



## Original Work

### Laparoscopic colorectal cancer surgery - a prospective study of short-term outcomes of consecutive cases over 3 years

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**ABSTRACT:** This study was carried out with the objectives to study the feasibility of laparoscopic colorectal cancer resection, to observe short term outcome such as recovery parameters, oncologic safety, morbidity and mortality, and to analyze the experience of laparoscopic colorectal surgery in a teaching hospital. Between January 2007 and July 2009, all consecutive adult cases admitted to our department for colorectal cancer were assessed for eligibility. The ethical committee approved the protocol at the Sterling Hospital. Out of 31 patients, 17 were males and 14 females. The mean age was 59 years. The most common clinical presentation was weight loss and altered bowel habits. Rectum (51.61%) was the most commonly involved organ followed by cecum (22.58%). - median time to liquid diet was two days (range 1-22), and a solid diet was three days (range 3-30). The median time to first flatus was two days (range 1-5), and the first stool was five days (range 3-7). The postoperative stay was eight days (range 6-30) median time to mobilization was 2.5 days. The postoperative stay is cumulative and includes patients who underwent reoperation for the anastomotic leak. The median operating time was 240 mins (range 116 – 520). The median length of incision was 6 cm (range 4 – 10 cm). The median blood loss was 170 ml. Blood loss was higher in patients with hemorrhage and tumor adhesions, and both of them were converted to open. These patients incidentally had a more extended hospital stay. The laparoscopic technique for colorectal cancer is feasible and safe. Laparoscopic colorectal surgery (LCS) is associated with short term benefits like the earlier return of gastrointestinal function and shorter length of hospital stay. From the oncologic point of view, tumor resections are adequate, taking into context numbers of lymph nodes retrieved and resectional margins in context to oncologic safety. The decreased postoperative wound infections and early recovery facilitate appropriate adjuvant therapy. Advanced laparoscopic surgery requires a team approach with proper case selection. Transvaginal delivery of specimens can give scar-less surgery and the option for assisted natural orifice surgery.

**KEY WORDS:** *Colorectal cancer; Laparoscopy; Surgery; Recurrence; Hospital stay*

#### INTRODUCTION

Colorectal cancer (CRC) is one of the most common cancers in both female and male populations in the developed nations of Europe, America, Asia, and Australia. Radical resection of the tumor-bearing segment of the bowel with wide tumor-free resection margins and a systematic lymphadenectomy is the mainstay of curative therapy of colorectal cancer.

Five-year survival rates after R0-resection of colorectal cancer vary with the Union for International Cancer Control (UICC)-tumor stage from almost 100% (stage I) to 50% (stage III)<sup>1</sup>. Other diseases that may require elective resection of the large bowel are diverticulitis, Crohn's disease, ulcerative colitis, and familial adenomatous polyposis (FAP). Until recently, conventional surgery via laparotomy remained the "gold

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standard" for elective colorectal resection in both benign and malignant disease. The evolution of video-endoscopic surgery led to the idea of laparoscopic colorectal resection, which was first described in 1991.<sup>2,3</sup>

Short term advantages of the laparoscopic compared to the conventional approach to colorectal resection have been shown conclusively<sup>4,5</sup>: less pain, better pulmonary function, shorter duration of postoperative ileus, less fatigue, the better quality of life. However, the new method has not gained the same acceptance as laparoscopic cholecystectomy because short term advantages seemed not to be as apparent as for laparoscopic cholecystectomy.

Several prospective randomized trials, including the COLOR<sup>6</sup> and CLASSIC<sup>7</sup> studies, have demonstrated that laparoscopic-assisted surgery for colorectal cancer resulted in a shorter hospital stay, reduced analgesic use, and earlier recovery to bowel movement. Recently increased usage of laparoscopy in colorectal cancer can be attributed to the following: Data available in context to radicality, oncological margin and port site recurrence, Better endovision – high definition camera (HD camera), Better energy sources – harmonic scalpel / ligasure, the increasing experience of laparoscopic surgeons

This study was carried out with the following aims and objectives: to study the feasibility of laparoscopic colorectal cancer resection, to study the following short term outcome such as recovery parameters - time to first stool, time to a solid diet, time to mobilization, and hospital stay, oncologic data - staging, lymph nodes, and margins, morbidity and mortality (30 day mortality), and to analyze the experience of laparoscopic colorectal surgery in a teaching hospital.

