

# The Learning Curve of Laparoscopic Colorectal Surgery - A Single Center Initial Experience at a Tertiary Hospital

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## ABSTRACT

### BACKGROUND

Laparoscopic colorectal procedure is technically challenging and has a long learning curve to learn the procedure. Here we are reporting our initial experience of laparoscopic colorectal procedures in 51 cases.

### METHODS

This is a retrospective study where we analysed 51 cases of laparoscopic colorectal surgeries from January 2014 to February 2020 in our tertiary care institute. Here we report the demography, indications, technique, complications, and outcomes.

### RESULTS

In our study, the majority of cases had malignancy as an indication for surgery [39 (76.47%)]. The procedures consist of various laparoscopic colectomies [37 (72.50%)], 6 (11.76%) laparoscopic low anterior resections and 8 laparoscopic APR (15.68%). The mean operative time was 150 minutes (110-240 mins); mean operative blood loss was 80 mL (60-165 mL); 1 (4%) case had been converted to open procedure. The mean length of hospital stay was 5.88 days (3- 29 days). The total number of short term complications was 18 (33.96%). On maximum 60 months follow up, 3 (5.88%) cases developed long term complications.

### CONCLUSIONS

Laparoscopic colorectal procedures are difficult to learn and have a long learning curve; however, a simple and well adopted laparoscopic approach could make this procedure simple and provide better outcomes.

### KEYWORDS

Colon Cancer, Laparoscopic Right Hemicolectomy, Extracorporeal Bowel Anastomosis, Laparoscopic Anterior Resection

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**BACKGROUND**

Advanced laparoscopic revolution is the result of continuous learning and ongoing innovation of energy and stapling devices. There is a rapid dissemination of the laparoscopic technique throughout the surgical specialties. However, the laparoscopic colorectal procedure still behind because of longer learning curve and technical difficulties.<sup>1</sup> Even after first laparoscopic colectomy reported by Jacobs et al in 1991.<sup>2,3,4</sup> The reports of laparoscopic colorectal surgery are still scattered and not well accepted as laparoscopic cholecystectomy a gold standard treatment for chronic calculous cholecystitis. This is mainly due to the technical challenges and the longer steep learning curve as a less familiar procedure.<sup>5,6,7,8</sup> Its utility for getting all benefits of minimal invasive procedure e.g decrease in postoperative pain, low incidence of paralytic ileus, shorter hospital stay as compare to open surgery well supported by controlled and metanalysis studies.<sup>9,10</sup> Its biochemical aspect was also well reported by low serum levels of interleukin-6 and other proinflammatory cytokines as an indicator of inflammatory response in the postoperative period.<sup>11</sup> Here we report our initial experience with laparoscopic colorectal surgery by the lateral to medial approach and highlighting demography, indications, technique, complications, and outcomes.

**METHODS**

This is a retrospective study at our tertiary care institute between January 2014 and February 2020. Total 383 colorectal surgeries were performed, out of which 332 cases were performed by open method and of 51 patients underwent for laparoscopic colorectal procedure. The study included mostly elective procedures. The case notes for patients were retrieved and analyzed for demographic data, indications, operative findings, blood loss and the duration of hospitalization, complications and outcomes were tabulated. The patients were counseled, and consent taken prior to the surgery and patient investigated with all preoperative blood investigations, X-ray chest, ECG.

All the colorectal cancer cases were preoperatively evaluated by colonoscopy to know the accurate site of the lesion and to get the biopsy from the lesion. Staging and resectability evaluated by computerized tomography (CT) scan or Magnetic resonance (MRI) of the chest, abdomen and pelvis.

All patients were admitted the day before surgery with preoperative evaluation and bowel preparation was routinely started as early as possible to avoid gaseous distension of the colon during the laparoscopic procedure. DVT-prophylaxis and Prophylactic antibiotics were administered to all colorectal cases. Follow up data was obtained from outpatient follow up cards, postal and telephonic communication.

