A Study of 101 Laparoscopic Colorectal Surgeries: a Single Surgeon Experience. How Important Is the Learning Curve?

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Abstract This study aims to document demographic and intraoperative variables and short-term postoperative outcomes in patients being operated by laparoscopy-assisted colorectal surgeries and assessing the magnitude of impact of the learning curve on surgical results. This study included 101 patients with colonic or rectal pathology getting operated for laparoscopy-assisted colorectal surgeries carried out by the same surgeon over 5 years (2008 to 2013). The patient data was retrospectively analyzed for pre-decided variables. Also, comparison was made between the surgeries performed during the learning curve of initial 30 cases with subsequent operations. Laparoscopic colorectal surgeries give satisfactory results in terms of intraoperative parameters like surgical duration, blood loss, and clinico-pathologic parameters like lymph nodal resection and distal and circumferential margins. Patients undergoing laparoscopic colorectal surgeries fare better in short-term postoperative period while early long-term outcomes appear similar as compared to the standard open colorectal surgeries. The surgical outcomes, both intraoperative and early postoperative, improve significantly once the

learning curve is negotiated. Laparoscopic Surgery can be safely used as an alternative to conventional open colorectal surgeries without compromising on oncological principles.

Keywords Laparoscopic colorectal surgery · Learning curve · Minimal access · Colorectal cancer

Introduction

Laparoscopic colorectal surgery is an upcoming approach towards management of colorectal diseases but it is yet to establish itself as a preferred modality of surgery. Laparoscopy, over the last three decades, has rapidly gained favor with surgeons but the same alacrity was not shown when it came to colorectal surgeries. Chief reasons being the complexity of the procedure, the learning curve involved some initial reports of port site metastasis and concerns regarding the oncological adequacy of resection. Laparoscopy in colorectal surgeries is gaining global acceptance yet only selected centers in India utilize it as preferred approach to colorectal diseases. We started with the minimal invasive approach since 2008 and found it to be both convenient and beneficial for the patients in the early postoperative period. We retrospectively examined the records of patients who underwent laparoscopic colorectal surgeries between 2008 and 2013 with an aim to evaluate and document the feasibility of minimal access colorectal surgery in Indian setting.

What Does This Paper Add to the Literature? Worldwide, multiple trials and studies have recently documented the feasibility of minimal access approach to colorectal diseases but very few studies are available from India. Through this case series, we attempt to evaluate the application of this approach in the context of Indian patients.

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Patients and Methods

Inclusion Criteria

Patients getting operated for any of right hemicolectomy, left hemicolectomy, sigmoid colectomy, total colectomy, anterior

resection, or abdomino-perineal resection and who were willing and medically fit to undergo a laparoscopic surgery were included in the study.

Exclusion Criteria

1. Any medical contraindications to laparoscopy
2. Emergency indications like acute intestinal obstruction
3. Pregnant females
4. Pediatric patients

All the surgeries were done by a team led by the same surgeon who is well experienced in both laparoscopic and open colorectal surgeries, supported by two other surgeons, one responsible for the camera and the other as a surgical assistant. The rest of the team consisted of a single scrub nurse experienced in laparoscopic procedures.

A total of 101 patients operated between the year 2008 and 2013 were found eligible for this study.

Their case records and histopathology reports were examined for predefined variables like patient demographic data, surgical time, intraoperative blood loss, conversion rates, distal and circumferential margins, lymph node yield, and early postoperative parameters like ICU and total hospital stay, time to pass the first flatus, and time the first oral feed could be tolerated. The data thus collected was then statistically analyzed.

The time of surgery was calculated from the time of the first port placement to the time of completion of closure of the wound. The surgeries which were converted to open were not considered for surgical time analysis.

The distal and circumferential margins, lymph node yield, were obtained as per the histopathology reports. Circumferential resection margins (CRMs) were defined as positive if malignant cells were found at microscopy at a distance of less than 2 mm between the outermost part of the tumor and the CRM.

Patients' early postoperative parameters were obtained from the case files and from their progress noted during their follow-up visits which were timed at 5, 10, and 30 days post discharge and then 3 monthly for the first year.

Results

The patients were evaluated for certain pre-decided demographic, intraoperative, and early postoperative parameters.

The indications of surgery in our sample was malignancy in 96 of which 17 cases were post chemotherapy and/or radiation while 5 cases were operated for non-cancerous pathologies (2 ulcerative colitis, 2 Crohn's disease, and 1 multiple colorectal polyps) (Tables 1 and 2, Fig. 1).

All patients included in the study were given preoperative bowel preparation with polyethylene glycol a day prior to surgery. General anesthesia with epidural analgesia was the preferred mode of anesthesia. The Epidural was removed on the 3rd day post-surgery and the patient was then continued on NSAIDs for pain relief. Average time to pass the first flatus was 1.83 days (range 1–5 days), and average time to start oral feeds was 4.00 days (range 3–6 days).

