Original Article

End-to-end versus side-to-end colorectal anastomosis for laparoscopic low anterior resection; A prospective comparative study

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ABSTRACT

Background: The increasing emphasis on sphincter-preserving procedures for rectal pathology has led to advancements in surgical techniques, including transanal complete mesorectal excision, low anterior resection, and ultralow anterior resection. These innovations, supported by technological developments in surgical instruments, facilitate improved visualization and mobilization during rectal surgeries, allowing better adherence to surgical standards.

Aim: This study aims to compare the postoperative outcomes and complications associated with end-to-end versus side-to-end colorectal anastomosis in patients undergoing laparoscopic low anterior resection.

Patients and Methods: A prospective comparative study was conducted involving 40 patients diagnosed with low rectal cancer at Ain Shams University hospitals. Participants were divided into two groups: group A (23 patients) underwent laparoscopic low anterior resection with end-to-end colorectal anastomosis, while group B (17 patients) underwent side-to-end colorectal anastomosis.

Results: The study found that group A exhibited significantly shorter anastomotic and operative times compared to group B (*P<0.001*). Additionally, group A reported significantly higher urgency of defecation at 12 months postsurgery compared to group B (*P=0.018*). However, all other comparative measures yielded statistically insignificant results.

Conclusion: The findings suggest that both surgical techniques yield comparable outcomes, with group A demonstrating faster operation times but a slight increase in long-term urgency of defecation. Conversely, group B may offer better functional outcomes despite a longer operation duration. These results underscore the need for personalized surgical approaches based on patient needs and preferences.

Key Words: Anastomosis, bowel, laparoscopic, resection.

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INTRODUCTION

In the case of rectal pathology, sphincter-preserving measures have become more important. These techniques include low anterior resection, ultralow anterior resection, and transanal full mesorectal excision. The dissemination of these techniques has been facilitated by technological advancements in surgical equipment, which have allowed for more distant anastomoses as well as more comprehensive visualization and mobilization inside the confines of the deep pelvis. Because of this, it is simpler to dissect between anatomic tissue planes and follow excellent operational standards during rectal surgery[1].

Thus, during rectal surgery, it is easier to adhere to good operating standards and dissect within anatomic tissue planes. Therefore, after distal anastomoses, surgical approaches to rectal disease have increasingly concentrated on postoperative morbidity and postoperative bowel function[2,3].

One surgical variable that may be changed that has the potential to affect both bowel function and postoperative morbidity is a reconstructive approach used following laparoscopic procedures. There are now several reconstructive procedures available, such as transverse coloplasty, colonic J-pouch, end-to-side anastomoses, and end-to-end anastomoses[4].

The foundation of all reconstructive procedures is the same: maximizing anastomotic structural integrity to reduce postoperative morbidity caused by anastomotic leak. Specifically, the danger of anastomotic leak is greatly decreased by having a sufficient proximal colonic length to enable tension-free anastomosis and to maintain vascular perfusion of the proximal cut end[5,6].

The development of a colonic reservoir is an extra advantage of the final three anastomotic procedures. Low anterior resection syndrome risk can be reduced, and postoperative bowel function can be improved with a sufficient remaining intestinal reservoir[7,8].

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Aim

The aim of this study is to compare between end-to-end and side-to-end colorectal anastomosis in the laparoscopic low anterior resection procedure as regards postoperative outcomes and complications.

PATIENTS AND METHODS:

The study was carried out in the General Surgery Department of Ain Shams University Hospitals.

Patient details: 40 patients diagnosed as having low rectal cancer for low anterior resection procedure presenting to Ain Shams University hospitals.

The project had received ethical committee approval, and each participant gave their informed consent.

Type of study: prospective comparative study.

(1) Inclusion criteria: clinically diagnosed low rectal cancer. Age 20–70 years old. Absence of local invasion or distant metastasis. The patient received neoadjuvant chemotherapy and radiotherapy.

(2) Exclusion criteria: patient with locally advanced cancer rectum. Patient with distant metastasis. Complicated rectal cancer (obstruction, perforation). Patient with previous midline laparotomy or any colonic surgery other than appendectomy.

Study procedures

Assessment of the patient

Clinical assessment: personal history, including age, weight, profession, and any unique or medically significant habits, like smoking. History of present illness: symptoms such as bleeding per rectum, pain, tenesmus, change of bowel habits, piles, and weight loss. Number of cycles of neoadjuvant therapy. History of medical diseases, especially diabetes, drug allergy, previous blood transfusion, and previous operations.

Clinical examination: general examination. The general condition of the patient and the comorbidities. Chest examination. Cardiological examination. Local examination of the abdomen and DRE.

Investigations:

(1) Laboratory: preoperative laboratories.

(2) Radiological:

Dynamic MRI for rectal cancer. Chest, abdomen, and pelvis computed tomography scan with contrast for metastasis.

(3) Colonoscopy with histopathology.

Special investigations were requested for patients with specific complaints, such as ECG above the age of 40 and Echo for patients above the age of 60.

Operative technique

Anterior resections were carried out by laparoscopy. The colon and rectum were mobilized, lymph nodes were dissected, and IMA and IMV were tied. There was a complete mesorectal resection. By protecting the parietal layer, we were able to prevent damage to the sympathetic nervous system, the left and right hypogastric plexuses, and the superior hypogastric plexus. Pneumodissection was used to assist with posterior dissection. Next, an incision was made along the right side of the rectum to expose the anterior reflection, which is rectovaginal in females and recessional in males. The left side of the pelvis, which houses the ureter and the hypogastric nerve, is where the incision is finished. The anterior dissection between the rectum and the posterior vaginal wall in females and between the rectum and Denonvilliers' fascia in males came next. There was the middle rectal artery located lateral to the pelvic floor. To maintain the pelvic plexus, this artery was sectioned between clips or coagulated at its intermediate segment rather than at its origin. The fourth sacral vertebra was the point of incision for the posterior incision of the rectosacral ligament.

This cut made it possible to access the pelvic floor's muscle plane. The bowel was dissected laterally and posteriorly until it was completely mobilized circumferentially. Next, at the distal end of the resection range, the rectum is resected using an Endo GIA stapler or a contour stapler. Using a pfannenstiel incision, the mobilized colon is removed during the laparoscopic procedure, and the proximal side of the resection range is then identified. With the EEA Covidien stapler 29 mm, either side-to-end or end-to-end anastomosis will be completed. When the surgeons concluded there would be a high level of stress at the anastomosis site, end-to-end anastomosis was performed. The anvil of the circular stapler was placed into the lumen of the open end in the side-to-end anastomosis group. The colon's antimesenteric wall was then stapled at a distance of three to four centimeters from the open end. The linear stapler is used to staple the open end.

