Outcomes of anterior resection after laparoscopic and open surgery

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Background
The introduction of the laparoscope has improved the feasibility and patient health, owing to being a less invasive procedure. The use of a laparoscope for colorectal cancer surgery was debatable for fear of recurrence, tumor spillage, and nonradical tumor excision. However, the tendency for using laparoscopy in colorectal cancer surgery is in favor nowadays.
Aim
The aim was to compare the results of laparoscopic and open surgical techniques in colorectal cancer located in the rectosigmoid region.
Patients and methods
This prospective study included 50 patients with upper rectal cancer attending the outpatient clinic of Ain Shams University Hospitals, who were treated over a 3-year period. Patients underwent anterior resection either by open technique (first group) or using laparoscopy (second group). Comparative items included operative events (time, blood loss, efficacy of tumor resection, etc.), early postoperative complications (wound infection, anastomotic leakage, etc.), and late postoperative complications (stricture and local recurrence).
Results
This study shows no significant difference between the two groups regarding length of specimen, safety margins, number of retrieved lymph nodes, tumor recurrence, or mortality. However, it shows significantly longer procedure, less blood loss, and less wound complications in the laparoscopic group.
Conclusion
Both laparoscopic and open procedures for rectal cancer surgeries can achieve the same radical resection; however, wound complications seemingly are more frequent in cases having open colorectal resections. The time consumption problem of advanced laparoscopic surgery will improve by gaining more experience and using the best equipment.

Keywords:
laparoscopic surgery, open surgery, rectal cancer

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Introduction

Colorectal cancer is considered the third commonest type of cancer and the second most common cause of cancer-related deaths in the western world [1]. The number of newly discovered cases of colorectal cancer is 40.1 per 100 000 per year [2]. Open colorectal procedures have always been considered the ideal technique for colorectal malignancy. However, since the laparoscopy was invented in 1985, it has allowed safe and more advanced procedures to be performed starting from laparoscopic appendectomy and up to laparoscopic liver, pancreatic, and colorectal resection. The first laparoscopic colectomy was performed in 1991 [3]. There are no uniformly accepted specific contraindications for laparoscopy except for perforated and obstructing tumors [4].

Laparoscopic procedures in the management of colorectal tumors are considered one of the most complex laparoscopic procedures. This technique needs mobilization of bulky structures, working in multiple abdominal quadrants, ligation or clipping of great blood vessels, extraction of a large specimen, and of course creation of a safe anastomosis. The oncologic principles must be respected in any technique with achieving adequate surgical margins, appropriate lymphadenectomy, central ligation of the vascular pedicles, and avoidance of handling or perforation of the tumor [4].

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Aim

The aim of this study was to compare the results of laparoscopic and open surgical techniques in colorectal cancer located in the recto-sigmoid region.

Patients and methods

This is a prospective comparative study that included 63 patients presenting with upper rectal cancers to the outpatient clinic of Ain Shams University Hospitals over a period of 3 years from August 2016 till July 2019 after approval of the Research Ethics Committee of the Department of General Surgery, Ain Shams University. Thirteen patients were excluded from the study: seven patients were discovered to be advanced (infiltrating the lateral pelvic wall, bladder, or vagina) and six patients needed stoma owing to low level of anastomosis). So the study ended up with 50 patients.

Using closed envelope method, patients were randomly divided into two groups (open and laparoscopic). All patients were informed about the details of the study that they will participate in, and all patients signed a detailed informed consent form:

(1) Group A included 25 patients operated upon by laparoscopic technique.
(2) Group B included 25 patients operated upon by open technique.

All patients were examined preoperatively for the following: history taking, general and abdominal examination, routine laboratory investigations, and assessment of tumor markers: CEA and CA19.9. Radiological investigations included MRI pelviabdomen, computed tomography (CT) scan chest, and colonoscopy with biopsy.

