The Egyptian Journal of Hospital Medicine (July 2018) Vol. 72 (1), Page 3741-3748

Comparative Study between Laparoscopic Assisted versus Open Left Sided Hemicolectomy and Sigmoidectomy for Cancer Colon

Mahmoud A. El-Shafei, Mohamed A. Amer, Ahmed A. Darwish,
Moheb S. Eskandaros, Ahmed A. Hosny
Department of General Surgery, Faculty of Medicine, Ain Shams University
Corresponding author: Ahmed A. Hosny; Mobile: +201229123399; Email: ahmedatef1987@hotmail.com

ABSTRACT

Background: Traditionally, open procedure through exploratory incisions remains the gold standard approach for treating colorectal (CRC). Laparoscopic colectomy was proved to be a better alternative to the open approach. Though in some studies, it was found that the length of the operation tends to be somehow longer. However, in experienced hands it has comparable oncologic outcomes. Moreover, the laparoscopic approach is associated with less postoperative pain, faster return of bowel activity, earlier resumption of oral intake and lesser hospital stay. **Aim of the Study:** to study and evaluate the effectiveness of laparoscopic left hemicolectomy and sigmoidectomy compared to the open left sided colectomy and sigmoidectomy for malignancy regarding operative time, length of hospital stay, return of bowel function, resumption of oral intake, postoperative pain perception, general postoperative complications, surgical site infections and early recurrence. **Patients and methods:** This comparative study has been conducted in El-Demerdash hospital, Ain Shams University - Cairo, Egypt and has included 60 patients where half of the patients underwent open left hemicolectomy or sigmoidectomy and the other half underwent laparoscopic left hemicolectomy or simoidectomy. We performed both procedures during the period between 1st of January 2016 and 1st of January 2017 with 12 months of follow-up post-operatively. **Results:** In our study, the laparoscopic operation was associated with less hospital stay, earlier return of bowel activity, earlier resumption of oral intake without the use of the regular anti-emetics with better pain control and perception postoperatively. Moreover, it was associated with less surgical site infections and general complications including the respiratory ones than the open operation. We had similar anastomotic leak rates and early recurrence rate between both operations. Finally, the laparoscopic operation was associated with more operative time compared to the open operation. **Conclusion:** Laparoscopic left hemicolectomy and sigmoidectomy are oncologically sound when compared to the open left hemicolectomy and sigmoidectomy for treating left sided and sigmoid cancers. Moreover the laparoscopic approach yielded better outcomes regarding the postoperative recovery compared to the open approach. **Recommendation:** A further high volume study is needed to assess the long term effects of both procedures in our hospital.

Keywords: laparoscopic assisted, open left-sided hemicolectomy, sigmoidectomy, cancer colon.

INTRODUCTION

Colorectal cancer (CRC) is a common and lethal disease. Its incidence and mortality rates vary markedly around the world. Globally, there are 1.4 million new cases and almost 694,000 deaths estimated to have occurred in 2014 [(1)]. Environmental and genetic factors can increase the likelihood of developing CRC. Although inherited susceptibility results in the most striking increase in the risk, the majority of CRCs are sporadic rather than familial. Familial adenomatous polyposis (FAP) and Hereditary non-polyposis colorectal cancer (HNPCC) represent the most common of the familial colon cancer syndromes, but together these two conditions account for only about 5 percent of CRC cases. Patients with a personal history of CRC or adenomatous polyps of the colon are at risk for the future development of colon cancer. In patients undergoing resection of a single CRC, meta-synchronous primary cancers develop in 1.5 to 3 percent of patients in the first five years postoperatively. Also, there is a well-documented association between chronic ulcerative colitis and colonic neoplasia with the extent, duration, and activity of disease being the primary determinants. Although there are much fewer data, it appears that pancolitis due to Crohn's disease is associated with a similar relative risk of colon malignancy as extensive ulcerative colitis, although the data are less consistent [(2)]. There are a large number of clinical, environmental and lifestyle factors that are associated with a small and/or uncertain increased risk of CRC. Obesity is a risk factor for colorectal cancer and also appears to increase the likelihood of dying from CRC. Although the data are not entirely consistent, long-term consumption of red meat or processed meat appears to be associated with an increased risk of CRC, particularly for the left-sided tumors. Cigarette smoking has been associated with increased incidence and mortality from CRC. Other factors include; Diabetes, alcoholism, previous cholecystectomy and previous abdominal exposure to radiation [(3)].

