Original Article

Short-term outcomes and oncological safety profile of laparoscopic versus open left hemicolectomy for descending colon cancer: A multicentric retrospective cohort study in two busy Egyptian University Hospitals

Mostafa M.S. Mostafa[a], Mahmoud Farghaly[b] and Mohamed G. Qassem[b]

Department of [a]General Surgery, Faculty of Medicine, Al Azhar University, [b]General and GIT Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt.

ABSTRACT

Purpose: Tumors in the distal transverse, splenic flexure, and descending colon can be resected by standard open left hemicolectomy. The laparoscopic approach has become the gold standard approach for managing colorectal cancers. This study aims at comparing the results of both approaches regarding operative technique postoperative complications and patient recovery.

Patients and Methods: Seventy-two patients having cancer in the distal transverse, splenic flexure, and descending colon were operated on by laparoscopic (36 patients, LAP group) and open (36 patients, OS group) left hemicolectomy. They were admitted to Al-Al-Azhar University hospitals during the period from 2019 to 2022. Both groups were compared regarding operative technique and postoperative recovery and complications.

Results: Comparable baseline variables between both groups included age, sex, BMI, a history of past abdominal surgeries, and the location of the tumor. The LAP and OS groups' average operating duration was 235 min. Both groups suffered from similar intraoperative blood loss. There were no variations between the two groups in the occurrence of postoperative complications (surgical-site infections, ileus, leak, and chest infection). Less pain, a shorter time to restart a regular diet and pass flatus, and a shorter hospital time of stay are all signs of a quicker postoperative recovery in the LAP group. The two groups' surgeries were similarly radical, according to pathological analyses. There were no portsite or local recurrences during the LAP group's follow-up, which lasted an average of 12 months. However, there were four distant metastases (5.7%) during this time.

Conclusion: In the context of operating descending colon cancer, laparoscopic left hemicolectomy is superior to open approach in terms of less postoperative pain, shorter hospital stay and earlier restoration of bowel functions with a comparable oncological safety profile. Further randomized controlled trials are warranted to consolidate our results.

Key Words: Descending colon cancer, laparoscopic left hemicolectomy, open left hemicolectomy, surgical outcomes.

Received: 22 August 2024, **Accepted:** 16 September 2024, **Published:** 1 January 2025

Corresponding Author: Mostafa M. S. Mostafa, MD, Department of General Surgery, Faculty of Medicine, Al Azhar University, Cairo, Egypt. **Tel.:** 01110816308, **E-mail:** mostafa_salama_2015@yahoo.com

ISSN: 1110-1121, January 2025, Vol. 44, No. 1: 312-321, © The Egyptian Journal of Surgery

INTRODUCTION

Globally, one of the most common solid tumors is colorectal cancer (CRC)[1]. The GLOBOCAN mega project of the WHO Cancer Research Centre estimates that there were roughly 1.93 million new cases of CRC globally in 2020 and a~940 000 deaths[2]. The degree of socioeconomic status is directly correlated with CRC. It has been steadily rising all over the world as a result of Western lifestyles' popularity, altered food habits, and a decline in physical activities[3].

Cancers of the splenic flexure are most frequently referred to as those that are found in the proximal 10 cm of the descending colon, the distal third of the transverse colon, and the splenic flexure in between[4,5].

The majority of gastrointestinal surgeons now consider laparoscopic surgery as a common safe form of patient care for treating both benign and malignant disorders of the colon. Several random comparative studies have already evaluated the safety and complete cure of laparoscopic surgical treatments for colon cancer. The findings highlight benefits like less intestine manipulation, reduced postoperative pain, and a shorter hospital stay; as a result, the return to normal life was quick[6–10]. As a result, the indications for a laparoscopic approach in the management of colon malignancy have been gradually growing.

In comparison to laparotomy, laparoscopy has been linked to decreased rates of hernias and surgical-site infections, as well as higher levels of patient satisfaction[11,12].

DOI: 10.21608/EJSUR.2024.314792.1176

Laparoscopic resection for colon cancer was first described in 1991[13], but to this day, it has not gained widespread acceptance as a substitute for open surgery and is still seen with skepticism in everyday practice. As a result, it is not offered at all digestive surgery departments, especially those with a small patient load.

Although initial worries about the recurrence and survival rates connected with laparoscopic approach for colon cancer resections initially subdued interest in minimally invasive surgery (MIS) in this setting, later clinical studies stated that properly-done laparoscopies lead to better colon cancer results comparable to those of open approach, as well as enhanced clinical outcomes[5,14].

According to embryology, the inferior mesenteric artery (IMA) supplies blood to the left colon. The superior mesenteric artery (SMA) and the IMA are connected by a blood vessel called the marginal artery of Drummond. The left branch of the middle colic artery, which is a branch of the SMA, generally supplies the distal transverse colon, which includes the splenic flexure and the descending colon. Branches of the IMA supply the left colon's remaining tissue[15].

