

## Original Research Article

# Outcomes of laparoscopic assisted versus open complete mesocolic excision for right sided colon cancer

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## ABSTRACT

**Background:** Complete mesocolic excision (CME) as a standard surgery for left sided colon cancer is proven however there is a great debate and deal of discussion if the extra effort needed for it in right sided colon cancer worth the gain that is achieved. We aimed in our study to assess the outcome of CME with central vascular ligation for treatment of right sided colon cancer performed either laparoscopic (lap.) assisted or by open technique.

**Methods:** This was a prospective randomized study on sixty patients who were presented with right sided colonic cancer. Patients were divided into two groups. Group (A) open one and group (B) lap. assisted group.

**Results:** Both groups were comparable regarding demographic data, although operative time was significantly shorter in open group ( $p < 0.001$ ). Lap. assisted group achieved a significant difference as regards to blood loss, incision length, duration of hospital stay, resume of oral feeding, tumor to high vascular tie as well as higher number of harvested lymph nodes with no difference in recurrence rate and overall survival rate over a period of 3 years follow up.

**Conclusions:** The principles underlying CME are anatomical and logical as it entails return back to embryology, and the results published points to the improved survival and decreased local recurrence particularly when it is performed in the proper mesocolic plane, using of laparoscopy may help in that due to better visualization of planes thus the gain of CME even in right sided colon cancer may exceed the pain in hand skilled colorectal lap. surgeons.

**Keywords:** Right colon cancer, Mesocolic excision, Laparoscopic assisted group

## INTRODUCTION

With the introduction of concept of total mesorectal excision (TME) by Heald 20 years ago. This has resulted in a revolution in the treatment of cancer rectum with significant improvement in both local recurrence and overall survival.<sup>1-3</sup>

From the embryological point of view these planes are not limited to the rectum and mesorectal layers but continue to the sigmoid and descending colon on the left side, running behind the pancreas and around the spleen, then include the duodenum with the head of the pancreas,

the cecum and ascending colon with the mesenteric root on the right side and the lymphatic drainage accompanying the corresponding arteries.<sup>4</sup>

This has made Hohenberger publish his article about complete mesocolic excision (CME) with central vascular ligation for colon cancer that follows the same oncological principles as TME does for rectal cancer.<sup>4</sup>

The concept of CME is to remove the afflicted colon and its accessory lympho-vascular supply by resecting the colon and mesocolon in an intact coverage of visceral peritoneum. The mesocolon is situated within two layers

of the visceral fascia.<sup>5</sup> This envelope holds potentially disseminated lymph nodes and, by removing it intact, the risk of cancer cells dissemination into the peritoneal cavity is markedly reduced. The second component of CME is a central vascular tie to remove completely all lymph nodes in the central (vertical) direction.<sup>6</sup>

But there is still an argument if this concept of CME will worth the gain to be a standard technique for treatment of colon cancer particularly for the right side 'as many centers follow it on the left side' as this may be more traumatic for both the patient and doctor than standard surgery.<sup>7</sup>

### **Aim**

So we aimed in our study to assess the outcome of CME with central vascular ligation for treatment of right sided colon cancer performed either laparoscopic (lap.) assisted or by open technique.

### **METHODS**

This was a prospective randomized study on patients who were presented with right colonic cancer to be managed in General surgery department, Faculty of Medicine, Menoufia University, Egypt. Sixty consecutive patients with right colon cancer were enrolled in the study from April 2016 to July 2019.

#### **Inclusion criteria**

Patients with operable right colonic cancer, tumor length 6 cm or less, with no permeation of fat planes, encasement of major vessels or extensive local spread by (computed tomography scan).

#### **Exclusion criteria**

Included previous abdominal surgery, received emergency surgery due to acute intestinal obstruction or perforation, metastatic colon cancer and patients undergoing colectomy including another part of the colon than right colon.

Patients were randomized using a computerized simple randomization scheme in a 1:1 ratio into 2 groups each was 30 patients.

