Short-term perioperative and oncological outcomes of complete versus conventional mesocolic excision in laparoscopic right hemicolectomy

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Introduction
Complete mesocolic excision (CME) has been proposed for colon cancer to improve both pathological and oncological outcomes. In this study, we compared the short-term and the relatively long-term (3 years) outcomes of CME with conventional excision in laparoscopic right hemicolectomy for right colon cancer.

Patients and methods
A total of 38 patients were recruited from the Department of General Surgery, Menoufia University Hospitals, who were had right-sided colon cancer and were treated by laparoscopic total mesocolic excision from December 2016 to December 2020. The perioperative and oncological outcomes in the CME group were compared with the conventional group, which included 38 patients who were previously treated in our unit.

Results
There was no significant difference between the CME and conventional groups regarding intraoperative blood loss, postoperative morbidity, or hospital stay. However, the CME group had more lymph nodes harvested (P=0.004), longer duration of surgery (P=0.001), and more R0 resection (P=0.04) versus the conventional group. There was no difference in the 3-year overall survival rate between both the groups, but the 3-year disease-free survival was significantly better in the CME group (P=0.03).

Conclusion
Laparoscopic CME is a safe, valid, and feasible surgical method for right-sided colon cancer. It is associated with comparable postoperative morbidity with the traditional method but has better pathological and short-term oncological outcomes.

Keywords:
complete mesocolon excision, laparoscopic, lymph node harvest, right colon cancer

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Introduction

Total mesorectal excision (TME) is now considered the cornerstone and the standard surgical approach for rectal cancers, resulting in improved both recurrence-free and all-over 5-year survival rates [1,2]. It leads to a totally enclosed fascial-lined specimen containing all of the draining blood vessels, lymphatic vessels, and lymph nodes, where possible metastasis was present [3]. Recently, the term 'complete mesocolic excision' (CME) has been implemented in colon cancer [4,5]. It is accomplished by sharp separation of the visceral fascial layer from the parietal layer, resulting in complete mobilization of the mesocolon, covered by an intact visceral fascial layer, and central ligation of the supplying arteries [6]. Some authors have suggested that CME using central vascular ligation (CVL) should be a standard technique for colon cancer surgery, reducing local recurrence and improving long-term survival when compared with previous conventional techniques [3,4]. However, CME is still a new concept, and more data are needed to support this approach.

The aim of this study was to evaluate and compare the short perioperative and relatively long-term oncological outcomes after laparoscopic TME with those of the conventional laparoscopic excision for cancer of the right colon.

Patients and methods

This is a prospective, comparative, clinical study done on 38 fit patients (CME group) diagnosed as having stages I–IIIC cancer right colon by colonoscopic biopsy and staged by abdominopelvic computed tomography

(CT), chest CT, and carcinoembryonic antigen at General Surgery Department, Menoufia University Hospitals, between December 2016 to April 2021.

Ethical approval was granted for the study by Menoufia University, Faculty of Medicine's ethics committee according to the Declaration of Helsinki. It was taken for research done on patients diagnosed with right colon cancer.

Patients with distant metastasis (stage IV), patients with obstructed or perforated tumor, patients with synchronous multicentric tumors, and unfit patients for general anesthesia and laparoscopy were excluded from the study.

The following data were collected, recorded, and compared with a group of patients (38 patients) who previously had laparoscopic conventional right hemicolectomy in our department (conventional group).

Patient demographics (age, sex, and comorbidities), tumor characteristics (site, pathological type, stage, safety margin, lymph node retrieval, grade, and number of R0 resection), surgical perioperative data (duration of operation, blood loss, conversion rate, first time passage of flatus, postoperative complications, and duration of hospital stay) and oncological outcomes (overall survival and disease-free survival) were assessed.

