

Laparoscopic evaluation of medial-to-lateral approach of for management of left-sided colon cancer

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Background

To date, there remain limited data supporting either medial or lateral approach for laparoscopic left colectomy; therefore, the purpose of the study was to evaluate the medial approach (MA) in left-sided colonic cancer.

Patients and methods

A total of 40 patients with nonmetastatic left colonic adenocarcinoma were prospectively subjected to MA laparoscopic colectomy in the Department of Gastrointestinal Surgery, Faculty of Medicine, Alexandria University, Egypt, in the period from July 2017 to July 2019. Data regarding operative time, bleeding, number of lymph nodes dissected, functional recovery (bowel sounds, gases passage intake of liquids and solids), length of hospital stay, and morbidity and mortality rates were all collected and recorded.

Results

There were 22 males and 18 females. Their ages ranged from 32 to 70 years, with a mean±SD of 55.61±9.78 years. Bleeding per rectum was the most common presentation in 52.5% of patients. A total of 20 (50%) patients underwent left hemicolectomy, nine (22.5%) patients underwent sigmoidectomy, and 11 (27.5%) patients underwent anterior resection. The mean operative time was 227.3 ±40.3 min, and the mean blood loss was 212.2±101 ml. Anastomotic leak was detected in six (15%) patients, and surgical site infection developed in five (12.5%) patients.

Conclusion

The medial (artery-first) approach is preferred in patients with left-sided colon cancer undergoing laparoscopic colectomy. We think that stapled reconstruction of colonic continuity decreases the risk of surgical site infection.

Keywords:

laparoscopic colectomy, left colon cancer, medial-to-lateral approach

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Introduction

Colorectal cancer is the third most common cancer worldwide [1] and the fourth leading cause of cancer death [2], with more than half of the cases occurring in the left side [3] followed by the rectum in ~27% of cases [3]. The symptoms of colorectal cancer are generally nonspecific; highly suspicious symptoms include changes in bowel habits, rectal bleeding, and iron-deficiency anemia [4].

Evidence-based practice has confirmed the advantages of laparoscopic surgery over open surgery, such as less postoperative pain, decreased use of analgesics, less blood loss, shorter hospital stay, and faster return to normal activity [5]. Since Jacobs *et al.* [6] introduced laparoscopic colectomy in 1991, two approaches were described: the lateral approach (LA), which follows the traditional sequence of open surgery starting with mobilization of the colon from the lateral peritoneal attachment then ligation of the vessels [7] and the medial-to-lateral approach starting by vascular dissection.

There is a paucity of data about which approach has better short-term and long-term benefits over the other. Although the European Association of Endoscopic Surgeons (EAES) recommended the medial approach (MA) in laparoscopic colon surgery, this recommendation failed to abort the debate as the level of evidence was only five and the recommendation grade was D [8]. On the contrary, some institutions advocate the LA as the dissection is familiar to open colectomies assisted by gravity force in the right-lateral position aided by the sigmoid colon retracting the small bowel away in case of obstruction or morbid obese patients [9]. This study aimed to assess the early surgical outcomes of the medial-to-lateral laparoscopic approach in patients with left-sided colon cancer.

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Patients and methods

Study population

This study was conducted on 41 patients; however, one patient was excluded from the final results owing to irresectable tumor infiltrating the urinary bladder and abdominal wall and was managed by diverting colostomy. The studied population included 22 (55.0%) males and 18 (45.0%) females, and their ages ranged from 32 to 70 years, with a mean of 55.61 ± 9.78 years.

In this prospective study, patients underwent laparoscopic left colon resection with curative intent by the medial-to-lateral (MA) approach at the Gastrointestinal Surgery Unit, Faculty of Medicine, Alexandria University, Egypt, in the period from July 2017 to July 2019. Inclusion criteria included patients with histologically proven adenocarcinoma of the left colon without extracolonic or distant metastasis. Those with fixed, obstructed or perforated tumors, as well as those with contraindications to laparoscopy were excluded. The study protocol was approved by the local ethics committee of our institution, and an informed consent was taken from all patients including the possibility of stoma.

All patients were subjected to thorough history taking, full clinical examination, and laboratory investigations, which included complete blood picture, liver and renal function tests, glucose level, and carcinoembryonic antigen. Computed tomography (CT) enterocolonography for staging and localization of the tumor followed by colonoscopy and biopsy, metastasis workup by CT chest, and pelvic-abdominal ultrasound scan were performed. The TNM classification of the American Joint Committee on Cancer (AJCC) 8th edition staging of colon cancer was adopted [10].