CRC is diagnosed after the onset of symptoms or because of occult bleeding in the majority of patients. There are no symptoms in the majority of patients with early stage colon cancer and these patients are diagnosed as a result of

Received:20 / 3 /2018 DOI: **10.12816/0047739**
Accepted:30 / 3 /2018

screening. Typical symptoms and signs associated with CRC include haematochezia or melena, abdominal pain, otherwise unexplained iron deficiency anaemia, and/or a change in bowel habits. Less common presenting symptoms include abdominal distention, nausea and vomiting, which may be indicators of obstruction. Patients may also present with signs and symptoms of metastatic disease. Sometimes, emergency admission with intestinal obstruction, peritonitis, or rarely, an acute gastrointestinal (GI) bleed can be the presentation [(4)].

Colonoscopy is the most accurate and versatile diagnostic test for CRC, since it can localize and biopsy lesions throughout the large bowel, detect synchronous neoplasms, and remove polyps.CTC (Computed Tomography colonography) (also called virtual colonoscopy or CT colography) provides a computer-simulated endo-luminal perspective of the air-filled distended colon. CT colonography has been evaluated in patients with incomplete colonoscopy and as an initial diagnostic test in patients with symptoms suggestive of CRC. A variety of serum markers have been associated with CRC, particularly carcino-embryonic antigen (CEA). However, all these markers, including CEA, have a low diagnostic ability to detect primary CRC due to significant overlap with benign disease and low sensitivity for early-stage disease [(5)].

Once the diagnosis of colorectal cancer (CRC) is established, the local and distant extent of disease is determined to provide a framework for discussing therapy and prognosis. The Tumor Node Metastases (TNM) staging system of the American Joint Committee on Cancer/Union for International Cancer Control is the preferred staging system for CRC. Preoperative clinical staging is best accomplished by CT scan of the abdomen and pelvis, and chest imaging. Positron emission tomography (PET) scans do not appear to add significant information to CT scans for routine preoperative staging of CRC. Contrast-enhanced MRI of the liver can identify more hepatic lesions than are visualized by CT, and is particularly valuable in patients with background fatty liver changes[(6)]. Approximately 80 percent of cancers are localized to the colon wall and/or regional nodes. Surgery is the only curative modality for localized colon cancer. The goal of surgery for invasive cancer is complete removal of the tumor, the major vascular pedicle, and the lymphatic drainage basin of the affected colonic segment. Laparoscopic-assisted colectomy rather than open colectomy is an acceptable option for patients with non-obstructed, non-perforated, non-locally advanced colon cancers who have not had prior extensive abdominal surgery [(7)]. The left or sigmoid colon can be mobilized and regional lymphadenectomy performed using laparoscopic instruments and video-imaging equipment. The advantage of laparoscopic colectomy is the use of small abdominal port site and wound incisions which translate to reduced postoperative pain and analgesic requirement, earlier return of bowel function and normal physical activities, and shorter hospital stay without increasing health care costs. Laparoscopic colectomy compares favorably with open colectomy in terms of surgical morbidity and mortality. The laparoscopic approach has been shown to be technically and oncologically feasible with equivalent lymph node harvest from mesenteric lymphadenectomy and achieves adequate proximal and distal margins of colonic resection [(8)].

AIM OF THE WORK

The aim of this work is to study and evaluate the effectiveness of laparoscopic left hemicolectomy and sigmoidectomy compared to the open left sided colectomy and sigmoidectomy for malignancy regarding operative time, length of hospital stay, return of bowel function, resumption of oral intake, postoperative pain perception, general postoperative complications, surgical site infections and early recurrence.

PATIENTS AND METHODS

Study Design:

This is a comparative study that has been conducted in El-Demerdash hospital, Ain Shams University - Cairo, Egypt and has included 60 patients where half of the patients underwent open left hemicolectomy or sigmoidectomy and the other half underwent laparoscopic left hemicolectomy or simoidectomy.

- We performed both procedures during the period between 1st of January 2016 and 1st of January 2017 with 12 months of follow-up post-operatively. A comprehensive assessment program was carefully structured so that a disciplined routine is followed in each patient. Operations were conducted by one team who performed both procedures. Informed consent had been conducted to the patients.
- **Randomization method:**

We generated 60 sealed envelopes where they would represent two equal halves equivalent to the two procedures.