Based on these findings, the current study was conducted to highlight the outcomes of surgery on a particular colon segment, to spark discussion about the topic and encourage those who have the intention to design randomized studies to consider these findings.

PATIENTS AND METHODS:

This retrospective study was conducted on 72 patients operated at Al-Azhar University Hospital and Ain Shams University Hospital (Eldemerdash Hospital). Between March 2019 and January 2023, 72 patients with cancer in the region of distal transverse to distal descending colon were admitted for surgery. Patients are presented in many scenarios. The majority presented by intestinal obstruction but in the early stage without marked distension. Others presented by disturbed bowel behavior and bleeding per-rectum. Colonoscopy was done for five patients who presented by anemia only with occasional constipation. Screening colonoscopy after age of 50 was done in two patients and discovered colonic cancer.

Patients were divided equally into two groups without any selection criteria for grouping, laparoscopic (LAP) group, and open (OS) group. Even many patients with early colonic obstruction and one patient with colo-colic intussusception because of cancer were operated on laparoscopically. Full history. Clinical examination and routine investigations. chest radiography, ECG, and echocardiography were done for all patients. 72 patients had CT abdomen, pelvis, and chest with contrast and preoperative CEA level assessed. All patients without obstruction who need urgent surgery had colonoscopies and biopsies of the swelling.

Stages of the disease were classified us the American Joint Committee on Cancer (AJCC) tumor, node metastasis (TNM) classification, 6th edition.

All surgeons sharing in the study are in the early learning curve in laparoscopic colectomy, but professional in open colectomy.

Data collection and comparing both groups regarding basic characteristics (Age, sex, BMI) tumor location, preoperative CEA, operative time, amount of blood loss, tumor stage, postoperative complications, and recovery, passing flatus, time to first oral intake, and pain; hospital stay following surgery, complications, and oncological outcomes (Distance from tumors to resection margins, quantity of resected lmph nodes removed, and patterns of recurrence).

Surgical methods: For the purposes of our investigation, a radical left hemicolectomy is the full resection of the main tumor and excision of all lymph nodes, with ligation of the origin of the left colic artery.

Laparoscopic left hemicolectomy: Colonic preparation for elective cases. Correction of anemia for cases of bleeding per rectum. Prophylactic antibiotics cefazolin 2 gm iv and flagyl 500 mg before induction of anesthesia. All patients were positioned in the reverse Brandenburg position with the elevated left side. Verress needle insufflation at palmer point with pressure at 14 mmHg. Camera lens 5 mm was used in all patients in port 5 mm at the umbilicus. Port 12 at rt lumbar and another one at the suprapubic area. Port 5 mm at left iliac fossa for assistant. Laparoscopic exploration of the whole abdomen then medial to lateral approach dissection started. A plane behind the left colic mesentery superficial to Gerota fascia was developed with ligation of IMV. The peritoneum at the white line was reached and then opened to separate the left colon from its mesentery completely. Left colic vessels and upper branches of the sigmoid artery and the left branch of the middle colic vessels were ligated and cut near its root and removed with accompanying lymph nodes. Part of the greater omentum was taken with the specimen. The colon was transected at the midst-transverse colon and distal descending colon. The side-to-side colo-colic anastomosis was created using a linear stapler and completed using V-loc 3/0. The big specimen was retrieved in all cases from small pfennesteil incision of 5 cm with no muscle cutting using a wound protector. Two drains were put in, one in the left paracolic gutter and one in the pelvis (Figs 1–8).

Open left hemicolectomy: the same steps but with a midline incision and anastomosis were completed by stapler or hand-sewn technique.

Statistical analysis

Recorded data were analyzed using the statistical package for social sciences,

The statistical software for social sciences (SPSS Inc., Chicago, Illinois, USA), version 23.0, was used to analyze the data that had been collected. Mean, SD, and ranges were used to show the quantitative data. Additionally, qualitative characteristics were shown as percentages and numbers. Shapiro–Wilk and Kolmogorov–Smirnov tests were used to examine the data for normality.

The following tests were done:

(a) For nonparametric data, the Mann–Whitney U test and the independent-samples t-test of significance were employed to compare two means.

(b) When comparing groups using qualitative data, χ^2 tests and Fisher's exact tests were used instead of the χ^2 test, but only when the anticipated count in any cell was less than 5.

(c) The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the *P value* was considered significant if less than 0.05 and highly significant if less than 0.001. if *P value* is more than 0.05, it is considered insignificant.

