







# Analysis of feasibility and safety of laparoscopic complete mesocolic excision with central vascular ligation for right-sided colon cancer. A single centre experience

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## Abstract

**Aim:** Colectomies performed according to complete mesocolic excision (CME) principles have demonstrated an improvement in the quality of surgical specimen and a potential improvement of long-term results. The procedure is technically challenging and has a risk of serious complications, especially when performed laparoscopically. We here aimed to analyze our short-term results in relation to laparoscopic CME right hemicolectomy carried out for right-sided colon cancers.

**Material and Methods:** Demographic data and preoperative, perioperative and postoperative parameters of twenty-three patients who underwent laparoscopic CME between January 2017 and January 2019 in our clinic for right-sided colon adenocarcinoma were retrospectively analysed.

**Results:** There were 23 patients in our study and the mean (SD) age was 61.9±14.8. In the present series, 30% of patients were ≥70 years old, and three were ≥80 years old. Four patients were ASA class 3. Fifty-two percent of patients had comorbidities, and two had different system malignancies in their medical history. While the mean (SD) body mass index (BMI) was 25±4.3, BMI of 4 patients were over 30. Six of patients had a history of previous abdominal surgery. No perioperative mortality was observed. Thirteen percent of the patients developed wound site infection. Anastomotic leakage occurred in 2 cases, and one of them underwent reoperation. The mean (SD) operation time was 168±33 min. Good quality specimens were obtained with a mean (SD) length of 34.2±9.7 cm, a proximal margin of 14±8.2 cm and a distal margin of 16.6±8.9 cm. The mean (SD) number of harvested lymph nodes was 31.9±7.7. The radial surgical margin of all specimens was negative. The mean (SD) postoperative hospital stay was 7.2±2.8 days.

**Conclusion:** We believe that our CME technique performed by laparoscopic method for right-sided colon cancers is safe and applicable, and allows obtaining good quality specimens when evaluating the short-term results. However, there is still a need for randomized controlled trials to evaluate the contribution to survival.

**Keywords:** Colon cancer; complete mesocolic excision; laparoscopy; right hemicolectomy

## INTRODUCTION

Thanks to total mesorectal excision (TME), better prognosis and higher survival rates have been achieved in patients with rectal cancer than in patients with colon cancer over the past 30 years (1). This technique is based on resection of mesorectum with intact fascia, including blood and lymphatic vessels as well as lymph nodes in which the tumor can spread (2). The key quality factor for colon resections is the need to respect embryological plans. Hohenberger *et al.* described central vascular ligation (CVL) together with complete mesocolic excision (CME) for colon cancer in 2007 (3). CME surgery was similar to the TME principles for rectal cancer. Studies

have shown that, in open colon cancer surgery, CVL with CME improves local disease control and overall survival (4,5). The CME technique is basically to maintain dissection during embryological plans in order to obtain a clean circumferential surgical margin, and to separate the main arteries and veins from their origin after extensive colon mobilization (4,6,7). This technique results in a large bowel resection with CME, and provides multiple lymph node excision (5-7).

In colorectal cancers, laparoscopic interventions are considered equivalent to open surgical procedures (8). However, the laparoscopic technique gives better short-term results with regard to blood loss, pain sensation,

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return of bowel function, early initiation of oral food, and short hospital stay (9-11). Some investigators have disputed the supremacy of laparoscopic approach in right-sided colon cancer in terms of clinical results and technical challenges in relation to vascular diversification (12,13). Studies have demonstrated the practicability of laparoscopic CME for right-sided colon cancer (14-16). Laparoscopic technique requires initial adaptation to meet CME requirements (17). Different laparoscopic right hemicolectomy techniques have been proposed for CME (14,18-20), but this process has high complexity in terms of vascular variability (21), and the procedure carries an important complication risk.

The objective of the present study was to define the laparoscopic CME technique in right-sided colon cancers and to present the short-term results of our cases to ensure the practicability and reliability of this technique.

### MATERIAL and METHODS

The present study was planned as a single center and retrospective study. The data of the patients who underwent laparoscopic CME with the diagnosis of right colon adenocarcinoma in our clinic between January 2017 and January 2019 were analyzed. Written informed consent was obtained from each patient for surgical intervention prior to surgery. This study was approved by the Institutional Review Board of our institute (IRB No. 14.06.2019/89/46).

