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ORIGINAL ARTICLE

Attempting a Laparoscopic Approach in Patients Undergoing Left-Sided Colorectal Surgery Who Have Had a Previous Laparotomy: Is it Feasible?

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Abstract

Background The feasibility of a laparoscopic approach in patients who have had a prior laparotomy (PL) remains controversial. We hypothesized that laparoscopic colorectal resection was safe and feasible in patients with previous open abdominal surgery.

Methods A retrospective review (2007–2015) of all patients undergoing laparoscopic resection for sigmoid and rectal adenocarcinoma with or without prior midline laparotomy (NPL) was performed. Primary endpoints included conversion and perioperative morbidity. Secondary endpoints included length of stay and perioperative outcomes. Demographics, surgical history, oncologic staging, and short-term outcomes were reviewed.

Results We identified 211 patients, of whom 33 (15.6%) had a prior laparotomy. Significantly more patients in the PL group were female (76.2 vs. 52.8%, $p = 0.004$). Patients with PL were of similar age to NPL patients (69.3 vs. 62.5, $p = 0.09$), and comorbidities, tumor staging, and neoadjuvant therapy were comparable between groups (all $p > 0.05$). Additional trocar placement was significantly higher in PL group (33.3 vs. 17.4%, $p = 0.03$), while conversion rate did not reach statistical significance (24.2 vs. 12.9%, $p = 0.08$). The postoperative complication rate was comparable between PL and NPL patients (33.3 vs. 25.3%, respectively, $p = 0.2$).

Conclusions Prior laparotomy should not be a contraindication to patients undergoing laparoscopic colorectal surgery, though surgeons should anticipate a higher likelihood of conversion to open.

Keywords Laparoscopy · Laparotomy · Colorectal · Cancer

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Introduction

Laparoscopic colorectal surgery has been shown to have many advantages compared to open surgery. This includes decreased postoperative narcotic usage, faster return of bowel function, decreased length of hospital stay and enhanced cosmesis with comparable oncologic outcomes to open surgery.[1–3] However, for those patients who have had a prior laparotomy, laparoscopic colorectal surgery can be much more challenging.

Previous abdominal surgery usually promotes the formation of intraperitoneal adhesions in over 66% of patients.[4] Previous studies have shown that reoperation after previous laparotomy is associated with increased operative time and complications, including the risk of enterotomy.[5,6] Due to decreased tactile feedback with laparoscopic surgery and risk for injury, previous laparotomy has historically been considered a

relative exclusion for a laparoscopic approach to subsequent abdominal operations.

The progressive improvement in laparoscopic techniques and increased experience of surgeons, however, has expanded the indication for laparoscopy to more complicated situations including those patients with prior open abdominal surgeries. Studies evaluating the feasibility of laparoscopic colorectal surgery in setting of previous abdominal surgery are limited. While a recent review demonstrated similar morbidity but higher conversion rates, there was a large amount of heterogeneity among the studies.[7] Furthermore, left-sided and rectal resections constitute a perceived more difficult procedure and make up a paucity of the present literature. As such, further experience is needed. Thus, the aim of our present study was to evaluate the safety and feasibility of laparoscopic colorectal resection after prior laparotomy.

Materials and Methods

Institutional Review Board (IRB) approval was obtained prior to chart review (Reference No. 09-15-11C). A retrospective review of the electronic medical record was performed on patients who underwent laparoscopic colorectal resection for adenocarcinomas of the sigmoid colon or rectum between 2007 and 2015 at University Hospitals Cleveland Medical Center. Patients were identified using *Current Procedural Terminology* codes 44204-44208, 44210-12, 45395, 45397, 45499 with or without *International Classification of Disease 9th Revision* code V64.41 to account for laparoscopic procedures converted to open surgery. All surgical procedures were performed by five experienced, board-certified colorectal surgeons who had performed more than 500 laparoscopic colectomies. Laparoscopic surgeries of interest included low anterior resections (LAR), abdominoperineal resections (APR), and sigmoid colectomies. Exclusion criteria were patients under 18 years of age, patients with incomplete medical records, benign pathology, or undergoing resection for palliation. Patients with a prior pfannenstiel or subcostal laparotomy were also excluded. Patients were grouped based upon presence of prior laparotomy (PL) or absence of prior laparotomy (NPL).

