

FEASIBILITY OF CRANIAL TO CAUDAL APPROACH IN LAPAROSCOPIC COMPLETE MESOCOLIC EXCISION FOR RIGHT COLON CANCER

By

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ABSTRACT

Background: Complete mesocolic excision with central vascular ligation is considered to contribute to superior oncological outcomes after colon cancer surgery. For advanced right-sided colon cancer, this surgery sometimes requires lymph node (LN) dissection along the superior mesenteric vein (SMV), with division of the middle colic vessels, or their right branches, at origin.

Objective: To evaluate the feasibility of cranial to caudal approach in LN dissection along superior mesenteric vein in laparoscopic right hemicolectomy as a novel technique as regard its impact on both radicality and outcome.

Patients and Methods: This retrospective study was carried out at Bab El-Sha'aria University Hospital and AL Salam Oncology Center, during the period from March 2020 to March 2021. Around 20 patients who were posted for laparoscopic complete mesocolic excision with central vascular ligation in cranial to caudal approach were included in the study.

Results: Tumor site in different parts of the right colon was distributed as follow: 5% in the cecum, percentage in the cecum and ascending colon was 10%, in ascending colon 40%, in the hepatic flexure 40%, and in proximal transverse colon 5%. 85% of cases were moderately differentiated adenocarcinoma and 15% poorly differentiated adenocarcinoma. In our study, complete mesocolic excision (CME) was in 20 cases (100%). The average number of harvested lymph nodes was 16.85 ± 6.39 . Histological examination revealed that proximal and distal margins were free of tumor cells in all surgical specimens. The proximal and distal margins were > 5 cm in all specimens. The length of the ileocolic segment was 35.30 ± 7.41 cm.

Conclusion: We presented cranially approached radical LN dissection along the surgical trunk during laparoscopic right hemicolectomy.

Keywords: Colorectal cancer, superior mesenteric vein.

INTRODUCTION

The concept of complete excision of the involved organ along with its primitive mesentery, associated to central ligation of

the supplying blood vessels, is progressively gaining acceptance as the next step towards a modern surgical oncology; surgical resection of the

primitive embryological mesenterium is in fact pivotal for optimal local clearance. The primitive mesenterium is the embryological envelope where the neurolymphovascular structures develop within a double-layered mesenchymal fibro fatty tissue and the initial pathway for cancerous diffusion: Its intact, complete excision is thus essential to clear residual disease in the surgical field, with consequent impact on local control. Furthermore, CVL allows for an extensive lymph node dissection along the feeding vessels, with significant effect on regional recurrence and systemic dissemination, as shown by improved survival in stage I-III colonic cancers treated with enhanced lymph node harvesting (*Le Voyer et al., 2010*).

Complete mesocolic excision with central vascular ligation is considered to contribute to superior oncological outcomes after colon cancer surgery. For advanced right-sided colon cancer, this surgery sometimes requires lymph node (LN) dissection along the superior mesenteric vein (SMV), with division of the middle colic vessels, or their right branches, at origin. In the present study, this technique in laparoscopic right hemicolectomy has been discussed with focus on embryology. Here, we present cranially approached radical LN dissection along the surgical trunk to take advantage of minimally invasive techniques, laparoscopic approach to CME with CVL seems the natural consequence in the evolution of this procedure (*Ouyang et al., 2019*).

The aim of the present study was to evaluate the feasibility of cranial to caudal approach In LN dissection along superior

mesenteric vein in laparoscopic right hemicolectomy as a novel technique as regard its impact on both radicality and outcome.

PATIENTS AND METHODS

This retrospective study was carried out at Bab El-Sha'aria University Hospital and Al Salam Oncology Center, during the period from March 2020 to March 2021. Around 20 patients who were posted for laparoscopic complete mesocolic excision with central vascular ligation in cranial to caudal approach were included in the study.

Inclusion criteria: Patients aged up to 75 years, no known inflammatory conditions.

