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RESEARCH ARTICLE

# Laparoscopic Versus Open Complete Mesocolic Excision with Central Vascular Ligation for Right-sided Colon Cancer: Early Postoperative Outcomes

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## ABSTRACT

**Aim:** To evaluate postoperative histopathological findings and short-term clinical outcomes of laparoscopic complete mesocolic excision (L-CME) versus open-complete mesocolic excision (O-CME) for right-sided colon cancers.

**Method:** A total of 36 eligible patients were included. Patients were divided into two main groups as L-CME (n=21) and O-CME (n=15). Demographic parameters, intraoperative findings, early postoperative outcomes and histopathological findings were compared between the groups.

**Results:** Age, sex, body mass index, American Society of Anesthesiology scores, comorbid diseases, neoadjuvant treatment, carcinoembryonic antigen level, and tumor locations were similar in L-CME and O-CME groups. tumor, node, and metastasis stage, mean proximal and distal surgical margin distances, and mean total retrieved lymph nodes (L-CME: 27.9 vs O-CME: 28.4; p=0.368) were similar between the groups. Duration of operation (L-CME: 171.9 vs O-CME: 164.7 minutes; p=0.287), estimated blood loss (L-CME: 130 vs O-CME: 143.3 mL; p=0.508), length of hospital stay (L-CME: 8.6 vs O-CME: 11.5 days; p=0.936), intraoperative complication rates, postoperative non-surgical complication rates (L-CME: 4.8% vs O-CME: 20.0%; p=0.214), postoperative mortality rates (L-CME: 0.0% vs O-CME: 13.3%; p=0.085), and re-operation rates (L-CME: 4.8% vs O-CME: 6.7%; p=0.806) were also similar between the groups. First flatus time was shorter (L-CME: 2.5 vs O-CME: 2.9 days; p=0.038), postoperative surgical complication rate was less (L-CME: 14.3% vs O-CME: 53.7%; p=0.008), overall postoperative 30-day complication rates were less (L-CME: 14.3% vs O-CME: 60.0%; p=0.004), and the severity of complications were less (p=0.016) in L-CME group.

**Conclusion:** L-CME is technically feasible and safe for right colon cancers. It appears to be non-inferior to O-CME in terms of harvested lymph nodes and it provides faster postoperative recovery.

**Keywords:** Laparoscopic right hemicolectomy, complete mesocolic excision, central vascular ligation, D3 lymph node dissection, right colon cancer

## Introduction

Colorectal cancer (CRC) is the third most common cancer and the second leading cause of cancer death worldwide, according to the 2020 data of the World Health Organization.[1] Surgical approaches still represent the mainstay of potentially curative treatments for CRC. Complete mesocolic excision (CME) with central vascular ligation (CVL) was first proposed as open surgery by Hohenberger et al.[2] The key feature of this approach is the mobilization of the colon within the avascular embryological planes between the retroperitoneal and mesocolic fascia and the ligation of the supplying arteries at their origin. In this way, the collection of lymph nodes along the entire length of the main vessels is ensured. As a result, en-bloc and complete resection of the mesocolon and draining lymph nodes is achieved.[2] Surgery performed according to the principles of surgical oncology affects long-term outcomes, while minimal invasive approaches is key for better postoperative short-term outcomes.[3] Thanks to recent technological developments and increasing experience with minimally invasive colorectal surgery, laparoscopic CME with CVL can be performed safely today.

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Laparoscopic approaches are associated with improved postoperative recovery and decreased morbidity compared with open approaches for CRCs. Although the duration of operation is longer, laparoscopic colorectal resections provide reduced postoperative complications, decreased intraoperative blood loss and length of hospital stay. Furthermore, a laparoscopic approach has similar rates of dissected total lymph nodes, disease free survival, overall survival and recurrence as open colorectal resections. As a result, laparoscopy is considered the gold standard surgical approach, having better short-term and comparable long-term outcomes compared to open surgery in CRCs.[4-7] However, considering the vascular anatomical variety, laparoscopic right hemicolectomy with CME is considered more challenging in relation to the higher technical complexity than conventional open surgery.[5,8,9] Therefore, the expected advantages of minimally invasive surgery in right hemicolectomies may not be achieved in inexperienced hands.

