



ORIGINAL ARTICLE

## Intracorporeal anastomosis versus extracorporeal anastomosis during laparoscopic right hemicolectomy for colon cancer management

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### ABSTRACT

**Background:** Recently performing laparoscopic right hemicolectomy, which is gaining wide acceptance for management of colon cancer, could be done through either intra-corporeal or extra-intracorporeal approaches. Both approaches have been used and a consensus is lacking. The aim of the current study was to compare the short-term and the long-term patients' outcomes of performing laparoscopic right hemicolectomy that was performed through either extracorporeal or intracorporeal surgical approach in patients with right sided cancer colon.

**Methods:** we analyzed data, retrospectively, from 120 colon cancer patients who were managed by laparoscopic right hemicolectomy by either intracorporeal or extracorporeal anastomoses. We compared between anastomoses regarding; demographic, clinicopathological, operative, perioperative, postoperative data, and data of disease recurrence, cancer specific death and survival rates. **Results:** The duration of the operative time was longer in the group of patients who underwent extracorporeal anastomosis than the group of patients who underwent intracorporeal anastomosis ( $p = 0.003$ ). We found a higher incidence of medical complications in the group of patients who underwent extracorporeal anastomosis than the group of patients who underwent intracorporeal anastomosis ( $p = 0.049$ ). The group of patients who underwent intracorporeal anastomosis has a shorter hospital stay than the group of patients who underwent extracorporeal anastomosis ( $p = 0.043$ ). We found no significant differences between the two operated groups regarding; disease recurrence, progression, five-year disease free survival rate and overall survival rate. **Conclusions:** We showed that intracorporeal anastomosis has many advantages over the extracorporeal anastomosis as shorted operative time, less pain, faster recovery and a less liability to occurrence of medical complications, but it did not affect long-term patients' oncologic outcomes as disease progression, recurrence and survival.

**Keywords:** colon cancer, laparoscopic right hemicolectomy, intracorporeal, extracorporeal

### INTRODUCTION

Recently performing laparoscopic right hemicolectomy, which is gaining wide acceptance for management of right colon cancer, could be done through either intra-corporeal or extra-intracorporeal approaches [1]. Both approaches have been used and a

consensus is lacking. Intracorporeal or extracorporeal anastomoses which were performed in laparoscopic right hemicolectomy involved many procedure variations that ranged total laparoscopic assisted approach to hand-assisted dissection and specimen mobilization [2]. Previous reports stated that short-term

complications and patients' outcomes, as time to pass flatus, time to oral diet resumption and duration of staying at hospital, were markedly decreased in patients underwent intracorporeal approach [3]. Although post-operative morbidities were found to be reduced in intracorporeal approach than extracorporeal approach in many previous studies [4, 5]. But there are still controversies regarding which approach is the best. Moreover there are few studies which assessed the long term patients' outcome, disease recurrence and survival after both approaches. Additionally information about patients' oncological outcomes on the long run is still lacking [1].

The aim of the current study was to compare the short-term and the long-term patients' outcomes of performing laparoscopic right hemicolectomy that was performed through either extracorporeal or intracorporeal surgical approach in patients with right sided cancer colon.

### METHODS

We analyzed data, retrospectively, from 120 colon cancer patients who were managed by laparoscopic right hemicolectomy in General Surgery Department, Zagazig University hospitals in the period from March 2015 to April 2020.

We collected all patients demographic, clinicopathological, operative, perioperative, and postoperative data in addition to data of disease recurrence, cancer specific death and survival rates.

#### Inclusion criteria

Patients with right sided colon cancer aged from 18 years to 60 years and underwent laparoscopic right colectomy electively with extracorporeal or intracorporeal approach.

#### Exclusion criteria

Patients with; locally advanced cancer colon, patients with distant metastases, patients with malignant obstruction or perforations of the colon that needs emergency colectomy, patients who were primarily included and managed by laparoscopic colectomy but converted to laparotomy, patients' received perioperative

and patients who refused to be included in the study were excluded.

Included patients were divided into two groups operated by laparoscopic right colectomy through either extracorporeal or intracorporeal anastomosis were compared with each other regarding short and long term patients and oncological outcomes.

Choosing anastomotic surgical approach was left to the choice of the operating oncologic surgeon.

Among the included 120 patients, we performed extracorporeal anastomosis for 60 patients (50%) and performed intracorporeal anastomosis for the remaining 60 patients (50%).