Surgical procedure

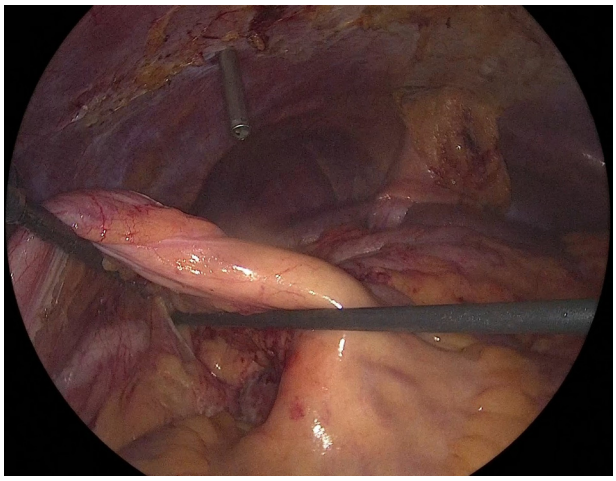
The patient was placed in a modified low lithotomy position with slight tilt to the left side. Abdominal access was accomplished through a supraumbilical 12-mm video port, two working ports in the right and the left iliac midclavicular point (12 and 5 mm), and one 5-mm port for the assistant area.

The main surgeon stood between the patient's legs, whereas the assistants stood to the right and left of the patient. After pneumoperitoneum and creation of working space, routine exploration of the abdominopelvic cavity was made first, and then a medial-to-lateral dissection was performed.

The dissection started caudally from the terminal ileum. The mesocolon is incised flush to the superior mesenteric vein, and the ileocolic vessels are divided as close as possible to the superior mesenteric vein (Figs 1 and 2).

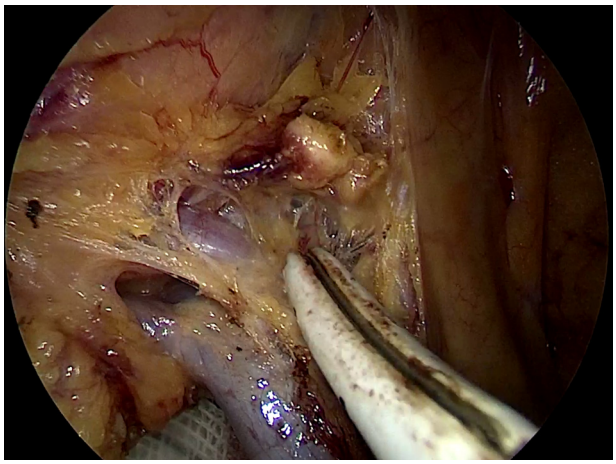
The aim of this dissection is complete separation of the mesocolon from Todd's fascia exposing the related retroperitoneal structures such as the pancreatic head, the duodenum, and the transverse mesocolon (Figs 3 and 4).

Figure 1



Dissection started from terminal ileum.

Figure 2

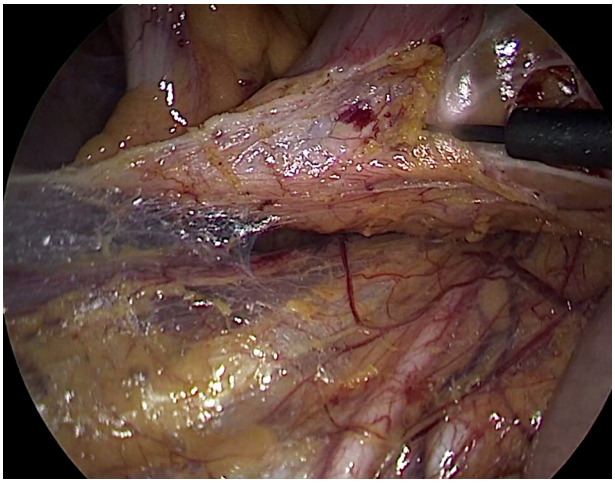


Dissection started from ileocolic vein.

Dissection then proceeds, in a cephalic direction, close to the superior mesenteric vein, exposing the gastrocolic trunk of Henle, and the origin middle colic artery is identified and clipped while rising from the superior mesenteric artery in cases of extended right hemicolectomy, and its right branch is clipped at its root in cases of right hemicolectomy. The middle colic vein is then identified and clipped at its root (Figs 5 and 6).