According to the results of published studies, focusing on the short-term clinical outcomes and the survival benefits of CME for right-sided colon cancers, this technique provides a significant decrease in local recurrence and improvements in cancer related 5-year survival. However, it seems to expose patients to a higher risk of surgical complications.[2,10] As a result, the indication for this procedure is still controversial. Based on these considerations, we present our early-period clinical outcomes and histopathological results of laparoscopic right hemicolectomy with CME in comparison with open surgery to evaluate the feasibility and the safety of the laparoscopic procedures for right-sided colon cancers.

## Materials and Methods

### Patient Selection and Study Overview

This is a single-center, prospectively collected, and retrospectively analyzed study from Fırat University Medical Faculty Hospital, Surgical Oncology Unit, enrolling all consecutive patients who underwent laparoscopic and open colon resections for right-sided colon cancer between April 2019 and April 2021. All the patients were histologically confirmed adenocarcinoma by preoperative colonoscopy with biopsies. To evaluate the extent of the disease, oral and intravenous, contrast-enhanced, thoraco-abdomino-pelvic computed tomography were examined for all patients. Positron emission tomography examinations were also used, if required. After clinical staging, all the patients were treated according to the National Comprehensive Cancer Network guidelines.

Right-sided colon carcinoma was defined as adenocarcinoma of any of the cecum, the ascending colon, the hepatic flexure, and the first-third of the transverse colon. In our department, CME with CVL has been implemented as the standard surgical approach for colon cancers since early 2018. Inclusion criteria were: aged 18 years and older; Eastern Cooperative Oncology Group (ECOG) score of 0 (asymptomatic) or 1 (symptomatic but completely ambulatory); and American Society of Anesthesiology (ASA) score 1-3. Exclusion criteria were: history of previous colectomy; history of other malignant diseases; emergency surgery due to complications caused by colon cancer such as bleeding, obstruction or perforation; and ECOG score of 2 or more; presence of metastasis to one or more distant sites or organs or peritoneal metastasis (M1+); and cases with simultaneous cholecystectomy or partial/total organ resections for invasion or metastasis. Out of 65 patients, 36 patients fulfilled the study criteria and were included for further analysis. The patients were categorized into two main groups according to the surgical procedure performed as open-complete mesocolic excision (O-CME) and laparoscopic-complete mesocolic excision (L-CME). In addition, patients were divided into subgroups according to the surgery performed for different tumor locations as right hemicolectomy or extended right hemicolectomy. The flow chart of patient enrollment is shown in Figure 1.

### Data Collection Process

Demographic parameters, preoperative laboratory tests, intra-operative findings, post-operative short-term clinical outcomes and histopathological data were recorded. Gender, age, comorbid diseases, body mass index (BMI) (kg/m$^2$), ASA scores, and history of neoadjuvant chemotherapy or radiotherapy were recorded. Surgical procedures (laparoscopic/open surgery and right hemicolectomy/extended right hemicolectomy), duration of operation (minutes), estimated intraoperative blood loss (mL), length of hospital stay (days), first flatus time (days), intraoperative complications, postoperative 30-day complications and mortality rates, repeat surgery, tumor location and histological type (classic/mucinous), morphological differentiation grade (well, moderate or poor), tumor size (cm), proximal and distal surgical margin (cm), number of dissected lymph nodes, number of metastatic lymph nodes and the pathologic stage were also recorded.

The greatest tumor dimension was recorded for tumor size. Surgical margin status was grouped as R0 (no cancer cells seen microscopically), R1 (cancer cells present microscopically) and R2 (presence of macroscopic residual tumor), according to the American Joint Committee on Cancer's (AJCC) 8$^{th}$ edition guidelines.[11] Tumor staging was also categorized according to AJCC 8$^{th}$ edition. Estimated blood loss was measured by suction volumes and number

of gauzes used during surgery. Intraoperative complications were classified as vascular or organ injuries. Postoperative 30-day complications were classified as surgical and systemic (non-surgical) complications and were graded according to the modified Clavien-Dindo Classification (CDC) system (Table 1)[12]. Minor complications were defined as CDC grades 1 and 2, and major complications were defined as CDC grades 3-5.