The circular stapler's anvil was attached at the open end of the end-to-end anastomosis group. A purse string suture using 2/0 prolene was then applied, and the anvil was then put into the circular stapler to staple both ends together. In order to prevent stress at the anastomosis site in both groups (IMA ligation, IMV ligation, and medial to lateral dissection), the splenic flexure is always mobilized in our study. 4-distal transverse colon separation from the gastro-colic omentum. In close proximity to the anastomosis region is a drain. In every instance, a diverting loop ileostomy was carried out[9,10].

Follow-up: all patients will be followed up for 12 months postoperative.

Short-term outcomes:

(1) Intraoperative: duration of surgery, intraoperative blood loss, vascularity of the colonic segment, colonic reach, anastomotic leak test.

(2) During hospital stay: postoperative hemorrhage, rate of the leak, time to be open bowel, hospital stay duration.

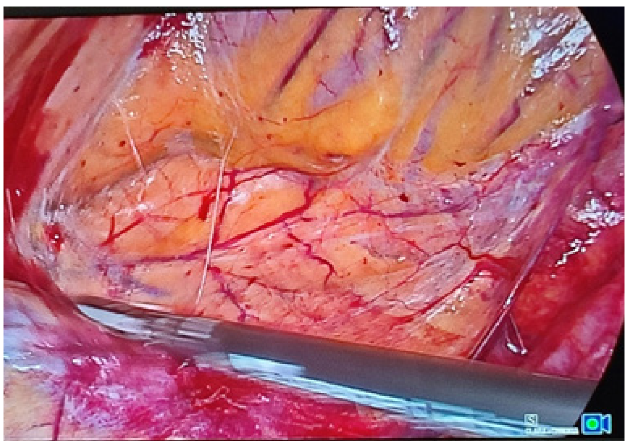

Fig. 1: Medial to lateral dissection.

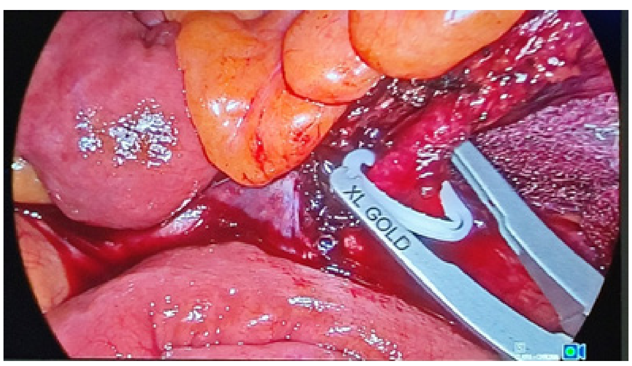

Fig. 2: IMA ligation.

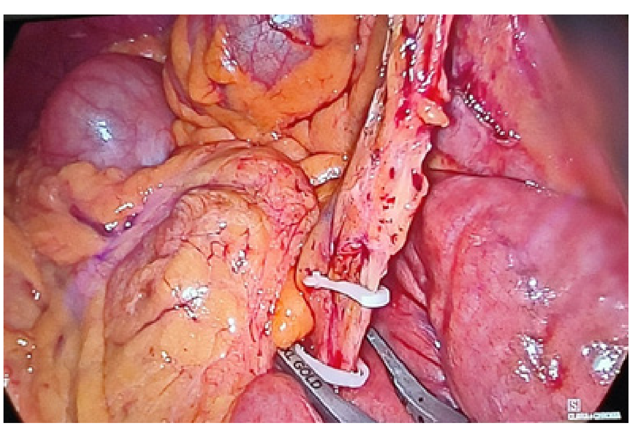

Fig. 3: IMV ligation.

Long-term outcomes (6 and 12 months postoperative): follow-up of cases with covering ileostomy will be closed within 3 months postoperative and followed up after closure. Follow-up of bowel motions as low anterior resection syndrome for: diarrhea: frequency of bowel motions and looseness of stool 2. Tenesmus: the feeling of emptying stool despite complete emptying. Urgency: the sudden rush to the bathroom to empty the bowel. Incomplete emptying (Figs 1–11).

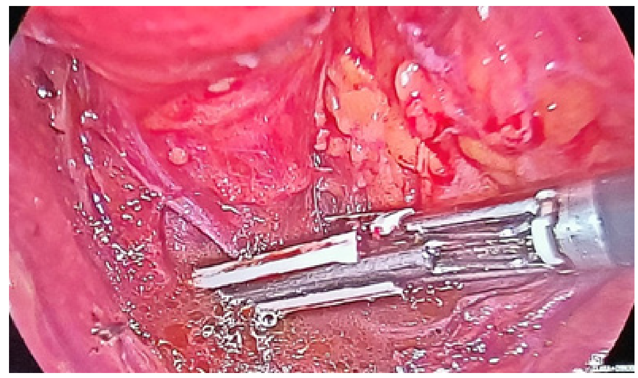

Fig. 4: Total mesorectal excision.

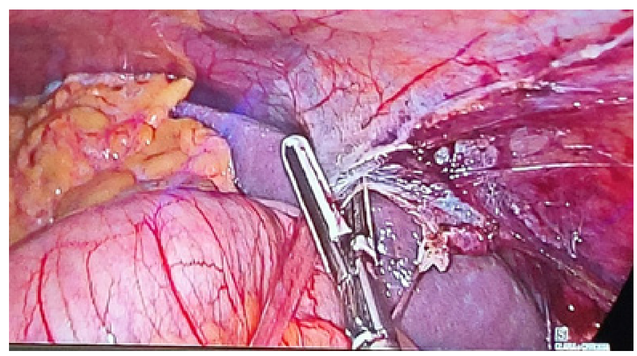

Fig. 5: Splenic flexure mobilization.

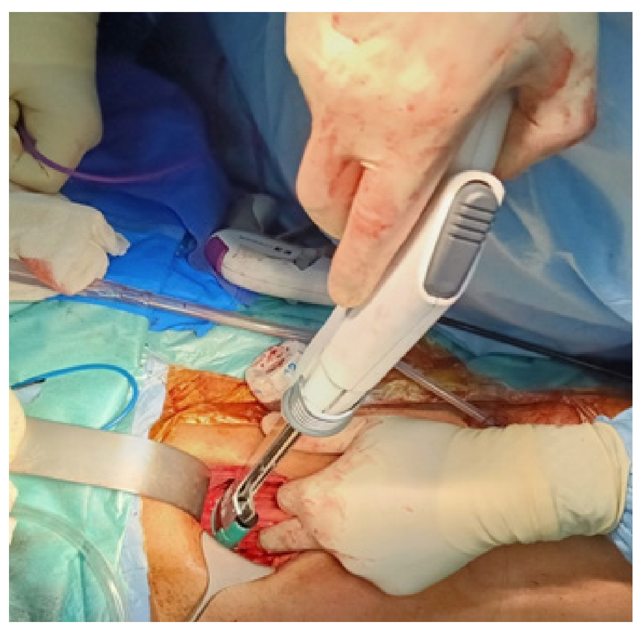

Fig. 6: Rectal resection with contour stapler.