#### Surgical Technique

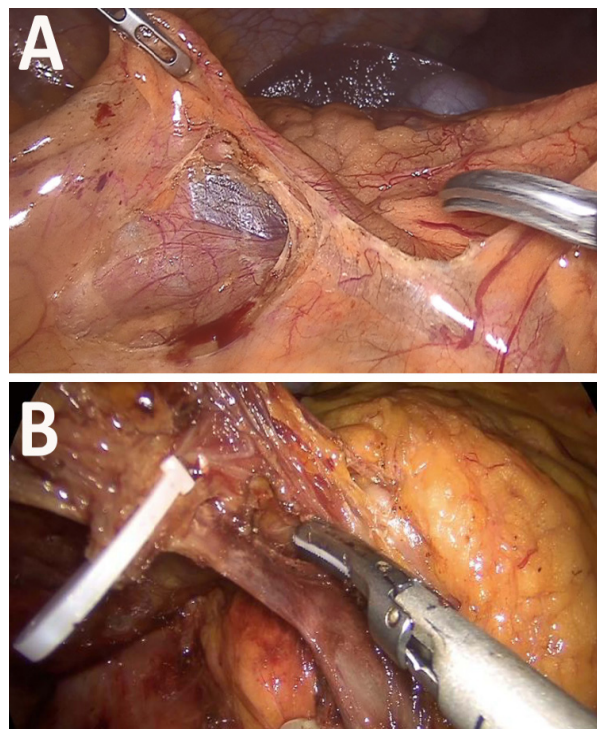
The patient was put in the supine position with a mild lean towards left with Trendelenburg on the operating table. While the resident was on the right side of the patient, the operator and the cameraman were on the left side. A 12 mm camera port was inserted under the umbilicus. A total of 3 ports were put into the abdomen, one 5 mm on the right side, and one 5 mm and one 10 mm on the left side. The trocar on right side was for traction, whereas the trocars on the left side were used as the main operating ports. The abdomen was explored after the operating area was provided. The procedure was divided into 4 sections: dissection, ligation of the vessels, release of the colon, extraction of the specimen and resection.

#### Stage 1

Right colon was pulled upward, along with the ileocolic mesentery, and incision was made under the ileocolic mesentery and then retroperitoneum was entered. Thus, the terminal ileum, cecum and the ascending colon mesentery were totally mobilized in a medial to lateral and a caudal to cranial fashion. Mobilization was continued until the duodenum and pancreatic head, the origin of the superior mesenteric vasculature and the origin of the middle colic vessels were completely visualised (Figures 1 A and B).

#### Stage 2

The ileocolic and middle colic pedicles were pulled upward and dissection of the anterior peritoneal sheath was



**Figure 1.** Pulling upward the right colon, along with the ileocolic mesentery, and entering the retroperitoneum under the ileocolic mesentery (A) and full mobilization of the right mesocolon (B)

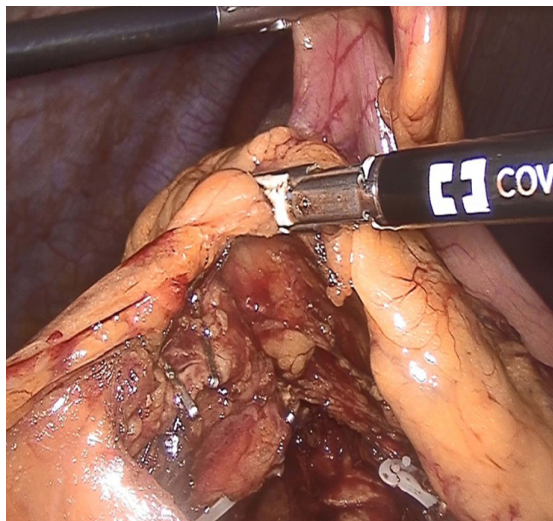


**Figure 2.** Transection of the branches of the superior mesenteric artery and vein from their roots

performed along the left side of the superior mesenteric artery with transection from the roots of ileocolic and right colic vessels. The en bloc lymphadenectomy of the anterior side of the superior mesenteric vein was performed from the ileocolic vessels to the gastrocolic trunk of Henle. While the middle colic veins were cut from their roots in the tumors of the hepatic flexure and transverse colon, they were clipped from the right branches in the cecum and ascending colon tumors. This technique was applied in all right-sided colon cancers (Figure 2).

**Stage 3**

Omentum was separated by cutting the right side. Gastrocolic ligament was opened by preserving the gastroepiploic vessels and released from the lateral ligaments of the right colon (Figure 3).



**Figure 3.** Separation of the right colon from the lateral ligaments and complete releasing the right colon

**Stage 4**

The freed colon on the right side was taken out of the abdomen through a mini-incision made on the umbilicus by using a wound protector. Both resection and a side-to-side anastomosis were performed with stapler, while looking out for safe surgical margins. A Jackson-Pratt drain was placed near the anastomosis (Figure 4).



**Figure 4.** The appearance of the surgical specimen

The clinical and pathological data of the patients were prospectively recorded and stored. Any deviation from postoperative normal course was accepted as a complication. Negative events occurring within the first

30 days after surgery were evaluated as morbidity and mortality.