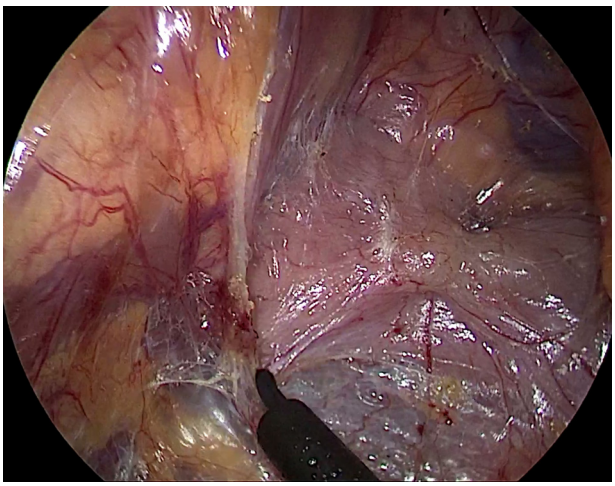
Then, the fascia between the omentum and transverse mesocolon is dissected, so the transverse mesocolon is dissected to the lower edge of the pancreas, exposing the superior mesenteric vein, and meeting the caudal plane of dissection (Figs 7 and 8).

Figure 3



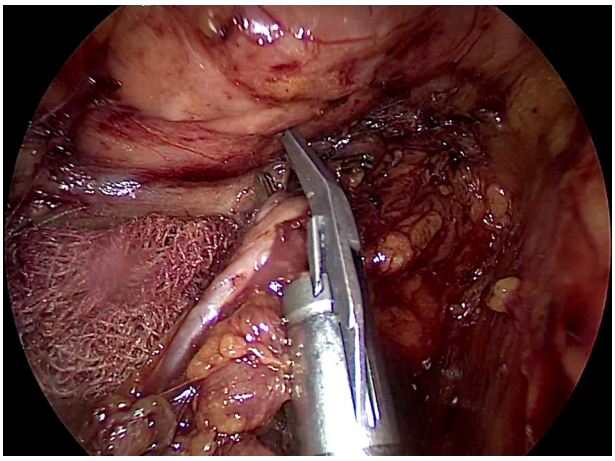
Dissection from retroperitoneal structures (ureter, iliac vein, duodenum, and head of pancreas).

Figure 4



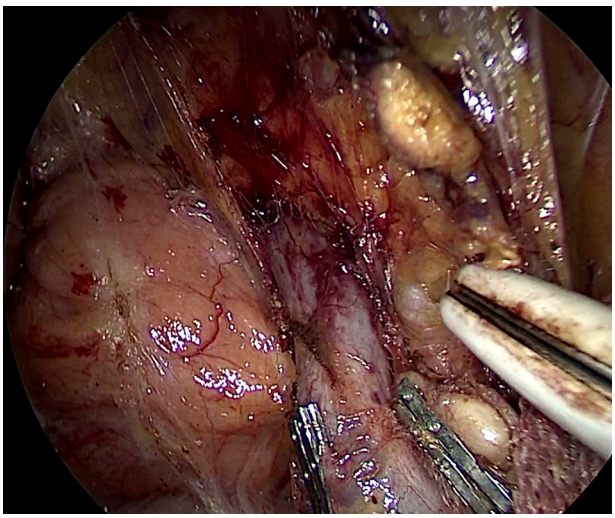
Dissection from retroperitoneal structures (ureter, iliac vein, duodenum, and head of pancreas).

Figure 5



Dissection and clipping of middle colic vessels in flush with superior mesenteric vein.

Figure 6



Dissection and clipping of middle colic vessels in flush with superior mesenteric vein.

Finally, the hepatic flexure, the peritoneum of the right paracolic sulcus, and at the peritoneal reflection of the terminal ileum, is dissected and mobilized.

Stapled intracorporeal anastomosis is accomplished, and the specimen is extracted through mini-Pfannenstiel incision (Fig. 9).

Dissection, coagulation, and cutting were done with monopolar diathermy and a high frequency ultrasound instrument, the Harmonic Ace.

After checking on the perfect anastomosis and hemostasis, the peritoneal cavity is drained by two tube drains: one at the Morrison's pouch, and the other at the pelvis (Fig. 10).

All patients were monitored in the surgical ward or in the high-dependency unit, and any immediate or early post complications were recorded.

