Comparative Study between Laparoscopic and Open approaches in Complete Mesocolic Excision in Right Hemicolectomy in Surgical Treatment of Tumors of the Ascending Colon

Abstract:

Background: Complete mesocolic excision is defined as a surgical technique that comprises sharp dissection of the mesocolon's visceral plane from the retroperitoneal plane without breaching of the visceral layer, which could lead to tumor cell spread within the peritoneal cavity. Heald et al, From Erlangen University first described complete mesocolic excision (CME) in conjunction with central vascular ligation (CVL) and demonstrated a correlation between anatomic and mesentery-based resection of right-sided colon cancer **Patients and methods:** This study includes a total of 40 patients with a diagnosis of Right Cancer Colon. By computer assisted randomization or card system our patients will be randomized into two groups: Group A: (20 patients) will undergo Open complete mesocolic right hemicolectomy and Group B: (20 patients) will undergo hand assisted laparoscopic complete mesocolic right hemicolectomy. The procedures occurred between 2021 and 2023. **Results:** The study showed no significant differences between the studied groups as regard all preoperative symptoms , preoperative lab findings, Stapler use , Method of dissection , blood loss , leakage , bleeding , infection and the pathological findings showed no significant differences as regard (prox. safety margin , distal safety margin , Harvested LNs , Positive LNs). There were significant differences as regards type of anastomosis, operative time, time of reconstruction, time to pass first motion, time to start oral intake and hospital stay. **Conclusion** the laparoscopic approach has some advantages over the open approach regarding post-operative course and pathological outcome.

Key words: Right cancer colon; complete mesocolic excision; laparoscopic

1. Introduction

Colorectal cancer is the 7th commonest cancer in Egypt, representing 3.47% of male cancers and 3% of female cancers. Colorectal surgery has followed a steady trend towards improved surgical techniques which has led to improved surgical outcomes over the past 10-15 years. **(1)**

Complete mesocolic excision is defined as a surgical technique that comprises sharp dissection of the mesocolon's visceral plane from the retroperitoneal plane without breaching of the visceral layer, which could lead to tumor cell spread within the peritoneal cavity. From Erlangen University first described complete mesocolic excision (CME) in conjunction with central vascular ligation (CVL) and demonstrated a correlation between anatomic and mesentery-based resection of right-sided colon cancer. Since CME became standard of care, 5-year local recurrence rates decreased from 6.5 to 3.6% and 5-year cancer-related survival improved from 82.1 to 89.1% (2)

The traditional sequence used in open right hemicolectomy begins with lateral-to-medial approach (LA)**(3).** With the uptake of minimal access techniques, many laparoscopic surgeons tried to use the medial-to-lateral approach (MA) **(4and5).**

In another study performed in which they compared CME (with central vascular ligation) between open and laparoscopic colon cancer surgery and reported that the laparoscopic approach produced colonic specimens of similar quality as those obtained via open surgery.[6]

Another study demonstrated both the safety and feasibility of laparoscopy-assisted CME compared with open CME for right colon cancer and demonstrated that laparoscopy-assisted CME resulted in better short-term outcomes compared with open CME.[7] In Contrast, this study showed that outcomes after surgery for colon cancer were similar for CME using a laparoscopic approach compared with the open approach [8].

Patients and Methods

This is a prospective study used to compare between Laparoscopic and Open approaches in Complete Mesocolic Excision in Right Hemicolectomy in Surgical Treatment of Tumors of the Right Colon as regards postoperative results and efficacy of the technique. For this study, 40 patients with history of right cancer colon were selected. The patients were admitted in general surgery department in Benha Univerisity hospitals in the period **from 2021 to 2023**, The study was approved by the Ethics Committee of Faculty of Medicine, Benha University Hospitals **{Approval code: M.D.8.3.2021},** and divided into two groups: Group A : (20 patients) underwent Open complete mesocolic right hemicolectomy and Group B : (20 patients) underwent hand assisted laparoscopic complete mesocolic right hemicolectomy. All intraoperative variants as operative time, type of Anaethesia, learning curve, intraoperative and postoperative variants as analgesics requirement, hospital stay, pathological outcome and postoperative complications (as bleeding, leakage, infection, et….) were observed.