Only resectable cases of upper rectal tumors with no distant metastasis were included in the study. So anterior resections with primary anastomosis were the aim of the study. Any case with T3 rectal cancer or N1, N2, or N3 rectal cancer were subjected to have neoadjuvant therapy, and surgery was performed 6–8 weeks after last session. Upper rectal cancer was defined as malignant tumors of the rectum above the peritoneal reflection.

Exclusion criteria

The following were the exclusion criteria:

(1) All cases of perforated, obstructed, or locally advanced tumors (T4).
(2) Rectal cancer below peritoneal reflection.
(3) All cases with cirrhotic liver disease or chronic renal insufficiency.
(4) Any patient with distant metastasis.
(5) Any patient who needed stoma.

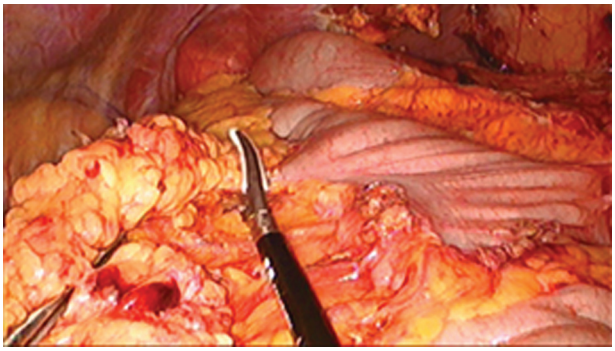
All patients were prepared in the same policy: clear fluids 2 days before surgery with a bowel enema 30 min before surgery. The patients received 1 g intravenous Ceftriaxone and 500 mg intravenous Metronidazole were given half an hour before the surgery. Subcutaneous anticoagulants (low molecular weight heparin) were given preoperatively to avoid venous thrombosis.

The oncological standards for colorectal cancer are respected. This included radical resection of the tumor-bearing segment with high ligation of inferior mesenteric vessels. End-to-end stapled anastomoses were used for all patients in both resection and restoration of bowel continuity in both techniques. Endo-GIA staplers (Johnson and Johnson New Brunswick, New Jersey USA) were used for specimen division in laparoscopic technique and contour of TA staplers in open technique. Circular staples (29, 31, and 33 mm) were used for bowel restoration in both groups. Specimen retrieval in laparoscopic technique occurred through mini pfannenstiel incision (Figs. 1–8).

Comparison was done between the open and the laparoscopic group for the following:

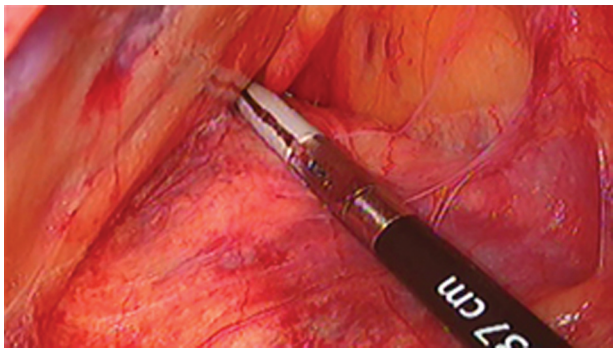
(1) Operative time, intraoperative blood loss, and operative complications.
(2) The time till resolution of postoperative pain and bowel movement.
(3) The efficiency of cancer resection (length of specimen and involvement of margins and number of lymph nodes).

Figure 1



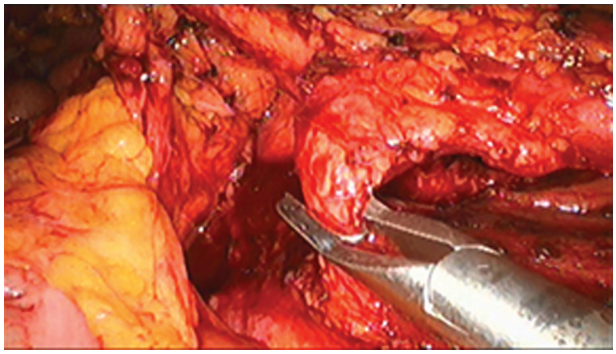
Access to the lesser sac.