**Procedure**

All the patients were placed in supine position, both legs were kept straight on the stirrup and space between the legs was open to allow passage of the circular staplers in left-sided colorectal procedures. Both arms and hands of patients were tugged by the patient's sides for better mobility of the surgeon. Patient's shoulders and arms were strapped to the table to avoid slippage during the steep reversed Trendelenburg position and right and left tilt of patient table. The surgeon usually stands on the left side of the patient for right hemicolectomy, on the right side for left hemicolectomy and anterior resection. Pneumoperitoneum usually created at the midclavicular line opposite to umbilicus as a camera port, a 12 mm port placed in the epigastric midline (EPI), 4-6 cm above the umbilicus for dissection, electrosurgical, and stapling devices, then one 5-mm port is placed in midline 4-5 cm infraumbilical (IU) (Figure 1). In a case with history of previous surgery and periumbilical scar, pneumoperitoneum created at the palmer point with Veress needle. The dissection starts by lateral to medial dissection, (Figure 2) lateral dissection started at the initial phase of surgery followed by vascular pedicle ligation at the end. In case of right hemicolectomy, right colon mobilized after gastrocolic ligament division and vascular pedicle ligation done at the end, tumor bearing segment exteriorized through periumbilical incision and ileocolic anastomosis done by double stapler or side to side hand sewn method. (Figure 3a, 3b) For left hemicolectomy, the colon is transected 5-7 cm distal to the lesion and tumor-bearing segment is exteriorized through periumbilical incision. The tumor-bearing colonic segment was then resected with the linear stapler device and the anvil of a circular stapler is secured with a purse-string around the distal colonic end, which is returned into the abdomen after that pneumoperitoneum reestablished and the bowel continuity is restored using a circular stapling device. Pelvic cavity thoroughly irrigated and two negative suction drains placed. At the end of all right sided colectomies, anastomosis was done extracorporeally. Left-sided colonic and rectal anastomosis was carried out intracorporeally. At the end of all rectal surgery, anastomosis leak test done by filling the pelvic cavity with normal saline and inflation of the distal stump with air. Surgical incision was closed in two layers. On first postoperative all patients are allowed sips of water orally followed semisolid diet and full oral diet on 2<sup>nd</sup> and third postoperative days.

**RESULTS**

Over the 60 months of follow up from January 2014 to February 2020 month, out of total 383 colorectal surgeries, 51 cases underwent laparoscopic colorectal surgery where 33 (64.70%) were males and 18 (35.29%) females respectively, the mean age of male patients were 54 years (19-71) and 45 years (18-81) of female patients. Colorectal procedures done for various indications, the majority 39 (76.47%) were for malignant disease and 12 (23.52%) for