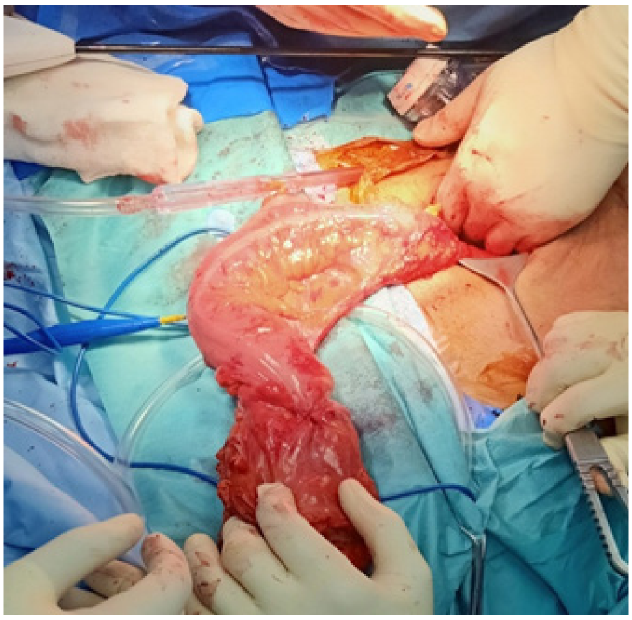

Fig. 7: Specimen extraction through Pfannenstiel incision.

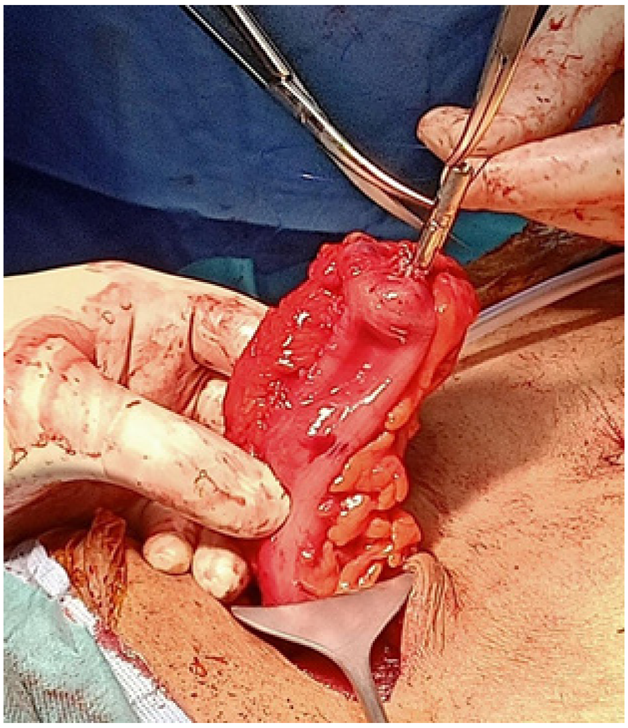

Fig. 8: Anvil insertion in the colonic segment at end-to-end anastomosis.

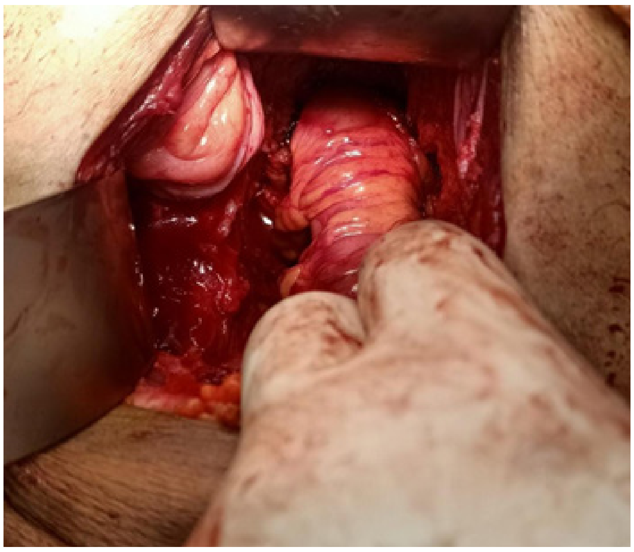

Fig. 9: End-to-end colorectal anastomosis.

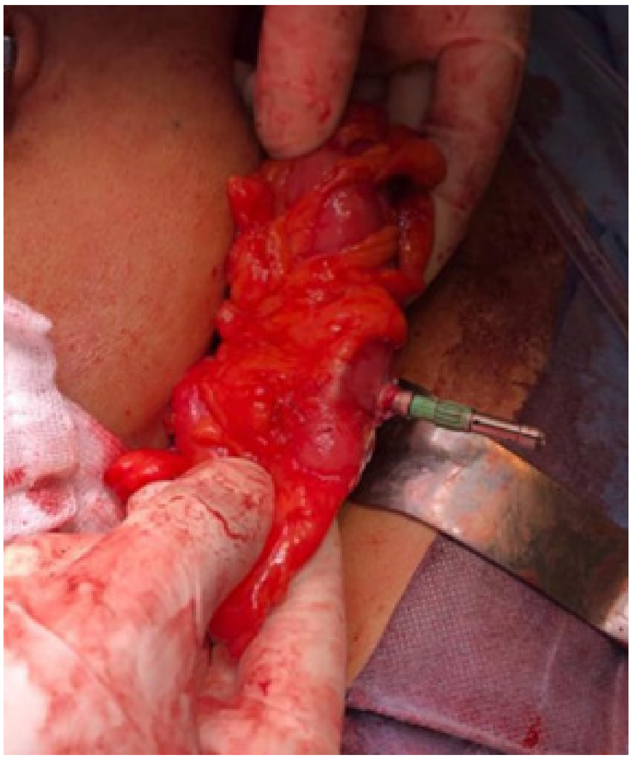

Fig. 10: Introduction of the anvil to the antimesenteric border.

Fig. 11: End-to-side anastomosis.

Statistical analysis

Our study has divided the studied patients into two groups according to the outcome of the development of sepsis with qualitative data was done by using the χ^2 test and/or Fisher exact test used instead of the χ^2 test when the expected count in any cell was found less than 5.

The comparison between two independent groups with quantitative data and parametric distribution was done by using the independent t test.

The confidence interval was set to 95%, and the margin of error accepted was set to 5%. The *P value* was considered significant as the following: *P value* more than 0.05=nonsignificant, *P value* less than 0.05=significant, *P value* less than 0.001=highly significant.

RESULTS:

Demographic data (age, sex, BMI, smoking, and ASA) were insignificantly different between both groups (Table 1; Figs 12,13).