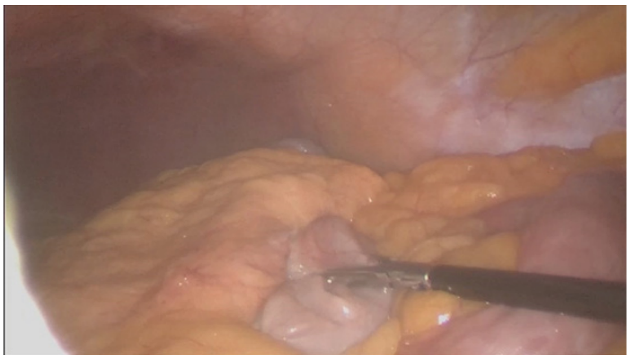

Fig. 1: Patients with cancer distal transverse colon.

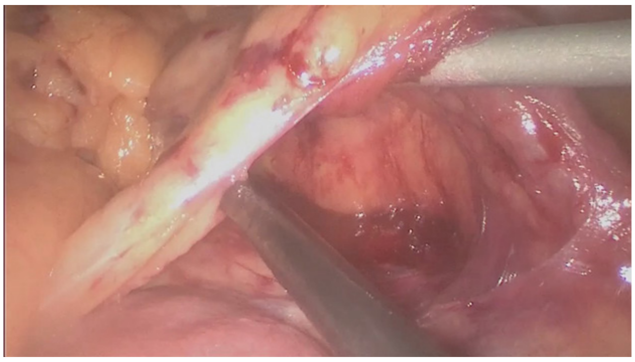

Fig. 2: Dissection between descending mesocolon and gerota fascia.

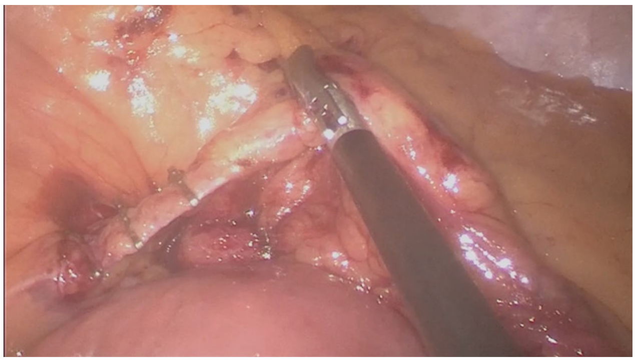

Fig. 3: Ligation and cutting of inferior mesenteric vein.

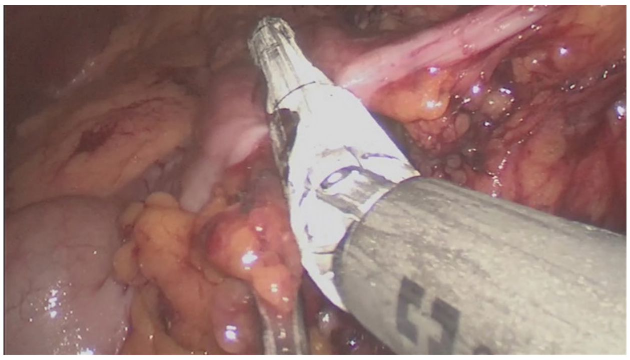

Fig. 4: Transection of transverse colon proximal to tumor.

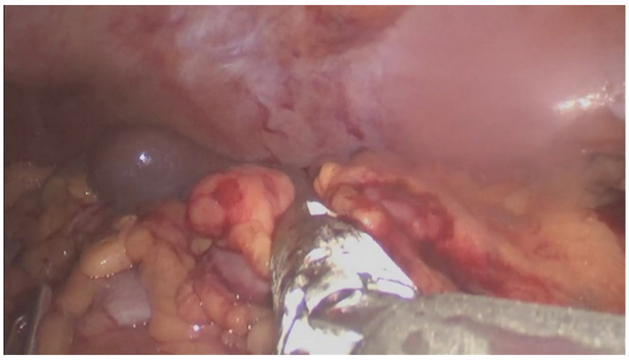

Fig. 5: Transection of descending colon distal to tumor.

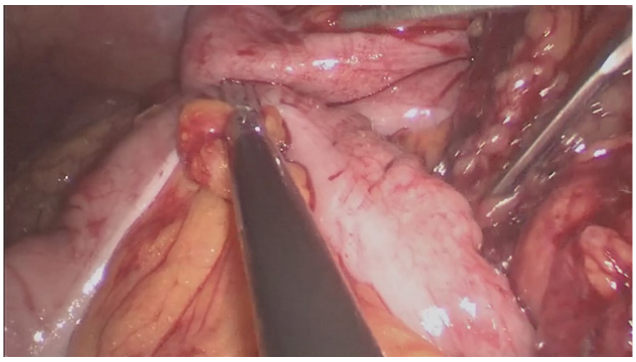

Fig. 6: Easy approximation between transverse and sigmod colon before anastomosis.