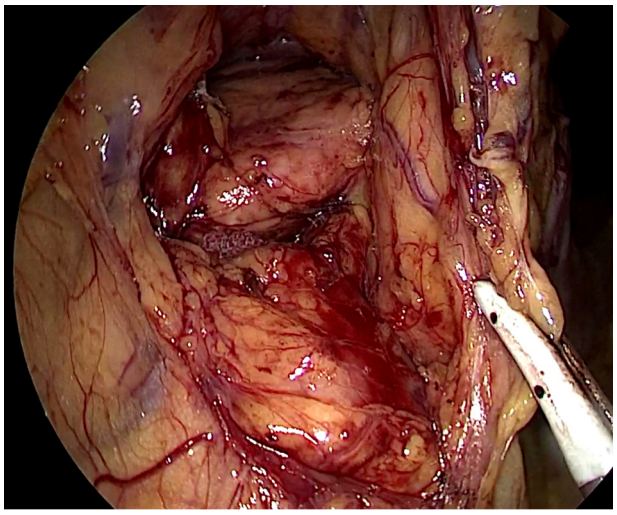
Oral intake was permitted when the intestinal movement regained, and drains were removed after their output dropped below 30 ml per day.

All patients were followed up every 6 months for detection of local and systemic recurrence by means of physical examination, carcinoembryonic antigen level, CT scan, and colonoscopy when necessary.

Statistical analysis

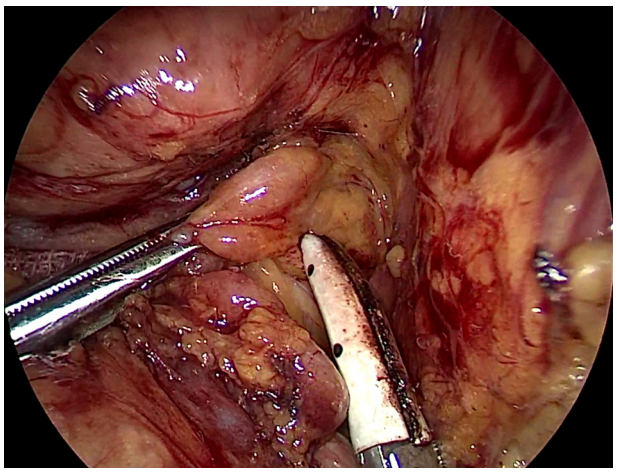
All data were statistically analyzed using Statistical Package of Social Science (SPSS). Data

Figure 7



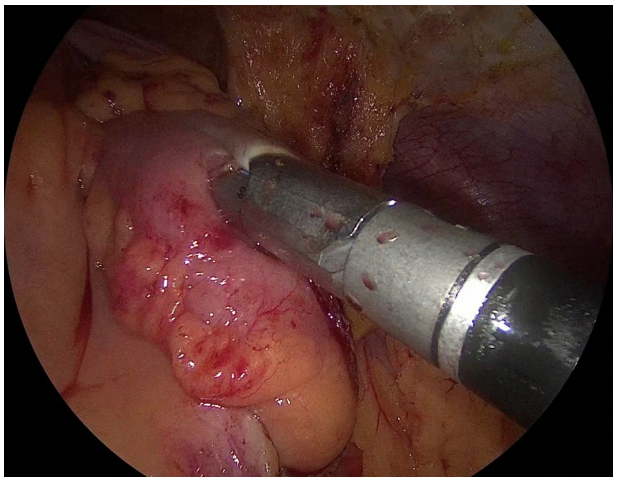
Supracolic dissection and apical lymphadenectomy.

Figure 8



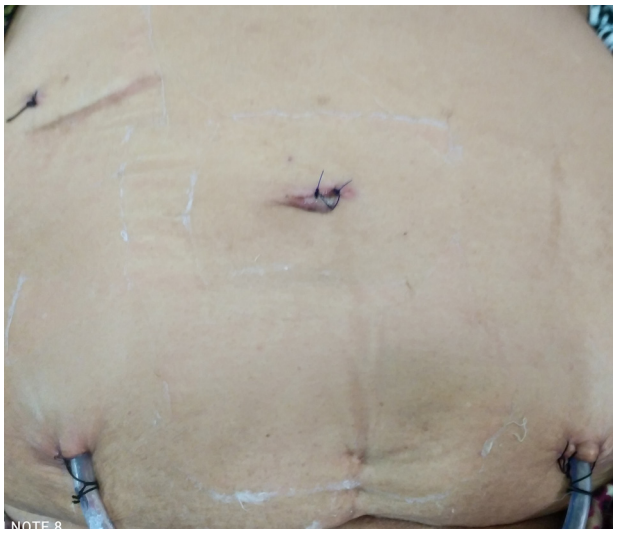
Supracolic dissection and apical lymphadenectomy.