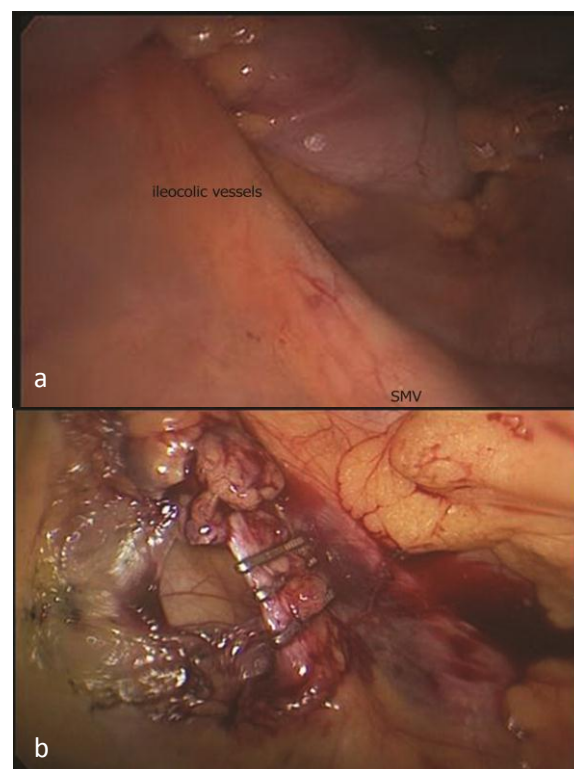
**Group A:** Those undergoing open right hemicolectomy with CME and central vascular ligation.

**Group B:** Those undergoing lap. assisted right hemicolectomy with CME and central vascular ligation.

#### **Procedure for lap. assisted right hemicolectomy**

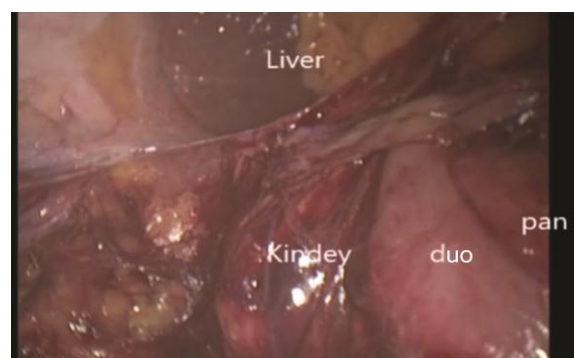
Each patient was placed in a modified lithotomy position. A pneumo-peritoneum was created through supra-umbilical incision and maintained at 12 mm Hg. A 4-port

technique was use. Surgery was carried out from medial to lateral. The intestines were pulled down to lt. iliac fossa to fully expose the ascending mesocolon. Identifying the main superior mesenteric vein (SMV) and ileocolic vessels. The vessels were ligated at their roots (Figures 1a and b).



**Figure 1: (a) Identifying of ileocolic vessels and (b) clipping of ileocolic vessels.**

Dissection proceeded along the SMV to expose the main veins and arteries to the colonic segment. We transected the right colic vessels (if present) and the right branch of the middle colic artery. The right mesocolon was incised along the right edge of the SMV up to Toldt's space. After complete medial dissection with particular care for the duodenum, ureter and gonadal vessels then mobilization of lateral peritoneal attachment (Figure 2).



**Figure 2: Final picture after complete medial dissection and removal of lateral peritoneal attachment.**

Separation of mesentery of terminal ileum using ligasure. Finally extraction of specimen from lower lateral abdominal incision with extracorporeal hand-sewn anastomosis.

Open surgery with CME was performed after midline incision via a lateral to medial approach in a caudal to cranial direction. Mobilization of the right hemicolon and mesocolon was similar to that of lap. CME.

### Outcomes of interest

Three types of study outcomes were of interest.

- The safety of CME, including operative time, intra-operative blood loss, postoperative surgical complications and postoperative mortality.
- The quality of CME, including large bowel length, distance from the tumor to the high vascular tie (HVT), area of mesentery and total lymph nodes.
- The effect of CME, including overall survival, recurrence rate.

### Statistical analysis

Data was collected and entered to the computer using Statistical Package for Social Science (SPSS) program for statistical analysis 'version 20'. Two types of statistics were done which are descriptive statistics which included quantitative data as [mean, standard deviation (SD), median and range] and qualitative data as frequency and percent and analytical statistics which included (Fisher exact test and Mann Whitney test). P value was considered statistically significant when it was less than 0.05.

## RESULTS

This study was performed upon 60 patients with operable right sided colon cancer. Patients were divided into two groups that were comparable regarding demographic data

as shown in Table 1 with no significant differences between them regarding age, gender, BMI and comorbidities.