Inclusion Criteria:

- Patients' age 45-70.
- Preoperative histopathological diagnosis of either adenocarcinoma or high grade dysplasia.
- T1/2 tumors in either the descending colon or sigmoid on pelviabdominal CT/endoscopy.

Exclusion Criteria:

- Patient's Choice.
- Locally advanced and infiltrating tumors (≥ T3 tumors)
- Metastatic tumors.
- All complicated cases were excluded as obstruction, perforation or major GI bleeding.

- Patients above 70 years old.
- Debilitating cardiorespiratory diseases.

METHODS

The documented preoperative, operative and postoperative follow up data for all patients were collected and reviewed and the outcome of surgery was evaluated. **The study was approved by the Ethics Board of Ain Shams University.**

Pre-operative assessment:

All patients were diagnosed by adenocarcinoma or high grade dysplasia after an endoscopic biopsy. Staging was done by pelvi-abdominal and chest CT. Full colonic examination was done either by the index colonoscopy or by a CT pneumocolon. CEA was used a tumor marker preoperatively.

Surgical technique:

Technique of open left hemicolectomy or sigmoidectomy (Group A):

- Midline laparotomy was done.
- Assessment of tumor resectablity and excluding liver or peritoneal disease.
- Lateral mobilization of colon.
- High ligation of inferior mesenteric pedicle.
- Resection of tumor with a safety margin ≥ 5cm.
- Circular stapler (CDH 29 mm) was used to construct the anastomosis.
- Air leak test by a rigid sigmoidoscope.
- Closure of abdominal wall by loop PDS 0.
- Closure of skin by monocryl 3/0.

A) Technique of laparoscopic left hemicolectomy or sigmoidectomy (Group B):

- Pneumoperioneum set as 12 mmHg through a 10 mm umbilical port placed under direct vision. A 30 mm scope was used
- 12 mm port was placed in the right iliac fossa for the surgeon's right hand, 5 mm port was placed in the right upper quadrant for the surgeon's left hand and another 5 mm port was placed in the left iliac fossa for the surgeon's assistant.
- Assessment of tumor resectability and excluding liver or peritoneal disease.
- Medial to lateral approach started at rectosigmoid junction to access the total mesorectal excision plane and this plane was followed proximally till the inferior mesenteric pedicle (complete mesocolic excision).
- High ligation of IMA ± IMV.
- Lateral mobilization of the colon.
- Resection of tumor with at least 5 cm safety margin distally by a linear stapler.
- A transverse skin crease cut is fashioned in the left iliac fossa for tumor extraction.
- Resection of the proximal margin of bowel and placement of the anvil of circular stapler.
- Closure of the extraction site wound and re-establishment of pneumoperitoneum.
- Creation of anastomosis by the CDH 29 mm stapler.
- Air-leak test by rigid sigmoidoscope
- Closure of ≥ 10 mm ports by 0 vicryl J needle stitch,
- Closure of skin by Monocryl 3/0.

Post-operative follow up:

Early outcomes were assessed through follow up in the immediate postoperative care, at 3 months, 6 months and 12 months. Full clinical examination will be done at each visit. CEA was withdrawn at 3, 6 and 12 months. Pelviabdominal CT was done at 12 months. Flexible sigmoidoscope was done at 12 months.

Data collection:

Standardized data collection was performed which included:

- ***Preoperative data:***
  - Age
  - Sex
  - BMI
  - Co-morbidity
  - Preoperative pathology
- ***Operative data:***
  - Operative time which is defined as the time from the first incision to the placement of the last suture.
  - Local organ injury during procedure.
- ***Postoperative care data:***
  - The length of hospital stay which is defined as the number of days in the hospital after surgery inclusive of the day of surgery.
  - Postoperative pain score.
  - Passage of flatus and stools.
  - Resumption of oral diet.
  - Early recurrence.
  - Complications in the form of:
    - Bleeding.
    - Surgical site infections including deep wound infection.
    - Anastomotic leak.
    - Recurrence of disease.
    - General complications including respiratory ones.