Figure 9



Intracorporeal anastomosis.

Figure 10



Laparoscopic right hemicolectomy trocar sites and drains.

management: Using an IBM personal computer and IBM statistical package of social science (SPSS) version 26, data is taken, tabulated and statistical analysed (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as a mean±SD, whereas qualitative data were expressed as frequency and percentages. Qualitative variables were compared using a χ^2 test, whereas quantitative continuous data were compared using the Mann–Whitney test and one-way analysis of variance test. Scatter plot was measured for each scale and was used to compare the accuracy of the studied models.

A *P* value less than 0.05 was considered statistically significant. A univariant analysis with nonlinear correlation (cubic spline functions) was used to evaluate the shape of the relationship between the continuous variables and the outcome.

Results

Sociodemographic data

A prospective study was conducted at the Oncological Surgery Unit, Menoufia University Hospital, on 76 patients with right colon cancer. We recruited patients from the outpatient clinics. Patients were categorized into two groups: group I included patients who had the conventional method previously in our unit (38 patients), whereas group II included patients who underwent TME (38 patients).

Mean age of the included patients in the conventional group was 61±11 years (39–74), whereas in CME group was 58±13 years (35–71), with no significant *P* value (0.12).

Most included patients were males (71.1 and 65.8% in the conventional and CME groups, respectively), with insignificant difference between the groups (Table 1). Most patients had no comorbidities (65.8 and 60.2% in the conventional and CME groups, respectively), with insignificant difference (Table 1).

Clinicopathological factors of studied groups

Most lesions were found in the cecum (52.6%) in the conventional group versus 47.3% of the lesions in the CME group were found in Cecum, with insignificant difference (0.18) (Table 2).

Regarding staging of the patients, most cases were diagnosed in stage II (39.8% in the conventional group and 47.3% in the CME group), with insignificant difference (Table 2).

No significant difference was found between the two groups regarding proximal and distal margins (Table 2). Grade of tumors was well in 18.4% of the cases in the conventional group, whereas 23.7% of the cases were well in the CME group, with insignificant difference (0.08).

Interestingly, R0 resection was significantly high in the CME group (97.3%) versus the conventional method (86.8%), with significant difference (P=0.04), in addition to perfect R0 resection in the CME group. Lymph node retrieval was significantly high in TME group (19.8) versus the conventional group (12 lymph nodes), with significant difference (P=0.002) (Fig. 11).

Short-term operative outcomes

All included patients were assessed intraoperatively regarding duration of surgery, blood loss, and conversion rate, and postoperatively for the first time of passage of flatus, hospital stay, and 30-day morbidity.

Duration of surgery was significantly high in the CME group (188 min) versus the conventional group (136 min), with significant difference (P=0.001).

Blood loss was almost equal in the two groups, with insignificant difference. Three cases in the conventional group needed conversion versus two

Table 1 Sociodemographic data of participants

	Conventional group (38 patients) [*n* (%)]	TME group (38 patients) [*n* (%)]	χ^2/*t* test	*P* value
Age	61±11 (39–74)	58±13 (35–71)	1.8	0.12
Sex			2.3	0.09
Male	27 (71.1)	25 (65.8)		
Female	11 (29.9)	13 (34.2)		
Comorbidity			2.1	0.11
Yes	25 (65.8)	23 (60.2)		
No	13 (34.2)	15 (39.8)		

TME, total mesorectal excision.