**Postoperative measurements and data analysis**

Pathology samples were analyzed in accordance with the 7th edition of the American Joint Cancer Committee (AJCC) and the criteria of the Union for International Cancer Control (UICC). Tumor size, specimen length, and surgical resection margins were calculated from formalin-fixed specimens. Complications were rated by Clavien-Dindo classification (22).

Continuous data were presented as mean (standard deviation) or median (range) and categorical data as frequency.

**RESULTS**

The clinical and demographic characteristics of the patients are shown in Table 1. There were 23 patients in our study and the mean (SD) age was  $61.9 \pm 14.8$ . Seven of the patients were over 70, and 3 were over 80 years of age. Four patients were ASA class 3. Fifty-two percent of the patients had comorbidities. Two patients had a history of different system malignancies (1 patient had lung cancer and 1 patient had breast cancer).

**Table 1. Patient demographic and clinical characteristics for the 23 patients under study**

Data	Cases (n=23)
<b>Mean Age (SD)</b>	61.9±14.8
<b>Gender</b>	
Female	11 (47.8%)
Male	12 (52.2%)
<b>Mean BMI (SD)</b>	25±4.36
<b>Tumor location</b>	
Cecum	4 (17.4%)
Ascending	10 (43.5%)
Hepatic flexure	7 (30.4%)
Transverse	2 (8.7%)
<b>ASA class</b>	
ASA 1	5 (21.7%)
ASA 2	14 (60.9%)
ASA 3	4 (17.4%)
<b>Presence of comorbidities</b>	
No	11 (47.8%)
Yes	12 (52.2%)
<b>History of other malignancy</b>	
No	21 (91.3%)
Yes	2 (8.7%)
<b>Previous abdominal surgery</b>	
No	17 (73.9%)
Yes	6 (26.1%)

SD: Standard Deviation BMI: Body Mass Index

The mean (SD) body mass index (BMI) was  $25\pm 4.3$ , while there were 4 patients with a BMI over 30. Twenty-six percent of the patients had a history of prior abdominal surgical intervention.

Operative technical data are explained in Table 2. The mean (SD) operation time was  $168.2\pm 33$  minutes, the maximum operation time was 240 minutes, and the minimum operation time was 100 minutes. The median blood loss was 30 mL, the maximum blood loss was 160 mL, and the minimum blood loss was 15 mL. One patient had an intraoperative complication. One operation was converted to open surgery.

**Table 2. Data of surgical procedure for the 23 patients under study**

Data	Cases (n=23)
Mean time of surgery (SD)	168.2±33.1 min
Intraoperative complications	
No	22 (95.7%)
Yes	1 (4.3%)
Median blood loss (range)	30 (15-160) mL
Conversion	
No	22 (95.7%)
Yes	1 (4.3%)

SD: Standard Deviation

Histopathological examination results of surgical specimens are given in Table 3. The mean (SD) specimen length was  $34.2 \pm 9.7$  cm, the mean (SD) proximal surgical margin length was  $14\pm 9.75$  cm, the mean (SD) distal surgical margin length was  $16.6 \pm 8.9$  cm, and the mean (SD) tumor diameter was  $4.0\pm 1.7$  cm. The mean (SD) number of harvested lymph nodes was  $31.9\pm 7.7$ , the median number of retrieved lymph nodes was 30, and the minimum number of retrieved lymph nodes was 17. In 87% of patients, the depth of invasion was T3/T4 tumors and 52.2% of patients were N (+). One patient had liver metastasis. The radial surgical margin of all specimens was negative.

Postoperative complications were evaluated according to Clavien-Dindo classification and summarized in Table 4. One or more complications occurred in 39% of the patients. Grade 1 and 2 complications were developed in 7 of these patients, and grade 3 complications were occurred in 2 patients. In one of the patients, a grade 3b postoperative complication was taken place and the patient was re-operated due to anastomotic leakage.

Postoperative outcome of the patients is presented in Table 5. There was no perioperative mortality. Wound site infection developed in 13% of the patients. Anastomotic leakage occurred in two cases and one of these patients was re-operated. The mean (SD) postoperative length of stay was  $7.2 \pm 2.8$  days and the maximum hospital stay was 15 days.