Data collected included patient demographics, American Society of Anesthesiologists (ASA) score, body-mass index (BMI, kg/m^2), comorbidities, history of prior laparotomy, and laparotomy specifics, diagnosis, procedure performed, operative time, intraoperative details including conversion to an open procedure, intraoperative complications, tumor stage, length of stay (LOS), and postoperative complications.

Operative Technique and Postoperative Care

For both the PL and NPL, a Hasson technique was used for placement of an umbilical port for initiation of pneumoperitoneum. Most procedures were performed with four trocars, placed under direct visualization laparoscopically. If the surgeon commented on the need for an additional trocar during the course of the procedure, this was documented in our dataset. Conversion from a laparoscopic to open surgery was defined by the extension of the incision for reasons other than port placement, specimen extraction or extracorporeal anastomosis as documented in the operative report.

Both patient groups had similar perioperative management using an enhanced recovery pathway.

Statistical Analysis

Statistical analyses were performed using the SPSS 20 statistical package (IBM, Armonk, NY, USA). Continuous variables were expressed as the mean ± standard deviation and were compared using Student's *t* test. Categorical variables were expressed as the frequency with percentages. Group comparisons for categorical variables were performed with Chi-square or Fisher's exact test where appropriate. A p value less than 0.05 was considered to be statistically significant.

Results

We identified 211 patients who underwent colorectal resection for sigmoid or rectal cancer with curative intent between June 2007 and September 2015, of which 178 (84.4%) patients were classified in the NPL group while 33 (15.6%) were in the PL group (Table 1). PL patients were older than NPL patients by 6 years (p = 0.09) and were more often female (p = 0.004). More PL patients had an ASA score ≥ 3 but it did not reach statistical significance (51.5 vs 28.1%, p = 0.08).

Previous surgeries in PL patients included gynecological operations (n = 16, 48.5%), urological procedures (n = 7, 27.3%), hepatobiliary procedures (n = 3, 9.1%), colorectal operations (n = 2, 6.1%), small bowel resections (n = 2, 6.1%) and a laparotomy for peritonitis (n = 1, 3%). Eleven of the patient of 33 patients (33.3%) had two or more previous laparotomies before the present laparoscopic surgery. The prior laparotomy incision was midline in 30 (91%) of patients and paramedian in three (9%).

The most common procedure performed in either group was a LAR (Table 2). The overall conversion rate was 14.7%, which was higher in the PL group but did not reach statistical significance (24.2 vs. 12.9%, p = 0.08). On subset analysis of only patients converted to open, patients in the PL group underwent conversion more often due to adhesions (15.2%) compared to those in the NPL group (0.6%,

Table 1 Patient cohort characteristics

	Prior laparotomy (n = 33)	No prior laparotomy (n = 178)	p value
Age, mean (± SD)	69 ± 14.9	62.5 ± 13.9	0.09
Rectal cancer (n, %)	29 (87.9)	149 (83.7)	0.4
Female gender, (n, %)	26 (76.2)	94 (52.8)	0.004
History of smoking (n, %)	7 (21.2)	41 (23)	0.5
BMI, mean (± SD)	38.2 ± 6.8	29.3 ± 6.7	0.9
ASA ≥ 3 (n, %)	17 (51.5)	50 (28.1)	0.08
COPD (n, %)	2 (6.1)	15 (8.4)	0.5
Diabetes (n, %)	8 (24.2)	45 (25.3)	0.5
Rectal cancer patients receiving neoadjuvant chemoradiation (n, %)	23 (69.7)	101 (56.7)	0.2
T1/2 (n, %)	16 (48.5)	85 (47.8)	0.5
T3/4 (n, %)	17 (51.5)	93 (52.2)	

SD standard deviation, *BMI* body mass index, *ASA* American Society of Anesthesiologists, *COPD* chronic obstructive lung disease, *T* tumor stage

$p < 0.001$). There were no significant differences in conversion rates based on indications for the prior surgery ($p = 0.68$).