#### Perioperative management

We performed no preoperative preparation of the bowel. Included patients were admitted to hospital a day before the procedure. Patients were given low-molecular weight heparin (4000 IU) for prophylaxis against deep venous thrombosis starting from the evening before surgery continued to the postoperative period.

Before anesthesia induction patients administered 2 g cefazolin and 500 mg metronidazole as a prophylactic therapy.

#### Surgical technique [2]

We have performed two surgical procedures, namely extracorporeal and intracorporeal anastomoses for patients and then compared between them.

Veress needle technique has been used for creation of pneumoperitoneum in both surgical techniques and we employed four total ports and we placed them similarly in both approaches. We inserted two ports of a size 12-mm ports in the abdominal wall at the left side along the pararectal line, where one was inserted above the umbilicus and the other one was inserted below for about 30° camera and another port of about 10-mm was inserted in median suprapubic region. The 4<sup>th</sup> port of about 5-mm was inserted in right hypochondrium for the assistant.

The first step is to expose vascular pedicles of the right colic and ileocolic trunks then to ligate

the right branch of the medium colic pedicle intracorporeally.

The second step was to mobilize the right colon and terminal ileal loop completely in a medial-to lateral way. We incised colo-hepatic peritoneum, lowered the hepatic flexure for exposure of the duodenum. After performing complete mobilization of the specimen, we have transected right colon and terminal ileal segment with the use of a linear stapler.

#### **Extracorporeal anastomosis**

We extracted the specimen through an incision in the abdominal wall with subsequent bowel transection extracorporeally, this was done after abdominal wall protection. We performed the anastomosis with a manual sutures or stapler. We did not insert an abdominal drain.

#### **Intracorporeal anastomosis**

We performed such anastomosis using 4-0 absorbable sutures or a stapler and we have closed the mesenteric breach. We perform a complete mobilization of the specimen before its extraction. Finally we protected the wound before specimen extraction.

Any events which occurred in the period of staying at hospital or within 90 days from operation were termed postoperative events.

Short-term patients' outcomes were the postoperative morbidities which were categorized according to the classification of Clavien–Dindo where we considered complications of  $\geq 3$  as severe complications. We assessed time to first flatus, occurrence of postoperative ileus, duration of staying at hospital stay, wound infection, leakage or bleeding from the anastomotic site and postoperative mortality [6].

All post-operative medical complications as cardiac, urinary, vascular and pulmonary events were assessed and registered at time of discharge or at first outpatient visit in the databases.

#### **Statistical analysis**

We presented the continuous variables as median and range and we presented the categorical variables as numbers and percentages. We performed binary, linear and multimodal regression analyses for assessment

of the effects of detected variables on operative and postoperative findings. Kaplan Meir survival curves were used to assess survival of patients in both operated groups and comparison was done by cox regression. We considered a  $p$  value  $< 0.05$  as significant.

### **RESULTS**

#### **Demographic results**

Table 1 summarizes patients demographic and clinicopathological findings of all included patients who underwent laparoscopic right hemicolectomy by either intracorporeal or extracorporeal resection.

We found no statistically significant differences between patients operated by extracorporeal or intracorporeal approach regarding; age or gender or BMI of the patients, size of the tumor or histopathological subtype, tumor grade or stage, presence of comorbid conditions or previous history of abdominal surgery. Table 1 and Figure 1.

#### **Intraoperative results were shown in table 2**

The duration of the operative time was longer in the group of patients who underwent extracorporeal anastomosis than the group of patients who underwent intracorporeal anastomosis ( $p = 0.003$ ). Performing manual anastomosis was found more in the extracorporeal group ( $p = 0.002$ ). Other operative events and rate of intraoperative blood loss and the need for intraoperative blood transfusion was comparable in both groups.

#### **Postoperative results were shown in table 3**

We found significant differences between both patients operated by both surgical approaches regarding occurrence of post-operative complications particularly; medical complications, with a higher incidence of these complications in the group of patients who underwent extracorporeal anastomosis than the group of patients who underwent intracorporeal anastomosis ( $p = 0.049$  and  $0.011$ ).

The group of patients who underwent intracorporeal anastomosis has a shorter period before intake of regular diet ( $p = 0.046$ ), a shorter hospital stay than the group of patients who underwent extracorporeal anastomosis ( $p = 0.43$ ).

We found no significant differences between the two operated groups regarding postoperative surgical complications or need to reoperation.

### Long term patients' outcome, disease recurrence and survival results

We found no significant differences between the two operated groups regarding; disease recurrence, progression, five-year disease free survival rate and overall survival rate. Table 3 and Figure 2.