Surgical technique

All the patients received standard bowel preparation “3 days before surgery". The day before operation the patients were given prophylactic antibiotics and subcutaneous anticoagulant in patients with high risk of thrombo-embolism.

Open Technique: (medial approach for right hemicolectomy):

- The patient was placed in a supine position, and the operation was performed in a standard manner including CME and CVL.
- Midline or paramedian laparotomy was done.
- Exploration for liver and peritoneal metastasis and assessment of the resectability of the tumor.
- the transverse colon and the ileocecal junction were retracted cranially and laterally respectively. These retractions tented up the root of the mesentery and the right mesocolon, displaying the ileocolic and superior mesenteric vessels clearly.
- Opening the “mesenteric window” and exploring the right retrocolic space.

Identification of ileo-colic vessels and identification of superior mesenteric vessels. An opening of the lesser sac in the middle of the transverse colon allows a good exploration and dissection for all gastro-colic vascular structures from the middle of the transverse colon to the right colonic flexure.

Ligation and division of ileo-colic vessels and right colic vessels as well as middle colic vessels in case of extended right hemicolectomy at their origin form superior mesenteric vessels.

- Resection of the specimen proximally at terminal ileum and distally at transverse colon. Then an ileo-transverse anastomosis was created using hand-sewn sutures or stapled end-to-side or side-to-side anastomosis. Two abdominal drains were put one in paracolic gutter and the other in pelvis.

- Closure of anterior abdominal wall in layers with subcutaneous drain.

Laparoscopic

- The preferred patient's position was modified lithotomy position, where the surgeon is standing between the patient's legs. Technique. The position may also be supine position.

- Two working trocars were placed to the left from the midline. Number, position, and size of trocars were very variable and depend on the anatomical particularities and personal surgeon preferences. Another assisting port was placed in right mid clavicular line two fingers below the umbilicus for traction.

- Preparation along the ileocolic pedicle from central to peripheral and the peritoneum was cut on both sides from the middle of the vascular pedicle. The mesenteric and middle colic pedicles were identified at first. After that, the ileocolic and right colic (if available) vessels were centrally ligated and transected.

- Right colonic mobilization from medial to lateral approach in caecum and ascending colon and the dissection was performed in either mesofascial or retrofascial plane. Then from bottom to top at hepatic flexure and proximal transverse colon.

- Transection of ileal stump and transverse colon stump by stapling was done and intracorporeal ileo-transverse anastomosis by stapling, then a single pelvic drain was inserted.

- A pfennistiel incision was made to deliver the excised specimen and sent for histopathology.

- **Statistical methods**
- Data management and statistical analysis were done using SPSS version 28 (IBM, Armonk, New York, United States). Quantitative data were assessed for normality using the Shapiro-Wilk test and direct data visualization methods. According to normality, quantitative data were summarized as means and standard deviations or

medians and ranges. Categorical data were summarized as numbers and percentages. Quantitative data were compared between the studied groups using the independent t-test or Mann-Whitney U test for normally and non-normally distributed quantitative variables, respectively. Categorical data were compared using the Chi-square or Fisher's exact test. All statistical tests were two-sided. P values less than 0.05 were considered significant.