Surgical technique (medial-to-lateral approach)

The colon was prepared by polyethylene glycol in all cases. Prophylactic antibiotic was given (ceftriaxone sodium, 1 g) at the time of induction of anesthesia, and a urinary catheter was inserted.

The patient was positioned in the modified lithotomy position with the main surgeon standing in between the abducted legs. The patient's head is lowered by 15° (Trendelenburg position), and table was 20° right-tilted. The position was adjusted at the time of splenic flexure mobilization to head elevation by 20° to let the small bowel go down toward the pelvis.

Figure 1



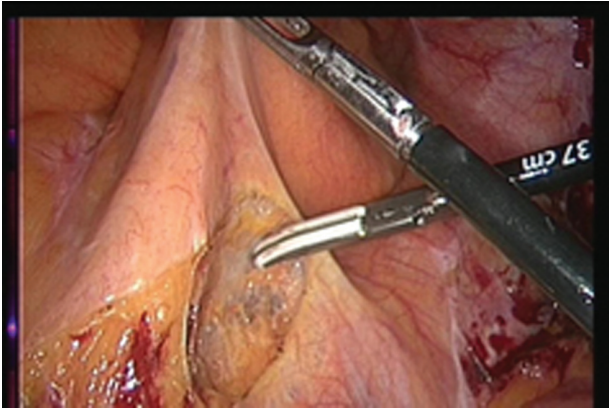
Port sites for laparoscopic left colectomy.

Five ports were introduced (Fig. 1): a 10-mm port in the midline 4 cm above the umbilicus to increase the field of view, a second 5 mm port in the right midclavicular line just below the umbilicus, a third 10–12-mm port at the right midclavicular line in the right iliac fossa, a fourth 5-mm port in the left midclavicular line 2 cm above the level of the umbilicus, and a last 5-mm port in the midline 4 cm above the pubic bone.

The tumor was localized by either visual inspection or intraoperative colonoscopy. The summit of sigmoid colon was then pulled anteriorly with a grasper toward the abdominal wall to create tension on the inferior mesenteric artery (IMA), followed by incising the medial peritoneum with a sealing device at the base of sigmoid mesocolon from the sacral promontory to the duodenojejunal junction to expose the IMA and left colic artery (Fig. 2). The IMA was then dissected with the surrounding lymph nodes (LNs) and transected after application of two proximal double clips or ligatures (Fig. 3). Dissection was continued below the vessels separating sigmoid mesofascia from Toldt's fascia, which is the embryological cover of the retroperitoneal structures, dropping down the gonadal vessels and left ureter and hypogastric plexus of nerves (Fig. 4). In anterior resection, dissection of the mesorectum started from the sacral promontory in the avascular retrorectal plane till the pelvic floor followed by dissecting the anterior mesorectum from the base of the bladder and prostate in males and from the vagina in females.

Once the distal transection level is determined with adequate safety margin, division using articulating

Figure 2



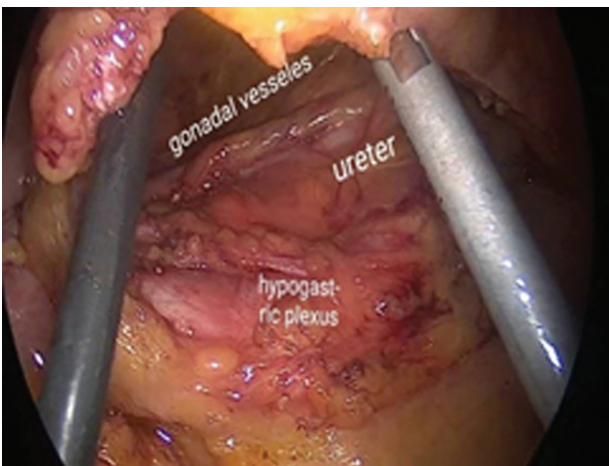
Opening the mesocolon from the medial side.

Figure 3



Clipping the inferior mesenteric artery (IMA).