The prevalence of different comorbidities (diabetes mellitus, hypertension, and coronary artery disease) was insignificantly different between both groups (Table 2; Fig. 14).

Tumor data (tumor size, tumor stage, and lymph node stage) were insignificantly different between both groups (Table 3; Fig. 15).

Group A had significantly shorter anastomotic and operative time compared to group B (*P<0.001*) (Table 4; Fig. 16).

Anastomotic time: time starts with anvil placement and firing of the circular stapler and ends with the end of the air leak test.

Time to ileostomy closure and distance of the anastomosis from the anal verge were insignificantly different between both groups (Table 5).

Intraoperative data (intraoperative blood loss and intraoperative anastomotic leak) were insignificantly different between both groups (Table 6; Fig. 17).

Length of hospital stay was insignificantly different between both groups. No dead cases were reported in both groups (Table 7; Fig. 18).

The range of bowel frequency at 3, 6, and 12 months after operation was insignificantly different between both groups (Table 8, Fig. 19).

The urgency of defecation at 3 and 6 months was insignificantly different between both groups. Group A had a significantly higher urgency of defecation at 12 months compared to group B (*P=0.018*) (Table 9, Fig. 20).

The prevalence of different complications (postoperative hemorrhage, diarrhea, constipation, tenesmus, incomplete emptying, seroma/hematoma, adhesive intestinal obstruction, intraabdominal abscess) was insignificantly different between both groups (Table 10; Fig. 21).

Table 1: Comparison between group A and group B regarding demographic data and characteristics of the studied patients

	Group A	Group B			
	N=23	*N*=17	Test value	*P* value	Significance
Age (years)					
Mean±SD	46.22±12.06	43.53±16.6	0.594•	0.556	NS
Range	29–65	20–67			
Sex					
Male	18 (78.3)	11 (64.7)	0.901*	0.343	NS

Female	5 (21.7)	6 (35.3)			
BMI					
Mean±SD	26.83±4.46	27±3.41	–0.130•	0.898	NS
Range	20.42–33.23	22.68–33.56			
Smoking					
No	12 (52.2)	8 (47.1)	0.102*	0.749	NS
Yes	11 (47.8)	9 (52.9)			
ASA					
I	18 (78.3)	11 (64.7)	0.901*	0.343	NS
II	5 (21.7)	6 (35.3)			

•Independent t test.
*χ^2 test.
P value more than 0.05: nonsignificant; *P value* less than 0.05: significant; *P value* less than 0.01: highly significant.

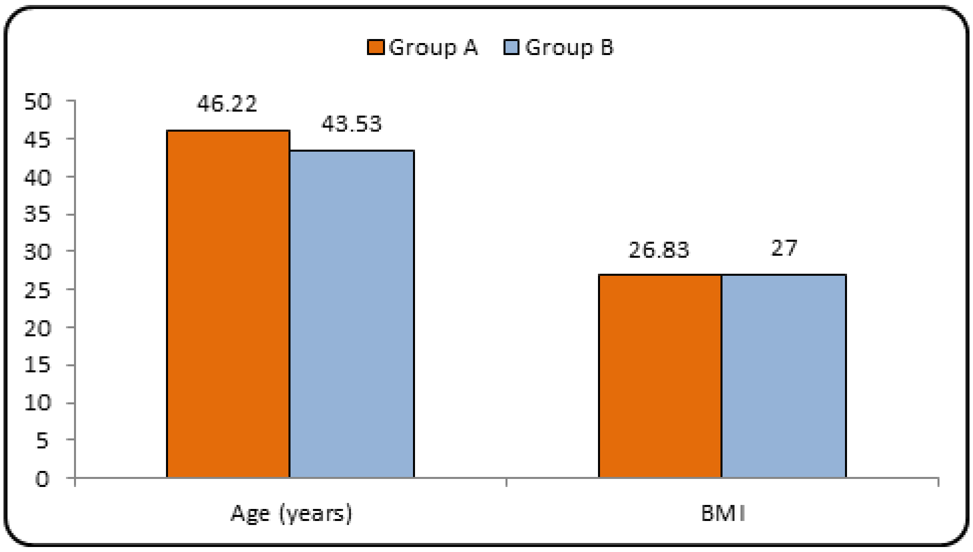

Fig. 12: Comparison between group A and group B regarding age and BMI of the studied patients.

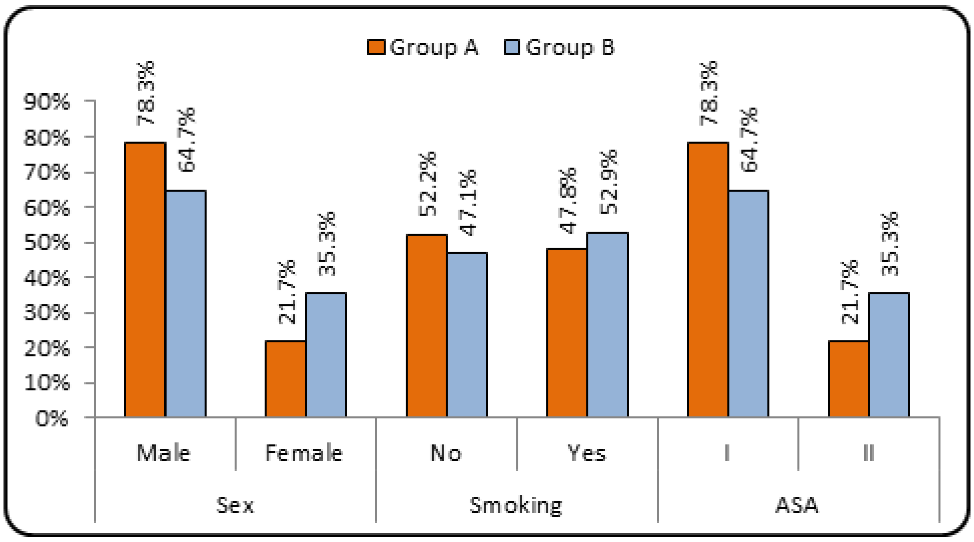

Fig. 13: Comparison between group A and group B regarding sex, smoking, and ASA classification of the studied patients.