2. Results:

The studied groups were comparable regarding all demographic characteristics, including age (P = 0.089), sex (P = -0.206), smoking (p = 0.197), body mass index (P = 0.147), diabetes mellitus (P = 0.465), and hypertension (P = 0.490) **.**

Preoperative symptoms:

No significant differences were observed between the studied groups regarding all preoperative symptoms, including bleeding (P = 0.288), constipation, and pain (P = 1.0) **(Table 1, Figure 1).**

Table (1) Preoperative symptoms in the studied groups

		Group A (n = 20)	Group B (n = 20)	P-value
Bleeding	n (%)	7 (35)	4 (20)	0.288
Constipation	n (%)	0 (0)	0 (0)	-
Weight loss	n (%)	8 (40)	8 (40)	1.0
Pain	n (%)	14 (70)	14 (70)	1.0

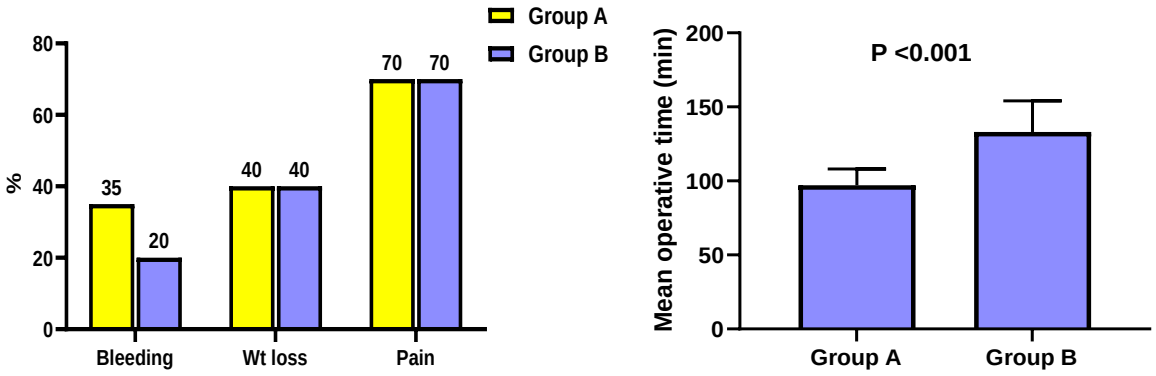

Figure (1) Preoperative symptoms and Operative time in the studied groups

Preoperative laboratory findings:

No significant differences were observed between the studied groups regarding hemoglobin (P = 0.670), WBCs (P = 0.618), albumin (P = 0.720), CEA (P = 0.478), and CA19.9 (P = 0.091) **(Table 2)**

CEA: carcinoembryonic antigen; CA: Cancer antigen

Table (2) Preoperative laboratory findings in the studied groups

		Group A (n = 20)	Group B (n = 20)	P-value
Hemoglobin (g/dl)	Mean ±SD	11.1 ±1.3	11.3 ±1.5	0.670
WBCs	Mean ±SD	8.08 ±2.27	7.72 ±2.26	0.618
Albumin	Mean ±SD	3.5 ±0.4	3.5 ±0.3	0.720
CEA	Median (range)	3 (0.4 - 20)	2.5 (0.5 - 19)	0.478
CA19.9	Median (range)	11 (2 - 150)	21 (2 - 150)	0.091

Intraoperative findings:

Group B demonstrated significantly higher side-to-side anastomosis (100% vs. 75%, P = 0.047), operative time (133 ±21 vs. 97 ±11, P < 0.001), and time of anastomosis (P = < 0.001). No significant differences were observed between the studied groups regarding stapler use (P = 0.231), method of dissection (P = 0.106), covering ileostomy, and blood loss (P = 0.461) **(Table 3, Figures 2).**