Figure 2



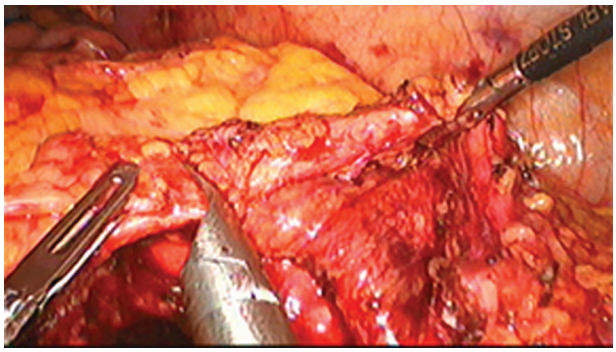
Medial to lateral dissection.

Figure 3



Inferior mesenteric artery clipping.

Figure 4



Inferior mesenteric vein clipping.

(4) The early and late postoperative complications.
(5) Need for IV analgesics.
(6) The length of hospital stay postoperatively and to return to normal activity.

Early follow-up (2 weeks and 1 month) regarding removal of stitches, wound infection, and anastomotic leakage.

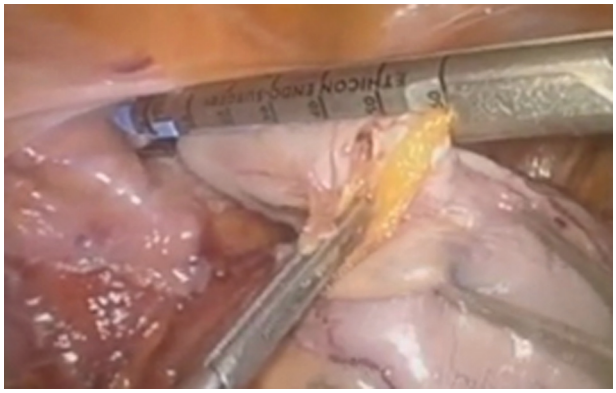
Late follow-up (6 months, 1 year, and 2 years) was done regarding bowel habits, bleeding per rectum, early recurrence (by CT scan and tumor markers), and stricture at site of anastomosis (by colonoscopy).

Data were collected. All removed specimens were sent for histopathological examination.

Figure 5

Dissection towards pelvic floor.

Figure 6

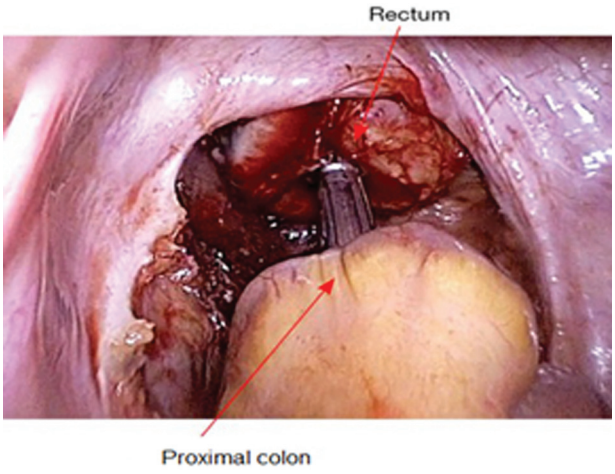


Division of the bowel with the linear stapler.

Figure 7

Anvil placed and fixed with proximal bowel.

Figure 8



Connecting stapler parts.

Table 1 Patients' demography

	Surgical Access					
	Open (*n*=25)		Lap (*n*=25)		*P*	Significance
Sex						
Male	15	60	14	56	0.735	NS
Female	10	40	11	44		

All the patients were followed up by the oncologist postoperatively to prescribe the proper radiotherapy and chemotherapy for each patient according to their individual histopathological examination. Long-term follow-up is done through physical examination, laboratory investigations, tumor markers, pelviabdominal ultrasound and CT, and also MRI, especially pelvis.

Data management and analysis

The Statistical Package for the Social Sciences (SPSS) was used to collect data, revise, code, tabulate, and introduce to a PC.