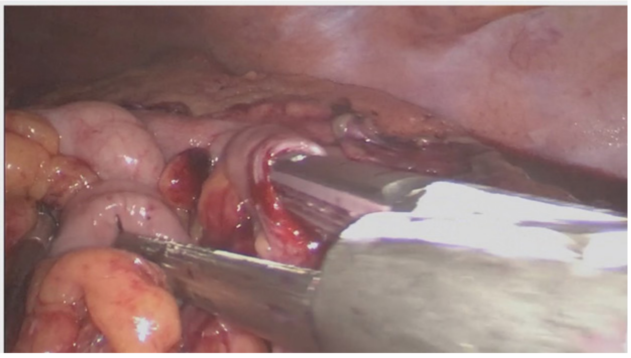

Fig. 7: Colocolic anastomosis using stapler.

Fig. 8: Patient at the fourth postoperative day.

RESULTS:

Clinical-pathological characteristics

The mean age of the subject patients in the LAP group was 46.50 years (range: 29–65 years), while that in the OS group was 48.33 years (range: 31–70 years). Thirteen patients were female and 23 individuals were male in the LAP group. There were 21 male and 15 female patients in the OS group. In the two patient groups, there were no appreciable differences in the BMIs groups, the presence or absence of concomitant disorders, or the prior history of abdominal surgery. The distal transverse colon, splenic flexure, and descending colon were the sites of the tumors in the LAP group, which included 11 (30.6%) patients, 14 (38.9%) patients, respectively. The distal transverse colon, the splenic flexure, and the descending colon were the sites in the OS group, with 11 (30.6%) patients, 16 (44.4%) patients, and 9 (25%) patients, respectively, having these conditions (Table 1).

Preoperative serum CEA values were 2.98 1.01 ng/ml and 3.04 0.96 ng/ml, respectively, for the LAP group and the OS group, and there was no statistically significant difference between these values. No failure in the laparoscopic approach in the patients on whom laparoscopic surgery was attempted. The mean duration of operation in the LAP was 235.39 min (range, 170-290 min), and in the OS group was 235.06 min (range, 170-295 min), with no significant differences (Table 2).

After surgery, the average time for the LAP group to experience their first period of gas was 1.4 days (range: 1-4 days), compared with the OS group's duration of 3.22 days (ranging from 2-4 days), which is considerably shorter in the LAP group (*P value* < 0.001) After surgery, it took an average of 5 days for members of the LAP group to eat regular meals (the range was 3–6 days), compared with 5.5 days for members of the S group (the range was 4-8 days). This difference was statistically significant ($P=0.017$) in favor of the LAP group. Following surgery, the average hospital stay for the LAP group was 5.11 days (range: 4-6 days), compared with an average of 6.39 days (range: 5-10 days) for the OS group (Table 2). The LAP group's hospital stay was considerably shorter ($P<0.001$), while the OS group's was significantly longer (range: 5-10 days). In the LAP group, morbidity was 19.5% (seven patients from a total of 36 patients) and death was 0%. Morbidity was 36% (13 patients out of a total of 36 patients) in the OS group, but death was 0% (Table 2). In the LAP group, infections in the surgical wound region, hemorrhages following surgery, and lung infections brought on by atelectasis were all reported as problems. Anastomotic leakage occurred in one patient. In the OS group, there were three wound infections, two postoperative hemorrhages, one anastomosis leak, and one pneumonia episode brought on by atelectasis. According to Dindo's categorization system, there were no appreciable differences between the two groups' overall incidence rates or serious complication rates (Table 3, Figs 9-12).

Comparing the pathological outcomes for the two groups of patients who received surgery for tumours. The mean size of the lesions in the LAP group was 4.14±1.12 cm, while it was 4.25±1.00 cm in the OS group. The average number of excised lymph nodes for the LAP group was 14.81±2.53, which was smaller than the average number for the OS group of 14.78±1.93 lymph nodes, but this difference was not statistically significant ($P=0.958$). The distances to the proximal and distal resection margins for the LAP group were 10.44±1.21 cm and 10.72±1.21 cm, respectively; these values did not differ substantially from those for the OS group. Stage 0 or 1 of the TNM was found in 15 (41.7%) of the LAP group's participants. stage 2 in 16 (44.4%), stage 3 in 5, and both in stage 2. Stage 0 or 1 was noticed in 14 (38.1%) OS participants. stage 2 in 16 (44.4%) cases, stage 3 in seven(19.4%) cases (Table 3). The median follow-up observation length for the 36 patients in the LAP group was 12 months (range, 1 to 60 months), and no research subject patient died during this time (Table 4).

No patients had regional recurrence or port site recurrence at that time, while 3 patients (8.5%) developed distant metastases. The liver and peritoneum were involved in one patient who had systemic recurrence, the lung was the site in one patient, and the peritoneum was the location in 1 patient. For the LAP group, the time from surgery to recurrence was 10.3 months on average (ranging from 4 to 22 months). In contrast, the OS group's median follow-up duration was 26 months (with a range of 2 to 60 months), and recurrence was noted in eight patients (14.5%). The OS group saw one instance of anastomosis site recurrence and seven instances of systemic recurrence. For the seven patients who experienced a systemic recurrence, the recurrences occurred at the liver twice, the liver and peritoneum once, the lung three times, and the iliac lymph node once.