Data Management and Analysis:

The collected data was revised, coded, tabulated and introduced to a PC using SPSS software package version 23.0 (Statistical Package for Social Science, Chicago, IL, USA). Data was presented and a T-test was used to compare between the results. Data were graphically represented using Excel program.

RESULTS

Our study involved sixty patients who presented to our outpatient clinic in Ain-Shams University Hospitals and who were selected upon the selection criteria adopted for this study, thirty patients underwent open left hemicolectomy or sigmoidectomy (Group A) and the other thirty patients underwent laparoscopic left hemicolectomy or sigmoidectomy (Group B).

Table (1): Patients' characteristic clinical data:

Parameter		Group A (n=30)		Group B (n=30)		p value	significance
		No	%	No	%		
Age (years)	Mean ±SD	64 ± 5		63 ± 4		0.73	NS
	Range	15		12			
Sex	Male	17	56	16	53	0.714	NS
	Female	13	43	14	47		
Preoperative BMI (kg/m²)	Mean ±SD	31 ± 3.4		33 ± 2.3		0.82	NS
	Range	8		7			
Co-morbidity		12	40	8	26.6	0.136	NS

This series involved 60 patients. For group A, there were 17 males and 13 females involved making a Male to Female ratio of 1.3% whereas for group B there were 16 males and 14 females making the Male to Female ratio of 1.14%. The mean age for group A was 64± 5 years with a range of 15 years for group B it was 63± 4 years with a range of 12 years. The preoperative BMI for patients in group A was 31± 3.4 kg/m^2 whereas for group B it was 33± 2.3 kg/m^2.

Out of the 30 patients allocated in group A, 12 of them were co-morbid as such; 6 were hypertensive, 3 were type II diabetic, 2 had Chronic Obstructive pulmonary disease (COPD) and 1 had non-limiting osteoarthritis. On the other side, for group B, 4 patients were hypertensive and the other 4 were type II diabetic.

All of the patients were pre-operatively diagnosed with adenocarcinoma on histopathology except 4 of them who had high grade dysplasia after endoscopic biopsies from tumors/adenomas.

Table (2): Statistical comparison between the two patient groups regarding the operative time and the length of the hospital stay

Parameter	Group A (n=30)				Group B (n=30)				p value	significance
	Min	Max	Mean	Std. deviation	Min.	Max.	Mean	Std. deviation		
Operative time (minutes)	100	200	129.4	35.4	120	220	149.6	24.5	0.0128	**S**
Hospital stay (Days)	5	22	8.7	2.9	5	18	6.9	2.6	0.0193	**S**

For group A, the mean operative time was 129.4 minutes ranging from 100 to 200 minutes whereas for group B, the mean operative time was 149.6 minutes ranging from 120 to 220 minutes.

Regarding the mean length of hospital stay, For Group A, it was 8.7 days ranging from 5 to 22 days whereas for group B, it was 6 days ranging from 5 to 18 days.

For Group A, 8 operations were done roughly in 120 minutes. These patients were with BMI ranging from 20-24 kg/m^2. The anatomy was straight forward with an easily accessible pedicle. One patient needed a lengthy operation that was estimated to be of 200 minutes because of technical challenges; a BMI of 38 kg/m^2, adhesions from a previous laparotomy and difficulties identifying the left ureter.

For Group B, 6 operations were done roughly in 140 minutes, again, a low BMI ranging from 19-23 kg/m^2.9 operations were done in lengthy times ranging from 200 to 230 minutes for different reasons as bulky tortuous sigmoid hindering its maneuvering, heavy bulky tumor with lots of adhesions to parietal peritoneum, bleeding from pedicle necessitating an open conversion and difficulties identifying the left ureter. Thus from the data above, we can conclude that statistically group B patients took longer in theatre compared to group A patients.

One patient in group A stayed for 22 days, this patient presented on day 3 with tachypnea, fever, tachycardia and an ileus. She had a CT which showed fluid and gas near the anastomotic site. She was taken back to theatre on day 4 for washout and take down of the anastomosis with formation of a colostomy and a mucus fistula. She had a had a protracted recovery with a subsequent surgical site infection, partial dehiscence in anterior abdominal wall that was managed conservatively, pleural effusions and a poor nutritional state was managed at some point by parentral nutrition.

For group B, one patient stayed for 18 days. This was for a conversion to open intraoperatively and this patient developed a long standing ileus that was managed conservatively with some nutritional support in the form of parentral nutrition. Thus we can conclude that group A patients statistically had a less hospital stay compared to group B patients.