Table 2 Clinicopathological factors of studied groups

	Conventional group [*n* (%)]	TME group [*n* (%)]	χ^2	*P* value
Site			1.9	0.18
Cecum	20 (52.6)	18 (47.3)		
Ascending colon	15 (39.8)	18 (47.3)		
Hepatic flexure	3 (7.6)	2 (5.4)		
Stage				
I	5 (13.1)	3 (7.6)		
II	15 (39.8)	18 (47.3)		
IIIA	7 (18.4)	4 (10.5)		
IIIB	6 (15.6)	7 (18.4)		
IIIC	5 (13.1)	6 (15.6)		
Proximal margin (cm)	11.4±4.6	12.5±5.2	1.8	0.12
Distal margin (cm)	12.7±5.4	13.2±4.4	2.1	0.11
Grade			3.4	0.08
Well	7 (18.4)	9 (23.7)		
Moderate	21 (55.2)	17 (44.7)		
Poor	10 (26.4)	12 (31.6)		
R0 resection	33 (86.8)	37 (97.3)	31	0.04
LN retrieval	12±2.4	19.8±3.1	56	0.002

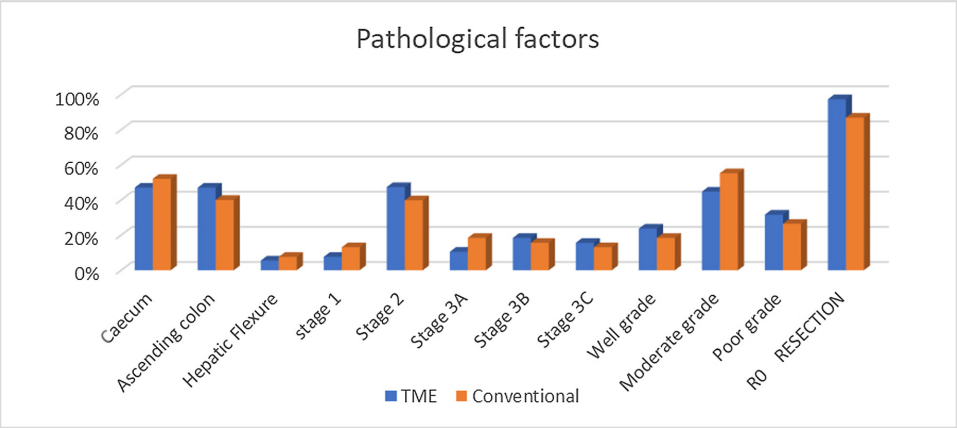
LN, lymph node; TME, total mesorectal excision.

cases in the CME group, with insignificant difference (Table 3).

Conversion to open approach was done in three (7.6%) cases in the conventional group: two of them owing to intraabdominal adhesions and one for intraoperative bleeding. This was comparable to that of CME group, where two (5.4%) cases were converted to open owing to adhesions.

Mean of hospital stay was insignificantly lower in the conventional group (7.8 days) than in the CME group (8.3 days), and 30-day postoperative morbidity was almost equal in both groups, with no mortality (Fig. 12).

Figure 11



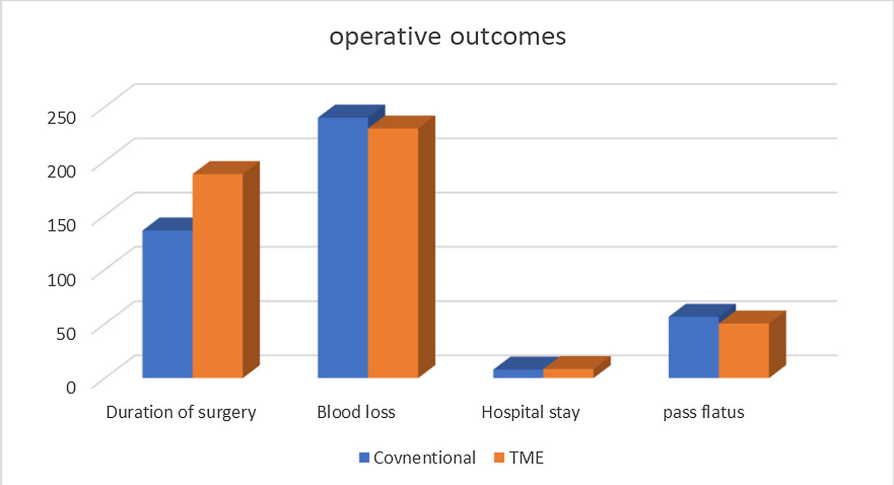
Pathological factors of the studied groups.