Figure 4



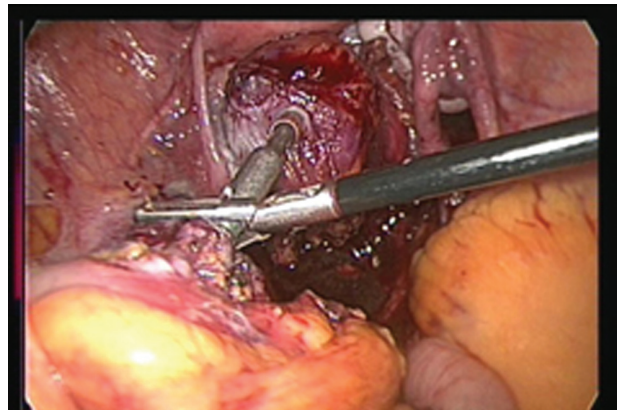
Identification of retroperitoneal structures.

Figure 5



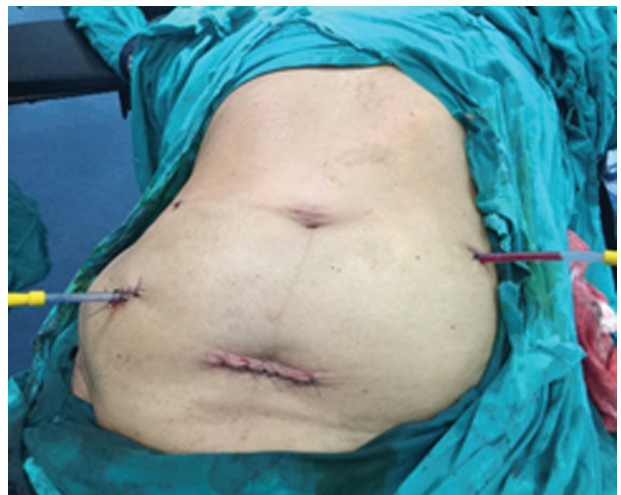
Division of distal colon by stapler.

Figure 6



Colorectal anastomosis by circular stapler.

Figure 7

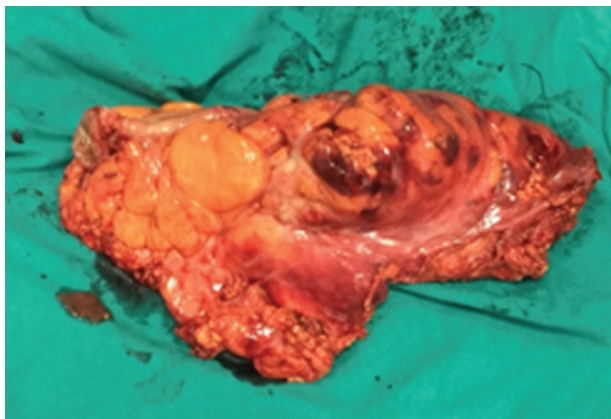


Closure of Pfannenstiel incision.

linear stapler was performed (Fig. 5). Through a Pfannenstiel or lower midline incision, the colon was delivered, dividing the proximal end, and then a hand-sewn colo-colic anastomosis or stapled colorectal anastomosis was done (Fig. 6). At the end, two

drains were inserted beside the anastomotic site (Fig. 7). Patients resumed feeding on the fourth or fifth postoperative day after passage of flatus. In cases of diverting stoma, oral feeding was started once stoma started functioning.

Figure 8



Specimen with intact mesocolon.

Data collected included operative time, nomogram, mesocolic integrity, radicality of the excision, and leakage rate.

- (1) Operative time was calculated in minutes from insertion of the first port till the last port site closure.
- (2) Nomogram is the number of infiltrated LNs divided by the total number of LNs extracted. Nomogram is valid only for cases if LNs extracted were more than 12 LNs [11].
Nomogram = positive LNs / total number LNs extracted.
- (3) Regarding mesocolon integrity, mesocolon dissection was described as 'good' if dissection was performed in the proper mesofacial plane between Gerota fascia and the mesocolon maintaining an intact mesocolon (Fig. 8), described as 'moderate' in case of irregular breaches not reaching the muscle layer, and described as 'poor' when there is disruption of the colonic-musculosa [12].
- (4) Radicality of the surgical resection was divided into R0: curative, no residual tumor; R1: questionably curative, with microscopic residual at resection margins and gray zone situation that would question a curative operation, such as suspect but unproven metastases; and R2: palliative or unresectable, gross tumor left behind [13].
- (5) Leakage was graded according to the International Study Group of Rectal Cancer [14] into the following:
 - (a) Grade A: leakage identified radiologically or by passage of enteric contents.
 - (b) Grade B: leakage requiring therapeutic intervention but not necessarily reoperation.
 - (c) Grade C: leakage requiring reoperation.