## METHODOLOGY

This prospective study was performed at Sterling hospital, Ahmedabad, India. Patients who underwent laparoscopic colorectal surgery between January 2007 and July 2009 were enrolled. The study was conducted following the Declaration of Helsinki and was approved by the local Ethics Committee of the institute. Informed written consent was obtained from all patients before their enrollment in this study. The patients of age more than 18 years, histological diagnosis of CRC, and suitable candidates for elective laparoscopic surgery were enrolled for the study.

Patients who required emergency surgery either due to perforation or obstruction, colorectal stent failure, patients with T4 lesion that could not be resected laparoscopically and patients with contraindications to general anesthesia were excluded from the study.

At the time of hospital admission, demographics, nutritional status, and primary diagnosis were recorded for all patients.

Pathologic confirmation, colonoscopy, computed tomography (CT), ultrasonography, and chest X-rays were performed for diagnosis in all patients preoperatively. If radiological localization was unclear, preoperative colonoscopic India ink tattooing or endoscopic clipping was performed. All patients with colorectal adenocarcinoma admitted to Sterling hospital, Ahmedabad were considered for laparoscopic surgery. Undernutrition was defined as weight loss of more than 10% concerning usual body weight in the six months before admission. Obesity was defined as body mass index (weight in kilograms/height in meters<sup>2</sup>) more than 30. The presence of comorbid factors was assessed according to the American Society of Anesthesiologists (ASA) score. In all patients, bowel preparation was carried out one day before operation by intestinal washout with an iso-osmotic solution (2 L). The evening before and the morning of the surgery, patients were given an enema. As antibiotic prophylaxis, all patients received a single dose of 3rd generation Cephalosporin (Ceftriaxone 2 gm intravenously) during the induction of anesthesia. A second dose of the same antibiotic was administered intraoperatively if surgery lasted more than 4 hours. Deep vein thrombosis prophylaxis was carried out with low-molecular-weight heparin (50 IU/kg/d) in all patients, six hours before surgery. All patients underwent general anesthesia plus thoracic epidural anesthesia. All the operations were performed by four surgeons, well trained in both laparoscopic and open colorectal surgery. Pneumoperitoneum was induced by insufflation of CO<sub>2</sub> and was maintained at 12 mmHg during the entire surgical procedure. The procedures were standardized to meet oncologic principles.

Right colectomy (RC); colonic mobilization was done from medial side up to the duodenum, followed by ileocolic pedicle and ligation of the right branch of a colic artery. All the lymphatic tissue was excised from the ileocaecal junction up to the middle colic vessels.

All the procedures were performed using standard techniques.

The mobilization of colonic segments was carried out by the harmonic scalpel (Ethicon Endosurgery Inc., Cincinnati, OH). The specimen was always retrieved with wound protection in an impermeable bag to prevent tumor spillage and wound contamination. An extracorporeal hand-sewn anastomosis was fashioned in all patients who underwent right colectomy (RC).

The procedures were converted to open surgery in case of technical difficulties, finding of advanced disease, and inadequate oncologic margins.

**RESULT**

**Demographic and clinical data**

The study included 31 patients, with a mean age of 59 years (range, 24–80 years); 54.83 % (n = 17) were male. In this cohort, 22% (n = 14) of patients were over 65 years of age. Clinical features that were noted included: altered bowel habits (48%), melena (48.5%) and weight loss (48.4%). Several patients(n=16) had significant medical comorbidities. Hypertension (n=6), Diabetes (n=6), hypothyroidism (n=2), Ischemic heart disease (n=1), Ulcerative colitis (n=1). The mean hemoglobin level was 8.8 gm (range 6-12). The mean re-operative hemoglobin was 15 (range 6 -12).

