Clinical outcomes of laparoscopic completely intracorporeal versus right open hemicolectomy in colon carcinoma

Mohamed Samir[a], Mohamed Selima[a], Mohamed R. Abdelfattah[b]

[a]Department of Surgery, Medical Research Institute, [b]Department of Surgery, Faculty of Medicine, Alexandria University, Alexandria, Egypt

Correspondence to Mohamed Samir, MD, MRCS, Department of Surgery, Medical Research Institute, Alexandria University, 165 Horreya Street, Alexandria, 21561, Egypt. Tel: +20 100 505 6056; fax: +203 4283719; e-mails: mohamedsamir12@yahoo.com, mohamed.samir.kamel@alexu.edu.eg

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Background
Right hemicolectomy can be performed using either a conventional open or a minimally invasive laparoscopic technique. It is not yet clear whether these different access routes differ regarding short-term postoperative outcomes. Therefore, the aim of this study was to review the clinical outcomes of patients who underwent laparoscopic right hemicolectomy for carcinoma of the colon and to compare the results with those of patients who underwent an open surgery.
Patients and methods
The study included patients admitted to the Surgery Department of the Medical Research Institute, Alexandria University, Colon Cancer Registry, who underwent a right hemicolectomy. The registered data were analyzed regarding the early postoperative complications operation time, length of postoperative hospital stay, and incidence of complications.
Results
The results showed that the operative time was significantly higher in the LR (laparoscopic) group, whereas the amount of opioid used, blood loss, and hospital stay were significantly higher in the open right hemicolectomy (OR) group. In line, the postoperative complication rate was higher in the OR than in the LR group.
Conclusions
The minimally invasive laparoscopic access with intracorporeal anastomosis is feasible and a safe route in terms of the operative, postoperative complications, and oncological safety for patients presented with right cancer colon.

Keywords:
intracorporeal, laparoscopic, right open hemicolectomy

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Introduction

In 2009, Hohenberger and colleagues dramatically changed the surgical procedure for colorectal cancer. At the same time, laparoscopic techniques for colorectal cancer have shown marked growth in popularity. Laparoscopic resection of the left colon and rectum is now standardized and achieves the same oncological results as an open resection with lower perioperative morbidity [1,2].

The first laparoscopic colectomy was performed in 1991 [3]. Initially, it was not widely accepted for cancer treatment because of technical difficulties such as working in multiple intra-abdominal quadrants, ligation of vessels, reestablishment of intestinal continuity, and oncological concerns including retrieval of lymph nodes, surgical resection margin, and survival results [4].

These controversies gradually settled with the accumulation of experience and advances in technology [5]. Since then, further evidence has accumulated to support the feasibility, safety, and benefits of the laparoscopic surgery for colorectal cancer [6].

Since the successful introduction of laparoscopic colectomy by Jacobs *et al.* [3], laparoscopic surgery, especially laparoscopic rectal surgery, for the treatment of colorectal cancer, has been considerably developed [7]. However, the results could not be extrapolated to right-sided colon cancer because of the wider range of resection, more complicated regional anatomy, and more advanced technical requirements in laparoscopic right hemicolectomy than those of the traditional procedure for the rectosigmoid cancer [8].

The evolution of minimally invasive surgery with the introduction of the laparoscopic technique has allowed for revolutionary changes in the way colon resections are carried out. An increasing number of colorectal surgeons believe that the laparoscopic approach to colectomy allows for quicker recovery of the bowel function, less postoperative pain, a shorter hospital stay, and a faster return to daily activities, all of

which are accompanied by comparable or even better oncological outcomes than those of the traditional open approach [9,10].

However, laparoscopic colectomy is far from representing a common surgical practice, considering that in Europe and in the USA, it is estimated that on an average only 10–22% of operations are carried out using this approach [11].

Hence, the aim of this study was to review the outcomes of patients who underwent laparoscopic right hemicolectomy for carcinoma of the colon and to compare them with the outcomes of patients who underwent an open surgery.

Patients and methods

This comparative study was carried out at the Medical Research Institute, Alexandria University, Surgery Department, on 40 patients with colon carcinoma. It involved two arms, group A, laparoscopic resection group, and group B, open resection group, recruited retrospectively from the hospital registry.

All patients underwent clinical, laboratory, and imaging examinations. A right colectomy intervention was performed by a laparoscopic technique or by a traditional laparotomy.

The study was approved by the Medical Ethics Committee of the Alexandria Faculty of Medicine. Informed consent was obtained from all patients before the procedure.

Inclusion criteria

The following were the inclusion criteria:

(1) Diagnosis of adenocarcinoma of the right colon.
(2) Stages I–III.