Table 1: Comparison between Laparoscopic Colectomy Patients and Open Colectomy Patients according to baseline characteristics

Baseline characteristics	Laparoscopic colectomy patients (*n*=36)	Open colectomy patients (*n*=36)	Test value	*P* value
Age (years)				
Mean±SD	46.50±10.09	48.33±10.49	−0.756	0.452
Range	29–65	31–70		
Sex, *n* (%)				
Female	13 (36.1)	15 (41.7	0.234	0.629
Male	23 (63.9)	21 (58.3%)		
BMI				
Mean±SD	26.03±5.96	25.58±5.21	0.337	0.737
Range	18–40	18–35		
ASA score, *n* (%)				
1	12 (33.3)	12 (33.3)		
2	21 (58.3)	18 (50.0)	1.231	0.540
3	3 (8.3)	6 (16.7)		
Tumor location:				
Distal transverse colon	11 (30.6)	11 (30.6)	0.000	1.000
Splenic flexure	11 (30.6)	9 (25.0)	0.277	0.599
Descending colon	14 (38.9)	16 (44.4)	0.229	0.633

Using: t-Independent Sample t-test for Mean±SD; x^2: Chi-square test for number (%).
P value greater than 0.05 is insignificant.

Table 2: Comparison between Laparoscopic Colectomy Patients and Open Colectomy Patients according to preoperative and intraoperative

Preoperative and intraoperative	Laproscopic colectomy patients (*n*=36)	Open colectomy patients (*n*=36)	Test value	*P* value
Preoperative serum CEA (ng/ml)				
Mean±SD	2.98±1.01	3.04±0.96	−0.252	0.802
Range	0–5	0–5		
Prior abdominal surgery	5 (13.9)	7 (19.4)	0.400	0.527
Duration of operation				
Mean±SD	235.39±26.34	235.06±29.29	0.051	0.960
Range	170–290	170–295		
Estimated blood loss (ml)				
Mean±SD	198.64±80.02	209.94±71.57	−0.632	0.530
Range	78–450	120–450		

Using: t-Independent Sample t-test for Mean±SD; x^2: Chi-square test for Number (%).
P value greater than 0.05 is insignificant.
**P value* less than 0.05 is significant.
***P value* less than 0.001 is highly significant.

Table 3: Comparison between Laparoscopic Colectomy Patients and Open Colectomy Patients according to postoperative variables

Postoperative	Laproscopic Colectomy Patients (n=36)	Open Colectomy Patients (n=36)	Test value	P-value
Hospital stay (days)				
Mean±SD	5.11±0.71	6.39±1.08	–5.950	<0.001**
Range	4–6	5–10		
SSI	1 (2.8)	3 (8.3)	1.059	0.303
Leakage	1 (2.8)	1 (2.8)	0.000	1.000
Ileus	2 (5.6)	5 (13.9)	1.424	0.233
Chest infection	1 (2.8)	2 (5.6)	0.348	0.555
VAS scale				
Mean±SD	2.58±1.00	3.69±0.79	–5.252	<0.001**
Median (IQR)	2 (2–3)	4 (3–4)		
Range	0–5	2–6		
Anaemia requiring Blood transfusion	2 (5.6)	2 (5.6)	0.000	1.000
Flatus passage (day)				
Mean±SD	2.36±0.80	3.22±0.68	–4.924	<0.001**
Range	1–4	2–4		
Time to resume regular diet (day)				
Mean±SD	5.00±0.86	5.50±0.88	–2.438	0.017*

Using: t-Independent Sample t-test for Mean±SD; x^2: Chi-square test and FE: fisher's Exact test for Number (%).
P value greater than 0.05 is insignificant.
**P value* less than 0.05 is significant.
***P value* less than 0.001 is highly significant.

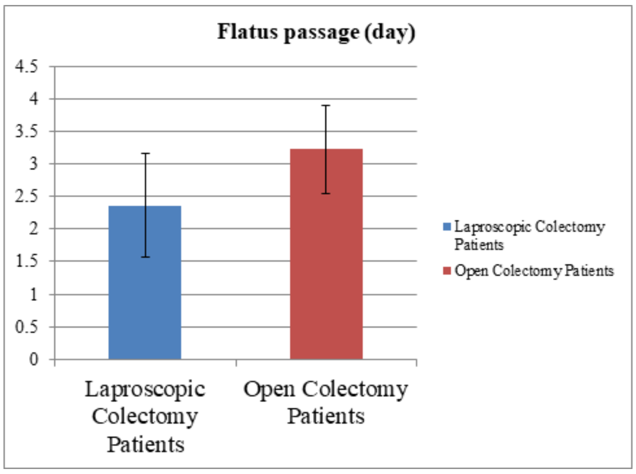

Fig. 9: Comparison between Laparoscopic Colectomy Patients and Open Colectomy Patients according to flatus passage 'day'.