**Operative procedure**

The most common site of lesion was rectum in 51.61% (n=16) followed by caecum in 22.58% (n=7), sigmoid colon (n=5), descending colon (n=2). The procedures for rectal cancer included: - Abdominoperineal resection (APR)(n=4), anterior resection (AR) (n=5), low anterior resection (LAR) (n=6), ileal pouch–anal anastomosis (IPAA) (n=1). (Table 1)

**Table 1: Operative procedure**

Procedure performed	N=31
Right colectomy (RC)	8 (25.80%)
Left colectomy (LC)	2 (6.45%)
Anterior resection	5 (16.12%)
Low anterior resection	6 (19.35%)
Abdomino perineal resection	4 (12.90%)
IPAA	1 (3.22%)
Sigmoidectomy	5 (16.12%)
Diversion	4 (12.90%)
Others	2 (6.45%)
<b>Incision (median)</b>	<b>Size</b>
	6 cm (4 – 10)

Primary diverting stoma was fashioned in 4 patients (12.4%) and these were for LAR (n=3) and IPAA (n=1). Three patients required conversion-hemorrhage (n=1), injury to ureter (n=1), and tumor adhesions (n=1). Hemorrhage occurred from middle colic artery. It was promptly decided to convert. On exploration there was a spurting vessel, which was

suture controlled. The second patient was a case of suspected (left) ureteric injury for left colectomy. The third case was of carcinoma rectum, which showed adhesions with uterus. It was difficult to proceed with dissection and hence it was converted to open. Two patients underwent hysterectomy with salpingo-oophorectomy and both of them were performed by total laparoscopic method. In one patient specimen was delivered trans-vaginally and had no laparotomy scar on abdomen.

**Surgical outcomes and postoperative recovery**

As for the post-operative course (Table. 2) - median time to fluid diet was 2 days (range 1-22), and solid diet was 3 days range (3-30 days). The median time to first flatus was 2 days (1-5) and first stool was 5 days (range 3- 7 days). The postoperative stay was 8 days (range 6 - 30) median time to mobilization was 2.5 days. The post-operative stay is cumulative and includes patients who underwent reoperation for anastomotic leak. The median operating time was 240 mins (range 116 – 520) (Table 2). The median length of incision was 6cm (range 4 – 10cm). The median blood loss was 170 ml. Blood loss was higher in patients with haemorrhage and tumour adhesions and both of them were converted to open. These patients incidentally had longer hospital stay

**Table 2: Short term outcomes**

Median operative time (min)	240 min (116 -520)
Median time to start liquid diet	2 days (1 - 22)
Median time to start solid diet	3 days (3 - 30)
Median time to pass first flatus	2 days (1 - 5)
Median time to first stool	5 days (3 - 7)
Median blood loss (ml)	170 ml (140 - 550)
Median post-operative stay	8 days (6 - 30)
Median analgesic requirement	3 days
Median time to mobilization	2.5 days (1 - 6)

Patients were started with sips of water immediately and liquid diet was introduced following passage of first flatus. Abdominal drain was removed when it was serous and drained less than 20ml. Foley catheter was removed after full mobilization of the patient. Major morbidity (defined as a condition which requires re-operative surgery or increases the length of stay) was seen in four (12%) patients - peritonitis subsequent to anastomotic leak (n=1),

wound dehiscence (n=1), small bowel obstruction (n=1), and diarrhea (n=1).

Anastomotic leak presented with features suggestive of peritonitis and sepsis. Emergency exploratory laparotomy proceed to diversion and peritoneal toilet was done. This patient was given neoadjuvant therapy, required pre and intraoperative transfusion, and had advanced tumour of rectum. Wound dehiscence required secondary suturing

One patient who underwent anterior resection developed small bowel obstruction who was treated conservatively. Non-infectious diarrhea was seen in one patient, for whom no cause could be identified. This patient had undergone sigmoidectomy and colorectal anastomosis.