Exclusion criteria

The following were the exclusion criteria:

(1) Age more than 80 years; less than 18 years.
(2) Stage IV.
(3) Radiological evidence of locally infiltrating and locally advanced tumor.
(4) American Society of Anesthesiologist (ASA) more than or equal to 3.

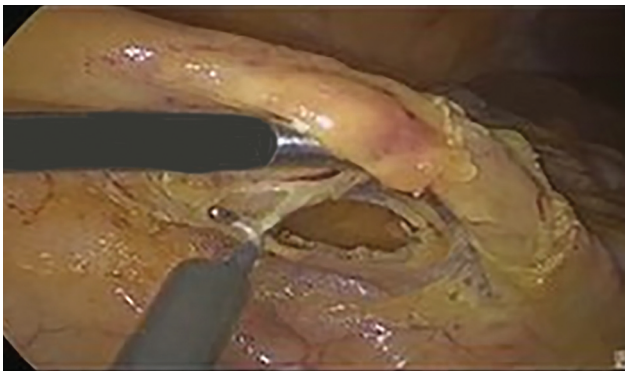
Surgical techniques

Patients in the laparoscopic right hemicolectomy (LRH) group were tilted to the left with the head slightly downward and given general anesthesia. The surgeon stood on the left side of the patient, with the first assistant on his right. After the pneumoperitoneum was established using an open technique, and the pressure was maintained at 14 mmHg. Overall, four ports were placed: one 5-mm diameter port was in the upper right abdomen, one 5-mm port in the left iliac fossa, another 5-mm port in the suprapubic area, and one 10-mm port at the infraumbilical area.

The ileocolic vessels were identified first, followed by the right colic vessels and the middle colic vessels if necessary. After identification of ileocolic vessels, they were dissected/transected with double ligature or double clips close to their origins. This created a triangular area below the mesocolon, with easily dissectible loose connective tissue. This allowed us to progress from the medial to lateral side and from downward up until the identification of the duodenum and isolation of the gastrocolonic trunk (Figs 1–3).

The terminal ileum, cecum, and ascending colon were completely mobilized up to the level of the hepatic

Figure 1

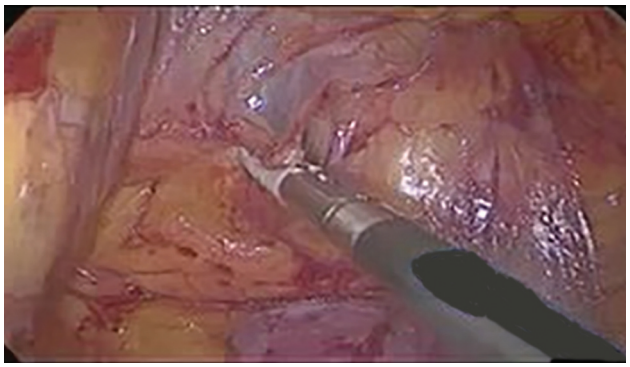


Dissection of the ileocolic trunk.

Figure 2

Cutting of the ileocolic trunk between two secure knots.

Figure 3



Dissection below the mesocolon and directed upward and laterally toward the hepatic flexure.

flexure. The patient was then tilted with the head upward to facilitate the division of the gastrocolic ligament and the mobilization of the transverse colon and hepatic flexure.

The divisions of the remaining mesentery, marginal artery, and bowel, as well as the ileocolic anastomosis, were performed intracorporeally using staplers. The enterotomy was closed using a 3-0 absorbable suture (Figs 4 and 5).

After completion of the anastomosis, the drain was inserted at the paracolic gutter, and the specimen was extracted through a small Pfannenstiel incision.

Statistical analysis

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS, version 21) software (IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY, USA).

Results

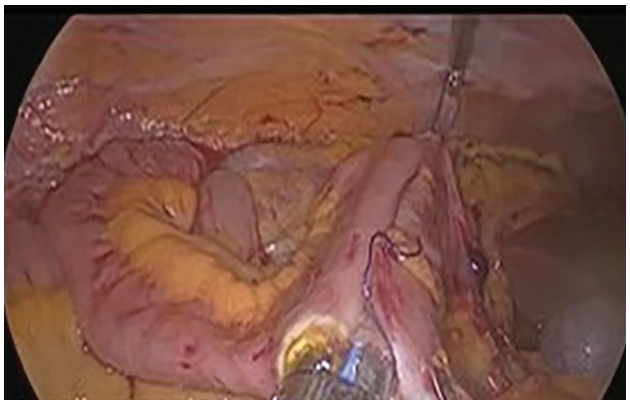
Comparison of demographic data

The demographic data of the two groups are shown in Table 1. Regarding age and sex, the two groups were matched without a significant difference ($P>0.05$). All patients in the two groups were ASA I and II only. There was no significant difference between the two groups regarding the ASA status. The medical history regarding the different comorbidities in the two groups was matched without significant differences in the Union Internationale Contre le Cancer (UICC) stage.