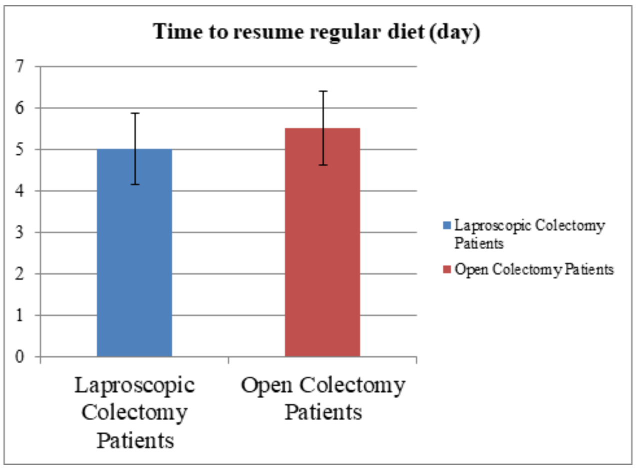

Fig. 10: Comparison between Laparoscopic Colectomy Patients and Open Colectomy Patients according to time to resume regular diet 'days'.

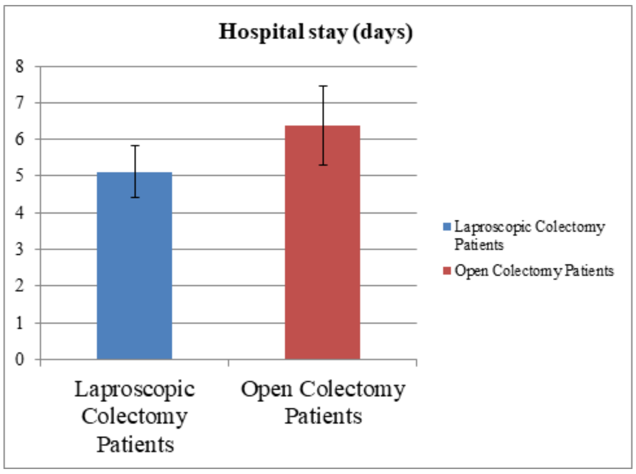

Fig. 11: Comparison between Laparoscopic Colectomy Patients and Open Colectomy Patients according to hospital stay 'days'.

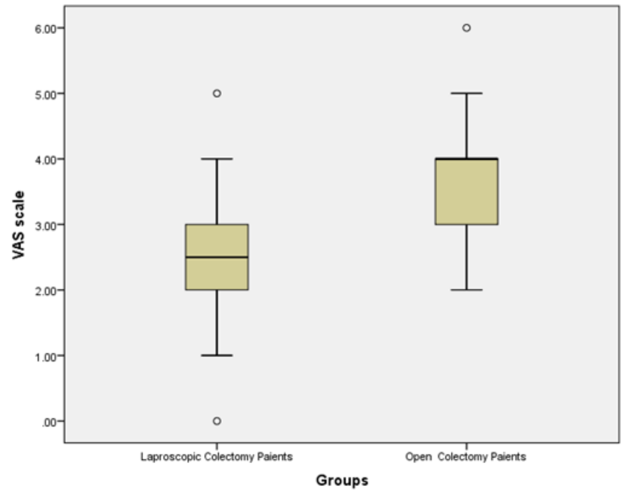

Fig. 12: Box plot betsween Laparoscopic Colectomy Patients and Open Colectomy Patients according to VAS scale.

Table 4: Comparison between Laproscopic Colectomy Patients & Open Colectomy Patients according to oncological outcomes

Outcome	Laproscopic Colectomy Patients (*n*=36)	Open Colectomy Patients (*n*=36)	Test value	*P*-value
Tumor size (cm)				
Mean±SD	4.14±1.12	4.25±1.00	–0.467	0.642
Range	2–6	2–6		
Proximal margin (cm)				
Mean±SD	10.44±1.21	10.72±1.23	–0.966	0.337
Range	8–14	9–15		
Distal margin (cm)				
Mean±SD	7.24±1.45	7.35±1.22	–0.325	0.746
Range	5–10	5–10		
Number of lymph nodes retrieved				
Mean±SD	14.81±2.53	14.78±1.93	0.052	0.958
Range	11–22	11–19		
Histologic differentiation:				
Well	15 (41.7%)	16 (44.4%)	0.057	0.812
Moderate	13 (36.1%)	11 (30.6%)	0.25	0.617
Poorly	8 (22.2%)	9 (25.0%)	0.077	0.781
Stage				
Stage 1	15 (41.7%)	14 (38.9%)	0.058	0.810
Stage 2	16 (44.4%)	15 (41.7%)	0.057	0.812
Stage 3	5 (13.9%)	7 (19.4%)	0.400	0.527

IQR, Interquartile range.
Using: t-Independent Sample t-test for Mean±SD; U: Mann-Whitney test for Median (IQR).
Using: x2: Chi-square test for Number (%).
P-value >0.05 is insignificant.
*P-value <0.05 is significant.
***P-value* <0.001 is highly significant.