### Preparation for Surgery and Surgical Procedures

The patients received antibiotic prophylaxis orally with ciprofloxacin and metronidazole and low-weight-molecular-heparin was administered the day before surgery. Intravenous cephalosporin was given 30 minutes prior to skin incision. No mechanical bowel preparation was used routinely.

All the patients with right-sided colon cancers included in the study were operated by the same specialized surgical team. Right hemicolectomy was performed for tumors located at the cecum and the ascending colon, and extended right hemicolectomy was performed for tumors of the hepatic flexure and transverse colon. The planning of open or laparoscopic surgery preference was made randomly for all patients considering with the availability of technical materials. Laparoscopic procedures were performed using four working ports including an infraumbilical optic port in both right and extended right hemicolectomies. In O-CME cases, the intra-abdominal space was entered with a partial upper and lower midline incision. An electronic scalpel was used for mobilization and dissection in laparoscopic and open procedures. In L-CME cases medial-to-lateral approach and in O-CME cases lateral-to-medial approach was preferred for the mesocolon dissection along the mesenteric axis. The ileocolic vessels were transected at their origin. After exposing the mesocolic interface, a wide separation was achieved between the right colon and retroperitoneal

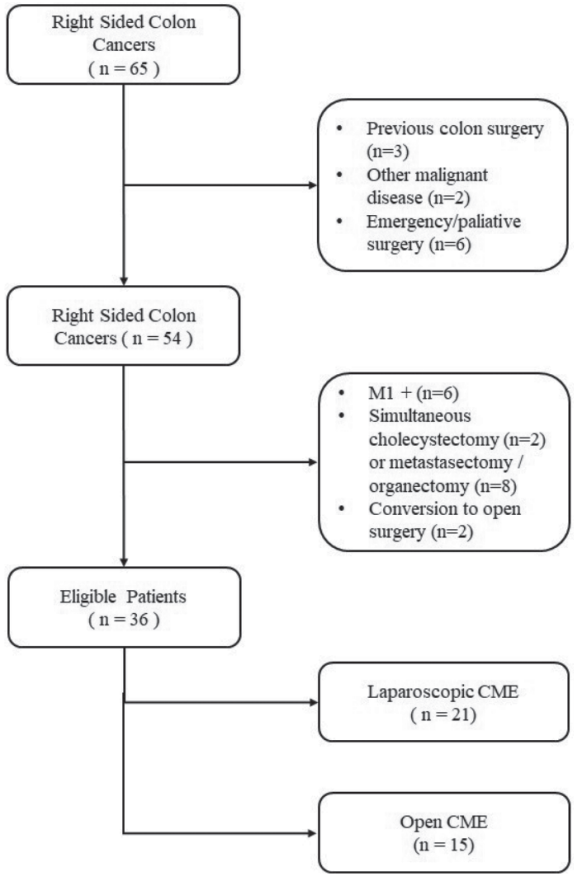


**Figure 1.** Flow chart illustrating patient enrolment
*CME: Complete mesocolic excision*

**Table 1.** Comparison of patient characteristics

| | O-CME, (n=15) | L-CME, (n=21) | p |
|---|---|---|---|
| Age (years) | 68.9±13.9 | 61.5±11.0 | 0.138 |
| **Gender** | | | |
| Female | 6 (40.0) | 15 (71.4) | 0.059 |
| Male | 9 (60.0) | 6 (28.6) | |
| BMI (kg/m$^2$) | 28.3±3.4 | 27.3±3.9 | 0.268 |
| **ASA score** | | | |
| II | 5 (33.3) | 12 (57.1) | 0.158 |
| III | 10 (66.7) | 9 (42.9) | |
| **Presence of comorbidities** | | | |
| None | 3 (20.0) | 10 (47.6) | 0.194 |
| 1 | 5 (33.3) | 6 (28.6) | |
| ≥2 | 7 (46.7) | 5 (23.8) | |
| Previous abdominal surgery | 1 (6.7) | 8 (38.1) | **0.032** |
| Neoadjuvant treatment | 1 (6.7) | 1 (4.8) | 0.806 |
| Preoperative CEA level | 14.2±21.0 | 5.8±11.9 | 0.119 |
| **Tumor location** | | | |
| Cecum | 6 (40.0) | 7 (33.3) | 0.353 |
| Ascending colon | 6 (40.0) | 5 (23.8) | |
| Hepatic flexure | 3 (20.0) | 6 (28.6) | |
| Transverse colon | 0 (0.0) | 3 (14.3) | |
| **Extent of resection** | | | |
| Right colectomy | 12 (80.0) | 12 (57.1) | 0.151 |
| Extended right colectomy | 3 (20.0) | 9 (42.9) | |