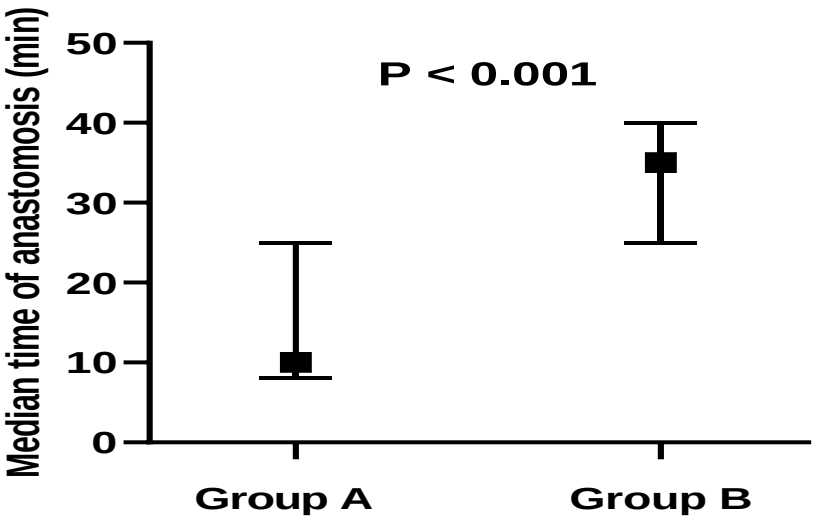

Figure (2) Time of anastomosis in the studied groups

Table (3) Intraoperative characteristics of the studied groups

		Group A (n = 20)	Group B (n = 20)	P-value
Type of anastomosis				
Side to side	n (%)	15 (75)	20 (100)	0.047*
End to side	n (%)	5 (25)	0 (0)	

Stapler use	n (%)	17 (85)	20 (100)	0.231
Method of dissection				
Harmonic	n (%)	16 (80)	20 (100)	0.106
Diathermy	n (%)	4 (20)	0 (0)	
Covering ileostomy	n (%)	0 (0)	0 (0)	-
Blood loss (ml)	Median (range)	100 (40 - 400)	100 (50 - 250)	0.461
Operative time (min)	Mean ±SD	97 ±11	133 ±21	<0.001*
Time of anastomosis (min)	Median (range)	10 (8 - 25)	35 (25 - 40)	<0.001*

Postoperative findings

Group A demonstrated significantly higher time to 1st motion (median = 3 vs. 2 days, P = 0.017), time to oral intake (median = 3 vs. 2 days, P = 0.017), and hospital stay (6 ±1 vs. 5 ±1, P = 0.004) than group B ***(Table 5 , figure 3,4)***

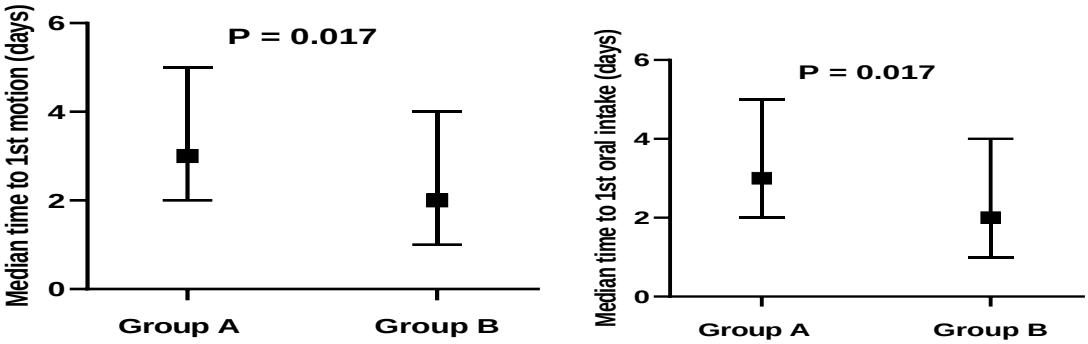

Figure (3) Time to 1st motion and oral intake in the studied groups.