### Oncological results and follow-up result

All patients had adenocarcinoma. 20 patients (64.51%) had moderately differentiated, 9 (29.03%) patients had poorly differentiated adenocarcinoma and, 3 (9.6%) had well differentiated adenocarcinoma. The median length of the tumor was 4.5 cm (range 2 – 10cm). The median lymph node retrieved were 14 (range 2 - 53) and the median positive lymph nodes were 2 (0 – 14). Majority of the tumor were in T3 stage (n=22), followed by T4 (n=5), T2 (n=3) and T1 (n=1). (Table 3)

**Table 3: Histopathology data**

<b>Histology type</b>	
<b>Differentiation (Adenocarcinoma)</b>	
Well	3
Moderately	20
Poorly	9
Median Lymph node retrieved	14
Median lymph node positive for tumor	2
<b>T (Tumor)- stage</b>	
T0	0
T1	1
T2	3
T3	22
T4	5
<b>N (Node) stage</b>	
N0	6
N1	15
N2	10
Tumor size median in cm	4.5
Proximal resection margin in cm (PRM)	12.0
Distal resection margin in cm (DRM)	8.0
Radial margin in cm	1.5

The average follow-up was of 20 months. There was no operative or hospital-based mortality. 5 patients died - hepatic metastasis (n=1), pulmonary metastasis (n=1) and cerebrovascular stroke (n=1), cause could not be ascertained in 2 patients. 3 (9%) patients were lost to follow up and all these were from village. Recurrence was seen in seven (22.58%) patients 4 (12.9%) patients had local recurrence and 3(9.6%) had distant recurrence. There was no port site recurrence seen in any patients on follow up. The mean follow-up of the patients who died was 8 months.

### DISCUSSION

With the increasing popularity of minimally invasive approaches to surgery, laparoscopic techniques are being applied increasingly to more complex procedures. The feasibility and safety of laparoscopic colorectal cancer resection (CRC) have been reported<sup>8-11</sup>. With the emerging evidence of the safety of laparoscopic surgery, there is a transition from formal/open approach to a minimally invasive procedure. In our study, all patients underwent preoperative colonoscopy, and the diagnosis of adenocarcinoma was made by preoperative biopsy. The majority of the patients had carcinoma of the rectum. The operative procedures performed in his study were mostly anterior resections.

The short-term parameters like bowel movements, time to start liquid to a solid diet, the median length of stay are similar to those reported in other series<sup>12,9,10</sup>. More rapid return of bowel functions, as evidenced by the passage of flatus, represents a definite advantage. The use of analgesics (median three days) is less as the access trauma is significantly reduced, and so is the pain caused due to prolonged standing retraction, as seen in open or conventional surgery<sup>13</sup>.

There are reports of significantly shorter duration of hospital stay in patients undergoing laparoscopic surgery<sup>10,14-16</sup>. In the current study, lower postoperative complication rates coupled with earlier recovery of both bowel function and oral feeding may represent an important determinant of hospital stay<sup>17-20</sup>. The emphasis on early mobilization (median 2.5 days, range 1 - 6), rapid removal of tubes (abdominal drain and Foley) helps in a more meaningful sense of well-being. We thus propose - laparoscopic approach combined with early feedings, early ambulation, and a proactive nursing team leads to rapid discharge of the patients from the hospital<sup>21</sup>.