Follow up of the patients:

A) Postoperative parameters:

Table (3): Statistical comparison regarding the postoperative time where the bowels were opened and resumption of oral intake between the two groups:

Parameter	Group A (n=30)				Group B (n=30)				P value	Significance
	Min	Max	Mean	Std. Deviation	Min	Max	Mean	Std. Deviation		
Bowels opened (Days)	3	7	4.2	1.01	2	5	3.33	0.66	0.000272	**HS**
Resumption of oral intake (Days)	3	6	4.53	0.86	2	6	3.76	0.89	0.001313	**HS**

On average, patients who underwent an open procedure (Group A) opened their bowels on day 4 and started tolerating solid intake without the use of regular antiemetics on day 6. As for those who underwent a laparoscopic procedure, on average, the patients opened their bowel on day 3 and started tolerating the solid intake on day 4. Thus the above table shows that there is a statistical significance between the 2 groups where group B patients tend to open their bowels and restart their solid oral intake without regular antiemetics earlier than group A.

Table (4): Statistical comparison of mean pain score between the two patient groups:

Parameter	Group A							Group B							P value	Significance
Days	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		
Pain Score	6	7	5	5	4	2	2	4	4	3	3	2	1	1	**0.052**	**S**

Pain was assessed using a pain scoring scale graded out of 10 over a period of 7 days postoperatively, for which a score of 0 meant the patient felt no pain, 1-3 was interpreted as mild pain that minimally interferes with the daily activities of life, 4-6 was moderate pain that significantly interferes with the daily activities of life and a score of 7-10 meant severe disabling pain. For the patients in Group A, on average, their pain perception scored 6 on day 1 climbing to 7 on day 2 then slowly decreasing over the next few days till 2 on day 7. As for patients who underwent a laparoscopic operation (Group B), on average, their pain perception scored a 4 on day 1 and 2 then slowly decreasing to 1 on day 7. Thus from the above statistical date we concluded that patients in group B suffered from less postoperative pain compared to group A patients.

B) Postoperative complications:

Table (5): Statistical comparison between postoperative complications in the two patient groups:

Parameter	Group A (n=30)		Group B (n=30)		p value	significance
	No.	%	No.	%		
Bleeding	2	6.66	2	6.66	1	**NS**
Surgical site infection	6	20	2	6.66	**0.003**	**HS**
Anastomotic leak	2	6.66	2	6.66	1	**NS**
Local injury	0	0	1	3.33	0.329	**NS**
General complications	8	26.66	3	10	**0.002**	**HS**

In Group A, 2 patients presented with bleeding postoperatively as rectal bleeding presumably from the anastomotic line. They were both haemodynamically stable and were managed conservatively with tranexemic acid. In Group B, 2 patients presented with bleeding, one as rectal bleeding while the other presented with sanguinous

output through the drain for 2 days postoperatively and again was managed conservatively.

In group A, 6 patients developed a surgical site infection in the early postoperative period. One of them needed another operation for a leak and ended up having a partial dehiscence in the anterior abdominal wall while the other 5 patients developed superficial infections that were managed with simple dressings. For group B, 2 patients developed superficial wound infection at the specimen extraction site and was managed by simple dressings.

We encountered 4 postoperative anastomotic leaks in the 2 groups, 2 in group A and 2 in group B. One patient in Group A was symptomatic with fever, tachypnea and tachycardia and ended up de-functioned in another operation. The other 3 patients were treated with antibiotics as the leak was contained and the patients were well with it.

We had no recurrence in the early postoperative period as by clinical examination. All of the excised specimens were oncologically sound; R0 with at least 12 lymph nodes harvested in the specimens. We encountered no local injuries in patients of group A yet, one patient had been encountered in group B had a splenic trauma during mobilizing the splenic flexure and was packed with Surgical intraoperatively.

For the patients who underwent an open operation (Group A), 3 developed hospital acquired pneumonias and were treated with antibiotics, one patient developed bilateral pleural effusions in the context of other morbidities as leak, dehiscence and the need for another operation, and another patient developed deep venous thrombosis manifested as a unilateral calf swelling with a documented thrombus on Duplex and was treating with low molecular weighted heparin. As for patients who underwent a laparoscopic operation (Group B), 2 patients developed hospital acquired pneumonias and were treated with antibiotics.