Of total 101 subjects, 10 (9.90 %) required conversion to open surgery; common causes were bulky disease (3 patients) and widespread adhesions (7 patients) especially in patients having received neoadjuvant chemo-radiation. A covering colostomy was required for 7 (16.2 %) out of 43 anterior resections.

Mean surgical time improved from 182.76 min in our learning period of the initial 30 surgeries to 162.5 min in subsequent operations ($p=0.0229$, statistically significant). Mean intraoperative blood loss came down from 111.72 to 93.03 ml ($p=0.0589$, not significant). Average yield of lymph nodes was 12.05 (range 1 to 23) out of which on average 1.84 LN turned out to be positive (range 0 to 16). The patient who underwent neoadjuvant treatment had a lesser mean LN harvest (6.11 nodes) as compared to those who underwent surgery as the primary intervention (15.08 nodes). In our initial 30 surgeries, we harvested an average of 11.57 LN per surgery which went up to 12.26 in subsequent surgeries ($p=0.5978$,

Table 1 Patient characteristics

Patient characteristics	
Sex	
Males	65
Females	36
BMI	
<19.9	8
20–24.9	58
25–29.9	31
>30	4
Age (years)	
<30	5
31–50	20
51–70	50
>71	26
ASA	
I	0
II	35
III	53
IV	13
Previous treatment	
None (upfront surgery)	84
Neoadjuvant chemo±radiation	17
Total	101

Table 2 Pathological diagnosis

Pathological diagnosis	
Well differentiated	9
Moderately differentiated	62
Poorly differentiated	13
NHL	2
GIST	1
Non-malignant	5
Total	101

not statistically significant). The average distal margin was 2.84 cm while circumferential margin was more than 0.3 cm in all 101 cases. Twenty-eight (27.72 %) patients did not require any ICU stay, while only 21 patients (20.79 %) stayed in ICU for more than 2 days, mean ICU stay being 1.62 days. Total stay ranged from 4 to 23 days, (average 8.63 days) (Table 3).

Two (out of 31) (6.4 %) patients had stoma-related complications (1 prolapsed stoma and 1 retraction). Wound infection was seen in 3 patients (2.9 %); 1 patient had an intra-abdominal collection and needed CT-guided drainage of the same. Anastomosis was required in 73 subjects of which leak were found in 3 patients (4.11 %).

We faced 1 (0.9 %) mortality in a patient who had developed a leak on day 4 of an ultra-low lap-assisted anterior resection with covering colostomy and was re-explored, but the patient deteriorated and expired on day 8.

On follow-up visits, 3 patients were found to develop fistulas, 1 having a recto vaginal fistula while the other 2 had a fecal fistula. Four patients showed metastatic/recurrent disease, 1 in the lung; 1 had brain metastasis while 2 developed local recurrence.

Fig. 1 Anatomical distribution of disease

Discussion

Minimal access surgery for colorectal cancer is fast establishing itself as a preferred approach over conventional open surgery. The obvious advantages of minimal access surgery like less pain, early mobilization, reduced hospital stay, better cosmesis, and less morbidity attracted our attention, and we decided to apply it to colorectal surgery beginning from 2008 and soon made it our modality of choice. Evidence in form of multicentric trials worldwide have demonstrated the comparability between the open and laparoscopic colorectal surgeries and vindicated our choice.

We found that the learning curve is a daunting challenge. However, in our experience, a trained colorectal surgeon can duplicate the results of open surgery quite easily once he trains himself in laparoscopy. This learning curve has been thought to plateau after more than 20 surgeries [1]. Although, different studies report range from 11 to 110 [2, 3]. We also noticed improvement in our operative parameters after 20 to 30 surgeries.

Time required for a laparoscopic surgery was more than its conventional open counterpart. Multiple studies reported that laparoscopic surgeries took longer time than conventional open methods. While some studies like COREAN, COLOR II, Lacy, and Koh found the increased operative time to be statistically significant, Prakash and Yang Q found operating time for laparoscopy group to be more, though statistically not significant [4–9]. In our experience, the operating time decreases significantly with the surgeon's increasing experience.