Exclusion criteria: Patients on anticoagulant treatment with altered blood clotting or immune system, patients having distance metastasis especially in liver, patient with intestinal perforation, patient unfit for surgery, and Previous major colorectal surgery Pregnancy.

Careful history taking: Personal history associated in detailed analysis of the symptoms and any associated symptoms, past and family history of a similar conditions and chronic systemic diseases.

Examination: For general conditions and vital signs and color of the patient and for any sign of chronic disease, and Thorough abdominal examination. Diagnostic work up: Preoperative radiological assessment included ultrasound, CT abdomen and pelvis and MRI. Tumor markers (CEA), colonoscopy and histopathological biopsy examination. Preoperative laboratory assessment included complete blood picture, random blood sugar, liver function tests, kidney function tests, and

serum electrolytes will be done. ECG& echocardiogram. Preoperative preparation: Fasting started only 8 hours before surgery, No mechanical bowel preparation was done, Low molecular weight heparin (LMWH) at night of surgery for prophylaxis against DVT. Cross-matched blood will be available for transfusion during or after the operation if needed. Written consents were taken from patients explaining the details of surgery, the advantages of minimally invasive surgery and concepts of fast track surgery, clarifying the possible complications of surgery and the possibility of conversion to open surgery.

Type of anesthesia: General anesthesia with endotracheal intubation.

Intra operative protocol: Prophylactic parental antibiotics in the form of 3rd generation cephalosporines 30 minutes before induction of anaesthesia and continued postoperatively. No central venous catheter except if needed. Urinary catheter insertion. NGT inserted, removed immediately postoperative.

Equipments: Telescope 10mm 30° (HOPKINS® and HOPKINS® II Karl storz). 3 chip laparoscopic camera (storz). 2 digital flat screens Monitor (storz). High-flow CO2 automatic insufflator (>6 L/min) with digital intraabdominal pressure, volume, and gas display (Storz). Ultracision (ethicon endosurgery). Ligasure (Medtronic). Bipolar diathermy (Storz). Laparoscopic 5-mm bowel graspers (two per case). Laparoscopic 5-mm dissector. Laparoscopic 5-mm scissor. Laparoscopic 5-mm needle holder. Suction/irrigation cannulae (5 mm). Multifire clip applier (10 mm).

Careful exploration was for bleeding at sites of dissection and also at port sites which was an important step, then drains were left. Closure of port sites using 3/0 monocryl sutures.

Post-operative Protocol: Patients were transferred after the operation to the recovery room and then to the normal unit, Analgesia via intravenous route then oral when patient could tolerate oral intake, Iv fluids, Patient mobilization as early as possible, Oral fluids usually the first day after the operation(start with oral fluids then semisolid like yougurt and finally allow free oral intake), Removal of drains at 4th day postoperative and removal of urinary catheter usually at the second day post-operative, If postoperative course was uneventful, patients were discharged on the 5th or 6th postoperative day.

Follow up: Patients were reviewed every month in outpatient's clinic visits for the 1st6 months. During such visits, history and physical examination were taken and blood samples were obtained to check CEA. Further imaging (chest, abdominal, and pelvic CT) and colonoscopy were done if CEA level is elevated or clinical suspicion of recurrence.

The following short term outcomes measures were analyzed:

- 1. Operative time:** Time from skin incision to skin closure.
- 2. Conversion rate:** Conversion was defined as the need for prematurely making the abdominal incision for bowel mobilization and/or vascular control. The necessity for an abdominal incision to deal with any

intra-abdominal complication was also considered conversion.

3. **Intraoperative blood loss.**
4. **Intraoperative complications.**
5. **Functional date** (Time of first oral intake).
6. **Duration of hospital stay.**
7. **Post-operative complications** that contributed to prolonged hospital stay or lead to additional interventions or procedures.
8. **Perioperative mortality.**

Assessment of quality of surgical specimen:

1. Plane of dissection:
 - Mesocolic.
 - Intramesocolic.
 - Muscularis propria.
2. Proximal and distal margins.
3. Length of ileocolic segment (cm).