As regards to operative details we had found that duration of operation ranged from 75-175 min with a median time of  $114.4 \pm 23.5$  min. for open group while for lap. assisted one ranged from 100-180 min with a median time of  $135.9 \pm 22.8$  min with a significant difference ( $p < 0.001$ ) in favor of open group this may be due to longer time in early cases of lap. Group that decreased in the last cases with improved learning curve. However blood loss and incision length were significantly less in lap. assisted group ( $p < 0.008$ ) and ( $p < 0.001$ ) respectively (Table 2).

Although mass size and length of the resected large bowel length were not significantly different the length of the tumor to HVT was longer in lap. Group ( $118.8 \pm 17.4$  mm) and was significantly different from the open group ( $101.1 \pm 11.2$  mm) ( $p < 0.001$ ).

From post-operative data we found no significant difference between both groups as regards to post-operative complications (leakage or wound infection) however lap. group recorded significantly shorter period of hospital stay and earlier resume of oral feeding this may be due to less manipulation in lap. Group as well as the significantly less pain reported by visual analogue scale (VAS) as shown in (Table 3) also we had no reported mortality in any of both groups.

As regards to the oncological outcomes R0 resection was achieved in all cases with significantly higher no. of harvested lymph nodes ( $27.9 \pm 7.4$ ) for lap. group vs. ( $24.6 \pm 4.5$ ) for open group with ( $p < 0.037$ ).

During follow up period of about 3 years, 3 cases of recurrence were reported 2 for open and one for lap. with no significant difference, also the median overall survival rate was 73.6% and 70.3% for open and lap. group respectively with no significant difference (Table 4).

**Table 1: Demographic data of both groups.**

	Open group (n=30)	Lap. assisted (n=30)	Test of significance	P value
<b>Age</b>	$51.5 \pm 9.46$ (32-66)	$53.47 \pm 11.5$ (25-68)	T test: 0.724	0.472
<b>Male</b>	17 (56.7%)	19 (63.3%)	Fisher's test: 0.278	0.792
<b>Female</b>	13 (43.3%)	11 (36.7%)		
<b>BMI</b>	25.56 (19-41)	27.8 (19-35)	T test: 1.6	0.12
<b>DM</b>	4 (13.3%)	6 (20%)	Fisher's test: 0.48	0.731

**Table 2: Operative data of both groups.**

	Open (n=30)	Lap. (n=30)	T test	P value
<b>Operative time minutes</b>	$114.4 \pm 23.5$ (75-175)	$135.9 \pm 22.8$ (100-180)	3.6	0.001**
<b>Blood loss ml</b>	$236.2 \pm 49.8$ (150-540)	$195.3 \pm 63.6$ (90-420)	2.8	0.008**
<b>Incision length CM</b>	$19.6 \pm 2.44$ (16-23)	$5.03 \pm 0.54$ (4.5-6)	31.94	0.001**
<b>Mass size CM</b>	$5 \pm 0.85$ (4-6)	$4.5 \pm 1.1$ (3-6)	1.55	0.13
<b>Tumor to HVT mm</b>	$101.1 \pm 11.2$ (85-142)	$118.8 \pm 17.4$ (82-140)	4.7	0.001**
<b>Length of large bowel mm</b>	$224.4 \pm 41.5$ (165-292)	$223.2 \pm 51.3$ (154-315)	0.11	0.92

**Table 3: Post-operative data.**

	Open (n=30)	Lap. assisted (n=30)	Test of sig.	P value
<b>Hospital stay days</b>	6.5±3.04 (5-20)	4.4±1.2 (3-8)	T test: 3.6	0.001**
<b>Time to resume oral intake days</b>	4.9±2.2 (3-9)	3.8±1.4 (2-6)	T test: 2.2	0.031*
<b>Leakage</b>	1 (3.3%)	0 (0%)	Fisher's test: 1.02	1.0
<b>Wound infection</b>	3 (10%)	1 (3.3%)	Fisher's test: 1.1	0.62
<b>VAS.D1</b>	7.4±1.2 (6-9)	4.9±0.78 (4-6)	T test: 9.6	0.001**
<b>VAS.D3</b>	3.9±0.78 (3-5)	1.9±0.83 (1-3)	T test: 9.6	0.001**
<b>Hospital mortality</b>	0	0	--	---