Data presented as mean ± standard deviation, minimum-maximum range or number (%). Bold values indicate statistical significance p<0.05. BMI: Body mass index, ASA: American Society of Anesthesiologists, O-CME: Open-complete mesocolic excision, L-CME: Laparoscopic-complete mesocolic excision, CEA: Carcinoembryonic antigen

structures in the inferior part, and the pancreatic head and the transverse colon in the superior part. Then, dissection proceeded along the superior mesenteric vein, exposing the gastro-pancreato-colic (GPC) trunk of Henle. The middle colic artery was then identified at its origin at the superior mesenteric artery and was transected at the root of its right colic branch in case of right hemicolectomy, or at the origin of middle colic artery in case of extended right hemicolectomy. Lymph nodes located along the right gastroepiploic arch were also included in the lymphatic dissection field in extended right hemicolectomy cases. The omentum, transverse mesocolon and transverse colon were divided, taking into account that at least macroscopically 10 cm distal surgical margin especially in hepatic flexure or transvers colon located cancers. Then, the terminal ileum was divided at approximately 15-20 cm from the ileocecal junction, considering the area feeding by the ileocolic vessels and to achieve negative surgical margin in cecal-located cancers.

A Pfannenstiel incision was made for specimen retraction in L-CME cases. Intracorporeal anastomosis was performed with endo-stapler as isoperistaltic side-to-side and staple openings were closed in double layers with 3/0 PDS sutures. For O-CME cases, end-to-side ileo-transversostomy was the preferred technique with double layers suturing with 3/0 PDS sutures. A drainage catheter was placed in the operation field routinely. The oncological principles and surgical technique of CME with CVL are shown in Figure 2.

### Postoperative Patient Care and Clinical Outcomes

Nasogastric tube was removed at the end of the surgery. The postoperative vital signs of the patients and the characteristics and amounts of the contents of the drainage catheter were recorded daily. Low-molecular-weight-heparin was administered postoperatively at 8 hours after surgery. A fluid content diet was started routinely on the third postoperative day and a solid diet was started on the fourth day for all patients. Patients were discharged when adequate oral food intake and regular defecation habit was established, and if there was no need for fluid infusion, dependence for mobilization, and analgesic medication. After discharge, all patients underwent weekly outpatient follow-up and clinical findings were recorded for the first month post-operatively.

### Statistical Analysis

All analyses were performed using IBM SPSS Statistics, version 22.0 (IBM Inc., Armonk, NY, USA) and RStudio. Categorical variables are expressed as numbers and percentages, whereas continuous variables are summarized as median and minimum-maximum. According to the distribution of variables, $\chi^2$ or Fisher's exact tests were used to compare differences in discrete or categorical variables.