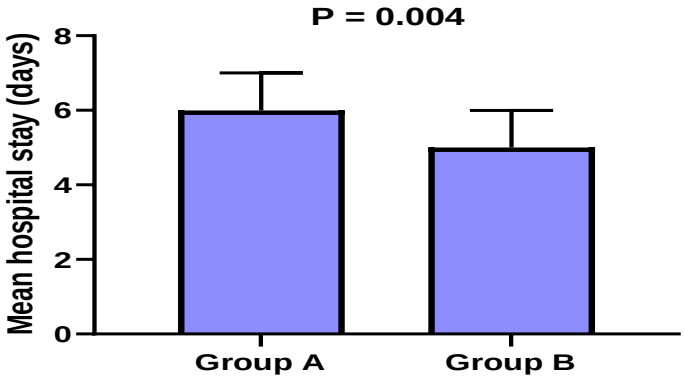

Figure (4) Hospital stay in the studied groups

Table (5) Postoperative characteristics of the studied groups

		Group A (n = 20)	**Group B (n = 20)**	**P-value**
Time to 1st motion (days)	Median (range)	3 (2 - 5)	2 (1 - 4)	0.017*
Time to oral intake (days)	Median (range)	3 (2 - 5)	2 (1 - 4)	0.017*
Hospital stay (days)	Mean ±SD	6 ±1	5 ±1	0.004*

Postoperative complications:

No significant differences were reported between the studied groups regarding leakage (P = 1.0), bleeding (P = 1.0), wound infection (P = 0.342), and intra-abdominal infection (P = 1.0) ***(Table 4)***

Table (4) Postoperative characteristics of the studied groups

		Group A (n = 20)	**Group B (n = 20)**	**P-value**
Leakage	n (%)	2 (10)	1 (5)	1.0
Bleeding	n (%)	1 (5)	1 (5)	1.0
Wound infection	n (%)	4 (20)	1 (5)	0.342
Intra abd. Infection	n (%)	2 (10)	1 (5)	1.0

Pathological findings

No significant differences were observed between the studied groups regarding the length of proximal (P = 0.102) and distal safety margins (P = 0.078), number of harvested lymph nodes (P = 0.582), and number of positive lymph nodes (P = 0.121) ***(Table 6).***

Table (6) Pathological findings in the studied groups

		Group A (n = 20)	Group B (n = 20)	P-value
Length of prox. safety margin (cm)	Median (range)	12 (8 - 16)	14 (9 - 42)	0.102
Length of distal safety margin (cm)	Mean ±SD	13 ±3	14 ±3	0.078
Harvested LNs	Mean ±SD	15 ±4	15 ±3	0.582
Positive LNs	Median (range)	2 (0 - 4)	1 (0 - 3)	0.121

3. Discussion:

Complete mesocolic excision (CME) and circumferential resection margin (CRM), first described by [2] respectively; have gained some sort of popularity in the management of cancer rectum. These two techniques are based upon the concept that mesorectum consists of two layers; visceral and parietal, those are found in two planes covering rectum like envelope which contains its supplying vessels and lymphatics. Thus, TME focuses on surgical removal of the rectum with its surrounding envelop of lymph nodes making the operation more radical oncologically. On the other hand, few number of research studies are existing to illustrate the concept of "envelope" mesentery on colon cancer surgery. Like mesorectum, both parietal and visceral peritoneal layers surround the whole colon in the same manner [9,10]

Not only that, but also these planes even extend to the whole colon, retro pancreatic space, duodenum and pancreatic head. [13] and colleagues "who recently drew the concept of mesocolic envelope into colon cancer surgery" conducted that open CME has the upper hand, when compared to the traditional surgical techniques, as regard 5-year survival and recurrence. Thus, technical- and conceptual-wise, CME resembles and succeeds TME that also confirms that sharp dissection between parietal and visceral layers is crucial for complete lymphatic clearance [11]

Moreover, as the study period was relatively short, it was not possible to collect information about the long-term oncological outcome and thus, the pathological findings of our study were compared to different literatures to give us a hint about the potential oncological outcomes.