benign indications. The indications of the laparoscopic approach to laparoscopic colorectal surgery were broad, ranging from malignant disease to inflammatory disease, 39 cases operated for colorectal malignancy out of which 25 (49.01%) for left or right colonic malignancy, 14 (27.45%) for rectal malignancy and 12 (23.52%) for benign indications. Regarding colonic malignancy adenocarcinoma was the most common type of histological variety of malignancies and 1 case of caecal GIST (gastrointestinal tumour) and 1 case of metastatic colonic malignant melanoma. In case of rectal malignancy lower rectal malignancy was the most common indication for laparoscopic rectal surgery. Ulcerative colitis and Ileocecal tuberculosis were most common benign indications (Table 1). The procedures consisted of 37 laparoscopic colectomies, 32 were right, left or extended colectomies and 5 laparoscopic subtotal colectomies. 25 hemicolectomies was performed for malignancy and 7 for benign indications. In 6 laparoscopic LAR (low anterior resection) and 8 laparoscopic APR (abdominoperineal resection) performed for rectal malignancy. All cases 49 (96.07%) were done electively except two cases (3.77%) were operated on emergency basis. One of them was a case of fulminant ulcerative colitis with steroid induced myopathy and CMV colitis which was managed by laparoscopic subtotal colectomy with end ileostomy and dysfunctional mucous fistula, another case of ascending colon carcinoma admitted in our emergency presented as a case of subacute intestinal obstruction initially he was managed conservatively followed by elective laparoscopic right hemicolectomy. 1 case needed conversion of procedure due severe post radiation, inflammatory changes and narrowed pelvic. Out of 14 rectal malignancy cases 11 received concurrent chemoradiotherapy (45 Gy in 18 fractions of 25 Gy concurrent radiotherapy followed by oral capecitabine, another 1 case of ascending colon adenocarcinoma also received a short course of 5 fractions 5 Gy of radiotherapy followed by two cycle capecitabin. The mean operating time was 150 minutes (110-240 mins) and mean operative blood loss was 80 mL (range 60-165 mL). None of our case needed intraoperative blood transfusion; however, two cases of right colonic malignancies received 1-2 units of blood transfusion in postoperative period. In all the cases that underwent laparoscopic colorectal surgeries, oral diet started between 2-5 days. The mean length of hospital stay was 5.88 days (range 3-29) (Table 2). Since 2017 we have done totally laparoscopic APR and trans perineal retrieval of specimen without making any abdominal incision.

**Short-Term Complications**

The total number of short term complications were 18 (35.29%) where 3 (5.88%) patients had wound infections, 4 (7.84%) prolonged ileus, 3 (5.88%) diarrhea, 2 (3.92%) Urinary retention, 3 (5.88%) Respiratory tract infection (2 upper respiratory tract infection, 1 plural effusion) (Table 3). 3 cases had major complications: 1 case had intraabdominal collection, which was managed by radiological intervention,

1 case of metastatic malignant melanoma of ascending colon had postoperative nasal bleeding and LFT derangement which was successfully managed with anterior nasal packing and conservative management and another 1 case of laparoscopic right hemicolectomy developed fever, abdominal pain and progressive abdominal distension on 4<sup>th</sup> postoperative day and seropurulent discharge from wound with feculent smell. In the view of possible anastomotic leak patient was explored, around one liter of turbid fluid with multiple flakes was aspirated, whole of the small bowel and large bowel was edematous, at the site was anastomosis, suture line was healthy no leak seen, however, in view sealed perforation proximal stoma was made around 1.5 feet proximal to anastomoses. Two 28 French drain was placed, patient allowed orally on 2<sup>nd</sup> postoperative day and discharge on 5<sup>th</sup> postoperative in satisfactory general condition, final histopathological report of this revealed inflammatory pathology, no evidence of malignancy or tuberculosis.

**Long Term Complications**

On long term follow up, 1 case developed an incisional hernia which managed by laparoscopic mesh hernioplasty, 1 case incision site metastasis after this /occurrence we adopt to use a wound protector for retrieval of specimens to avoid any incision site metastasis, another patient had metachronous periampullary carcinoma that undergone evaluation, staging laparoscopy and found to have liver metastasis.

<b>Sex N (%)</b>	
Males	33 (64.70)
Females	18 (35.29)
<b>Age (Years)</b>	
Male	54 years (range 19-71)
Female	45 years (range 18-81)
<b>BMI (Kg/m<sup>2</sup>)</b>	21 (19-29) Kg/m <sup>2</sup>
<b>Colonic Malignancy n=25(49.01)</b>	
Right or left colon malignancy (Adenocarcinoma)	22 (88)
Caecal GIST	1 (4)
Metastatic colonic malignant melanoma	1 (4)
Sigmoid adenocarcinoma	1 (4)
<b>Rectal Malignancy n= 14(27.45)</b>	
Lower rectal malignancy	9 (64.28)
Mid rectal malignancy	3 (21.42)
Upper rectal malignancy	2 (14.28)
<b>Benign n=12(23.52)</b>	
Colonic inflammatory stricture	3 (25)
Ulcerative colitis	4 (33.33)
Ileocecal tuberculosis	5 (41.66)

