.08
Seroma/Hematoma Absent Present	36(97.3%) 1(2.7%)	35(54.6%) 2(5.4%)	0.55
Wound infection (surgical site infection) Absent Present	35(94.6%) 2(5.4%)	33(89.2%) 4(10.8%)	0.39
Ileus	1(2.7%)	2(5.4%)	0.55
Anastomotic leak Yes No	5(13.5%) 32(86.5%)	3(8.1%) 34(91.9%)	0.47
Grade of anastomotic leak B C	1(2.7%) 4(10.8%)	2(5.4%) 1(2.7%)	0.18
Median time of diagnosis of anastomotic leak(days)	6.3±1.9	5.1±1.2	
Postoperative bleeding from anastomotic line Yes No	2(5.4%) 35(94.6%)	1(2.7%) 36(97.3%)	0.55
Stricture of anastomotic line	1(2.7%)	3(8.1%)	0.3
Intra-abdominal abscess	5(13.5%)	3(8.1%)	0.45
Adhesive Intestinal obstruction	1(2.7%)	2(5.4%)	0.55
Impotence	0(0%)	1(2.7%)	0.39
Recto-vaginal fistula	0(0%)	1(2.7%)	0.39

Surgical re-intervention			
Yes	6(16.2%)	6(16.2%)	1.0
No	31(83.8%)	31(83.8%)	
<u>Clavien-Dindo classification.</u>			
Grade I	3 (8.1%)	6 (16.2%)	0.28
Grade II	5 (13.5%)	4 (10.8%)	0.72
Grade III	9 (24.3%)	13 (35.1%)	0.32
Grade IV	2 (5.4%)	3 (8.1%)	0.64
Grade V	1 (2.7%)	2 (5.4%)	0.55
Overall postoperative complications	18/37(48.6%)	22/37(59.4%)	0.35

Table (4): Univariate analysis of anastomotic leak

	Anastomotic leakage (n=8)		No Anastomotic leakage (n=66)		p-value
Age(median)	53±13		61±24		0.29
Gender					0.17
Male	6	75.0%	25	37.8%	
Female	2	25.0%	41	62.2%	
ASA score					0.53
I	3	37.5%	41	62.2%	
II	2	25.0%	12	18.2%	
III	2	25.0%	7	10.6%	
IV	1	12.5%	6	9.0%	
BMI in kg/m2 mean ±SD	32.53±2.38		29.4±1.2		0.09
Diagnosis					0.17
Cancer sigmoid	2	25.0%	6	9.0%	
Cancer rectum	6	75.0%	60	91.0%	
Clavien-Dindo classification					0.11
I	1	12.5%	22	33.3%	
II	1	12.5%	19	28.7%	
III	5	62.5%	15	22.7%	
IV	1	12.5%	10	16.3%	
Surgical approach					0.45
Side to end approach	3	37.5%	34	51.5%	
End to end approach	5	62.5%	32	48.5%	
Surgical procedures					0.17
Sigmoid colectomy	2	25.0%	6	9.0%	
Rectal resection	6	75.0%	60	91.0%	
Perioperative blood loss					0.001**
<500	1	12.5%	47	71.2%	
>500	7	87.5%	19	28.8%	
Days in hospital, mean					0.0019*
<7days	2	25.0%	51	77.2%	
≥7 days	6	75.0%	15	22.8%	
90-day mortality(n)	3	37.5%	0	0.0%	0.0003**
Reoperation					0.01*
Yes	4	50.0%	9	13.6%	
No	4	50.0%	57	86.4%	
Wound infection					0.00**
Yes	6	75.0%	1	1.5%	
No	2	25.0%	65	98.5%	
Bleeding from anastomosis					0.018*
Yes	2	25.0%	1	1.5%	
No	6	75.0%	65	98.5%	

* Significant **strongly Significant BMI: Body Mass Index ASA: American Society of Anesthesiologists

Table (5): Clinical Low anterior resection syndrome(LARS) score results comparing Side-to-end and End-to-end anastomosis.