**Table 2.** correlations between intracorporeal anastomosis and extracorporeal anastomosis during laparoscopic right hemicolectomy regarding; demographic, clinical and pathological parameters:

	Intracorporeal anastomosis	extracorporeal anastomosis	P
	N=60 (%)	N=60 (%)	
<b>Age (years):</b>			
Mean ± SD	56.3 ± 12.18	57.25 ± 12.41	0.808
Range	30 - 75	29 - 80	
<b>Gender:</b>			
Male	42 (70)	42 (70)	1
Female	18 (30)	18 (30)	
<b>Size of the tumor (cm):</b>			
< 5 cm	15(25)	24 (40)	0.311
≥ 5 cm	45 (75)	36(60)	
<b>Histopathological type:</b>			
Conventional adenocarcinoma	15(25)	39 (66.4)	0.49
Mucoid carcinoma	45 (75)	21 (33.6)	
<b>BMI:</b>	25 [18–45]	23 [15–41]	0.043
<b>Grade:</b>			
I	9 (15)	9 (15)	0.585
II	27 (45)	18 (30)	
III	24 (40)	33 (55)	
<b>T stage:</b>			
T1	6 (10)	6(10)	0.979
T2	12 (20)	15 (25)	
T3	21 (35)	18 (30)	
T4	21 (35)	21 (35)	
<b>N stage:</b>			
N0	25 (41)	25 (41)	0.540
N1	14 (23)	14 (23)	
N2	11 (18)	11 (18)	
N3	10 (16)	10 (16)	
<b>Inflammatory bowel:</b>			
Present	33 (55)	25 (41)	0.143
Absent	27 (45)	35 (59)	
<b>TNM stage:</b>			
I	25 (41)	25 (41)	0.549
II	14 (23)	14 (23)	
III	21 (35)	21 (35)	
<b>Previous abdominal Surgery:</b>			
Present	51 (85)	49 (81.7)	0.063
Absent	9 (15)	11 (18.3)	
<b>Comorbid Medical Problems:</b>			
Present	20 (33)	26 (43)	0.102
Absent	40 (67)	34 (57)	

**Table 2.** correlations between intracorporeal anastomosis and extracorporeal anastomosis during laparoscopic right hemicolectomy regarding; operative, perioperative findings and short term postoperative outcomes

	<b>Intracorporeal anastomosis</b>	<b>extracorporeal anastomosis</b>	<b>P</b>
	<b>N=60 (%)</b>	<b>N=60 (%)</b>	
<b>Peridural anesthesia</b>	<b>9 (15)</b>	<b>4 (7)</b>	<b>0.808</b>
<b>Operative time (min) median, [range]</b>	<b>150 [90–360]</b>	<b>195 [60–695]</b>	<b>0.003</b>
<b>Transfusion (units)</b>	<b>8</b>	<b>12</b>	<b>0.311</b>
<b>Manual anastomosis (%)</b>	<b>7 (9.7)</b>	<b>32 (53)</b>	<b>0.002</b>
<b>Mechanical anastomosis (%)</b>	<b>53 (89.3)</b>	<b>28 (47)</b>	<b>0.004</b>
<b>Extraction of the specimen (%)</b>			<b>0.041</b>
<b>Median</b>	<b>28 (47)</b>	<b>40(66)</b>	
<b>Pfannenstiel</b>	<b>29 (49)</b>	<b>2 (2)</b>	
<b>Transverse</b>	<b>3 (4)</b>	<b>18 (31)</b>	
<b>Postoperative complications (%)</b>	<b>10 (16)</b>	<b>15 (25)</b>	<b>0.049</b>
<b>Postoperative severe complications (Clavien <math>\geq</math> 3a) (%)</b>	<b>5(8)</b>	<b>6 (9)</b>	<b>1</b>
<b>Medical complications (%)</b>	<b>8 (13)</b>	<b>12 (20)</b>	<b>0.011</b>
<b>Surgical complication (%)</b>	<b>13 (23)</b>	<b>14 (24)</b>	<b>0.49</b>
<b>Time to mobilization (days) median, [range]</b>	<b>1 [0–8]</b>	<b>1 [0–5]</b>	<b>0.603</b>
<b>Time to first feeding (days) median, [range]</b>	<b>1 [0–12]</b>	<b>4 [3–17]</b>	<b>0.046</b>
<b>Time to first flatus (days) median, [range]</b>	<b>1 [0–12]</b>	<b>4 [3–17]</b>	<b>0.046</b>
<b>Time to first stool (days) median, [range]</b>	<b>1 [0–12]</b>	<b>4 [3–17]</b>	<b>0.046</b>
<b>Reoperations (%)</b>	<b>4 (5.6)</b>	<b>3 (5.4)</b>	<b>0.543</b>
<b>Hospital stay (days) median, [range]</b>	<b>5 [1–15]</b>	<b>10 [5–56]</b>	<b>0.043</b>
<b>90-day mortality (%)</b>	<b>1 (2)</b>	<b>2 (3)</b>	<b>0.05</b>