Table 2: Comparison between group A and group B regarding comorbidities

	Group A *N*=23	Group B *N*=17	Test value	*P* value	Significance
DM					
No	11 (47.8)	11 (64.7)	1.125*	0.289	NS
Yes	12 (52.2)	6 (35.3)			
HTN					
No	8 (34.8)	5 (29.4)	0.129*	0.720	NS
Yes	15 (65.2)	12 (70.6)			
Coronary artery disease					
No	21 (91.3)	16 (94.1)	0.112*	0.738	NS
Yes	2 (8.7)	1 (5.9)			

*χ^2 test.
P value more than 0.05: nonsignificant; *P value* less than 0.05: significant; *P value* less than 0.01: highly significant**.**

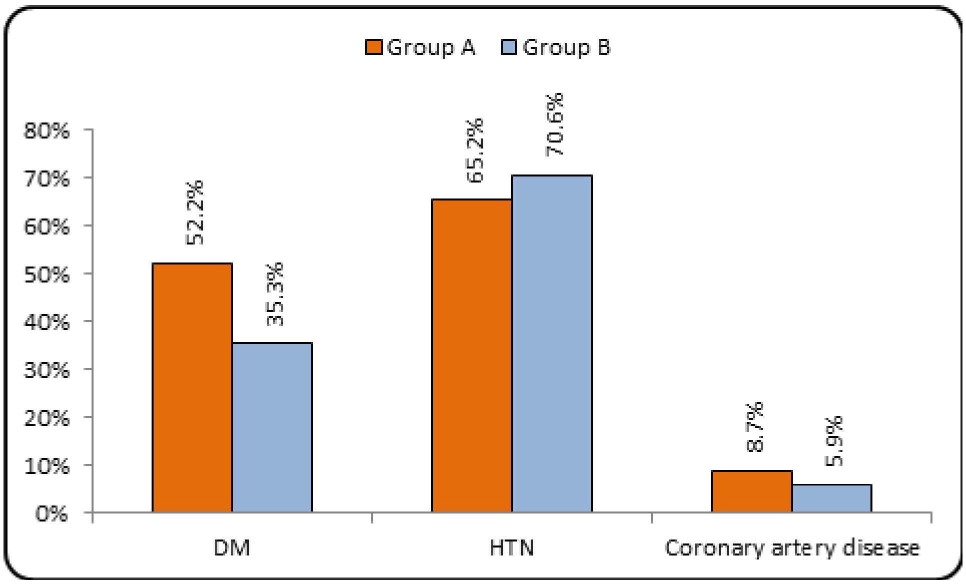

Figure 14: Comparison between group A and group B regarding comorbidities.

Table 3 Comparison between group A and group B regarding tumor stage and lymph node stage of the studied patients

	Group A *N*=23	Group B *N*=17	Test value	*P* value	Significance
Tumor stage					
T1	7 (30.4)	1 (5.9)			
T2	9 (39.1)	10 (58.8)	3.815*	0.148	NS
T3	7 (30.4)	6 (35.3)			
Lymph nodes stage					
N1	6 (26.1)	1 (5.9)			
N2	10 (43.5)	11 (64.7)	3.123*	0.210	NS
N3	7 (30.4)	5 (29.4)			

*χ^2 test.
P value more than 0.05: nonsignificant; *P value* less than 0.05: significant; *P value* less than 0.01: highly significant.

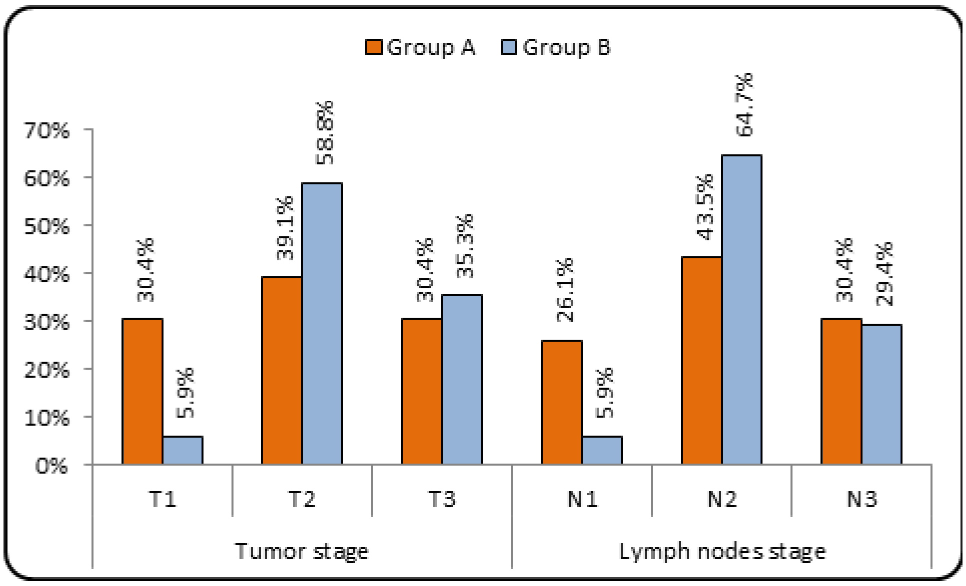

Figure 15 Comparison between group A and group B regarding tumor stage and lymph node stage of the studied patients.

Table 4: Comparison between group A and group B regarding anastomotic time and operative time of the studied patients

	Group A	Group B			
	N=23	*N*=17	Test value	*P* value	Significance
Anastomotic time					
Mean±SD	11.96±0.82	22.59±1.54	–28.126•	0.000	HS
Range	11–13	20–25			
Operative time					
Mean±SD	150.04±6.72	169.71±7.1	–8.936•	0.000	HS
Range	140–160	160–180			

•Independent t test.
P value more than 0.05: nonsignificant; *P value* less than 0.05: significant; *P value* less than 0.01: highly significant.

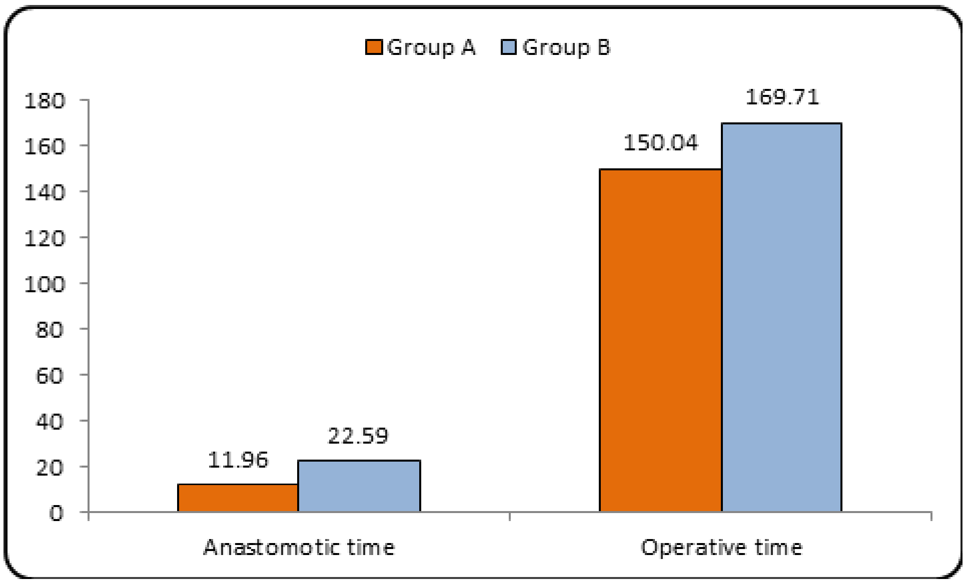

Fig. 16: Comparison between group A and group B regarding anastomotic time and operative time of the studied patients.