**Table 4: Oncologic outcomes in both groups.**

	Open (n=30)	Lap. (n=30)	Test of Sig.	P value
<b>Lymph node retrieved</b>	24.6±4.5 (17-33)	27.9±7.4 (18-50)	T test: 2.14	0.037*
<b>Safety margins R0</b>	30	30	---	----
<b>Recurrence rate</b>	2 (6.7%)	1 (3.3%)	Fisher's test: 0.35	1.0
<b>Median survival rate- 1 year survival</b>	29 (96.7%)	29 (96.7%)	Fisher's test: 0	1.0
<b>Median survival rate- 3 year survival</b>	22 (73.6%)	21 (70.3%)	Fisher's test: 0	1.0

## DISCUSSION

CME is considered by some surgeons a more extensive operation rather than a standard one. Primarily CME was described as an open procedure.<sup>4</sup> There is a great debate concerning whether the CME, particularly for the right sided cancer colon, worth the pain of it compared to non-CME whether it is performed either open or lap. Although the concept of CME is considered new in the western side as it had begun since 2008 in the eastern side where surgeons in Japan, China, Korea and Taiwan had used D3 lymphadenectomy resections for colon cancer for decades. The D3 lymphadenectomy is defined as the dissection of the paracolic, intermediate and central lymph nodes, a procedure equivalent to CME.<sup>8</sup> So in this study we tried to find out if CME for right sided colon cancer had benefits that exceed its hazards or not. We performed it upon sixty patients divided into two groups each was 30 patients group (A) by open technique, and group (B) by lap. assisted in both we performed CME with central vascular ligation.

In our study, the operative time in first lap. cases was about 180 min although this had decreased gradually to reach to 100 min. in the last cases. However there was a significant difference between both groups in favor for open group (group A) (p=0.001).

On the same way Chow et al and Melich et al in their studies reported that CME is a longer operation Procházka et al. at 2016 found that CME is longer than the conventional technique by 20 min.<sup>8-10</sup> Operation time on average is much longer for a CME compared with standard surgery with reported average operation times ranging from 150-220 min.<sup>11-15</sup>

On the other hand in a study by Bae et al at 2014, comparing lap. assisted vs open CME they reported operation time (179 vs. 194 minutes, p=0.862) and they explained that many cases in open group had previous laparotomies.<sup>16</sup> And this may or may not translate to increased morbidity but it does affect the efficiency of an operating theatre and thus health economics in a time of increasingly tight health budgets. One may assume a higher complication rate and also the possibility of catastrophic complications that might occur less frequently in a standard procedure.

In our study we reported some complications like leakage, wound infection, with no mortality although it was higher in the open group the difference was not significant, and the whole rate of complications in our study in both groups using CME is not different from that of the standard surgery.

Also in similar studies reported by Bertelsen et al, Killeen et al and Storli et al equivalent major morbidity rates when CME is compared to standard surgery and in the same way acceptable morbidity rates in other case series regarding CME published.<sup>12,14,15,17-21</sup> In Bae et al study they recorded that the morbidity within 30 days after surgery was comparable between the two groups (12.9 vs. 24.7%, p=0.050).<sup>16</sup>

Although unusual complications like vascular injuries, duodenal injury, or chyle leakage were reported in some studies.<sup>14,21</sup> We had recorded none of these complications in our study.

From the previous Tables (Table 2 and 3) the value of using laparoscopy in CME during right hemicolectomy appeared as there was significant difference between both groups in favor of lap. Assisted group regarding incision

length, tumor to HVT and the latter may be due to better visualization of planes.

In the same way also using laparoscopy had reflected on the post-operative data as there was significant difference in favor of (Group B) regarding early return of bowel movement, and so earlier to resume oral feeding, this may be due to less manipulation as well as the significant difference between both groups regarding the VAS recorded that revealed less pain in (Group B) and by far this had reflected on the date of discharge from hospital being shorter in lap. assisted group. Similar to us Bertelsen et al described how the induction of CME in Hillerod Hospital has influence the surgical and pathological outcomes.<sup>17</sup> They reported that the length of the vascular ligation increased from 7.1 to 9.6 cm ( $p<0.0001$ ) the length in our study was about 10 cm for the open group and 11 cm for the lap. group.