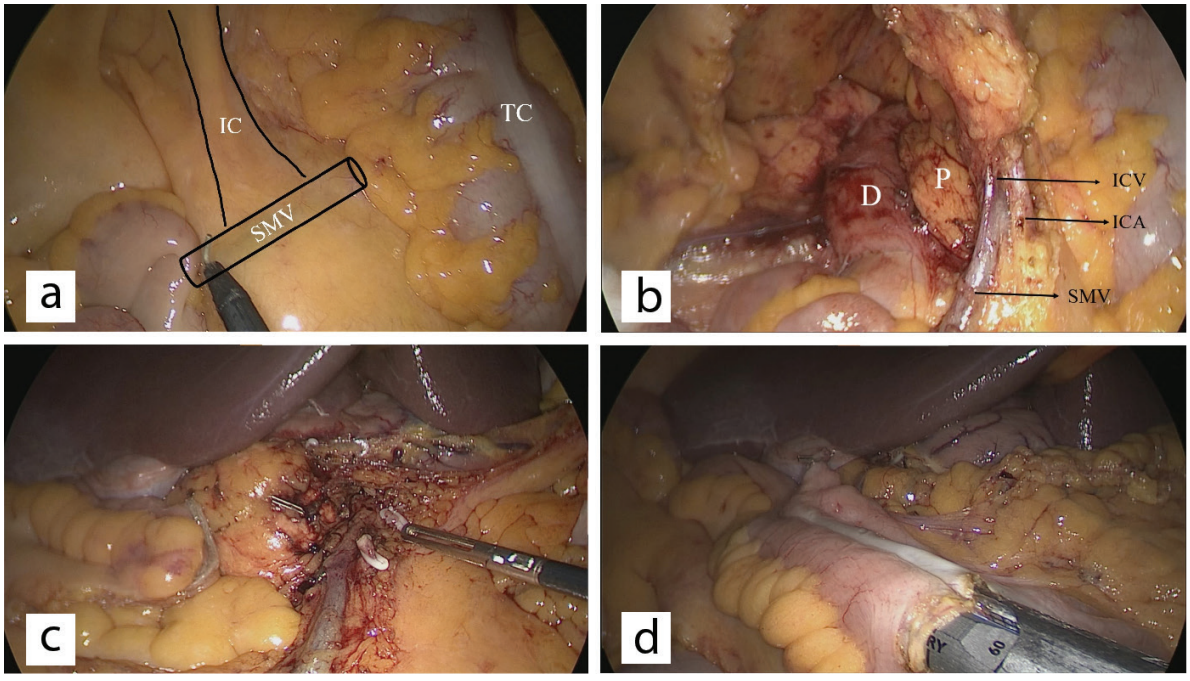


**Figure 2.** Lymphatic and vascular disection during laparoscopic extended right hemicolectomy with complete mesocolic excision. a) Illustration of superior mesenteric vein and ileocolic vessel bundle. b) Ileocolic artery and ileocolic vein at their origin from the SMV and SMA. c) Final vascular ligatures d) Intracorporeal isoperistaltic side-to-side ileo-transverse anastomosis

*TC: Transverse colon, IC: Ileocolic vessels, SMV: Superior mesenteric vein, D: Duodenum, P: Pancreas, ICV: Ileocolic vein, ICA: Ileocolic artery, SMA: Superior mesenteric artery*

The Mann-Whitney U test was used for comparison of continuous variables between the groups. The statistical significance level for all tests was considered to be $p<0.05$.

## Results

The mean age of the patients was 64.6 years. Of the patients 21 (58.3%) were female and 15 (41.7%) were male. Mean BMI of the patients was 27.7 kg/m$^2$. Tumor locations were 13 (36.1%) in the cecum, 11 (30.6%) in the ascending colon, 9 (25.0%) in the hepatic flexure and 3 (8.3%) in the first third of the transverse colon. Right hemicolectomy was performed in 24 (66.7%) cases and extended right hemicolectomy was performed in 12 (33.3%) cases. O-CME was performed in 15 (41.7%) while L-CME was performed in 21 (58.3%) of the patients included in the study.

There was no intraoperative transfusion requirement in any of the patients. One case was converted to open surgery due to technical problems. Duodenum injury occurred in one case, liver injury in one case, and GPC trunk injury in two cases in whom the laparoscopic procedure was performed. Organ and vascular injuries in these cases were managed with laparoscopic approaches without conversion to open surgery. In open procedures, there were two cases of vascular injury, one was to the right colic vein and the other was to GPC trunk. There was one case that required re-operation due to anastomotic leakage after a laparoscopic procedure. Another case was re-operated due to evisceration after open procedure. Two of the patients who underwent open surgery died postoperatively due to non-surgical complications. One was due to pneumonic septicemia and the other was due to cardiac complications. The surgical margin assessments were R0 in all cases.