**Table 3.** correlations between intracorporeal anastomosis and extracorporeal anastomosis during laparoscopic right hemicolectomy regarding; response to treatment and patient long-term outcome (relapse and death):

	Intracorporeal anastomosis	extracorporeal anastomosis	p
	N=60 (%)	N=60 (%)	
<b>Response to treatment:</b>			
PD	15 (25)	14 (24)	<b>0.948</b>
SD	9 (15)	12 (20)	
PR	12 (20)	12 (20)	
CR	24 (40)	22 (36)	
<b>Relapse:</b>			
Absent	18 (30)	17 (28)	<b>0.532</b>
Present	6(10)	5 (8)	
<b>Death</b>			
No	39(64)	35 (58)	<b>0.327</b>
Yes	21 (36)	25 (42)	
<b>Disease free survival:</b>			
Median	36.5	37	<b>0.227</b>
Range	14 - 52	15 - 55	
<b>Overall survival:</b>			
Median	19	18	<b>0.091</b>
Range	12 - 23	11 - 22	

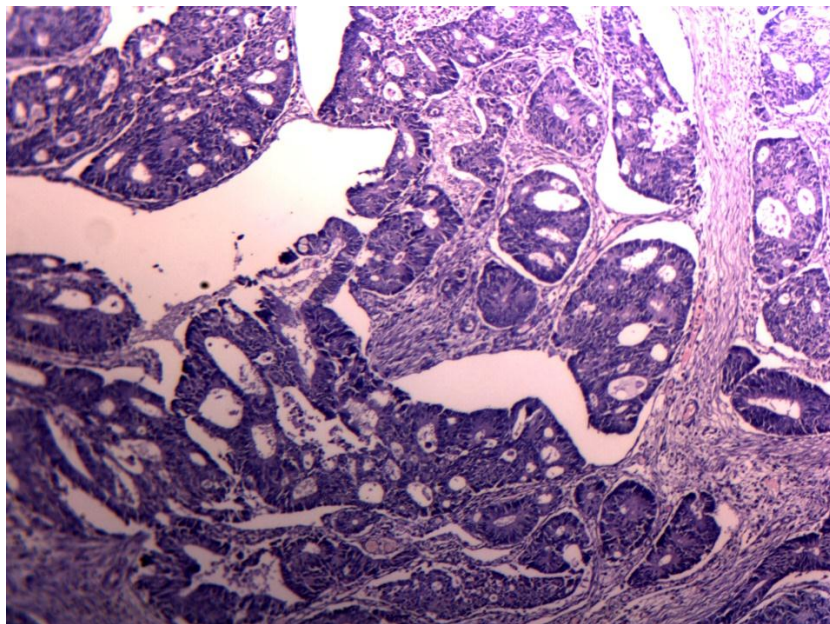


Figure 1-B

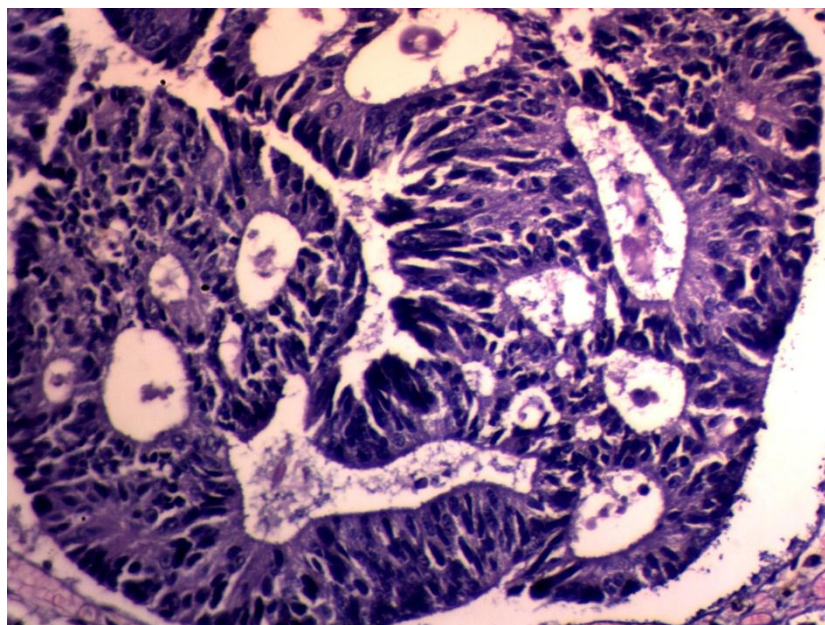


Figure 1-B