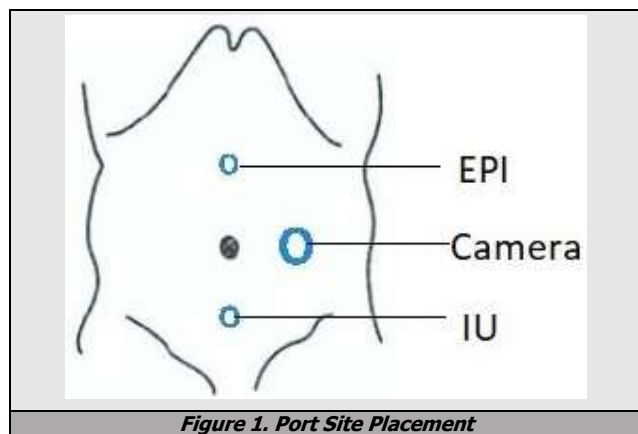
**Table 1. Demography and Indications of Patients Who Underwent Laparoscopic Colorectal Surgery (n=51)**

Laparoscopic hemi-colectomies	32 (62.74)
Laparoscopic LAR	6 (11.76)
Laparoscopic APR	8 (15.68)
Laparoscopic subtotal colectomies	5 (9.80)
<b>Surgical Outcomes in Patients who Underwent Laparoscopic Colorectal Surgery</b>	
<b>Variable</b>	<b>Values</b>
Operating time (min)	150 minutes (110-240 mins.)
Diet start	2-5 days
Blood loss (cc)	80 cc (60-165 mL)
Conversion to open surgery	1 (4.00)
Postoperative stay (day)	5.88 days (3-29)
OPD follow-up (months)	60 months

**Table 2. Colorectal Procedures (n=51) and Their Surgical Outcomes**

Short Term Complications	
Wound infection	3 (5.88)
Postoperative ileus	4 (7.84)
Diarrhoea	3 (5.88)
Urinary retention	2 (3.92)
Respiratory tract infection	3 (5.88)
Intra-abdominal collection	1 (1.96)
Nasal bleeding, liver function test derangement	1 (1.96)
Anastomotic leak	1 (1.96)
Long term complications 3 (5.88)	
Incisional hernias	1 (1.96)
Incision site metastasis	1 (1.96)
Metachronous periampullary carcinoma	1 (1.96)

**Table 3. Postoperative Complications, n=18 (35.29%)**



**DISCUSSION**

Since first reported of laparoscopic-assisted colectomy by Jacobs et al in 1991<sup>2</sup> large number of study and meta-analyses had shown the benefits laparoscopic colorectal surgery in terms lesser postoperative pain, earlier recovery of bowel transit and shorter hospital stay.<sup>5,6,7,8,9</sup> Reports also suggested that laparoscopic surgery was related to a decreased inflammatory response.<sup>10,11</sup> Laparoscopic colorectal surgery (LCR) is comparatively difficult surgery and it requires advanced skills and a specific training, this perceived difficulties are further made this more difficult by adapting concept of complete mesocolic excision (CME) in