**Table 3. Data of histopathological examination for the 23 patients under study**

Data	Cases (n=23)
Mean length of specimen (SD)	34.2±9.7 cm
Mean length of proximal margin (SD)	14±8.2 cm
Mean length of distal margin (SD)	16.6±8.9 cm
Mean tumor size (SD)	4±1.7 cm
Mean number of retrieved lymph nodes (SD)	31.9±7.7
Tumor grade	
High	5 (21.7%)
Moderate	10 (43.5%)
Low	8 (34.8%)
Depth of invasion (T)	
T1	1 (4.3%)
T2	2 (8.7%)
T3	4 (17.4%)
T4a	16 (69.6%)
Nodal involvement (N)	
N0	11 (47.8%)
N1a	7 (30.4%)
N1b	3 (13.2%)
N2a	1 (4.3%)
N2b	1 (4.3%)
Presence of metastasis (M)	
M0	22 (95.7%)
M1a	1 (4.3%)
AJCC / UICC TNM stage	
Stage 1	3 (13.0%)
Stage 2A	4 (17.4%)
Stage 2B	4 (17.4%)
Stage 3B	10 (43.5%)
Stage 3C	1 (4.3%)
Stage 4A	1 (4.3%)
Neural invasion	15 (65.2%)
Lymphovascular invasion	19 (82.6%)

SD: Standard Deviation AJCC: American Joint Cancer Committee  
UICC: Union for International Cancer Control

**Table 4. Post-operative complications of the 23 patients under study**

Data	Cases (n=23)
Post-operative complications	
None	14 (60.9%)
Grade 1	2 (8.7%)
Grade 2	5 (21.7%)
Grade 3a	1 (4.3%)
Grade 3b	1 (4.3%)

Table 5. Post-operative outcome of the 23 patients under study

Data	Cases (n=23)
RBC transfusion	6 (26.1%)
Respiratory complications	3 (13.0%)
Flatus recovery time (days)	
1	4 (17.4%)
2	8 (34.8%)
3	10 (43.5%)
4	1 (4.3%)
Liquid intake time (days)	
2	4 (17.4%)
3	10 (43.5%)
4	6 (26.1%)
5	2 (8.7%)
6	1 (4.3%)
Wound site infection	3 (13.0%)
Anastomotic leakage	2 (8.7%)
Re-operation	1 (4.3%)
Mean postoperative length of stay (SD) (days)	7.2±2.8

RBC: Red Blood Cell SD: Standard Deviation

## DISCUSSION

Colectomies performed according to CME principles in right-sided colon cancers have showed improvements in the quality of surgical specimens (providing clean surgical margins, high number of removed lymph nodes) (5,23,24). It was first introduced by Hohenberger *et al.* (4), and is now routinely performed in several hospitals in the West and more often in the Far East (7,15,25,26). There are also studies on radical lymph node dissections including Japanese D3 lymphadenectomy, CME and CVL (27-28).

CME described by Hohenberger *et al.* and Japanese CME were similar in cecum and ascending colon cancers, but vary in cancers of hepatic flexure and transverse colon (29). Kocher maneuver is not performed in Japanese CME right hemicolectomy, lymphadenectomy is confined to the anterior aspect of the superior mesenteric vein and bowel resection is performed by the direction of the arterial supply (27,28). Therefore, the dimension of colonic resection is larger in the Hohenberger's procedure (29).

Laparoscopic surgery in colon cancer has now become the standard surgical method after multiple randomized trials (9,10,30). Although laparoscopic surgery is nowadays regarded as the standard treatment for right-sided colon cancer resection, laparoscopic CME right hemicolectomy is seen as a difficult procedure (14,17-20).

Our CME procedure was performed by following the principles recommended by Hohenberger *et al.* The efficiency of this technique has been demonstrated by potentially high rates of curative (R0) resections in which the longitudinal and circumferential surgical margins

without involvement by the tumor are achieved and a sufficient number of lymph nodes are dissected.

The results of the present study coincide with other studies on standard right hemicolectomy from Europe and America (9-11,31-33). It is also tantamount to studies on CME right hemicolectomy performed in Western countries (14,33,34) and Eastern countries (15,20,26,35,36).

Laparoscopic CME right hemicolectomy is recognized as a complicated procedure involving various technical challenges (37). Developments in robotic surgery can help overcome some of these difficulties.

Despite the comprehensive analysis of robotic colorectal surgery, there are only a few comparative studies in relation to laparoscopic and robotic right hemicolectomy (38). While those studies have demonstrated that robotic CME right hemicolectomy is secure and practicable, they were not able to show the superiority of a robotic approach in comparison to a laparoscopic approach (39,40).

In our study, 7 of the patients were older than 70 years and 3 of them were over 80 years of age. Four patients were ASA class 3. Fifty-two percent of the patients had an additional disease. Two of our patients had a history of malignancy of other systems. There were 4 patients with a BMI over 30. Twenty-six percent of the patients had a history of prior abdominal surgical intervention. No perioperative or postoperative mortality was observed and postoperative complication ratio was comparable to previous studies. Wound site infection rates were slightly higher in our study.

## CONCLUSION

In conclusion, short-term results for right-sided colon cancers were evaluated and laparoscopic CME technique was found to be safe and feasible and it improved the quality of surgical specimens.

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