In another study Galizia, et al reported that the length of the vascular ligation was significantly better in the CME group ( $p<0.01$ ).<sup>22</sup> In a small Japanese study the lap. group showed a greater distance from tumor to high tie and nearest bowel wall to high tie in right sided resections (121 vs 100 mm;  $p=0.018$ , 113 vs 89 mm;  $p=0.18$ ).<sup>23</sup>

In a comparison study from Greece, open vs lap. proximal right sided colon cancer, this study showed equivalence between lap. and open groups in term of high tie to tumor and high tie to nearest bowel wall in proximal right sided resections.<sup>24</sup>

In a Danish article lap. resections pre and post the introduction of the CME as a standard of care were compared in which distance from tumor to high tie [9.4 cm (4-16) vs 7.7 cm (1-12)  $p=0.0018$ ] compared to their standard lap. operation.<sup>17</sup> In a Korean study the median time to soft diet (LCME 6 days vs. OCME 7 days,  $p<0.001$ ) and the possible length of stay (7 days vs. 13 days,  $p<0.001$ ) were significantly shorter in the lap. group.<sup>16</sup>

Theoretically removal of the whole mesocolon will by far results in larger number of lymph nodes and even will overcome what is so called skip lymph nodes that may occur with affection of apical lymph nodes without affected intermediate group this may results in up-staging of the disease with resultant change in the protocol of treatment with final improvement in the survival rate and decrease in the recurrence rate.

In our study we had recorded median no. of lymph nodes of ( $24.6\pm4.5$  and  $27.9\pm7.4$ ) for open and lap. assisted groups respectively with significant difference between them in favor for lap. assisted group ( $p<0.037$ ).

Regarding recurrence rate we reported 3 cases with recurrence about 5% in the whole study 2 in group A and one in group B with no significant difference between them.

The overall survival in our study over a period of about 3 years follow up was 73.7% and 70.3% for group A and B respectively with no significant difference between both groups. On the same way, In Bae et al study at 2014 had a median lymph node harvest number of 27 and 28 in the lap. and open groups respectively.<sup>16</sup> Their overall rates of recurrence did not differ significantly between both groups (12.9 vs. 20.0 %,  $p=0.215$ ). However they reported overall survival after five years which was significantly better for lap. group. West et al reported that specimens from colon cancer resections from Erlangen, Germany, where CME and central venous ligation are routinely applied have higher number of lymph nodes harvest (median 30 vs 18,  $p<0.0001$ ) compared to standard specimens from Leeds, United Kingdom, also they reported that meticulous plane of complete mesocolic surgery is associated with a fifteen percent greater 5-year overall survival rate compared with cases where defects in the mesocolon reached muscularis propria.<sup>25</sup>

Also Bertelsen et al described how the mean number of removed lymph nodes increased from 24.5 to 26.7 ( $p=0.0095$ ) after the start of CME in their study in Hillerod Hospital.<sup>17</sup> On the same way Galizia et al reported that the number of the removed lymph nodes was better in the CME group ( $p<0.01$ ).<sup>22</sup> Moreover, a higher number of tumor deposits were detected, thus allowing chemotherapy in those newly upstaged patients. Interestingly, during follow up they reported no local recurrence in the CME group but there was in 21% of the standard group. However more early stage cancer patients were enrolled in the CME group.

A Norwegian retrospective study compared colon cancer survival between one hospital that used the CME approach and two other centers that used the "standard" approach.<sup>26</sup> The authors observed a better 3-year overall survival rate (88.1% vs 79.0%,  $p=0.003$ ) in the CME group of patients.

In another study by El-Fol et al reported no statistical significant difference between lap. CME and open CME groups for rt. sided colon cancer during the follow-up period of 24 months regarding tumor recurrence, metastasis or cancer-related deaths in both groups.<sup>27</sup> On the opposite side, Lacy et al showed that the 5-year overall survival of patients with stage III disease was significantly better after lap. surgery.<sup>28</sup> But this study was limited because it had a low lymph node yield (understaging), high local recurrence rates in the open group (26%).

Bilimoria et al reported that the 5-year overall survival of patients with stage I and II disease was significantly better after lap. surgery, but this was a retrospective comparative study from a national cancer database which involved different sites and surgeons.<sup>29</sup> Another two nonrandomized comparative studies had shown better long-term oncologic outcomes in stage III cancers and



locally advanced cancers in lap. compared with open groups (all colon cancers with non-CME).<sup>18,30</sup>

## CONCLUSION

CME represents an appealing appellation for an already-practiced technique. The principles underlying CME are anatomical and logical as it entails return back to embryology, and the results published points to the improved survival and decreased local recurrence particularly when it is performed in the proper mesocolic plane, using of laparoscopy may help in that due to better visualization of planes thus the gain of CME even in right sided colon cancer may exceed the pain in hand skilled colorectal lap. surgeons.

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