Table 5: Comparison between group A and group B regarding time of ileostomy closure and distance of the anastomosis from anal verge among the studied patients

	Group A	Group B			
	N=23	*N*=17	Test value	*P* value	Significance
Time of ileostomy closure (months)					
Median (IQR)	2 (1–3)	2 (1–3)	−0.291≠	0.771	NS
Range	1–3	1–3			
Distance of the anastomosis from the anal verge (mm)					
Mean±SD	6.07±1.14	6.56±1.27	−1.293•	0.204	NS
Range	5–9.3	5–8.6			

≠Mann–Whitney test.
P value more than 0.05: nonsignificant; *P value* less than 0.05: significant; *P value* less than 0.01: highly significant.

Table 6: Comparison between group A and group B regarding intraoperative blood loss and anastomotic leak through air leak test among the studied patients

	Group A	Group B			
	N=23	*N*=17	Test value	*P* value	Significance
Intraoperative blood loss					
No	19 (82.6)	16 (94.1)	1.184*	0.277	NS
Yes	4 (17.4)	1 (5.9)			
Intraoperative anastomotic leak through air leak test					
No	21 (91.3)	15 (88.2)	0.102*	0.749	NS
Yes	2 (8.7)	2 (11.8)			

*χ^2 test.
P value more than 0.05: nonsignificant; *P value* less than 0.05: significant; *P value* less than 0.01: highly significant.

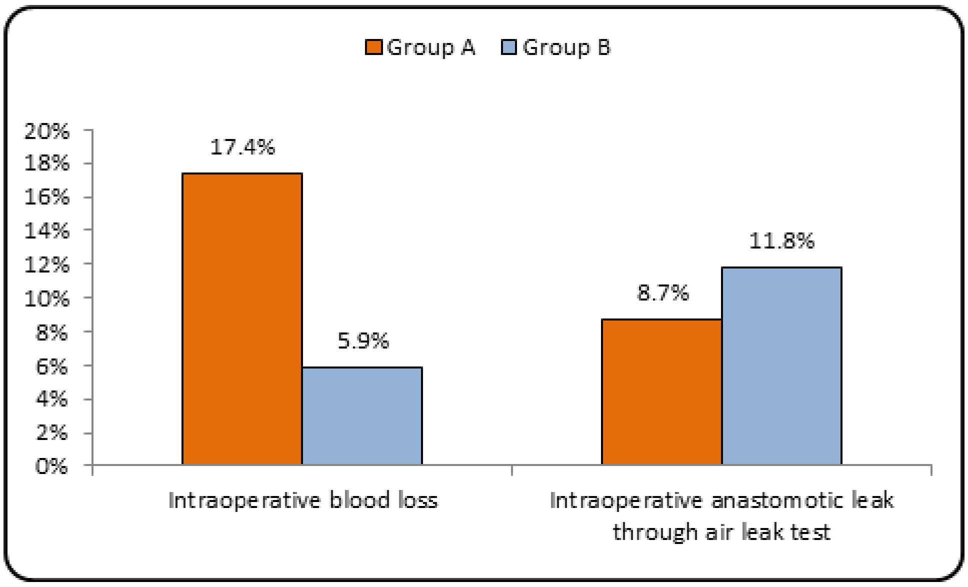

Fig. 17: Comparison between group A and group B regarding intraoperative blood loss and anastomotic leak through air leak test among the studied patients.

Table 7: Comparison between group A and group B regarding the length of stay and mortality among the studied patients

	Group A	Group B			
	N=23	*N*=17	Test value	*P* value	Significance
Length of stay					
Mean±SD	4.43±1.24	4.24±1.25	0.502•	0.619	NS
Range	3–6	3–6			
Mortality					
No	23 (100.0)	17 (100.0)	–	–	–
Yes	0	0			

•Independent t test.
P value more than 0.05: nonsignificant; *P value* less than 0.05: significant; *P value* less than 0.01: highly significant.

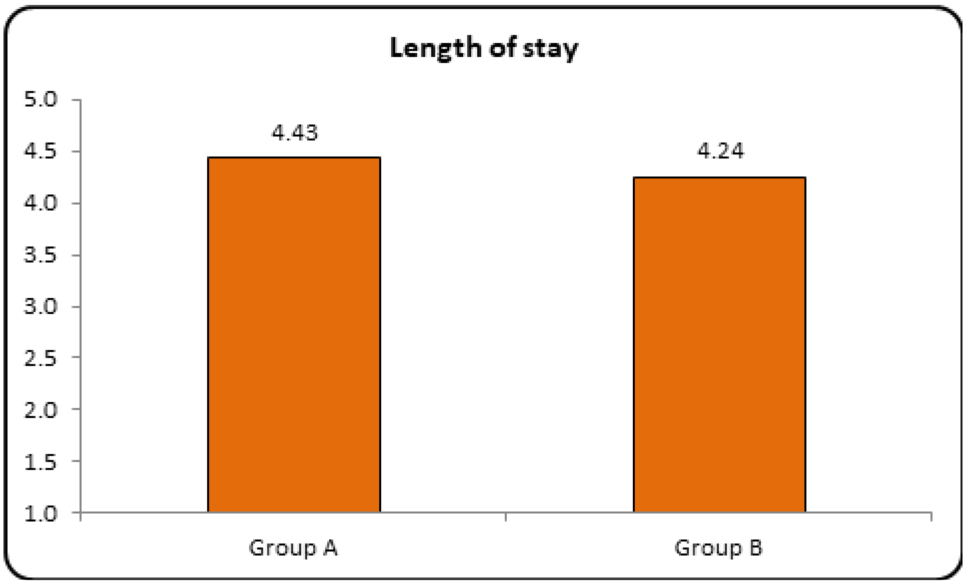

Fig. 18: Comparison between group A and group B regarding length of stay among the studied patients.

Table 8: Comparison between group A and group B regarding the range of bowel frequency at 3, 6, and 12 months among the studied patients

	Group A	Group B			
Range of bowel frequency	*N*=23	*N*=17	Test value	*P* value	Significance
3 months					
1–3	1 (4.3)	4 (23.5)			
4–7	15 (65.2)	11 (64.7)	4.392*	0.111	NS
>7	7 (30.4)	2 (11.8)			
6 months					
1–3	6 (26.1)	9 (52.9)			
4–7	13 (56.5)	8 (47.1)	5.003*	0.082	NS
>7	4 (17.4)	0			
12 months					
1–3	11 (47.8)	13 (76.5)			
4–7	12 (52.2)	4 (23.5)	3.342*	0.068	NS
>7	0	0			

*χ^2 test.
P value more than 0.05: nonsignificant; *P value* less than 0.05: significant; *P value* less than 0.01: highly significant.