Descriptive statistics included the following:

(1) Mean.
(2) SD.
(3) Minimum and maximum values (range) for numerical data.
(4) Frequency and percentage of nonnumerical data.

Analytical statistics performed were as follows:

P value expressed the level of significance as follows:
P greater than 0.05: nonsignificant.
P less than 0.05: significant.
P less than 0.01: slightly significant.

Table 2 TNM classification of open and laparoscopic surgery group patients

	Surgical access [*n* (%)]			
	Open	Laparoscopic	*P*	Significance
Final pretreatment category				
T1	2 (8)	3 (12)	0.757	NS
T2	16 (64)	15 (60)		
T3	7 (28)	7 (28)		
Final pretreatment N category				
N0	8 (32)	9 (36.0)	0.805	NS
N1	12 (48)	12 (48.0)		
N2	5 (20)	4 (16.0)		
Final pretreatment M category				
M0	25 (100)	25 (100)	1.000	NS
M1	0	0		
Neoadjuvant therapy				
Yes	18 (72)	19 (76)	0.748	NS
No	7 (28)	6 (24)		

Results

A total of 50 patients participated in the current study, comprising 29 males, with an age range from 32 to 67 years old, with mean age of 57 years (Table 1).

There was no significant difference between the two groups regarding preoperative TNM classification and/or in receiving neoadjuvant therapy, as shown in Table 2.

Table 3 shows a significant high incidence of wound complications (infections, burst abdomen, and incisional hernia) in open than laparoscopic procedure.

Table 4 shows a highly significant difference regarding duration of procedure in laparoscopic surgery (mean of 196 min) than in open surgery (mean of 140 min). Moreover, there is a significantly higher blood loss in open group (mean of 530 ml) compared with laparoscopic group (mean of 270 ml).

Table 5 shows a significantly longer length of hospital stay in open surgery (mean 10.7 day) than in laparoscopic surgery (mean 6.9 days). It also shows more need for pain killers after open surgery than in laparoscopic surgery, and this difference was highly significant. Regarding oral diet, the difference between both groups was highly significant. In laparoscopic surgery, patients started oral diet earlier by a mean of 2.9 days in comparison with open type by a mean of 3.9 days.

Over a period of 2-year follow-up, none of our patients in both groups showed any local recurrence or stricture.

Table 3 Comparison between open and laparoscopic patients regarding postoperative complications

	Surgical access [*n* (%)]			
	Open	Laparoscopic	*P*	Significance
Procedure complications of bleeding or blood loss				
None	12 (48)	20 (80)	0.028	S
Respiratory	5 (20)	3 (12)		
Ureteric injury	0	0		
Wound complications	8 (32)	2 (8)		
Leak	0	0		
Mortality				
No	25 (100)	25 (100)	1.000	NS
Yes	0	0		
Serosal perforation				
No	21 (84)	23 (92)	0.658	NS
Yes	4 (16)	2 (8)		
Excision margin				
Margin not involved	25 (100)	25 (100)	1.000	NS
Margin involved	0	0		
Tumor recurrence				
No	25 (100)	25 (100)	1.000	NS
Yes	0	0		

S, significance.

Table 4 Comparison between open and laparoscopic patients regarding preoperative and operative details

	Open		Laparoscopic			
	Mean±SD	Median	Mean±SD	Median	*P*	Significance
Duration of procedure(min)	140±25.46	145	196±35.64	190	<0.0001	HS
Tumor size (mm)	51.2±23.5	50.0	45.5±17.5	40.0	0.336	NS
Distance of tumor to nearest excision margin (mm)	54.6±34.0	50.0	45.0±23.8	40.0	0.253	NS
Removed nodes	21.1±13.3	17.0	23.4±13.4	20.0	0.545	NS
Length of specimen (mm)	223.8±87.1	200.0	234.2±87.7	230.0	0.676	NS
Estimated blood loss (ml)	530±75.16	500	270±85.6	280	<0.0001	HS

HS, highly significant; S, significance. *Mann–Whitney test.