Follow-up

Patients were followed up regularly once weekly in the first month and then every 3 months for 1 year, and carcinoembryonic antigen level was estimated at 4 months, postoperatively.

Results

In the studied population, bleeding and passage of mucus per rectum was the main complaint occurring in 21 (52.5%) patients, and the least symptom was diarrhea, occurring in four (10%) patients. Two asymptomatic patients were referred from a screening program. The descending colon from splenic flexure to the descendo-sigmoid junction was the primary tumor site (50%) for which left hemicolectomy was performed. Adhesions and narrow pelvis were the dominant difficulties encountered intraoperatively. Acceptable mesocolic resection (good and moderate) was achieved in 87.5% of the patients. Detailed preoperative and operative data collected are summarized in Table 1.

The colonic continuity was restored by hand-sewn anastomosis in left colectomies (50%) and by end-to-end anastomosis stapler in sigmoidectomies and anterior resection (50%). Stoma was constructed intraoperatively in six (15%) patients after tumor resection.

Four patients were converted to open surgery, including two patients owing to malignant adhesions (T4b) to the nearby structures: the uterus in one patient and the urinary bladder in the other. In the third patient, obesity, heavy omentum, thick mesentery, and accidental technical problem in operating table led to abortion of the procedure, and in the fourth patient, a superficial spreading tumor could not be localized.

Surgical site infection (SSI) developed in five (12.5%) patients postoperatively and was managed by daily dressing and proper antibiotics based on culture and sensitivity test. Four (10%) patients experienced grade A leakage and were treated conservatively, whereas two (5%) others experienced grade C leakage, which needed re-exploration and diversion. The first patient had signs of toxemia and a high output fecal discharge on the seventh postoperative day after left hemicolectomy. Anastomotic leak was confirmed by CT contrast leakage with loculated collection. On re-exploration, tension and ischemia on suture line were found, and leakage was urgently managed by abdominal lavage and diversion. The second patient

Table 1 Preoperative and operative data of studied patients (N=40)

| Preoperative data | |
|--|--------------|
| Main complaint | <i>n</i> (%) |
| Blood and mucus per rectum | 21 (52.5) |
| Constipation | 18 (45.0) |
| Abdominal pain | 18 (45.0) |
| Weight loss | 11 (27.5) |
| Diarrhea | 4 (10.0) |
| No symptoms | 2 (5.0) |
| Tumor site | <i>n</i> (%) |
| Descending colon | 14 (35.0) |
| Recto-sigmoid junction | 11 (27.5) |
| Sigmoid colon | 9 (22.5) |
| Descendo-sigmoid junction | 5 (12.5) |
| Splenic flexure | 1 (2.5) |
| Operative data | |
| Type of surgery | <i>n</i> (%) |
| Left hemicolectomy | 20 (50.0) |
| Anterior resection | 11 (27.5) |
| Sigmoidectomy | 9 (22.5) |
| Operative time (min) | |
| Mean±SD | 227.3±40.31 |
| Minimum–maximum | 120–320 |
| Blood loss (ml) | |
| Mean±SD | 212.2±101.7 |
| Minimum–maximum | 50.0–550.0 |
| Operative difficulty | <i>n</i> (%) |
| Adhesions to nearby structure | 11 (27.5) |
| Narrow pelvis | 11 (27.5) |
| Large tumor size (>5 cm) | 10 (25.0) |
| Dilated colon | 8 (20.0) |
| Difficult splenic flexure mobilization | 8 (20.0) |
| Poor tumor localization | 7 (17.5) |
| Bleeding | 1 (2.5) |
| Mesocolic integrity | <i>n</i> (%) |
| Good | 20 (50.0) |
| Moderate | 15 (37.5) |
| Poor | 5 (12.5) |

presented with pelvic abscess 6 weeks after anterior resection. On re-exploration, after failure of two percutaneous drainages, two defects on both sides of anastomotic site were found connected to the abscess cavity and were managed by refashioning of the anastomosis and a diversion ileostomy.

R0 resection was obtained in 38 (95%) patients and R1 resection in two patients; positive circumferential resection margin (CRM) was found in one patient, and distal margin infiltration in the other. The hospital stay ranged from 3 to 21 days, with a mean of 7.49±3.57 days.