Comparison of demographic parameters, clinical findings and surgical procedures of the groups are shown in Table 1. There was no difference between the groups in terms of mean age, gender distribution, mean BMI, ASA score, comorbid diseases, neoadjuvant therapy history, preoperative carcinoembryonic antigen levels, and tumor locations. However, previous abdominal surgery history was higher in the L-CME group (38.1% vs 6.7; p=0.032). Although the number of patients who underwent extended right hemicolectomy procedure was higher in the L-CME group, the difference was not significant (42.9% vs 20.0%; p=0.151).

When the post-surgical histopathological findings were compared between the groups, there were no significant differences between the histological type, tumor diameter, depth of tumor invasion (pT), lymph node involvement (pN), distant organ metastasis status, pathologic tumor, node, and metastasis stage, tumoral morphological differentiation grade, total number of retrieved lymph nodes (O-CME: 28.4±9.1 vs L-CME: 27.9±15.5; p=0.368), number of metastatic retrieved lymph nodes, and proximal and distal margin distance (Table 2).

Duration of operation, estimated blood loss, and length of stay were similar between the groups. There were no differences in intraoperative or postoperative non-surgical complication rates between the groups. Additionally, mortality and re-operation rates were similar. However, mean first flatus time was earlier (L-CME: 2.5±0.7 days vs O-CME: 2.9±0.8 days; p=0.038), postoperative surgery related complications (L-CME: 14.3% vs O-CME: 60%; p=0.008), overall postoperative 30 days complications (L-CME: 14.3% vs O-CME: 53.7%; p=0.004) and minor complication rate (L-CME: 9.5% vs O-CME: 33.3%) and major complication rate (L-CME: 4.8% vs O-CME: 26.1%) were significantly (p=0.016) lower in the L-CME group (Table 3).

## Discussion

Our results showed that duration of operation, estimated blood loss, intraoperative complications, postoperative surgical and non-surgical complication rates, mortality and re-operation rates were similar between L-CME and O-CME procedures for right sided colon cancers. Moreover, the mean number of retrieved lymph node counts and surgical margin distances were also similar. However, the onset of intestinal motility time was shorter, overall postoperative short-term complication rates and the severity of complications was lower in the L-CME group. The length of hospital stay was relatively shorter in the L-CME group but the difference was not significant.

CME is the dissection in the embryological plane to create an intact envelope of the mesocolic fascia, which results in the removal of a specimen that contains the draining lymphatics and the lymph nodes which may have potential metastasis by central ligation of the supplying vessels. This procedure provides improved specimen quality and better oncological results.[4-7] However, it has not gained widespread preference for right-sided colon cancers due to both technical and oncological concerns. In systemic reviews, L-CME for right colon cancers is associated with higher intraoperative complications and postoperative morbidity, particularly due to the complex and highly heterogeneous vascular anatomy of the right colon as compared with the left colon and rectum. It was shown that, the surgical challenges involve potential vascular injuries to the GPC colic trunk, middle colic vein, and superior mesenteric vein, due to the necessity of the ligation of the vessels at their roots and excessive traction. Moreover, the survival benefits of L-CME are still controversial for right colon cancers.[13]