We encountered one recurrence among each group as detected by CEA measurement, flexible sigmoidoscopy and CT. The patient who developed recurrence in group A had a stricture at the anastomotic line at 12 months and it was proved to be cancerous on histopathology whereas in group B, the patient who developed recurrence was in the form of liver and lung metastasis as detected by CT scan at 12 months.

DISCUSSION

Colorectal cancer affects more than one million people worldwide annually. The management of colon cancer depends on the stage at presentation. Patients can be divided into two categories: patients with atumor amenable to resection with curative intent and patients in whom palliation is the goal. In patients with localized and potentially curable disease, surgical resection is generally the primary and initial therapy followed by adjuvant chemotherapy in some cases. When patients present with advanced disease, chemotherapy is often the first line of therapy, and palliative resection is reserved for cases of locally symptomatic disease [(9)].

The goals of surgical therapy with curative intent are to achieve complete removal of the primary cancer with adequate tumor-free margins, an anatomically complete lymphadenectomy of the draining lymph nodes, en bloc resection of any involved adjacent organs and avoidance of contamination of the surgical field with tumor cells. Between 80% and 90% of patients are appropriate candidates at presentation for an attempt at curative resection. The extent of colonic resection is determined by the vascular pedicles to achieve an adequate regional lymphadenectomy. Often this requires resection of a larger segment of bowel beyond that necessary simply to obtain negative margins [(10)].

Laparoscopic colectomy has gained complete acceptance in the surgical management of colon cancer. Large, multicenter randomized controlled trials have confirmed that colorectal cancer resection is comparable to open resection regarding oncological efficacy, including nodal harvest, survival and locoregional recurrence. Moreover, this approach is typically associated with less postoperative pain, reduction in narcotic and oral analgesic requirements, and earlier resumption of diet [(11)].

We compared the mean operative time between the two operations. In our study, the mean operative time for the patients who underwent an open operation was 129.4 minutes while it was 149.6 for the patients who underwent a laparoscopic procedure. The results from other studies that we compared our study to also concluded that the laparoscopic approach needed a more lengthy operative time. **Desiderio *et al.*** [(12)]mean operative time was 264.56 minutes for the laparoscopic group and 223.33 minutes for the open group. Also **Nakashima *et al.*** [(13)] mean operative time was 209 minutes for the laparoscopic group and 178 minutes for the open group. These results matched other studies such as a study done in 2007 done by **Liang *et al.*** [(14)] and another one in 2004 by **Nelson *et al.*** [(15)].

The only opposing data found was from a study done in 2010 by **Han *et al.*** [(16)] his mean operative time for the open group was longer than that of the laparoscopic group (223.2 and 156.2 minutes respectively). Our conclusion was that the latter study was from a high volume laparoscopic colorectal center where apparently they had lots of experience with laparoscopic colorectal operations.

We only encountered one local injury and it was a splenic trauma during mobilizing the splenic flexure during doing one of the laparoscopic left hemicolemoies. Luckily, it was managed conservatively with only temporary packing and surgicell. We concluded that better port positioning when anticipating operating near the splenic flexure and adopting a single technique for mobilizing the flexure could bring about better results.

The laparoscopic operation came with better pain control postoperatively. When we compared it to the open operation over the period of 7 day, the patients tend to use less analgesia especially narcotic based ones.

Next, we compared the mean length of hospital stay as expressed in days. On average, patients in group B spent 6.9 days while patients in group A spent 8.7 days in the hospital. This result was statistically significant and matched results from other studies. **Desiderio *et al.*** [12]'s data was 6.86 for the laparoscopic group and 8.44 days for the open group. Also **Han *et al.*** [16] showed similar results, 8.7 and 12.2 respectively.

From our study, we concluded that the laparoscopic approach confers an earlier return of bowel activity and the patients started to tolerate oral intake faster than the patients who underwent an open operation. On average, in our study, the patients who underwent a laparoscopic approach opened their bowels at day 3.33 and started tolerating oral intake without the use of regular anti-emetics on 3.76 days. This data was slower for the patients who underwent an open operation. In our study on average, the patients opened their bowels on day 4.2 and started tolerating the oral intake on day 4.53.