4. Distance from near bowel wall to high vascular tie (mm).

5. Number of LN harvest.

Statistical Analysis:

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for the Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. Chi square test (χ^2) to calculate difference between two or more groups of qualitative variables. Quantitative data were expressed as mean \pm SD (Standard deviation). Independent samples t-test was used to compare between two independent groups of normally distributed variables (parametric data). P value $<$ 0.05 was considered significant.

RESULTS

The demographic data of the patients included in our study that showed 50 % of cases were females, and 50% were males. The age of this group of patients ranged from 39-72 years (the mean age was 56.65 ± 9.33 years). Sixty five percent of our patients complained of medical disorders and were distributed as follow 25% diabetic, 45% hypertensive, 10% hepatic, 5% renal problem, 5% bronchial asthma and 5% neurological history.

The conversion rate to open technique was zero percent as all patients underwent laparoscopic procedure, although the universal incidence is 12-16%. operative time ranged from 130 minutes to 200 minutes (the mean operative time was 138.50 ± 9.88), and intraoperative blood loss ranged from 50 ml to 100 ml (the mean blood loss was 76.67 ± 25.17 ml). No intraoperative complications such as vascular or visceral injury occurred in any of our patients (**Table 1**).

Table (1): Demographic and intraoperative data

Variables		No. = 20
Age (years)	Mean \pm SD	56.65 \pm 9.33
	Range	39 – 72
Sex	Female	10 (50.0%)
	Male	10 (50.0%)
Co-morbidity	No	7 (35.0%)
	Yes	13 (65.0%)
Neurological morbidity	No	19 (95.0%)
	Yes	1 (5.0%)
Renal morbidity	No	19 (95.0%)
	Yes	1 (5.0%)
Cardiac morbidity	No	20 (100.0%)
	Yes	0 (0.0%)
Hepatic morbidity	No	18 (90.0%)
	Yes	2 (10.0%)
Hypertension	No	11 (55.0%)
	Yes	9 (45.0%)
Diabetes mellitus	No	15 (75.0%)
	Yes	5 (25.0%)
Bronchial asthma	No	19 (95.0%)
	Yes	1 (5.0%)
Previous abdominal surgery	No	16 (80.0%)
	Yes	4 (20.0%)
Type of operation	No	16 (80.0%)
	Appendectomy	2 (10.0%)
	Hysterectomy	1 (5.0%)
	CS	1 (5.0%)
Type of incision	No	16 (80.0%)
	Gridiron	2 (10.0%)
	Pfenestiel	2 (10.0%)
Operative time (min)	Mean \pm SD	138.50 \pm 9.88
	Range	130 – 200
Intra operative blood loss	No	17 (85.0%)
	Yes	3 (15.0%)
Blood loss (ml)	Mean \pm SD	76.67 \pm 25.17
	Range	50 – 100
Intra operative complications	No	20 (100.0%)
Vascular injury	No	20 (100.0%)
Conversion to open	No	20 (100.0%)

We found that variant in tumor site 40% hepatic flexure, 40% ascending colon, 10% both cecum and ascending colon, 5% only at cecum and 5% at hepatic flexure and transverse colon. There was 85% found to be moderately differentiated while only 15% poorly

differentiated. All patients were allowed oral intake in the first postoperative day. As regard to postoperative complications (which occurred in 3 patients), one case suffered from paralytic ileus, and 2 cases suffered from urinary tract infection (**Table 2**).

Table (2): Tumor site and histology and percentage of TNM stage and postoperative data

	Variables	No.	%
Tumor site	Hepatic flexure	8	40.0%
	Ascending	8	40.0%
	Cecum and ascending	2	10.0%
	Cecum	1	5.0%
	Hepatic flexure and Transverse colon	1	5.0%
Histology of Adeno carcinoma	Poorly differentiated	3	15.0%
	Moderate. differentiated	17	85.0%
Tumor,Node,Metastasis stage	T3,N0	10	50.0%
	T3,N1a	3	15.0%
	T3,N1b	4	20.0%
	T3,N2a	1	5.0%
	T3,N2b	1	5.0%
	T4b,N0	1	5.0%
Postoperative oral intake	1st day post ope.	20	100.0%
Postoperative complications	No	17	85.0%
	Yes	3	15.0%
Urinary tract infection	No	18	90.0%
	Yes	2	10.0%
Paralytic ileus	No	19	95.0%
	Yes	1	5.0%
Pneumonia	No	20	100.0%
Anastomotic leakage	No	20	100.0%
Post-operative hernia	No	20	100.0%
Deep venous thrombosis	No	20	100.0%