Table 3 Intraoperative and postoperative outcomes of the studied groups

	Conventional group	TME group	χ^2	*P* value
Duration of surgery (min)	136±26	188±32	89.5	0.001
Blood loss (ml)	240±25	230±40	3.5	0.09
Conversion rate [*n* (%)]	3 (7.6)	2 (5.4)	1.1	0.23
First time passage of flatus (h)	56.5±2.5	50.25±3.5	8.6	0.06
Hospital stay (days)	7.8±2.4	8.3±1.8	2.8	0.09
30 day postoperative morbidity [*n* (%)]	10 (26.4)	9 (23.7)	1.3	0.12

TME, total mesorectal excision.

Figure 12



Operative outcomes.

Table 4 Short-term oncological outcomes of the studied groups

	Conventional group	CME group	χ^2	*P* value
Mean follow-up period (months)	46.3±3.7 (25–50)	38±3.8 (25–45)	78	0.01
3-year overall survival [*n* (%)]	32 patients (84.2)	33 patients (86.8)	2.3	0.12
Disease-free survival [*n* (%)]	28 patients (73.6)	32 patients (84.2)	19.7	0.03

CME, complete mesocolic excision.

Short-term oncological outcomes

Mean follow-up of patients was significantly higher in the conventional group than in the CME group, with *P* value of 0.01. This may be owing to the retrospective recruitment of the conventional group, which leads to a long period of follow-up in this group than in the CME group.

There was no significant difference between the two groups regarding 3-year overall survival rate (*P*=0.12). However, CME group had better 3-year disease-free survival (84.2%) than the conventional group (73.6%), with *P* value of 0.03 (Table 4).

Discussion

Colorectal cancer is the third most commonly diagnosed malignancy worldwide and the third leading cause of cancer death in the United States. In Egypt, nowadays, according to NCI database, there is a shift toward higher incidence in younger population than rest of the world [7].

Laparoscopic right hemicolectomy has increasingly become a standard surgical approach for right-sided colon cancer; with many short-term benefits, such as decreased postoperative pain, more rapid postoperative recovery, shortened duration of hospital stay, improved quality of life, and similar long-term oncological results as compared with the open right hemicolectomy [6,8].

After the implementation of TME principle in rectal cancer management and the dramatic improvements in long-term oncological outcomes, Hohenberger *et al.* [4] applied the same principle in cancer colon.

This theory of CME entailed complete separation by sharp dissection between the visceral and parietal peritoneal fascia up to the origin of superior mesenteric vessel, with CVL [4,9].

This leads to excision of the tumor and its draining vessels and lymph nodes totally enclosed in a closed facial envelope and avoids interruption of lymphatic and vascular drainage that may cause peritoneal dissemination of tumor cells. In addition, it increased the retrieved draining lymph nodes [10,11].

In spite of these advantages, there is still obvious controversy about the extent of mesenteric dissection, and some researchers have shown an advantage in the outcomes of CME with central ligation [12,13], whereas others have failed to show improved results when compared with standard techniques [14,15].

In this study, we have tried to introduce our early experience with this novel technique, comparing its short-term and long-term outcomes with those of the conventional excisions done previously in our unit.

Both groups were homogenous regarding the patient characteristics (age, sex, and presence of comorbidities).

There was no significant difference between the studied groups as regards some pathological characters of the resected tumors (site, stage, and grade).

Lymph node dissection is essential for accurate staging of colorectal carcinoma. Regarding the use of the conventional resection, some authors have claimed that lymph node recovery has consistently been at less than the recommended levels in many institutions, with only 37% of colorectal resection cases without neoadjuvant therapy reporting recovery of at least 12 lymph nodes in the surveillance epidemiology and end results database from 1988 to 2001 [16].

Many authors, like Schumacher *et al.* [17] and Moore *et al.* [18], suggested that the number of lymph nodes retrieved and the ratio of affected to nonaffected nodes appear to be significant prognostic factors even in patients with stage III colon cancer, in which improved survival is seen with increased lymph node yield.