Again, this data matched previous studies. **Desiderio *et al.*** [12]'s values data were as such: patients who underwent the laparoscopic operation opened their bowels on day 2.6 compared to 3.22 for the patients who underwent an open operation. Again, in his study, patients resumed their solid intake faster in the laparoscopic group than the open group (4.39 and 5.03 days respectively). This data also matched other studies of **Nakashima *et al.*** [13] and **Han *et al.*** [16].

Then, we compared both approaches regarding the rate of the postoperative complications. We studied the leak percentage, surgical site infections, bleeding and general complications including the respiratory ones. The anastomotic leak rate in our study was 6.66% in both groups. **Alkhamesi *et al.*** [17]found a higher leak rate in the patients who underwent an open operation (5 versus 2%). However, in his study he included the laparoscopic converted to open operations to the open group which brought about a higher leak rate in the open group. We think a 6.66% leak rate is somehow high, however, it can be explained by the small sample size (30 patients in each group).

We encountered more surgical site infections when we did the open left hemicolectomies and sigmoidectomies compared to the laparoscopic operations (20% versus 6.66%). The surgical site infections were mostly superficial ones that were managed by simple dressings except for one patient who developed a fascial dehiscence in the context of other complications this patient went through. The wound infections we encountered in the laparoscopic operations were related to the specimen extraction wound only. This data matched other studies as by **Nakashima *et al.*** [13] and **Alkhamesi et al.,** [17].

4 patients developed bleeding postoperatively, 2 in each group. One patient from the laparoscopic group developed sanguinous output through his drains for 2 days postoperatively and we concluded that this was due to the splenic trauma he had which was managed conservatively and to the dissection near the splenic flexure. All the 3 other patients developed rectal bleeding when they opened their bowels for 2 motions roughly and this was believed to be related to the anastomotic line and again it was managed conservatively. As we adopted the same technique for the anastomosis in both groups, we couldn't find any statistical significance between both groups regarding the postoperative bleeding.

The last parameter we compared both approaches to was the postoperative general complications, namely the respiratory and DVT incidence. Out of the 30 patients who underwent the laparoscopic operation 3 developed general complications compared to 8 from the open group. The incidence of atelectasis, hospital acquired pneumonias and DVT were higher in the open group. This matched results from other studies.

Though all of the operations were oncologically sound, we had one recurrence in each group, again emphasizing that the laparoscopic approach didn't bring about difference in the prognosis of the patients. One recurrence was detected by a flexible sigmoidoscope as a malignant stricture at the anastomotic line while the other recurrence was detected as subtly liver and lungs on CT at 12 months.

From all of the above mentioned results, it is clear the laparoscopic approach brings about a better outcome in the immediate postoperative period. Smaller wounds bring about a less post-surgical response which means less pain, better breathing, earlier return of bowel function and earlier resumption of oral intake. Though we didn't use wound protection kits yet, the laparoscopic operation definitely is followed by less surgical site infections compared to the conventional operation.

We couldn't find a difference in the operation regarding the bleeding rate, leak rate and the local iatrogenic injury. This somehow proves the safety of the laparoscopic operation as a choice for left sided hemicolectomy and sigmoidectomy.

Since we encountered one recurrence in each group of patients, this can somehow demonstrate the safety of the laparoscopic approach from the oncological point of view. We did harvest at least 12 nodes in every patient. However we need a longer study (than 12 months) with a larger sample size to properly assess the disease free survival.

Traditionally, open procedure through exploratory incisions remains the gold standard approach for treating CRC. The rationale of treatment is to remove the diseased segment of bowel with an adequate safety margin with high ligation of the vascular pedicle, en bloc resection of any involved viscera whenever possible and ensuring adequate lymphadenctomy.

Laparoscopic colectomy was proved to be a better alternative to the open approach. Though in some studies, it was found that the length of the operation tends to be somehow longer. However, in experienced hands it has comparable oncologic outcomes. Moreover the laparoscopic approach is associated with less postoperative pain, faster return of bowel activity, earlier resumption of oral intake and lesser hospital stay.

CONCLUSION

In our study, it was reviewed that laparoscopic left hemicolectomy and sigmoidectomy are oncologically sound when compared to the open left hemicolectomy and sigmoidectomy for treating left sided and sigmoid cancers. Moreover the laparoscopic approach yielded better outcomes regarding the postoperative recovery compared to the open approach. Finally, we recommend the laparoscopic approach for the left hemicolectomy and sigmoidectomy.