The quality of surgical specimen. The first parameter was the plane of dissection that being the mesocolic plane 100 %. The second parameter was the proximal and distal margins of the resected ileocolic segment which were free in all excised specimens. The length of the ileocolic segment ranged from 25cm to 48 cm (the average length was 35.30 ± 7.41 cm). The quality of lymphadenectomy the first parameter was total number of harvested

nodes 11-34 (with average mean 16.85 ± 6.39). The second parameter was metastatic lymph nodes 0-10 (with average median 0-1.5). The third parameter was number of free lymph nodes 4-30 nodes (average mean 15.50 ± 6.44). The hospital stay of patients ranged from 4 days to 6 days (with an average length 5.05 ± 0.51 days). Neither perioperative mortality nor recurrence occurred in any patient (**Table 3**).

Table (3): Quality of surgical specimen, lymphadenectomy and follow up data postoperatively

Variables		No. = 20
Grade plane of dissection	Mesocolic	20 (100.0%)
Free Proximal and Distal Margin	Free	20 (100.0%)
Length of ileocolic segment (cm)	Mean±SD	35.30 ± 7.41
	Range	25 – 48
Number of Harvested Lymph Nodes	Mean±SD	16.85 ± 6.39
	Range	11 – 34
Number of Metastatic Lymph Nodes	Median(IQR)	0 (0 - 1.5)
	Range	0 – 10
Free lymph node	Mean±SD	15.50 ± 6.44
	Range	4 – 30
Postoperative Hospital Stay (days)	Mean±SD	5.05 ± 0.51
	Range	4 – 6
Perioperative mortality	No	20 (100.0%)
Time of flatus postoperative	Mean±SD	2.35 ± 0.49
	Range	2 – 3
Time of defecation	Mean±SD	3.55 ± 0.51
	Range	3 – 4
Recurrence	No recurrence	20 (100.0%)

There was no statistically significant relation found between complication regarding operative time and intraoperative blood loss (ml). There was

no statistically significant relation found between Complication regarding postoperative stay and times of flatus or defecation (Table 4).

Table (4): Relation between complication and intraoperative data, and postoperative data

Parameters	Groups	Non-Complicated	Complicated	P-value
		No. = 17	No. = 3	
Operative time (min)	Mean ± SD	137.65 ± 9.03	143.33 ± 15.28	0.372
	Range	130 – 160	130 – 160	
Intraoperative blood loss	No	15 (88.2%)	2 (66.7%)	0.335
	Yes	2 (11.8%)	1 (33.3%)	
Blood loss (ml)	Mean ± SD	90.00 ± 14.14	50.00 ± 0.00	<0.001
	Range	80 – 100	50 – 50	
Postoperative Hospital Stay (days)	Mean ± SD	5.06 ± 0.43	5.00 ± 1.00	0.860
	Range	4 – 6	4 – 6	
Time of flatus postop.	Mean ± SD	2.41 ± 0.51	2.00 ± 0.00	0.186
	Range	2 – 3	2 – 2	
Time of defecation	Mean ± SD	3.59 ± 0.51	3.33 ± 0.58	0.440
	Range	3 – 4	3 – 4	

DISCUSSION

Complete excision of the primitive dorsal mesentery along the anatomico-embryological and surgical planes by means of CME is now the standard of care for colonic cancers. Technical strategies for CME include two aspects: sharp separation of visceral and parietal fascia, and ligation at the root of central supply vessels and more radical lymph node dissection for improving oncological outcomes (*Xie et al., 2017*). However, the right hemicolectomy is performed routinely worldwide, the feasibility and safety of complete mesocolic excision has recently been showed in open and laparoscopic surgeries (*Kim et al., 2016*).