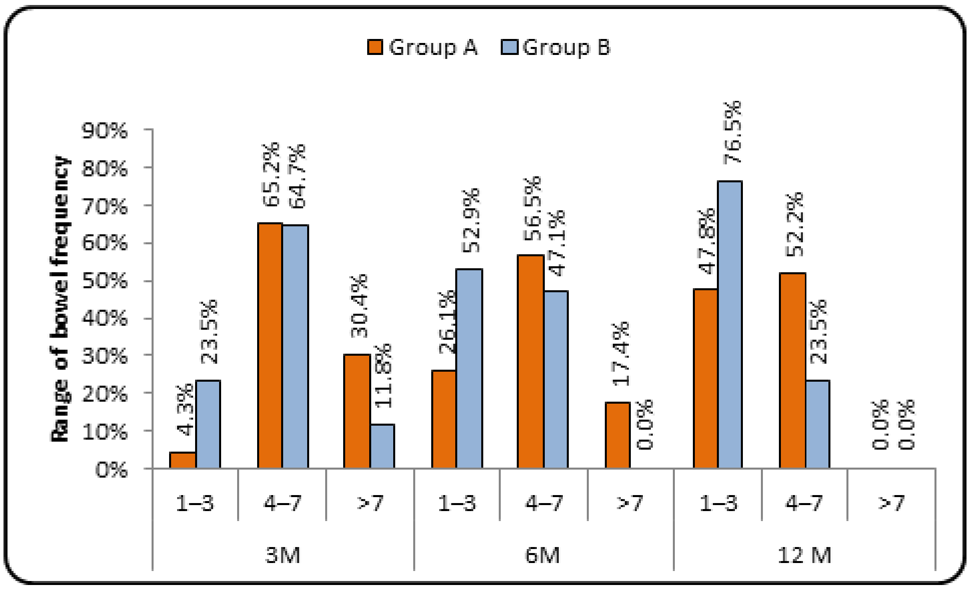

Fig. 19: Comparison between group A and group B regarding the range of bowel frequency at 3, 6, and 12 months among the studied patients.

Table 9: Comparison between group A and group B regarding the urgency of defection at 3, 6, and 12 months among the studied patients

	Group A	Group B			
Urgency of defecation	*N*=23	*N*=17	Test value	*P* value	Significance
3 months					
No	4 (17.4)	5 (29.4)	0.810*	0.368	NS
Yes	19 (82.6)	12 (70.6)			
6 months					
No	3 (13.0)	6 (35.3)	2.775*	0.096	NS
Yes	20 (87.0)	11 (64.7)			
12 months					
No	3 (13.0)	8 (47.1)	5.673*	0.017	S
Yes	20 (87.0)	9 (52.9)			

*χ^2 test.
P value more than 0.05: nonsignificant; *P value* less than 0.05: significant; *P value* less than 0.01: highly significant.

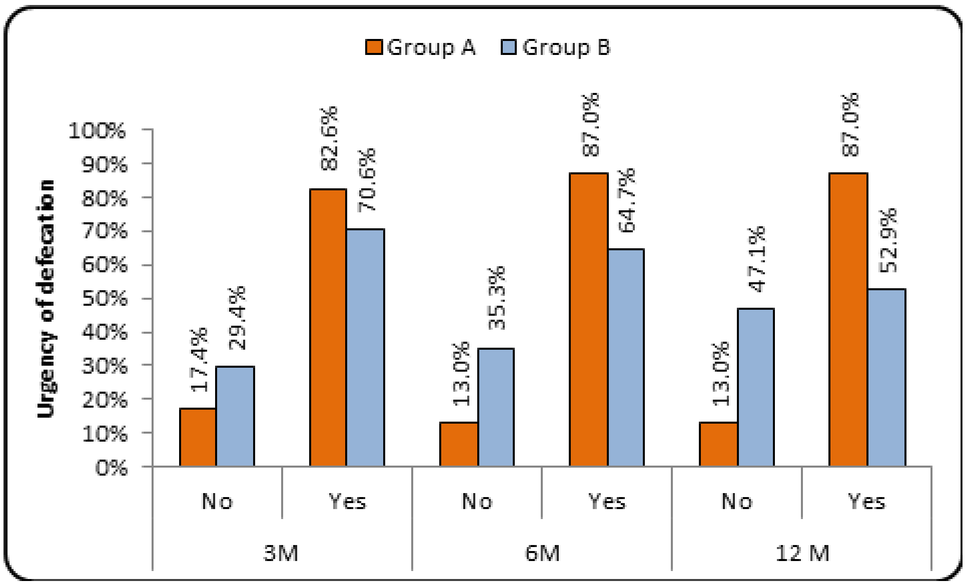

Fig. 20: Comparison between group A and group B regarding the urgency of defection at 3, 6, and 12 months among the studied patients.

Table 10: Comparison between group A and group B regarding postoperative complications among the studied patients

	Group A	Group B			
	N=23	*N*=17	Test value	*P* value	Significance
Postoperative hemorrhage					
No	21 (91.3)	17 (100.0)	1.556*	0.212	NS
Yes	2 (8.7)	0			
Tenesmus					
No	17 (73.9)	14 (82.4)	0.399*	0.527	NS
Yes	6 (26.1)	3 (17.6)			
Incomplete emptying					
No	23 (100.0)	17 (100.0)	–	–	–
Yes	0	0			
Adhesive intestinal obstruction					
No	22 (95.7)	15 (88.2)	0.775*	0.379	NS
Yes	1 (4.3)	2 (11.8)			
Intraabdominal abscess					
No	22 (95.7)	17 (100.0)	0.758*	0.384	NS
Yes	1 (4.3)	0			

*χ^2 test.
P value more than 0.05: nonsignificant; *P value* less than 0.05: significant; *P value* less than 0.01: highly significant.