**Figure 1.** Histopathological features of adenocarcinoma of the ascending colon. (A) Moderately differentiated adenocarcinoma of the colon grade II, Stage 2 H& E stain. Magnification= original magnificationx100. (B) Moderately differentiated adenocarcinoma of the colon grade II, Stage 2 H& E stain. Magnification= original magnificationx400

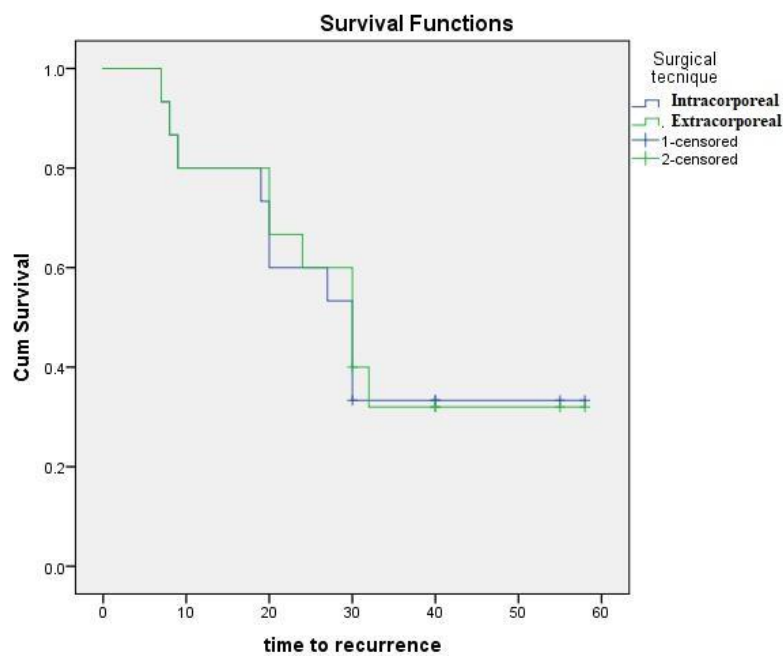


Figure 2-A

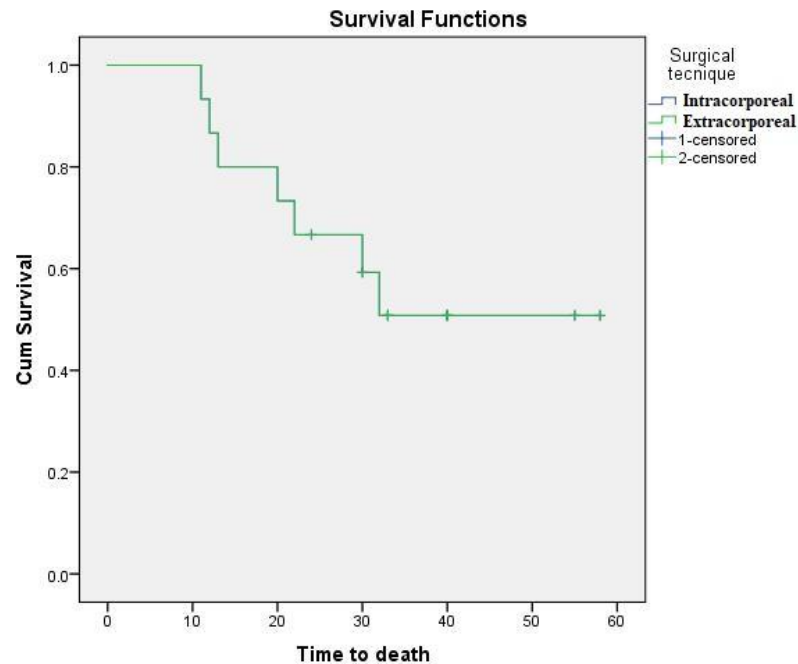


Figure 2-B

**Figure 2.** Kaplan Meir survival curves of included colon cancer patients who were operated by Intracorporeal and extracorporeal surgical anastomoses (A) Recurrence free survival of both groups of patients (B) Overall Survival rates of both groups of operated patients

## DISCUSSION

Laparoscopic colectomy is recently considered the best approach of management of colon cancer [7]. Laparoscopic right hemicolectomy could be done by either extracorporeal or intracorporeal anastomoses, previous studies assessed differences between both approaches but consensus regarding which technique is the best is not reached.