RECOMMENDATIONS

We need more training and standardization of the technique to bring about less operative times. We need to adopt a structured enhance recovery program for each patient. We also need high volume study to study the 5 year recurrence rate between the 2 operations.

REFERENCES

1) **Torre LA, Bray F, Siegel RL *et al.* (2015):** Global cancer statistics. CA Cancer J Clin., 65:87.
2) **Jenkins MA, Dowty JG, Ait Ouakrim D *et al.* (2015):** Short-term risk of colorectal cancer in individuals with lynch syndrome: a meta-analysis. J Clin Oncol., 33:326.
3) **Karahalios A, English DR and Simpson JA (2015):** Weight change and risk of colorectal cancer: a systematic review and meta-analysis. Am J Epidemiol., 181:832.
4) **Siegel RL, Miller KD and Jemal A (2015):** Cancer statistics. CA Cancer J Clin., 65:5.
5) **Atkin W, Dadswell E, Wooldrage K *et al.* (2013):** Computed tomographic colonography versus colonoscopy for investigation of patients with symptoms suggestive of colorectal cancer (SIGGAR): a multicentrerandomised trial. Lancet, 381:1194.
6) **Niekel MC, Bipat S and Stoker J (2010):** Diagnostic imaging of colorectal liver metastases with CT, MR imaging, FDG PET, and/or FDG PET/CT: a meta-analysis of prospective studies. Radiology; 257(3):674-84.
7) **Cukier M, Smith AJ and Milot L *et al.* (2012):**Neoadjuvantchemoradiotherapy and multivisceral resection for primary locally advanced adherent colon cancer: a single institution experience. Eur J SurgOncol., 38:677.
8) **Lin KM and Ota DM (2000):** Laparoscopic colectomy for cancer: an oncologic feasible option. Surgical Oncology, 9: 127-134.
9) **Zerey M, Hawyer LM, Awad Z *et al.* (2013):** SAGES evidence-based guidelines for the laparoscopic resection of curable colon and rectal cancer. SurgEndosc., 27:1-10.
10) **Levin B, Lieberman DA, McFarland B *et al.* (2008):** Screening and Surveillance for the Early Detection of Colorectal Cancer and Adenomatous Polyps, 2008: a Joint Guideline from the American Cancer Society, The US Multi-Society Task Force on Colorectal Cancer, and the American College of Radiology. CA Cancer J Clin., 58:130-160.
11) **National Comprehensive Cancer Network (NCCN) (2015):** Clinical Practice Guidelines in Oncology (NCCN Guidelines) for Colon Cancer V.3.2015, Fort Washington, PA. https://www.nccn.org/professionals/physician_gls/default.aspx
12) **Desiderio J, Trastalli S, Rici F *et al.* (2014):** Laparoscopic versus open colectomy in patients with sigmoid cancer: prospective cohort study with long term follow up. Int Journal of Surgery, 12(8):745-750.
13) **Nakashima M, Akiyoshi T, Ueno M *et al.* (2011):** Colon Cancer in the Splenic Flexure: Comparison of Short-term Outcomes of Laparoscopic and Open Colectomy. SurgLaparoscEndoscPercutan Tech., 21:415–418.
14) **Liang JT, Huang KC, Lai HS *et al.* (2007):** Oncologic Results of Laparoscopic Versus Conventional Open Surgery for Stage II or III Left-Sided Colon Cancers: A Randomized Controlled Trial. Annals of Surgical Oncology, 14(1):109–117.
15) **Nelson H, Sargent D, Weiand HS *et al.* (2004):** COST Study Group: A comparison of laparoscopically assisted and open colectomy for colon cancer. N Engl J Med., 350:2050-2059.
16) **Han KS, Choi GS, Park JS *et al.* (2010):** Short-term Outcomes of a Laparoscopic Left Hemicolectomy for Descending Colon Cancer: Retrospective Comparison with an Open Left Hemicolectomy. J Korean SocColoproctol., 26(5):347-353.
17) **Alkhamesi NA, Martin J and Schlachta CM (2011):** Cost-efficiency of laparoscopic versus open colon surgery in a tertiary care center. SurgEndosc., 25:3597–3604.