Complete mesocolic excision with central vascular ligation is considered to contribute to superior oncological outcomes after colon cancer surgery. For advanced right-sided colon cancer, this surgery sometimes requires lymph node (LN) dissection along the superior mesenteric vein (SMV), with division of the middle colic vessels, or their right branches, at origin *West et al. (2010)*. Presented cranially approached radical LN dissection along the surgical trunk during laparoscopic right hemicolectomy. The key characteristics in this procedure consist of easy access to pancreas, early division of ARCV and middle colic vessels at origin, and easy dissection along SMV. while *Kang et al. (2014)* reported hospital stay duration 5-7 days.

In the present study, twenty right hemicolectomies using CME with CVL technique were performed. The mean operating time was 138.50 ± 9.88 minutes and intraoperative blood loss was 76.67 ± 25.17 ml. Also reported operating time of

178 minutes, intraoperative blood loss was 149 ml. Finally, *Siani and Pulica (2015)* in his study reported, mean operative length of 179 ± 39 min. Contrasting our results with other studies, our mean operating time was slightly lower compared to others. the mean operating time was 165 ± 50 minutes (*Kim et al., 2016*). The mean duration of hospital stay in our study was 5.05 ± 0.51 days. *Kim et al. (2016)* reported hospital stay of 11 days.

According to study done by *Shin et al. (2018)*, the mean duration of hospital stay was 9.3 ± 3.2 days, while in a study by *Shin et al. (2018)*, *El-Fol et al. (2019)* in his study reported hospital stay 4.40 ± 0.910 days. while a study by *El-Fol et al. (2019)*, the mean operating time was 180.0 ± 20.0 minutes, intraoperative blood loss was 200.6 ± 50.5 ml.

The mean hospital stay in our study was even shorter than that of other studies. This can be attributed to the enhanced recovery program that was followed during the study *King et al. (2010)* demonstrated with the standardized postoperative program in a randomized controlled trial that the patients who underwent laparoscopic resection was associated with 32% reduction of hospital stay. While *Siani and Pulica (2015)* reported postoperative mortality of 1.7%. *Shin et al. (2018)* reported no deaths in his study.

In most randomized trials, the operative mortality did not show any statistical difference between the laparoscopic and open groups. However, the incidence of post-operative mortality in elective colectomy is low and a difference in mortality cannot be

demonstrated in individual trials. *Tjandra and Chan (2011)* in a systemic review demonstrated that the overall operative mortality rates of laparoscopic and open colectomy were 0.6% and 2.01%, respectively.

Three morbidities (15%) occurred in our study. One patient (5%) complained of paralytic ileus and conservative management in the form of intravenous fluids, nasogastric tube insertion and NBM was done and they passed successfully. Two patients (10%) developed UTI who were managed by urinary antiseptics.

Kang et al. (2014) demonstrated a morbidity of 4.6% (6cases) incidence of postoperative complications following laparoscopic resection for patients with right colon cancer. *Siani and Pulica (2015)* reported a 22.6% (26 cases). *Shin et al. (2018)* demonstrated a morbidity of 18.3% (125 cases) after laparoscopic resection for colon cancer. Overall complication rates after laparoscopic colon resection were evaluated in many trials. *El-Fol et al. (2019)* reported an incidence of complications following laparoscopic colon resections of 26.7% (8 cases).

As regard quality of surgical specimens, they were assessed using many parameters, such as plane of dissection, the proximal and distal resection margins, the length of the ileocolic segment, area of mesentery.

In our study, the average number of harvested lymph nodes was 16.85 ± 6.39 . The proximal and distal margins were free of tumor cells in all surgical specimens. The proximal and distal margins were > 5

cm in all specimens. The length of the ileocolic segment was 35.30 ± 7.41 cm.