In the current study we aimed to correlate between both approaches to detect which technique is the best regarding short term and long term outcomes.

Regarding the short term outcomes we showed that intracorporeal approach is better than extracorporeal approach regarding operative time, duration of post-operative staying at hospital and occurrence of medical complications. Regarding the long term oncological outcomes we found no significant differences between the two groups regarding postoperative complications, disease recurrence, progression, five-year disease free survival rate and overall survival rate.

Saleh et al., [2], showed similar short term outcomes results and Anania et al., [1], showed similar short-term and long term oncological outcomes results, moreover our results were near results of Aiolfi, et al., [8] metaanalysis

Jamali et al [9], revealed that performing laparoscopic right colectomy using intracorporeal anastomosis is technically more difficult than extracorporeal anastomosis. Previously there are only few surgeons who accept to perform intracorporeal approach [10]. The explanation of achieving a rapid recovery in using the intracorporeal anastomosis is due to rapid restoration of intestinal functions due to reduction of traction on the colon and its mesentery which gives a great patients comfort and satisfaction post-operatively [2]. Our results were in line with this hypothesis, as operated patients by intracorporeal anastomosis have a rapid recovery and shorter time of hospital stay, which was similar to previous studies [11]. Moreover we showed that operative time of this surgical procedure was



shorter and safe. Moreover performing a Pfannenstiel incision for specimen extraction was more frequent in the intracorporeal anastomosis group than in the extracorporeal anastomosis group which was correlated with less pain and rapid improvement of pulmonary recovery. Incisional hernia occurrence is less likely occurring with performing Pfannenstiel than with midline incisions [12, 13].

Occurrence of medical complications was less common in intracorporeal anastomosis as it required a smaller incision, but rates of severe complication did not differ between both groups that denoted safety of both techniques [2].

**Hanna et al. [14] and Lee et al. [15]**, found oncological results similar to our results that the overall and disease free survival did not differ between both groups.

Similar oncological outcome and survival rates in both groups are due to similar number of dissected lymph nodes in both groups which denoted adequacy of both surgical techniques that lead choosing one of the two techniques based only on short-term intraoperative and postoperative outcomes during performing laparoscopic hemicolectomy [16].

Slightly different results were detected by; **Anania et al. [17], Ricci et al. [13]**, who found no differences in duration of post-operative staying at hospital or rate of postoperative complication in both groups.

Moreover, **Vignali et al. [18]** showed even a longer time of the operation in the group of patients who were managed by intracorporeal anastomosis, additionally there are many reports did not show any difference in operative time among both operated groups [11, 13, 19]. While our results showed a shorter operative time of the intracorporeal anastomosis group, which could be attributed to short duration of making the anastomosis as showed by results of; **Allaix et al. [20], Bollo et al. [21]**.

### CONCLUSIONS

Based on our findings we showed that intracorporeal anastomosis has many advantages over the extracorporeal anastomosis as shorted operative time, less pain, faster

recovery, less liability to occurrence of medical complications and less liability to incisional hernia later on. We showed that anastomosis type whether intracorporeal or extracorporeal did not affect long-term patients oncologic outcomes as disease progression, recurrence and survival following laparoscopic right hemicolectomy in colon cancer. There were no differences between either types of anastomoses regarding rate of post-operative complications denoting safety of both technique and choosing one of them is a surgeon decision to improve short term outcomes taking in consideration that there are no oncological benefits of the patients on the long run.

The study included a large cohort of colon cancer patients which was operated in a single center and followed up for about 5 years by three expert oncologic gastrointestinal surgeons who were qualifies in laparoscopic colon cancer surgery, which allowed better assessment of the short term and long-term oncological outcomes of both surgical approaches.

We recommended a larger prospective are needed for confirmations of our findings regarding justification of intracorporeal anastomosis technique as a more beneficial approach of management of colon cancer patients.

**Conflict of interest:** Nothing to declare.

**Financial disclosure:** Nothing to declare.

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