By implementing the technique of CME, we found that the mean number of retrieved lymph nodes was significantly higher in the CME group (19.8±3.1) than that in the conventional group (12.3±2.4).

This copes with the results obtained by Sheng *et al.* [19], who in a comparative study between hand-assisted laparoscopic CME and open CME retrieved

about 19 nodes in both groups, and with the results of Galizia *et al.* [20], who in a comparative study between open CME and open conventional resection retrieved around 20 and 15 nodes in both groups, respectively.

Achievement of R0 resection is of utmost importance in the prognosis of colon cancer. In this study, R0 resection was accomplished in 97.3% (37/38) of the patients in CME group, and this is significantly higher than the conventional group (86.8%, 33/38).

These results are quite similar to those reported by Siani and Pulica [21], as they reported R0 resection in 97.3% of the patients of mesocolic group and in 88% in the patients of the intermesocolic group.

Some studies claimed increased rate of postoperative complications after CME, especially the vascular injuries of superior mesenteric vessels [9]. This is not the case in our study, where both groups were comparable regarding the postoperative morbidity, conversion rate, duration of surgery, and duration of hospital stay.

The 30-day postoperative morbidity in both groups was 26.4 and 23.7%, respectively, and this is almost similar to a systematic review done by Bertelsen *et al.* [22], who found that overall morbidity, 30-day mortality, and reoperative intervention for vascular complications were 19.4, 3.2, and 1.1%, respectively.

The duration of surgery and the steep learning curve are the main obstacles for laparoscopic CME, especially at the early experience with this technique [23]. In this study, the mean operative duration for laparoscopic CME was ~188 min, which is significantly longer than the duration reported for a conventional laparoscopic excision (136 min).

Among the advantages of CME and CVL is radical comprehensive lymphadenectomy, comprising apical lymph node dissection.

Excision of the apical nodes is of paramount importance in obtaining adequate regional control and had a positive effect on survival, because they could contain micrometastatic deposits frequently missed by routine histological examination and thus responsible for locoregional recurrence and systemic dissemination [24,25]. Furthermore, for hepatic flexure and proximal transverse colon tumors, there is a metastatic node incidence of ~5% for subpyloric station and ~4% for right gastroepiploic arcade, so central transection of middle colic vessels and ligation of right gastroepiploic vessels at the origin are mandatory for these nodes to be cleared [26].

In this study, we have a relatively short period of follow-up, especially in the CME group (38.3±2.3 months) as compared with the traditional group (46.4±3.7 months).

The 3-year overall survival in both groups are comparable (84.2 and 86.8%, respectively), but interestingly, the 3-year disease-free survival was significantly higher in the CME group (81.6%) when compared with that in the traditional group (73.6%).

This is quite different to the results of Storli *et al.* [27], who reported significantly better 3-year overall survival rate (88.1 vs. 79.0%) and disease-free survival rate (82.1 vs. 74.3%). However, our results cope with that reported by Bertelsen *et al.* [22] in a large retrospective study from Demark that included 364 patients who underwent CME compared with 1031 patients who were treated with non-CME colectomies. The 4-year disease-free survival rate was 85.8% after CME and 75.9% after non-CME surgery (P=0.001), whereas the overall survival was not significantly higher in the CME group compared with the non-CME group. Moreover, our results were quite similar with the results of a recent study by Zedan *et al.* [28], who found that 3-year overall survival rate was 78.2%±6.1 in the laparoscopic group as compared with 63.2%±11.0 in the open surgery.

This study had few limitations: the relatively small number of enrolled patients, but this could be explained by it is an early experience of this technique, the retrospective nature of the conventional group, and the relatively short period of follow-up.

The strength aspects of this study include the following: it is a single-center experience, the procedure was done by the same surgical team experienced in laparoscopic colorectal surgery, and the strict follow-up of the patients enrolled in this study was done.

Conclusion

Laparoscopic CME is a safe, valid, and feasible surgical method for right-sided colon cancer. It is associated with comparable postoperative morbidity with the conventional method but has better pathological and short-term oncological outcomes.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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