	1 Month	6 Months	24 Months	P value
Range of Bowel Frequency(per day)				
Side to end				
>7 times a day	2(5.4%)	0	0	0.12
4–7 times a day	10 (27%)	6(16.2%)	2 (5.7%)	
1–3 times a day	22(59.5%)	25 (69.4%)	27 (73%)	
<once a day	3(8.1%)	5(13.5%)	7 (18.9%)	
End-to-end				
>7 times a day	3(8.1%)	2(5.4%)	2(5.4%)	0.04*
4–7 times a day	16(43.2)	6 (17.1%)	5(13.5%)	
1–3 times a day	15(40.6%)	24 (68.5%)	23 (65.7%)	
<once a day	3(8.1%)	3(8.1%)	5 (13.5%)	
P	0.413	0.374	0.423	
Urgency of defecation				
Side to end				
Never	6(16.2%)	7(18.9%)	8(21.6%)	0.29
<once a week	19(51.4%)	23(62.2%)	22 (61.1%)	
>once a week	12(32.4%)	6 (16.7%)	6(16.2%)	
End to end				
Never	2(5.4%)	1 (2.7%)	1(2.7%)	0.56
<once a week	21(56.8%)	23 (65.7%)	24 (68.5%)	
>once a week	14(37.8%)	11 (31.4%)	10(27%)	
P	0.312	0.241	0.198	
Incontinence for Flatus				
Side to end				
Never	7(18.9%)	17 (47.2%)	29 (80.5%)	0.00**
<once/week	21(56.8%)	15(40.6%)	4(10.8%)	
≥once/week	9(24.3%)	4(10.8%)	3(8.1%)	
End-to-end				
Never	10(27%)	12(32.4%)	12 (34.2%)	0.12
<once/week	9(24.3%)	13 (37.1%)	14(37.8%)	
≥once/week	18(48.7%)	10 (27.0%)	9(24.4%)	
P	0.015*	0.16	0.0004**	
Incontinence for liquid stools				
Side to end				
Never	9(24.3%)	19 (52.7%)	30 (83.3%)	0.00**
<once/week	21(56.8%)	15(40.6%)	5(13.5%)	
≥once/week	7(18.9%)	2(5.4%)	1(2.7%)	
End-to-end				
Never	5(13.5%)	18(48.7%)	27 (77.1%)	0.00**
<once/week	20(54.1%)	12 (32.4%)	2(5.4%)	
≥once/week	12(32.4%)	5(13.5%)	6(16.2%)	
P	0.208	0.336	0.318	

Clustering of stool				
Side to end				
Never	6(16.2%)	12 (32.4%)	25(67.6%)	0.00**
<once a week	17(46%)	16(43.2%)	5 (13.5%)	
>once a week	14(37.8%)	8(21.6%)	6(16.2%)	
End to end				
Never	3(8.1%)	7(18.9%)	10(27%)	0.043*
<once a week	9(24.3%)	11 (31.4%)	10 (27.0%)	
>once a week	25(67.6%)	17(46%)	15(40.6%)	
P	0.037*	0.061	0.002*	

* Significant

**strongly Significant

LARS: low anterior resection syndrome.

Table (6): percentage of satisfied QoL scores and at different time-points

	Side to end group(Group A)			P	End to end group (Group B)			P
	Baseline (n)	6 month	Last follow (24 month)		baseline	6 month	Last follow (24 month)	
PWB	100.0%	78.3%*	100.0%	0.001**	97.2%	83.7%*	97.2%	0.041*
FWB	97.2%	83.7%*	97.2%	0.042*	100.0%	86.4%*	100.0%	0.048*
SWB	100.0%	86.4%	97.2%	0.098	100.0%	86.4%	89.1%	0.189
EWB	100.0%	97.2%	100.0%	0.988	97.2%	94.5%	97.2%	0.989
CCS	97.2%	81.1%*	97.2%	0.035*	97.2%	83.7%	89.1%	0.199

* Significant

QoL: quality of life

PWB physical well-being, FWB functional well-being, SWB social well-being,

EWB emotional well-being, CCS colorectal cancer symptoms positive

Figures

Figure 1

a flowchart of the inclusion and exclusion of patients in the study

Figure 2

approximation of anvil and nail of stapler in SEA group