Comparison of operative data

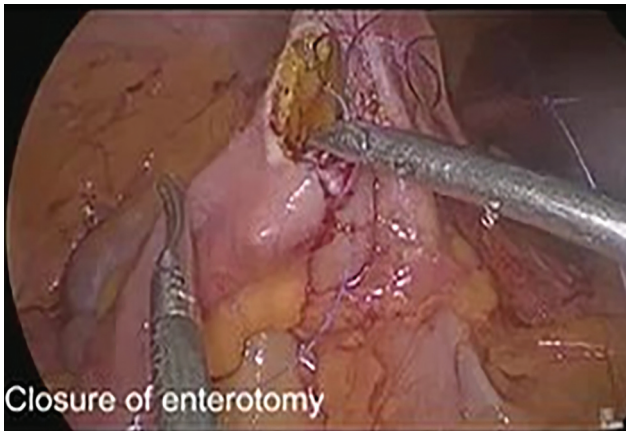
The operative time in group A 'LR' showed a highly significant increase in the operative time compared with the operative group ($P<0.01$). The opioid use in group B was significantly higher than that in group A. The amount of blood loss in group B (operative) was significantly higher than that in group A, whereas the

Figure 4



Ileocolic anastomosis.

Figure 5



Closure of enterotomy by 3/0 absorbable suture.

difference between hemoglobin level preoperatively and postoperatively was comparable between the two groups. The mean hospital stay (days) in the 'LR' group was 5.2±1.51 days, whereas it was 6.55±1.96 days in the operative group. There was a significant increase in the hospital stay in group B (open group) compared with group A. The ICU admission showed an insignificant difference between the two groups.

Comparison of postoperative complications

Postoperative complications, including wound complications, anastomotic leakage, and ileus, showed a higher percentage in the operative group than in the laparoscopic group, but this increase was insignificant. The abdominal sepsis showed a significant increase in the operative group compared with the laparoscopic group ($P<0.05$) (Tables 2 and 3).

Postoperative pathology

Type of tumor

The most common type of malignancy was the adenocarcinoma for 38 patients with its different

Table 1 Comparison between the two studied groups regarding the operative and postoperative data

	Group A 'LR' (*N*=20)	Group B 'OR' (*N*=20)	*P* value
Operative time (min)			
Range	128–183	96–124	0.0021*
Mean	159.1	107.25	
SD	14.18	8.61	
Opioid use (MEQ)			
Range	5–25	10–30	0.0032*
Mean	12	21	
Blood loss	5.48	5.98	
Range	51–134	94–156	0.0012*
Mean	88.85	116.4	
SD	26.08	18.10	
Hospital stay			
Range	3–7	4–12	0.0097*
Mean	5.2	6.55	
SD	1.51	1.96	

OR, open right hemicolectomy. *Statistically significant.

Table 2 Comparison between the two studied groups regarding the postoperative complications

Postoperative complication	Group A 'LR' (*N*=20)		Group B 'OR' (*N*=20)		*P* value
Wound complication	1	5.0	4	20.0	0.079
Anastomotic leakage	1	5.0	3	15.0	0.179
Ileus	1	5.0	3	15.0	0.152

OR, open right hemicolectomy.

types, and two patients had villous tumor with high-grade dysplasia. More than half of tumors were moderately differentiated. On comparing the two groups, there was no statistical difference between the two groups in tumor grading (P=0.18).

Tumor size

Most of the tumors were classified between T2 and T3. Most of T3 tumors were in the group of open surgery. From the graph presented later, we can notice that the tumors of the laparoscopic group had a smaller tumor, but this was statistically insignificant, with P=0.7.

Lymph nodes status

Lymph nodes status is considered one of the most important predictor of survival in colorectal carcinoma, and adequacy of lymph nodes dissection is very important for adequate evaluation of the postoperative condition of the patients and adequacy of resection. The average number of lymph node dissection was 11±3 nodes for the laparoscopic group versus 13±5 nodes for the open group, with a P value of 0.36. In 17 of the 40 patients, we had negative lymph nodes. A total of 15 patients were classified as N1 and eight patients as N2. Patients in the group of open surgery were in a stage more advanced than the laparoscopic group, but this was statistically insignificant (P=0.23).

Comparison of patient satisfaction

Patients in the laparoscopic group showed a significant increase in satisfaction compared with patients in the operative group (P<0.05) (Table 4).