**Table 2.** Comparison of histopathological findings

| | O-CME, (n=15) | L-CME, (n=21) | p |
|---|---|---|---|
| **Histological type** | | | |
| Adenocarcinoma | 14 (93.3) | 14 (66.7) | 0.058 |
| Mucinous adenocarcinoma | 1 (6.7) | 7 (33.3) | |
| **Tumor size (cm)** | 6.3±3.3 | 5.8±2.1 | 0.949 |
| **Depth of tumor invasion** | | | |
| pTis | 0 (0.0) | 1 (4.8) | 0.396 |
| pT1 | 1 (6.7) | 0 (0.0) | |
| pT2 | 0 (0.0) | 1 (4.8) | |
| pT3 | 11 (73.3) | 18 (85.7) | |
| pT4a | 2 (13.3) | 1 (4.8) | |
| pT4b | 1 (6.7) | 0 (0.0) | |
| **Lymph node involvement** | | | |
| pN0 | 3 (20.0) | 11 (52.4) | 0.198 |
| pN1a | 4 (26.7) | 6 (28.6) | |
| pN1b | 4 (26.7) | 3 (14.3) | |
| pN1c | 2 (13.3) | 0 (0.0) | |
| pN2a | 1 (6.7) | 1 (4.8) | |
| pN2b | 1 (6.7) | 0 (0.0) | |
| **Metastasis** | | | |
| M0 | 12 (80.0) | 19 (90.5) | 0.370 |
| M1a | 3 (20.0) | 2 (9.5) | |
| **pTNM stage*** | | | |
| 0 | 0 (0.0) | 1 (4.8) | 0.538 |
| I | 1 (6.7) | 1 (4.8) | |
| II | 2 (13.3) | 7 (33.3) | |
| III | 9 (60.0) | 10 (47.6) | |
| IV | 3 (20.0) | 2 (9.5) | |
| **Morphological differentiation** | | | |
| Well | 2 (13.3) | 2 (9.5) | 0.773 |
| Moderate | 9 (60.0) | 15 (71.4) | |
| Poor | 4 (26.7) | 4 (19.0) | |
| Total retrieved lymph nodes | 28.4±9.1 (11-44) | 27.9±15.5 (10-64) | 0.368 |
| Metastatic retrieved lymph nodes | 1.7±2.1 | 0.9±1.2 | 0.185 |
| Proximal margin distance (cm) | 13.2±6.2 | 15.1±8.9 | 0.653 |
| Distal margin distance (cm) | 13.5±6.0 | 14.9±7.9 | 0.898 |

Data presented as mean ± standard deviation, minimum-maximum range or number (%). *For pTNM stage the 8th edition of AJCC TNM staging system was used. O-CME: Open-complete mesocolic excision, L-CME: Laparoscopic-complete mesocolic excision, AJCC: American Joint Committee on Cancer, pTNM: Pathologic tumor, node, and metastasis

**Table 3.** Comparison of intraoperative findings and early-period clinical outcomes

| | O-CME, (n=15) | L-CME, (n=21) | p |
|---|---|---|---|
| Duration of operation (minutes) | 164.7±33.9 | 171.9±22.4 | 0.287 |
| Estimated blood loss (mL) | 143.3±84.0 | 130±93.5 | 0.508 |
| First flatus (days) | 2.9±0.8 | 2.5±0.7 | **0.038** |
| Length of stay (days) | 11.5±9.8 | 8.6±3.2 | 0.936 |
| **Intraoperative complications** | | | |
| Vascular injury | 2 (13.3) | 2 (9.5) | 0.454 |
| Organ injury | 0 (0.0) | 2 (9.5) | |
| Total | 2 (13.3) | 4 (19) | |
| **Postoperative Surgical complications** | | | |
| None | 7 (46.7) | 18 (85.7) | **0.008** |
| Anastomotic leakage | 0 (0.0) | 1 (4.8) | |
| Prolonged ileus | 1 (6.7) | 1 (4.8) | |
| Bleeding | 0 (0.0) | 0 (0.0) | |
| Abscess | 2 (13.3) | 0 (0.0) | |
| Wound infection | 2 (13.3) | 1 (4.8) | |
| Evisceration | 1 (6.7) | 0 (0.0) | |
| Total | 8 (53.7) | 3 (14.3) | |
| **Postoperative non-surgical complications** | | | |
| None | 12 (80.0) | 20 (95.2) | 0.214 |
| Respiratory | 1 (6.7) | 1 (4.8) | |
| Cardiovascular | 2 (13.3) | 0 (0.0) | |
| Total | 3 (20.0) | 1 (4.8) | |
| **Overall postoperative complications (30 days)** | 9 (60.0) | 4 (14.3) | **0.004** |
| Clavien-Dindo score | | | |
| Minor (I-II) | 5 (33.3) | 2 (9.5) | **0.016** |
| Major (III-V) | 4 (26.1) | 1 (4.8) | |
| Mortality | 2 (13.3) | 0 (0.0) | 0.085 |
| Re-operation | 1 (6.7) | 1 (4.8) | 0.806 |