DISCUSSION

Patients who have cancer in the descending colon that was treated by laparoscopic surgery vs those who underwent conventional open abdominal surgery were compared with examine the postoperative results and advantages of a laparoscopic left hemicolectomy in the early postoperative periods. The authors were able to establish that a laparoscopic left hemicolectomy had therapeutic advantages over an open left hemicolectomy in regard to factors like operating time, volume of blood transfused during surgery, bowel healing, and length of hospital stay. As for the pathological indices of the specimens or the postoperative problems, we can also see that it is oncologically safe. The introduction of laparoscopic instruments, such as ultrasonic devices like the Harmonic scalpel, systematized surgical techniques, and improved surgical techniques all played significant roles in the superior operational outcomes of laparoscopic left hemicolectomy.

The two groups' characteristics, including those related to gender, age, body mass index, ASA score, concomitant disorders, and tumor sites, were not statistically different. Even though our study was not a single-institutional trial, preoperative CEA and TNM stages did not change, and there was no restriction on the patients' choice. Sadly, there aren't many reports on laparoscopic surgical approach for descending colon malignancy, and in the majority of multicenter controlled prospective studies done to evaluate the safety of laparoscopic surgery for colon cancer, cancers in the descending colon, and distal transverse colon, were also excluded[1,4,9]. Highest reliability research methodologies, like prospective randomized controlled studies, may be required to conclusively demonstrate that the surgical and oncological outcomes of laparoscopic surgery are not less than those for the usual open surgery. A large-scale multicenter prospective research should be conducted in the future to confirm the clinical effectiveness and outcomes of laparoscopic surgery, which were found in this investigation.

When compared with right hemicolectomy and anterior resection, descending colon resection took longer to perform, had a longer hospital stay, and had greater rates of complications, according to our study and current research. This suggests that a left hemicolectomy and a radical splenic flexure resection are technically challenging procedures[10,11]. In each case, a medial approach was used to adequately separate the descending colon away from the retroperitoneum and subsequently expose the lesser sac by cutting the transverse mesocolon away from the pancreas. The lesser sac can be reached more safely and without harming the spleen using the medial technique as opposed to the lateral approach.

The inferior mesenteric vein ligation has drawn the attention of several researchers, who believe it could compromise the colon's blood flow. However, venous drainage to the internal iliac vein is sufficient, and IMV ligation streamlines the procedure, expands the field, and permits the colon to be longer. In our study, the majority of patients experienced no special complications related to blood flow impairment through the follow-up observation period. Similarly, no venous blood flow congestion was found during routine abdominal computed tomography exams that were performed during the follow-up period[16].

Overall complications between the two groups did not differ significantly. Five patients in the LAP group experienced problems resembling those noted by Han and colleagues in their observations. No hernia was also reported, although one patient in Han and colleagues had herniorrhaphy for a ventral incisional hernia 6 months after surgery, and the hernia eventually developed. 11 individuals had problems in the OS group. One of them, similar to Han and colleagues had sepsis and an intraperitoneal abscess as a result of anastomosis leaking. No significant problems were seen in the two groups, excluding these two individuals[17].

These complications are comparable to the results by Durak *et al*.[12]; where ileus occurred in 14.2%, surgical-site infections in 2.3%, blood transfusion 16.6% hospital stay 7.7 days mean value in lap. Group but in the open group they were 11.5, 11.5, and 19.2%, respectively.

In the present cases, the lymph nodes removed during laparoscopic hemicolectomy were 14.81 nodes, and the proximal resection margin was around 10.44 cm in length from the site of cancer, which are nearly similar to results by Han and colleagues (13.8, 10.0, respectively). However, the distal margin distance was less than Han and colleagues (7.24 vs. 12.5), and good resection margins and accepted lymphadenectomy were demonstrated.

Our cases had absolutely no cases of recurrence, which is quite similar to Han and colleagues who reported systemic recurrence in three patients, including one case of liver secondaries, one case of lung secondaries, and one case of liver secondaries and multiple peritoneal nodules concurrently. Within 6 months, distant metastases was found in two of the patients. Perhaps the micrometastases seen in these patients subsequently developed into full-blown metastases. Due to the very little follow-up observation period, we did not make a comparison between the survival rates of the LAP group with the OS group in this study. Nevertheless, the total recurrence rate in several studies was 8.5% throughout the 22-month follow-up period, thus we conclude that laparoscopic colectomy for descending colon cancer is equivalent to conventional surgery from the perspective of survival rate. The results of a laparoscopic resection for descending colon cancer are only briefly discussed in our article; more research and longer-term follow-up observations are required.