No mortality occurred intraoperatively. On follow-up, one patient died after 7 months after the discovery of brain metastasis, managed by metastasectomy; however, the patient died in the early postoperative

Table 2 Postoperative pathological findings in the studied patients (N=40)

| Parameters | <i>n</i> (%) |
|---------------------------------|--------------|
| T stage | |
| T1 | 1 (2.5) |
| T2 | 8 (20) |
| T3 | 20 (50) |
| T4a | 9 (22.5) |
| T4b | 2 (5.0) |
| N stage | |
| N0 | 14 (35.0) |
| N1a | 1 (2.5) |
| N1b | 7 (17.5) |
| N1c | 3 (7.5) |
| N2a | 5 (12.5) |
| N2b | 10 (25) |
| Lymphovascular invasion | 6 (15) |
| Perineural extension | 3 (7.5) |
| Number of lymph nodes harvested | |
| <12 | 10 (25) |
| >12 | 30 (75) |
| Nomogram (N=30) align="center" | |
| Mean±SD | 0.24±0.20 |
| Minimum–maximum | 0.0–0.64 |
| Recurrence | |
| Lymph nodes extracted <12 | 2 (20) |
| Lymph nodes extracted ? 12 | 1 (3.33) |

period. Three (7.5%) patients developed local recurrence at the anastomotic site; two of them had a LN harvest less than 12 in number.

Pathological assessment of the retrieved specimen showed that the tumor invaded through the muscularis propria into the pericolic tissues in 50% of the patients, and seven or more infiltrated LNs were discovered in 25% of the patients. Lymphovascular invasion and perineural invasion were confirmed in 15 and 7.5%, respectively. Recurrence was associated with less LNs extracted (20% of patients in whom LNs extracted were <12). Postoperative pathological data are summarized in Table 2.

Discussion

Although laparoscopic colorectal surgery is associated with improved short-term outcomes including fast recovery, reduced postoperative ileus, lower wound infection rate, shorter hospital stay, reduced postoperative pain, and earlier tolerance of oral diet [15], surgeons are still reluctant to adopt laparoscopic colorectal techniques owing to the inherent limitations of laparoscopy, technical challenges, long learning curve, limitations of manipulation and retraction, costs, and the prolonged operative time compared with open surgery [11]. Studies did not find superiority of open surgery regarding overall survival,

oncological clearance, recurrence rates, complication rates, and reoperation rate [16].

The MA was first reported by Milsom *et al.* [17] for proctosigmoidectomy with low colorectal anastomosis in a cadaver model. The hallmark of the approach is earlier identification and ligation of the vessels (artery-first approach), followed by exploration and protection of the retroperitoneal structures (e.g. ureter and gonadal vessels) [18]. Immediate identification of the plane between the mesocolon and the retroperitoneum in the MA renders the dissection faster and smoother [19].

Rotholtz *et al.* [20] and Liang *et al.* [21] proposed that the MA resembles the non-touch isolation technique introduced by Turnbull [22] and should therefore be more oncologically safe. Early ligation of mesenteric vessels and minimal manipulation of the tumor may potentially prevent tumor dissemination and reduce the risk of recurrence and metastasis [23].

In this study, it was noticed that the MA is characterized by minimal manipulation to the diseased colonic segment, and colonic uplift aids mesocolic dissection; in contrast, the LA increases redundancy and hinders dissection. In addition, early ureter and gonadal vasculature identification prevents their damage, and early vascular control reduces bleeding from dissection.

The mean operative time in the present study was 227.3 ± 40.31 min; this involves the time of mobilization of the colon, division of the inferior mesenteric vessels, exteriorization and resection of bowel, and anastomosis. A systemic review and meta-analysis published by Ding *et al.* [24] concluded that the operative time for MA was significantly shorter than that for LA. The mean amount of blood loss was 212.2 ± 101.7 ml, which is less than that reported by Mahmoud and Moneer [25], that is, 350 ml (60–600 ml); this was achieved by adopting dissection in the proper anatomical mesocolic planes. In accordance with our findings, Ding *et al.* [24] reported a significantly less blood loss in MA.