During this study, modified CME with CVL was performed for right-sided colon cancer in 40 cases, 20 cases underwent open approach and the remaining 20 patients underwent laparoscopic approach. Our results showed the superiority of laparoscopic group as regard enhanced post-operative recovery like starting bowel motion ($p = 0.017$), starting oral intake ($p = 0.017$), and duration of hospital stay ($p= 0.004$). However, no significant findings were detected as regard the amount of harvested or infiltrated lymph nodes ($p = 0.582$) , positive lymph nodes ($p = 0.121$) , length of proximal safety margin ($p = 0.102$) and length of distal safety margin ($p = 0.078$) . The open group showed some privilege over the laparoscopic one regarding operative and dissection time (p 0.001) and anastomotic reconstruction time ($p = 0.001$).

In a study performed on 36 patients who underwent CME, the mean operation time was 150 minutes and the mean amount of blood loss was 80 ml. In the same study, the median operative time was 150 and 180 minutes for group (A) and (B) in order. The time needed bowel motion and hospitalization was two and twelve days. Associated morbidities were seen in 3 cases (8.5%) [11]

While in our study which was perforemed on 40 patients also with CME, the mean operative time was 97 ± 11 and 133 ± 21 in both groups A and B respectively, the mean amount of blood loss was 100 ml in both groups; the time needed for hospitalization was 3 (2-5) days and 2 (1-4) days in both groups respectively.

Also, it has been reported the perioperative outcomes in 156 who underwent CME with CVL was as follows; the mean operative duration was 191.5 ± 56 min. The mean volume of blood loss was 85.6 ml. The duration of postoperative hospitalization was 13.9 ± 6.1 days. The mean time to begin oral fluid sips was 4.7 days. The mean time to partaking in a liquid diet was 6.3 ± 2 days. The mean time to begin a normal diet was 7.7 ± 2.7 days. The percentage of postoperative complications was (23.1%). Respiratory complications occurred in 3 patients with a percentage of 1.9%, local wound

complications (infection and/or dehiscence) occurred in 13 patients with a percentage of (8.3%). Postoperative haemorrhage was experienced only in 1 patient with a percentage of (0.6%). Intra-abdominal abscess occurred in 2 patients at a percentage of 1.3%. Chyle drainage occurred in two (1.3%) patients. Early mortality happened only one patient 30 days after the operation due to massive bleeding on the 4th day postoperatively [(12)]. In this study, chyle drainage, post-operative respiratory complications, and mortality were not found in our study.

Another study compared the perioperative outcomes between laparoscopic and open CME and no case in the laparoscopic (LS) group had to be converted into open surgery (OS). The mean operative time was nearly the same in the two groups with no significant difference The operative duration in the laparoscopic group was almost the same in the open group (194 ± 57 vs. 177 ± 51 min, respectively, $p = 0.118$). In our study, operative duration was found to be significant when comparing the two groups with less operative time for the open group ($p < 0.001$). The difference between the operative time was mainly due to dissection time which was longer for the laparoscopic group with significant difference as regard reconstruction time ($p < 0.001$). [(17)]

As reported by authors the time to start oral liquids (3 ± 2 vs. 5 ± 2 d, $p < 0.001$) and postoperative duration of hospitalization (11 ± 4 vs. 14 ± 6 d, $p = 0.002$) were significantly short in the laparoscopic group. [(13)]

A group of surgeons analyzed the data from retrospective study that was done on 31 cases who underwent laparoscopic CME for right colon cancer and found no intraoperative problems. The mean operative duration was 269 min (range, 165–420). In our study, the median operative duration was 97±11 minutes for the laparoscopic group. Regarding the post-operative complications most of the patients developed two main complications; anastomotic bleeding and ileus. Five complications were recorded in this study; two cases experienced leakage (10%) whiles the other four (20%) developed wound infection.[(8)]