Laparoscopic colorectal surgery seems to be associated with less tissue injury than open surgery. Thus, some possible benefits can be expected, such as better preservation of systemic immune function,

a less pronounced postoperative inflammatory response, decreased disability, and reduced postoperative pain, and faster recovery of intestinal

motility and function. This might translate into an improved outcome

**Table 4: LCS, comparison with the literature**

Study	Use of analgesics (days)	1 <sup>st</sup> stool (days)	Bowel Movement (days)	Liquid diet (days)	Normal diet (days)	Hospital stay (days)	Reoperation (%)	Conversion to (%)
Leung <i>et al</i> <sup>10</sup>		2.4	4.9		4.2	8.2		23.2
Hasengwa <i>et al</i> <sup>9</sup>		2.0				7.1		17
Lacy <i>et al</i> <sup>12</sup>			1.5		2.3	5.2		11
Present study	3	3	2	2	3	8.0	9.3	9.1%

Our rates of intraoperative (2.8%), and postoperative complications (16.8% minor complications, 8.0% major complications) are well within the range published by tertiary care centers<sup>22-24</sup>. The median operating time for our series was 240 .0 min (116 - 520 min) and is within the range reported by tertiary care centers<sup>23-25</sup>. In contrast, the potential disadvantages of laparoscopic surgery are the longer operative time and the higher charges for surgical devices and instruments compared to open surgery. Moreover, two studies reported that laparoscopic surgery caused a higher mental strain for the surgeon<sup>26,27</sup>.

The present study showed that intraoperative blood loss was significantly lower. This may be due to the regular use of harmonic ultrasonic shears (Ethicon USA) for dissection and ligation. Major pedicles were clipped with haemolock. This finding is consistent with the results by Psaila *et al*<sup>18</sup>. However, the lower blood loss observed in the laparoscopic group was not associated with a significant reduction in the transfusion rate as most of the patients were transfused preoperatively due to low hemoglobin.

The rate of conversion to open surgery is low when strict eligibility criteria are applied, and the surgical team is well trained<sup>28,29</sup>. The highest conversion rates were reported in a series resulting from early experiences<sup>30,31</sup>. In the present study, the conversion rate was 9.1 %, similar to that of other large series<sup>32,33</sup> (Table 4), but significantly less than COLOR, COST, and MRC- CLASSIC trials. Probably it might be due to a smaller number of patients in our study or exclusion of obese patients.

In this study, the cases converted to open had higher postoperative stay and higher morbidity. The common reasons for conversion in our series were difficult dissection like total mesorectal excision (TME), tumor bulk, and bleeding. As identified by

Schlachta *et al*, the surgeon's laparoscopic colorectal experience, a diagnosis of malignancy, and weight were factors predicting the risk of conversion<sup>34</sup>.

The question regarding the appropriate number of lymph nodes per specimen is also an area of debate. In the laparoscopic colorectal literature, the mean number of lymph nodes retrieved ranges from 6 to 14<sup>35,36</sup>. The median number of nodes in our series was 14 (range 2 - 53) and is well within the published range<sup>12,36</sup>. The actual number of lymph nodes retrieved from a specimen is influenced by the extent of the oncologic resection as well as the quality of the pathological evaluation. Korolija *et al*<sup>37</sup> showed a statistically significant difference in the average DRM in a meta-analysis of 16 comparative series was 4.6 cm by laparoscopic approach. Schwenk *et al*<sup>38</sup> found no difference in the resection margin. This may imply adequate clearance of margins where mobilization can play an important role.

Two patients underwent simultaneous laparoscopic salpingo-hysterectomy. One patient had transvaginal delivery of specimen – this further gives an option in the field of Natural Orifice Surgery. The second patient underwent APR.

**Limitations of the study:** This study is not a comparative study between laparoscopy and open colorectal surgery. It has a small cohort size. However, this study might help in the further research in this direction or meta-analysis.

## CONCLUSION

The laparoscopic technique for colorectal cancer is feasible and safe. LCS is associated with short term benefits like the earlier return of gastrointestinal function and shorter length of hospital stay. From the oncologic point of view, tumor resections are

adequate, taking into context the number of lymph nodes retrieved and resectional margins with regard to oncologic safety. The decreased post-operative wound infections and early recovery can facilitate appropriate adjuvant therapy. Advanced laparoscopic surgery requires a team approach with proper case selection. Transvaginal delivery of specimens can give scar-less surgery and the option for assisted natural orifice surgery.

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