Most agreed towards significantly less blood loss with laparoscopy [5, 6, 10]. One criticism for some initial studies was the high conversion rates, e.g., 21 % in the COST study. This may indicate that some surgeons in these studies have not yet

Table 3 Intraoperative and early postoperative parameters

Parameter	Mean value	Initial 30 cases	Subsequent cases	<i>p</i> value	Significance
Average surgical duration (min)	168.81 (range 80 to 300)	182.76	162.5	0.0229	Significant
Mean intraoperative blood loss (ml)	81.2 (range 30 to 300)	111.72	93.03	0.0589	Not significant
Lymph node yield (mean)	12.05	11.57	12.26	0.5978	Not significant
Mean ICU stay (days)	1.62	2.23	1.37	0.0131	Significant
Mean total stay (days)	8.63	11	7.63	<0.0001	Significant

approached the end of their learning curve. It is also indicative of the fact laparoscopic surgery was still evolving and many of the techniques were not yet mature. This has been borne out by results of the recent trials, especially some single-center studies show lower conversion rates 17 % (color II), 6.4 % (prakash), 6.06 % (Ivanov P), and 15.0 % (Kupcsulik P) [5, 8, 11, 12].

Owing to the magnification provided by the laparoscope, the overall surgery improves in fineness and accuracy, allowing better dissection, reducing tissue handling, retraction, and trauma, and helping preserve nerves, ureter and bladder, etc. in an easier way [13, 14]. These factors then reflect on patients' postoperative recovery in terms of pain, mobilization, ICU and total hospital stay, and return of bowel function that favor laparoscopic surgery [5, 7, 8, 11].

Current evidence confirms that tumor clearance and lymph node yields are comparable to open surgery. Lacy's group in Barcelona randomized 219 patients with colonic cancer to either laparoscopically assisted or open surgery. With a median follow-up of 43 months, the rate of tumor recurrence, site of recurrence, and overall survival were not significantly different between the two groups. Larger RCTs like COLOR II, MRC and CLASICC also showed no significant differences in terms of circumferential, proximal and distal margins, and lymph nodal yield between laparoscopy and open surgeries [5, 15].

The earlier concern regarding port site metastasis in minimal access surgery for malignancy is also now losing ground. Morino et al. reported a single incidence in a prospective study examining 100 consecutive patients with 4 years of median follow-up [16]. Lacy reported no incidence of port site metastasis in a series of 91 patients [6]. The actual rate of port site recurrences is below 1 %, which is similar to the recurrence rate in the incision scar in open surgeries [17].

Kupcsulik P et al. reported that length of hospital stay for non-complicated cases was 6.7 days with complication rate of 9.9 % and noted that laparoscopic surgery was found to be useful for all kind colorectal diseases requiring elective resection [12]. COLOR II and Ivanov P et al. also reported reduced hospital stay with faster recovery in laparoscopically operated patients [5, 11].

The reduced ICU and total stay, less analgesia requirement and less likelihood of complications, offsets the cost factor as well. A recent randomized study from Sweden has compared

laparoscopic with open surgery for colonic cancer and concluded that within 12 weeks of surgery, there was no significant difference in total costs to society [18].

Yang et al. reported fewer male sexual problems and better sexual functioning at 12–18 months after laparoscopic total mesorectal excision for low rectal cancer when compared with open surgery; better sexual life in the laparoscopic group was even observed after 24 months postoperatively [19].

Li et al. and Braga et al. have also supported better quality of life after laparoscopic surgery [20, 21].

The recent COLOR II trial consolidated our belief by reporting an intraoperative complication rate of 14 % in laparoscopy arm compared to 12 % in open surgeries. In laparoscopic and open surgeries, the anastomotic leak rates were 13 % and 10 %, respectively ($p=0.462$, not significant). Positive circumferential margins were found to be positive in 10 % patients in each arm while average distal margin was 3 cm in each of the arms. Their conversion rate was 17 %.

A Cochrane systematic review of randomized controlled trials by Kuhry E analyzed 12 trials (3346 patients) and found no significant differences in the occurrence of incisional hernias or the number of reoperations for adhesions ($p=0.32$ and 0.30 , respectively). Port-site metastases and wound recurrences were rare and no differences in tumor recurrence and overall mortality, concluding laparoscopic resection of carcinoma of the colon is associated with a long-term outcome that is similar to that after open colectomy [22]. This was supported by MRC CLASSIC as well.

We find long-term recovery to be similar in patients operated by either modality but with definite advantages in the immediate postoperative recovery in those operated by laparoscopy.

Conclusion

We realized that once past the “learning curve” that applies not just to the operating surgeon but to a good extent to the entire assisting team as well, the surgical time and quality improve significantly. The patients thus operated enjoy the benefits of laparoscopic surgery like less postoperative pain, less chances of postoperative complications, and early mobilization. These

benefits have a significant impact on outcomes of major surgeries as in colorectal context. As more and more data is published and presented and as more surgeons train and practice advanced laparoscopic surgeries, the apprehension regarding applicability of minimal access to colorectal should decrease leading to better surgical outcomes.

Conflicts of Interest None.

Author's Contribution Anil Heroor contributed to the conception and design of the work, revising it critically and giving final approval of the version to be published. Ghanishkumar Panjwani contributed to the acquisition, analysis, and interpretation of data and drafting of the work. Rahul Chaskar contributed to the acquisition of data.

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