In the current study, the conversion to open surgery occurred in four (10%) cases. Conversion rate varies in the literature from 7 to 25% in large series [26,27]. In general, the MA has less conversion rate than the LA, as malignant adhesions are more on the lateral side of the colon, which oppose IMA and ureter identification

from the lateral side [20]. Ding *et al.* [24] stated in their study that the conversion rate in the MA group was significantly lower than that for the LA group, owing to early identification and control of IMA, and concluded that adhesions and intraoperative complications (mesenteric bleeding and injury of the small intestine and ureter) were accused as the most common leading causes for conversion in the LA. In the study conducted by Mahmoud and Moneer [25], the conversion rate was 12% (six cases), comprising two cases owing to uretic injury, three cases owing to failure to progress, and tumor adherence to urinary bladder and uterus in one case, and they suggested that obesity, large tumor size, previous adhesions, and surgeon inexperience are risk factors for conversion in laparoscopic colectomy.

SSI occurred in five (12.5%) patients, in whom hand-sewn anastomosis was performed in four. In agreement, Hussain *et al.* [28] stated that SSI was reported in five (8.1%) cases in the MA and three (4.1%) cases in the LA owing to hand-sewing technique in colonic anastomosis, which leads to skin contamination. Poon *et al.* [29] suggested that infectious complications increase with the MA owing to the prolonged ischemic time of the devascularized colon segment; however, a meta-analysis revealed no significant difference between the two approaches.

In this study, the mean hospital stay was 7.49 ± 3.57 days (3–21 days), which is similar to the results of Hussain *et al.* [28] in which the median hospital stay in MA and LAs was 7 days (2–52 day). Another two studies showed a significantly shorter time for the MA group than for the LA group [21,30]. In the pooled data, Ding *et al.* [24] stated that hospital stay was not significantly different between the two approaches. In the study of Mahmoud and Moneer [25], the median hospital stay was only 4 days (3–12); they refer that to adoption of ERAS protocol (enhanced recovery after surgery program).

West *et al.* [12] presented strong evidence that dissection in the proper mesocolic planes is associated with survival improvement. Other authors concluded that poor mesocolic integrity (muscularis plane surgery) will jeopardize R0 resection, may disrupt the lymphatic and vascular drainage, and potentially result in a poor outcome [31]. In this study, the ability to preserve an intact mesocolon 'good' was achieved in 52.5% (21 patients), moderate in 35% (14 patients), and poor in 12.5% (five patients).

Multiple studies have declared the effect of increased extracted LNs on survival improvement [32]. Berger

et al. [33], in 2005, reported that the 5-year overall survival, disease-free survival, and cancer-specific survival were all improved by increased number of LNs resected. Moreover, in 2012, Schmoll *et al.* [34] reported that adjuvant chemotherapy is indicated for all patients with number of lymph nodes studied (NLNS) less than 6 and that NLNS less than 12 is also a risk for recurrence as mentioned by Watanabe *et al.* [35]. In this study, the median number of LNs resected was 15 LNs, with more than 12 LNs resected in 30 (75%) patients. The number of resected LNs increased by time owing to adoption of 'D3 resection,' which indicates extended lymphadenectomy on the IMA. Liang *et al.* [21], found equivalent number of LN harvest in both MA and LA. On the contrary, Poon *et al.* [29] and Honaker *et al.* [32] declared the superiority of the MA regarding LNs harvest. Hussain *et al.* [28] dissected a mean of 17 LNs in MA and 14 LNs in the lateral-to-medial approach, with no statistically significant difference. In the current study, two (5%) patients with inadequate resection (R1) were encountered; in the first patient, the lesion was deeply seated in his narrow pelvis, and the stapler was hardly adjusted on the distal margin leaving microscopically infiltrated distal margin, whereas in the other patient, the CRM was involved. Mahmoud and Moneer [25] reported in their study on 50 patients, two (4%) with pathologically proven incomplete R1 distal margin resection, Hussain *et al.* [28] had 11 (8.7%) patients with CRM infiltration, including 4.7% (six cases) in the LA and 3.9% (five cases) in the MA, with no significant difference.

In this study, local recurrence occurred in three (7.5%) patients at the anastomotic site, with no case of liver or peritoneal recurrence. Mahmoud and Moneer [25] reported a single case (2%) of anastomotic recurrence and two patients of liver recurrence and another two of peritoneal recurrence during a follow-up period of 5 years.

The main limitations of this study were the small sample size and lack of comparison with the LA. In conclusion, the medial-to-lateral (artery-first) approach is recommended in laparoscopic colorectal resection as it is a feasible and safe procedure with acceptable morbidity. Reconstruction by hand-sewn anastomosis is accompanied with increased wound infection incidence. Further research is needed to evaluate the effect of mesocolic integrity and D3 dissection on oncological outcome and prognosis.

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Conflicts of interest

There are no conflicts of interest.

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