Table 5 Comparison between open and laparoscopic patients regarding post-operative details

	Open		Laparoscopic			
	Mean±SD	Median	Mean±SD	Median	*P*	Significance
Length of stay (days)	10.7±2.1	7.0	6.9±2.7	6.0	<0.0001	HS
Pain control by oral analgesia (days)	5.3±0.9	5.0	3.9±1.0	4.0	<0.0001	HS
Oral diet	3.9±0.8	4.0	2.9±0.8	3.0	<0.0001	HS

HS, highly significant.

Moreover, none of our patients experienced bleeding per rectum or showed any signs of intestinal obstruction.

Discussion

The philosophy of minimally invasive surgery is to achieve the same goals of standard open surgery by less aggression without compromising exposure or rationale. Introduction of laparoscopic techniques in colorectal surgery did not gain much acceptance owing to several reasons related to professional skepticism as well as socioeconomic considerations of the community [5].

Professional concerns centered around two main considerations: feasibility and outcome of the technique. However, technological advances are progressing toward facilitating problems of exposure (good illumination, close-up magnified views, ongoing attempts to provide stereoscopic vision, and different fan retractors), dissection (ultrasonic dissectors and hand-assisted laparoscopy using special ports), gut resection and anastomosis (staplers and intracorporeal, as well as extra-corporeal knot-tying apparatuses), specimen retrieval, and proper training of the operating team. In laparoscopic surgery, the role of the camera man (the eye of the surgeon) as well as the assistant in exposure of the field is more crucial in

improving the results than their corresponding assistants in conventional open surgery [6].

Professional concerns about the results of laparoscopic colorectal surgery can be discussed under short-term variables (operative and early postoperative) and long-term variables, concerning recurrence of the disease, port site metastases, incidence of adhesive obstruction, as well as overall economics [6].

This study was concerned about feasibility and short-term results of laparoscopic colorectal resection procedures. The cumulative experience with the progressive ascent in the learning curve is bound to affect the outcome variables in future studies.

Patients recruited in the study were candidates of elective anterior resection procedures. They were allocated to either laparoscopic or open colorectal resection. Twenty-five patients were operated upon with conventional surgery (15 males and 10 females) vs 25 patients who were operated upon laparoscopically (14 males and 11 females). There was no significant statistical difference in the age, sex, site, size, distribution of malignant lesions, and neoadjuvant therapy received within the groups between laparoscopic and open groups, attesting to the homogenous distribution of the patients within the two groups.

The primary disadvantage for laparoscopic anterior resection is focused on the longer operative time needed for these procedures. This fact could be countered by the beneficial economic advantage of less hospital stay observed in patients who underwent laparoscopic colectomy. With improvement of the instrumentation and refinement of technique, operative time has decreased [7]. This was also emphasized by Khalili *et al.* [8] that there was no significant difference in their study concerning the operative time.

On the contrary, in our study, we found that there was a high significant difference in the operative time between laparoscopic and open colectomies. Laparoscopic procedures required more operative time with a mean of 196 min compared with 140 min for the open group. This was also the observation of Gandy *et al.* [9], as they stressed that operative time is longer after laparoscopic colorectal resections than for the open procedures, but they also mentioned that with increasing experience, these differences will decrease till reaching equivalence.

Gandy *et al.* [9] stated that the conversion rate for laparoscopic to open is slightly higher for rectal surgery than for colonic surgery. In our study, no cases were converted to open surgery; however, this may be attributed to the relatively small number and selection of patients recruited for this study, that is, exclusion of any advanced (T4), perforated, or obstructing tumor.

As expected, there was a statistically significant reduction of postoperative pain judged by the time patients needed to control their pain by intravenous and/or oral analgesics between the open and laparoscopic groups. Gandy and colleagues emphasized large conventional incisions are more traumatic than the laparoscopic procedure and cause adverse metabolic responses seen in the perioperative period [9]. The results of the present study are in agreement with most literature reviews [10], except for the study of Milson *et al.* [11], who found no difference in the amount of analgesia administered to cases and controls.