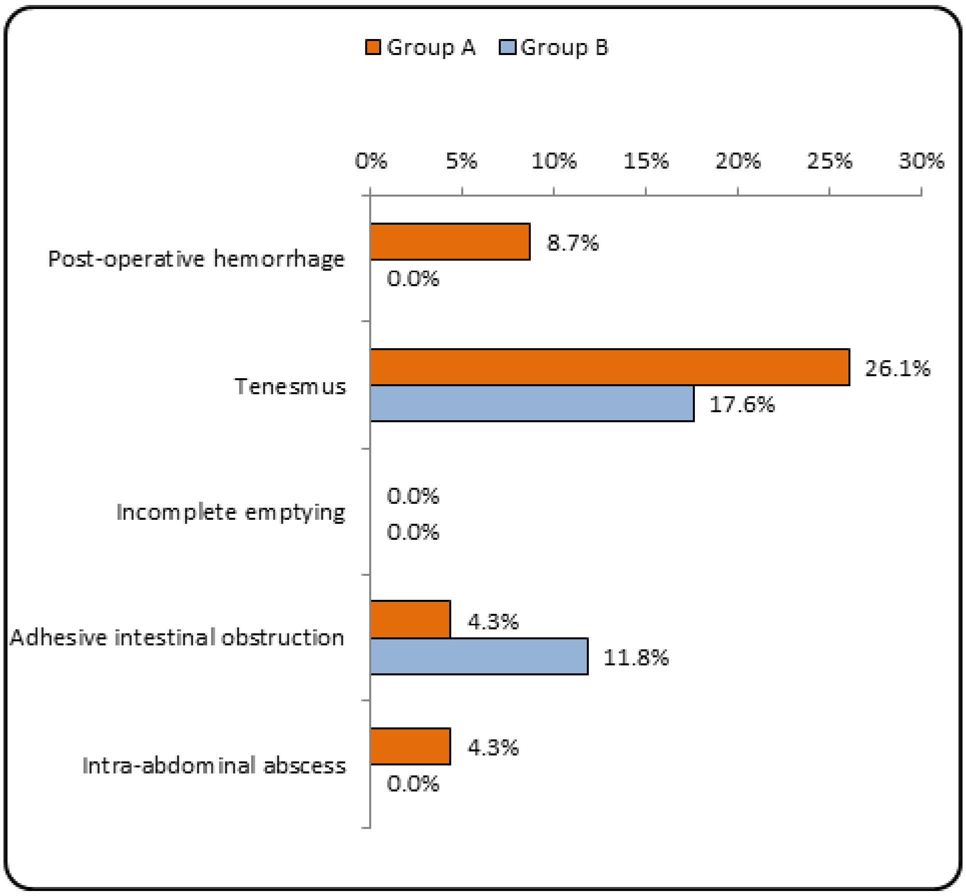

Fig. 21: Comparison between group A and group B regarding postoperative complications among the studied patients.

DISCUSSION

Advances in perioperative care and surgical technique have made anterior resection a standard therapy for rectal and rectosigmoid cancer, leading to improved surgical and oncological outcomes. Despite these advancements, research on anastomotic leakage, which can occur in the acute phase after anterior resection and is independent of the use of a temporary stoma, varies from 2% to 15%.

Age, sex, BMI, smoking, and ASA were found to be statistically insignificantly different between the two groups, not the current study. Consistent with our findings, Kato and colleagues carried out a prospective study comprising 62 patients (89 men and 73 women) who underwent anterior resection with anastomosis using a double-stapling technique. The patients were split into two groups: 63 patients (31 men and 32 women) underwent side-to-end anastomosis, while 99 patients (58 men and 41 women) underwent end-to-end anastomosis. Age, sex, place of residence, BMI, ASA, and smoking did not significantly differ between the two groups, according to the findings.

The current study discovered that there was no statistically significant difference in the prevalence of several comorbidities, such as coronary artery disease, hypertension, and diabetes mellitus, between the two groups. Kato and colleagues noted that, in line with our findings, there was no discernible difference between the two groups with respect to several comorbidities (diabetes mellitus, liver disease, renal disease, lung disease, and CVDs).

Tumor data (tumor stage and lymph node stage) were not substantially different between the two groups in the current investigation. According to Planellas and colleagues, there was no statistically significant difference in the tumor data (tumor location, tumor size, and tumor stage) between the two groups. Additionally, Abdwahed and colleagues showed that there was no statistically significant difference in the tumor site between the two groups.

The current study revealed that group A outperformed group B in terms of anastomotic and operational times, with a significant difference ($P<0.001$). In agreement with our findings, Abdwahed and colleagues found a statistically significant difference in the mean operative time between the two groups ($P=0.001$). The average operating duration in group B was 251.1 min, whereas it was 227.15 min in group A. This could be a result of the EEA group using the purse-string approach taking longer than the SEA group using linear staplers[11].

The current investigation indicated that there were no significant differences between the two groups in terms of the time to ileostomy closure or the distance of the anastomosis from the anal margin. Additionally, Planellas series revealed that 44.1% of patients experienced mild or moderate LARS 12 months following surgery or ileostomy closure (53.3% following low-mid rectal resection and 39.2% following high rectal or sigmoid resection), with no statistically significant difference between the two groups[12].

The intraoperative results (intraoperative blood loss and intraoperative anastomotic leak by air leak test) were not substantially different between the two groups in the current investigation. According to our findings, Brisinda and colleagues examined the surgical outcome in 40 patients, comparing the side-to-end anastomosis group to the end-to-end anastomosis group[14].

Thirty-seven individuals who had laparoscopic excision of T1 and T2 rectal cancer. They came to the conclusion that anastomotic leakage is less common when side-to-end anastomosis is used. Compared to the end-to-end group, anastomotic leak was statistically significantly less in the side-to-end group.

The current investigation revealed that there was no statistically significant difference in the duration of hospital stay between the two groups. In both groups, there were no recorded deaths. Kato and colleagues showed no statistically significant changes in the number of postoperative hospital days across the groups, which is consistent with our results.

The current investigation discovered that there was no statistically significant difference in the number of bowel movements in both groups at 3, 6, and 12 months following the procedure. There was no discernible difference in the urgency of defecation between the two groups at 3 and 6 months. At 12 months, group A's urgency of defecation was noticeably higher than group B's ($P=0.018$).

The functional outcomes of patients with low anterior resection who had end-to-end, colonic J-pouch, or side-to-end anastomosis were examined by Hou and colleagues. According to them, when it comes to early postoperative bowel function restoration, side-to-end colorectal anastomosis performs better than end-to-end anastomosis[13].

The current investigation discovered that there was no statistically significant difference in the prevalence of several problems (abdominal abscess, tenesmus, incomplete emptying, adhesion intestinal obstruction, and postoperative bleeding) between the two groups. According to Kato and colleagues, there were no appreciable variations in the incidence rates of additional problems across the groups, which is consistent with our findings. Additionally, Planellas and colleagues found no statistically significant variations in the incidence rates of additional problems across the groups.

CONCLUSION

This study compared two surgical techniques and did not identify any statistically significant differences in the tumor's characteristics, the postoperative course, complications, long-term bowel function, lab results, or patient demographics. However, group A reported defecating with a little greater urgency than group B 12 months following surgery, and their operation times were notably faster. These findings suggest that both treatments yield effects that are similar, with group A perhaps offering a time benefit but with a slight increase in long-term urgency and group B offering slightly better functional outcomes with a little longer operational duration.

CONFLICT OF INTEREST

There are no conflicts of interest.

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