CONCLUSION

In the context of operating descending colon cancer, laparoscopic left hemicolectomy is superior to the open approach in terms of less postoperative pain, shorter hospital stay, and earlier restoration of bowel functions with comparable oncological safety profile. Further randomized controlled trials are warranted to consolidate our results.

CONFLICT OF INTEREST

There are no conflicts of interest.

REFERENCES

1. Pedrazzani C, Turri G, Park SY, Hida K, Fukui Y, Crippa J, *et al*. Clinical-pathologic characteristics and long-term outcomes of left flexure colonic cancer: a retrospective analysis of an international multicenter cohort. Dis Colon Rectum 2020; 63:1593–601.

2. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, Bray F. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA Cancer J Clin 2021; 71:209–249.

3. Keum N, Giovannucci E. Global burden of colorectal cancer: emerging trends, risk factors and prevention strategies. Nat Rev Gastroenterol Hepatol 2019; 16:713–732.

4. Steffen C, Bokey EL, Chapuis PH. Carcinoma of the splenic flexure. Dis Colon Rectum 1987; 30:872–4.

5. Aldridge MC, Phillips RKS, Hittinger R, Fry JS, Fielding LP. Influence of tumour site on presentation, management and subsequent outcome in large bowel cancer. Br J Surg 2005; 73:663–70.

6. Leung KL, Kwok SP, Lam SC, Lee JF, Yiu RY, Ng SS, *et al*. Laparoscopic resection of rectosigmoid carcinoma: prospective randomised trial. Lancet 2004; 363:1187–92.

7. Guillou PJ, Quirke P, Thorpe H, Walker J, Jayne DG, Smith AM, *et al*. Short-term endpoints of conventional versus laparoscopicassisted surgery in patients with colorectal cancer (MRC CLASICC trial): multicentre, randomised controlled trial. Lancet 2005; 365:1718–26.

8. Lacy AM, Garcia-Valdecasas JC, Delgado S, Castells A, Taura P, Pique JM, *et al*. Laparoscopy-assisted colectomy versus open colectomy for treatment of non-metastatic colon cancer: a randomised trial. Lancet 2002; 359:2224–9.

9. Clinical Outcomes of Surgical Therapy Study Group. A comparison of laparoscopically assisted and open colectomy for colon cancer. N Engl J Med 2004; 350:2050–9.

10. Fleshman J, Sargent DJ, Green E, Anvari M, Stryker SJ, Beart RW Jr, *et al*. Laparoscopic colectomy for cancer is not inferior to open surgery based on 5-year data from the COST Study Group trial. Ann Surg 2007; 246:655–62.

11. Braga M, Frasson M, Vignali A, Zuliani W, Civelli V, Di Carlo V. Laparoscopic vs. open colectomy in cancer patients: long-term complications, quality of life, and survival. Dis Colon Rectum 2005; 48:2217–23.

12. Durak D, Alkurt E G, Turhan V, *et al*. (May 01, 2022) Comparison of Short-Term Results of Laparoscopic and Open Surgeries for Colorectal Cancer: A Single-Center Experience. Cureus 14(5): e24635.

13. Jacobs M, Verdeja JC, Goldstein HS. Minimally invasive colon resection (laparoscopic colectomy). Surg Laparosc Endosc 1991; 1:144e150.

14. Braga M, Frasson M, Vignali A, Zuliani W, Civelli V, Di Carlo V. Laparoscopic vs. open colectomy in cancer patients: long-term complications, quality of life, and survival. Dis Colon Rectum 2005; 48:2217–23.

15. Murrell Z, Stamos MJ. Open and minimally invasive left hemicolectomy for neoplasms of the descending colon, sigmoid, and upper rectum. Fischer J, Ellison EC, Upchurch GRJr, Galandiuk S, Gould JC, Klimberg VS, *et al*. eds. Fischer's Mastery of Surgery. 7th ed. Philadelphia: Wolters Kluwer; 2019. 2:153.

16. Yang L, Yu YY, Zhou ZG, Li Y, Xu B, Song JM, *et al*. Quality of life outcomes following

laparoscopic total mesorectal excision for low rectal cancers: a clinical control study. Eur J Surg Oncol 2007; 33:575–9.

17. Han KS, Choi GS, Park JS, Kim HJ, Park SY, Jun SH, *et al*. Short-term Outcomes of a Laparoscopic Left Hemicolectomy for Descending Colon Cancer: Retrospective Comparison with an Open Left Hemicolectomy. Department of Surgery, Kyungpook National University Hospital, Kyungpook National University School of Medicine, Daegu, Korea. J Korean Soc Coloproctol 2010; 26:347–353.