Shin et al. (2018) in his study reported that the average number of harvested lymph nodes was 25.7 ± 10.9 . Histological examination revealed that proximal and distal margins were free of tumor cells in all surgical specimens. The lengths of the proximal and distal margins were 15.1 ± 9.7 , 15.2 ± 7.4 cm respectively.

In the present study, tumor site in different parts of the right colon was distributed as follow 5 % in the cecum, percentage in the cecum and ascending colon was 10 %, in ascending colon 40%, in the hepatic flexure 40% and in proximal transverse colon 5%. 85% of cases were moderately differentiated adenocarcinoma and 15% poorly differentiated adenocarcinoma.

In a study by *El-Fol et al. (2019)*, tumor site in different parts of the right colon was distributed as follow 33.3 % in the cecum, 46.7% the ascending colon, and 20% in the hepatic flexure. 53.3% of cases were moderately differentiated adenocarcinoma, 20% well differentiated adenocarcinoma, 20% poorly differentiated adenocarcinoma, and 6.7% mucinous adenocarcinoma.

CONCLUSION

Dissection technique using a cranial to caudal approach was valid and useful as radicality and easy access to central vessels for performing complete mesocolic excision in laparoscopic right sided colon cancer.

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دراسة الجدوي من النهج الرأسى الي الذيلي للاستئصال الكامل للمسراق في اورام القولون الايمن عن طريق المنظار الجراحي

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خلفية البحث: يعتبر الاستئصال الكامل للقولون مع ربط الأوعية الدموية المركزي يساهم في نتائج الأورام المتفوقة بعد جراحة سرطان القولون. بالنسبة لسرطان القولون في الجانب الأيمن المتقدم، تتطلب هذه الجراحة أحياناً تشريح العقدة الليمفاوية على طول الوريد المساريقي العلوي، مع تقسيم أوعية القولون الوسطى، أو فروعها اليمنى في الأصل. في هذه الدراسة، تمت مناقشة هذه التقنية في استئصال النصف الأيمن بالمنظار مع التركيز على علم الأجنة.

الهدف من البحث: تقييم جدوى النهج القحفي إلى الذيلي في تشريح العقدة الليمفاوية على طول الوريد المساريقي العلوي في استئصال النصف الأيمن بالمنظار كأسلوب جديد فيما يتعلق بتأثيره على كل من التطرف والنتيجة.

المرضى وطرق البحث: أجريت هذه الدراسة بأثر رجعي في مستشفى باب الشريعة الجامعي، مركز السلام للأورام، في الفترة من مارس 2020 إلى مارس 2021. وقد تم تضمين حوالي 20 مريضاً في الختان الكامل للمقطع بالمنظار مع ربط الأوعية الدموية المركزية في نهج الجمجمة إلى الذيلية. في الدراسة.

نتائج البحث: في أطروحتنا كانت على النحو التالي، تم توزيع موقع الورم في أجزاء مختلفة من القولون الأيمن على النحو التالي 5% في الأعور، كانت النسبة المئوية في الأعور والقولون الصاعد 10%، في القولون الصاعد 40%، في الثني الكبد 40% وفي القولون المستعرض القريب 5%. 85% من الحالات كانت سرطانية غدية متباينة بشكل معتدل و 15% سرطان غدي متباين بشكل سيئ. في دراستنا، كان الاستئصال الكامل للقولون في 20 حالة (100%). كان متوسط عدد الغدد الليمفاوية المحصودة 6.39 ± 16.85 . أظهر الفحص النسيجي خلو الحواف القريبة والبعيدة من الخلايا السرطانية في جميع العينات الجراحية. كانت الهوامش القريبة والبعيدة < 5 سم في جميع العينات. كان طول المقطع اللفائفي القولوني 7.41 ± 35.30 سم.

الاستنتاج: إقترب تشريح العقدة الليمفاوية جذري من الجمجمة على طول الجذع الجراحي أثناء إستئصال النصف الأيمن بالمنظار.

الكلمات الدالة: سرطان القولون والمستقيم، الوريد المساريقي العلوي.