Also another study compared 128 patients who underwent laparoscopic CME to another 137 patients who underwent the same open technique for right-sided colon cancer in the period between 2006 and 2008. The aim of that prospective randomized study was to assess the efficacy and safety of laparoscopic CME for right colonic cancers, and the laparoscopic approach proved to have the upper hand when compared to the open one. The median time of starting oral fluids (Lap. 6 days vs. Open. 7 days, $p < 0.001$) and the length of hospital stay (7 vs. 13 days, $p < 0.001$) were significantly less in the laparoscopic group when compared to the open one. The median number of collected lymph nodes and median operative time were almost the same between the two groups ($p = 0.337$ and 0.862 respectively). Moreover, 30-day morbidity after surgery was nearly the same between the groups (12.9 vs. 24.7 %, $p = 0.050$). Whereas the 5-year overall survival was in the favour of laparoscopic group ($p = 0.028$), the 5-year disease free survival showed no difference between the two groups ($p = 0.578$).[(11)]

Additionally, investigated whether implementation of CME improved disease-free survival in comparison with traditional colon resection. Not only did their data support that CME had a better disease free survival, but also the over-all out comes were greatly improved after CME surgery.[(14)]

Also, conducted a study aiming to compare the safety and efficacy of open and laparoscopic approaches for extended lymphadenectomy techniques in colon cancer. No significant variable was

found between the open and laparoscopic groups regarding anastomotic leak, deep site infections, paralytic ileus, and short-term mortality ($p > 0.5$). Moreover, the same level of insignificance was found when over-all survival, disease-free survival, local recurrence, and distant metastasis were discussed. Despite the laparoscopic group had a significantly longer operative duration ($p = 0.05$), laparoscopic cases had a lower superficial infection rates plus less duration of hospital stay ($p = 0.005$).[15]

while in this study analyzed operative duration and post-operative outcomes after laparoscopic right hemicolectomy with total mesocolic excision. That study included 81 cases and the median value of operative time was 220 minutes. Initially, operative time was about 250 minutes in average, but after time, this duration had decreased down to 200 minutes in average. Major complication experienced had a percentage of 3.6% while the average number of lymph nodes dissected was 31.3 nodes. Cumulative Sum analysis showed accepted complication rates and oncological outcomes even at the beginning of their experience towards this approach [16]

Another group evaluated the clinical and pathological outcome after laparoscopic CME and CVL for colonic cancer. Their study included 222 cases and was conducted in the period between 2003 and 2011. Only 12.2% of cases needed conversion to the open approach. The cases were followed up for a median period of 5.5 years. The 5-year overall survival for all cases was 80.2% and disease-specific survival was 87.5%. The more lymph nodes infiltrated by malignancy, the less the 5-year disease free survival. The 5-year disease-free survival was 85.8% for all cases included: stage I tumors were found to be significantly more 5-year disease free survival when compared to higher stages ($p = 0.004$). The median length of hospital stay was 5 days; 30-day morbidity was about 19.7%, while mortality was 1.3%. It was concluded that laparoscopic CME and CVL for colon cancer resulted in good long-term oncologic outcome [17]

Finally this study revealed correlation between lymph node (LN) yield and survival after colonic resection for right colonic cancer. The study included 181 open cases, 163 laparoscopic cases, and 119 robotic cases who underwent right hemicolectomy. The mean number of harvested lymph node extracted from the surgical specimen was 28, 29, and 34 nodes for each group in order; the respective mean LN-LSS ratios were 0.83, 0.91 and 1.0. The robotic approach proved that it had the advantage over both other approaches as regard this perspective ($p < 0.01$). [18]

4. Conclusions

It was evident from our study that the laparoscopic approach for right hemicolectomy with complete mesocolic excision has some advantages over the open approach especially regarding post-operative course and pathological outcome. The disadvantage concerned with long operative time can be handled over time, as the more operations to be done, the higher learning curve the surgeon will achieve and of course, a less operative time.

Our recommendation is to start with laparoscopic approach in management of right colon cancer with CVL and CME techniques. Further studies should be done about this subject as the long-term oncological outcome, presented as disease free survival and overall survival, should be handled with more concentration. Reporting and sharing knowledge about the value of surgical dissection along surgical planes and complete lymphatic clearance with laparoscopic approach to the colorectal

community in order to improve the overall results and help surgeons to make knowledge-based decisions

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