Open exploratory incisions, unlike laparoscopic ports, lose large amounts of fluid and heat to the atmosphere, causing dehydration and hypothermia with dryness of the serosa and postoperative ileus. Short periods of ileus are the usual findings with regular intra-abdominal laparoscopic manipulations; however, sometimes in laparoscopic colorectal resections, a significant part of the anastomosis is performed extracorporeally, with the tendency of losing the aforementioned advantage. This is the finding of several authors involving a greater number of recruited patients [12,13]. In our study, we used the ability to resume oral diet as an indicator of resolution of postoperative ileus. We found that there was a highly significant difference in the period needed to resume oral diet, being less in the laparoscopic group. This same finding has been reported by Milson *et al.* [11].

In our study, there was a significantly more blood loss in open group than in laparoscopic group. This can be explained by the necessity of using a sealing device (Harmonic or Ligasure) and the need of completely dry field in laparoscopic surgery, as the red color of the blood distracts light.

Detailed pathological studies of the resected specimens revealed no statistically significant difference in the number of lymph nodes harvested, length of specimen, involvement of resection margins, and distance between cut edge and nearest excision margin during laparoscopic colorectal resections and their corresponding conventional counterpart attesting to the ability to fulfill the rationale of radical resections in both groups. A meta-analysis

included five randomized controlled trials concentrating on these issues and concluded no significant difference between laparoscopic and open resection groups [14].

Moreover, Schwenk *et al*. studied the Cochrane database and extracted seven trials comprising 688 patients and found no difference in the total number of lymph nodes after open and laparoscopic colorectal cancer resection [15]. The UK Medical Research Council trial of Conventional vs Laparoscopic-Assisted Surgery in Colorectal Cancer (MRC CLASSIC) had the same reports about statistically non-significant positive resection margins in both laparoscopic and open groups [16].

There was no statistically significant difference in the distribution of postoperative complications between laparoscopic and open groups. However, wound complications (infections and one instance of burst abdomen) seemingly were more frequent in cases having open colorectal resections (more traumatized potentially contaminated wounds). There was a statistically significant decrease in hospital stay in cases having laparoscopic colorectal resections when compared with those undergoing open resections. This result is in harmony with similar several studies in the literature. We would contribute this to the longer period of postoperative ileus and control of postoperative pain with oral analgesics in the open group. Patel and Bergamaschi [17] concluded that length of hospital stay depends on preoperative counseling, discharge criteria, social arrangements, patient's health literacy, or type of health system than the means of surgical access.

To recapitulate the findings of this preliminary randomized controlled study, laparoscopic colorectal resections are feasible technically with a comparable efficacy of resection of tumor-bearing segments with its lymph nodal basin to the corresponding open standard colorectal resections.

Furthermore, short-term findings of this study can be critically appraised as findings directly related to patient's acceptance of the technique and the more subtle consideration for effective safe practice that really concerns the medical profession.

In our study, we consider the most valuable short-term advantage for laparoscopic colorectal resection is the hospital stay time and less need to parenteral analgesia, and also for patient's physically comfort. This improves rates of patients getting back to their normal activity postoperatively and increases patients' turnover.

Robotic surgery is a recent technique that is used in resection of colorectal cancer mainly in the ultra-low anterior resection and in the narrow male pelvis. In a study, 115 patients underwent either robotic (57 patients) or laparoscopic (58 patients) surgery. The mean operation time was 190.1 min in robotic group and 191.1 min in the laparoscopic group (P=0.93). There was no converted cases in the robotic group and ~10.5% conversion rate in the laparoscopic group (P=0.012). The major complication rate was 5.4% in the robotic group and 19.2% in the laparoscopic group (P=0.03). The quality of the specimen was satisfactory in both groups [18].

Conclusion

Both laparoscopic and open procedures for rectal cancer surgeries can achieve the same radical resection; however, wound complications, blood loss, and postoperative pain seemingly are more frequent after open surgery. The time consumption problem of advanced laparoscopic surgery will improve by gaining more experience and using the best equipment.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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