Data presented as mean ± standard deviation, minimum-maximum range or number (%). Bold values indicate statistical significance p<0.05. O-CME: Open-complete mesocolic excision, L-CME: Laparoscopic-complete mesocolic excision

The mainstay of potential curative treatment of right colon cancers is still surgery and it also plays a critical role in staging. A minimum 12 lymph nodes should be evaluated for an accurate staging, according to guidelines.[14] Also, the increased number of harvested lymph nodes is associated with improved local control and overall survival.[15,16] L-CME may have the potential to harvest more lymph nodes than in O-CME. However, it was shown in recent systematic reviews that the difference in number of harvested lymph nodes is not significant between laparoscopic and open CME procedures, as in the results of the present study. Nevertheless, L-CME appears superior to O-CME in terms of overall 3- and 5-year recurrence rates. These results were underlined in the same review as the only measurable parameter of oncological adequacy of L-CME and it was recommended that there is a need for further confirmation of the results by enlarging the cohort of studies.[17]

Minimal invasive approaches should offer better short-term outcomes but they require advanced experience in laparoscopic techniques because this type of procedure is harder to perform and requires a longer learning curve. In recent studies, it was shown that laparoscopic approaches provide lower overall complications, lower estimated blood loss, lower wound infection rates, and shorter hospital stay, especially in high volume centers.[17,18] In this study, in line with the published data, postoperative overall complication rates and the severity of the complications were lower in laparoscopic procedures. In contrast, there were no differences in duration of operation and estimated blood loss between laparoscopic and open surgeries. Notably, length of hospital stay and postoperative mortality rates were lower in L-CME, but these were not significantly so when compared to open procedures at our center. Another issue to consider is earlier intestinal motility after postoperative surgery, which is associated with faster postoperative recovery. In systemic reviews, it was demonstrated that postoperative first flatus time was similar in open and laparoscopic procedures.[18] In contrast, our results demonstrated that first flatus time was significantly shorter in the L-CME group, which should be considered as an additional benefit of the laparoscopic approach.

Laparoscopy may fail and require conversion to open surgery due to uncontrollable vascular injury, organ injury or adhesions related to previous surgery. There are some consequences for the patients that should be considered in case of conversion to open surgery, such as longer duration of operation, complicated and longer hospital stay or postoperative intensive care unit requirement.[19] In our laparoscopic case series, two patients were converted to open surgery because of unexpected widespread adhesions, although neither patient developed any negative consequences of conversion.

### Study Limitations

The current study has several limitations. The potency of this study is limited due to its retrospective nature and limited number of patients. Furthermore, overall survival and local recurrence rates could not be evaluated due to the short follow-up period of the patients. Further high volume, prospective, randomized, controlled studies are needed to increase the quantity of the data and quality of the evidence.

## Conclusion

This study demonstrated that L-CME is not inferior to O-CME for right-sided colon cancers in terms of feasibility of the surgical principles and lymphatic dissection width. Moreover, earlier onset of intestinal motility, lower surgery related postoperative complications and overall postoperative short-term complication rates, and lower severity of complications make laparoscopic procedures safe and favorable for right colon cancers.

### Ethics

**Ethics Committee Approval:** This study was approved by the Fırat University Faculty of Medicine Ethics Committee (approval number: 86033, date: 09.11.2021) and was conducted in accordance with the Declaration of Helsinki and Good Clinical Practice.

**Informed Consent:** Informed consent from each patient was waived due to the retrospective nature of the study.

**Peer-review:** Externally and internally peer-reviewed.

### Authorship Contributions

Surgical and Medical Practices: A.L., E.A., M.Y., Y.S.İ., Concept: A.L., E.A., Y.S.İ., Design: A.L., E.A., V.K., İ.K., Data Collection or Processing: V.K., İ.K., E.K., A.A., Analysis or Interpretation: V.K., İ.K., E.K., A.A., Literature Search: A.L., A.A., M.Y., Writing: A.L., M.Y., Y.S.İ., E.K.

**Conflict of Interest:** No conflict of interest was declared by the authors.

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