Discussion

Laparoscopic right colectomy is developing quite slowly compared with laparoscopic left-side resection [12,13]. In earlier era, laparoscopic colectomy for colic malignancies had not been generally accepted, as the related operative safety, oncological results, and long-term survival rate remained unclear for a while. This homochromous clinical contrast study compared the clinical effects of laparoscopic and traditional open right colectomy to investigate the applicability of laparoscopic surgery for the right colon cancer [14].

In the present study, we compared the completely laparoscopic and open oncologic excision with central vascular ligation in right colon cancer in terms of technical feasibility and positive and negative effects of both techniques.

The findings of this study revealed no significant difference between the two groups regarding the demographic data, patient comorbidities, and tumor features. These results were in agreement with those reported by Vendramini *et al.* [15] who stated that the

Table 3 Comparison between the two studied groups regarding the postoperative pathology

Postoperative pathology	Group A 'LR' (*N*=20)	Group B 'OR' (*N*=20)	*P* value
Lymph node dissection	11±3	13±5	0.36
Safety margins	7.6±2	8.05±1.5	0.179
Differentiation			
Well	10	6	
Moderate	8	12	
Undifferentiated	0	2	
Tumor size			
T1	2	0	
T2	9	4	
T3	9	14	
T4	0	2	

OR, open right hemicolectomy.

Table 4 Comparison between the two studied groups regarding patient satisfaction

	Group A 'LR' (*N*=20)		Group B 'OR' (*N*=20)		*P* value
Patient satisfaction					
Unsatisfactory	1	5.0	4	20.0	0.0381*
Neutral	3	15.0	5	25.0	
Satisfactory	16	80.0	11	55.0	

OR, open right hemicolectomy; *Statistically significant.

outcomes of the open and laparoscopic techniques did not differ in relation to age, sex distribution, tumor localization, and potential comorbidities (all $P>0.05$). However, Vendramini *et al.* [15] observed that there was a statistically significant difference ($P=0.049$) with a higher prevalence of open procedure in patients aged 60 years and over, which may be attributed to selection bias as surgeons may fear prolonged operative time effect over the elderly age group.

The results of our study showed that the operative time was significantly higher in the LR group. These findings were also in agreement with the findings of Li *et al.* [16] who demonstrated that the operative time in the laparoscopic group was statistically longer than that in the open group (2.58±0.50 vs. 3.02±0.55 h, $P=0.004$). We observed that our operative time in laparoscopic patients is improving compared with that in the open group; however, these data are not published yet. On the contrary, Stergios *et al.* [17] reported that there was a statistically significant decrease in the operative time in the laparoscopic group [182 min (103–341 min)] compared with the open group [242 min (71–584 min)] ($P=0.006$), as their surgical team possessed better skills and experience in the laparoscopic technique.

The postoperative complications in our study were higher in the open right hemicolectomy (OR) group than in the LR group, but this difference was not significant. This was mainly owing to wound-related complications. As the laparoscopic wound is smaller, there is less tissue damage, and deeper layers are exposed for a shorter period of time. Chen *et al.* [18] reported that patients in the laparoscopic CME group had a similar incidence of postoperative complications ($P>0.05$) compared with the patients in the open group. Chen *et al.* [18] reported that there was no statistical difference between both groups ($P=0.222$) regarding the postoperative complications, and their rates in the laparoscopic CME and open CME groups were 4 (2/53) and 12% (6/49), respectively.

Regarding the use of opioids, blood loss, and hospital stay, the OR group showed significantly higher values, and the postoperative complications were also higher in the OR group than in the LR group. These results were in agreement with those of Bae *et al.* [19], who reported significant differences between the open and laparoscopic groups in blood loss (53.5 vs. 161.6 ml, $P<0.001$) and hospital stay duration (9 vs. 13 days, $P<0.001$). Most of these differences are owing to the reduced stress response to surgery. New insights into enhanced recovery after major elective surgeries came up for the first time in 1990 as a revolutionary change in the field of anesthesia. The change was associated with the development of minimally invasive laparoscopic techniques that have become widely adopted for some surgical procedures [20]. Laparoscopy brought a dramatic improvement to postoperative recovery and patients' return to normal functioning as it is based on the principle of reducing metabolic surgical stress by limiting its initiating factors, cytokines produced in an

injured tissue, and stress hormones from the hypothalamic–pituitary–adrenal axis [20].

Lymph node status and safety margins are the two pillars of adequate oncological resection, and they are responsible for the determination of future adjuvant treatment and for estimation of patient survival, in combination with other criteria. In the current study, there was no statistical difference between the two groups. Of note, Rausa *et al.* [21] concluded that totally laparoscopic and robotic surgeries are superior in this field compared with open and standard laparoscopy with extracorporeal anastomosis.

Conclusion

The findings of our study indicate that the laparoscopic resection and intracorporeal anastomosis approach is safe and acceptable for management of right colon cancer and can lead to satisfactory clinical results.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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