the surgical treatment of colon cancer.<sup>12,13</sup> To achieve the good oncologic results.<sup>14,15,16,17,18</sup> In the initial phase of learning, hand-assisted laparoscopic may be a useful strategy and it is well reported by prospective randomized and non-randomized trials<sup>19,20,21</sup> that hand-assisted laparoscopic colectomies (HALC) could utilize as bridge procedure toward totally laparoscopic colorectal procedures and offers all benefits of minimally invasive laparoscopic surgery.<sup>22,23</sup> In the initial phase of our study, all the laparoscopic colorectal procedure started in very selective cases where we adopt lateral to medial approach, in the first few cases we just mobilized colon by lateral to medial approach, all the vessel ligation and bowel anastomosis done by extracorporeal method. However, extracorporeal ligation of vessels and bowel anastomosis might lead to incomplete clearance of mesenteric lymph node and ultimately needs bigger incision. In our study all cases underwent laparoscopic colectomies by lateral to medial approach, this technique was first described by Young-Fadok and Nelson<sup>24</sup> which is similar to open procedure and better adopt by surgeons who already doing colectomies by open method. Young-Fadok and Nelson study advice to place the camera port in left upper quadrant and two 5 mm ports supraumbilical and infraumbilical respectably to start the colon mobilization from the caecum first approach in clockwise fashion, in this technique camera port placed on head side and two working ports in the lower abdomen which is totally differ from ergonomics view were eye situated in central of two hands (camera port between to working port) which create difficulty in get used to. Our technique is almost same as described by Marco Lotti et al<sup>25</sup> however, port placement is slightly different from them as they described, Marco Lotti et al used to place their camera port on the left side of the umbilicus and one 5 mm epigastric port and another 5 mm port on McBurney's point.

According to Jacob and Nelson approach clockwise dissection, where dissection started from the caecum to transverse colon may take you behind the kidney in the wrong dissection plan, while in our anticlockwise approach dissection started from the opening of gastrocolic, duodenocolic ligament followed by hepatic flexure, ascending colon and caecal mobilization, where head up and right up position of operating table also helping to keep the dissection plane open by gravity with actively pulling the tissues for traction. We use to attempt central vascular ligation at the end, which avoid any disruption of mesentery in the begins of procedure and lesser chance of spillage of cancer cells as used to sealing dissection device in view to seal the two facial layers of mesentery to avoid the cell spill, we utilized harmonic scalpel for dissection and divided vessel of application of Hem-o-Lock clip on both sides. Here we report our initial experience of a single institute laparoscopic colorectal procedure in 51 patients who underwent laparoscopic colorectal surgeries between January 2014 and February 2020. All the cases operated in our surgical gastroenterology department at tertiary care institute, the majority of our laparoscopic colorectal cases were conducted for malignant indications in a high number of cases 39

(76.47%). There was minimal blood loss 80 cc (60-165 mL) and none of the patients needed peroperative blood transfusion, however, two patients required 1-2 unite of postoperative PRBC transfusion, all intra-operative bleeding controlled by harmonic scalpel and vascular clip application. Regarding colectomies right hemicolectomies was the most common procedures in comparison to left sided hemicolectomies surgery. This is attributed to the fact that right-sided colonic cancers are more common than the left-sided in our area our tertiary referral institute. It is uncertain whether increased proportion of right-sided tumours is a referral bias or whether it is truly more common in north India.<sup>26</sup> Inflammatory diseases were also common indications for surgery in our study. In our series all cases were operated electively except two cases that were operated on an emergency basis. 1 case was admitted as a case of fulminant ulcerative colitis and another 1 case as carcinoma caecum presented as subacute intestinal obstruction. Our study shown less number of postoperative complications, reoperation, and minimal blood loss during the operation, 4 (7.84%) postoperative ileus, 3 (5.88%) diarrhoea and 3 (5.88%) wound infection were most common short term complications. We have a maximum 60 months of follow up and in this follow up period we haven't seen any e.g. ischemic bowel stricture, anastomotic leak. Regarding long term complications 1 case developed an incisional hernia, 1 case had incision site metastasis and another presented with metastatic metachronous periampullary carcinoma after 2 years of primary surgery.

### CONCLUSIONS

Although, in recent years, the number of laparoscopic colorectal surgeries has increased, several reports still show suboptimal use of minimally invasive technique in colorectal disease and is substantially different among centers. Although it has a long learning curve, and requires special skill and training, its implementation requires easiest laparoscopic approach which is more familiar to surgeons performing colorectal surgeries by open method. Results of this study support the view that stepwise continuous efforts, easy-to-perform surgical techniques, and adequate training in teaching-oriented environment can produce good outcome.

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