Table 2 Operative details

	Prior laparotomy (n = 33)	No prior laparotomy (n = 178)	p value
Procedure performed (n, %)			
LAR	25 (75.8)	120 (67.4)	0.7
APR	2 (6.1)	22 (12.4)	
Sigmoid colectomy	5 (15.2)	31 (17.4)	
Hartmann's procedure	1 (3)	5 (2.8)	
Operative time, in minutes, mean (± SD)	264.8 ± 75	266.8 ± 96	0.9
Estimated blood loss, in ml, mean (± SD)	83.9 ± 73	84.8 ± 84	1.0
Conversion rate (n, %)	8 (24.2)	23 (12.9)	0.08
Indication for conversion (n, %)			
Adhesions	5 (15.2)	1 (0.6)	< 0.001
Hemorrhage	1 (3)	1 (0.6)	0.2
Bulky tumor/narrow pelvis	2 (6.1)	18 (10.1)	0.5
Other	0	3 (1.7)	0.5
Additional trocar insertion (n, %)	11 (33.3)	31 (17.4)	0.03
Length of specimen	25.6 ± 7.2	26.7 ± 9.9	0.6
CRM, in cm, mean (± SD)	1.3 ± 0.8	1.3 ± 1.3	0.7
Distal margin, in cm, mean (± SD)	5 ± 3.5	4.1 ± 2.6	0.1
No. of extracted LN, mean (± SD)	19.3 ± 5.4	20.3 ± 5.5	0.6
Positive margin, n (%)	1 (3)	2 (1.1)	0.5

LAR low anterior resection, *APR* abdominoperineal resection, *SD* standard deviation, *CRM* circumferential radial margin, *LN* lymph nodes

Significantly more patients in the PL group required an additional trocar (33.3 vs. 17.4%, $p = 0.03$). There were no reported inadvertent bowel injuries, with only one case in each cohort of intraoperative bleeding that necessitated conversion ($p = 0.3$). Oncologically, there was no significant difference between PL and NPL groups in mean circumferential radial margin (1.3 ± 0.8 cm vs. 1.3 ± 1.3, respectively, $p = 0.7$), distal margin (5.0 ± 3.5 cm vs. 4.1 ± 2.6, respectively, $p = 0.1$), percentage of patients with positive margins (2 vs. 1%, respectively, $p = 0.5$), or number of lymph nodes harvested (19.3 ± 5.4 vs. 20.3 ± 5.5, respectively, $p = 0.6$).

Postoperatively, the mean LOS was similar between groups ($p = 0.1$, Table 3). The overall complications rate was 29% and was similar between PL and NPL groups (33.3 vs. 25.3%, respectively, $p = 0.2$). Patients in the PL group had a higher incidence of urinary tract infection (9.1 vs. 1.1%, $P = 0.03$), DVT (9.1 vs. 1.1%, $p = 0.03$), but other complications including reoperation and readmission rates were similar (all $p > 0.05$). There were no mortalities within 30 days of surgery.

Discussion

The aim of our study was to evaluate the safety and feasibility of laparoscopic sigmoid or rectal resection for cancer in patients with a prior laparotomy. Our results showed that PL was associated with a higher, but not statistically significant, increased rate of conversion and significantly higher rate of need for an additional trocar. However, this was not associated with an increase of intraoperative complications. Oncologic short-term outcomes were also similar between groups. Overall rates of postoperative complications, reoperation, and readmission were similar.

Our patient cohorts were overall statistically similar with respect to number with sigmoid or rectal cancer, BMI, ASA score, and other comorbidities; however, we had significantly more old and female patients in the PL group. This suggests that although female patients are regarded to have a wider pelvis which facilitates an easier laparoscopic pelvic dissection, prior laparotomy can reduce this inherent anatomical advantage.

Our overall conversion rate was higher in the PL group, though it did not reach statistical significance, but indication for conversion secondary to adhesions was significantly higher. Our results are in contrast to those reported by Aytac et al. who conducted a case-match series for patients with prior midline laparotomy.[8] They found that the conversion rate was similar between patients but that overall postoperative complications and postoperative ileus were significantly higher in the prior midline laparotomy group. Our conversion rate was higher in the PL group; however, an important difference to note is that only a quarter of their patients underwent laparoscopic sigmoid or rectal resection which some may argue is in

Table 3 Postoperative outcomes

	Prior laparotomy (n = 33)	No prior laparotomy (n = 178)	p value
LOS, in days, mean (± SD)	6.4 ± 4	5.4 ± 3	0.1
Postoperative complications (n, %)	11 (33.3)	45 (25.3)	0.2
UTI (n, %)	3 (9.1)	2 (1.1)	0.03
Urinary retention (n, %)	2 (6.1)	7 (3.9)	0.4
DVT (n, %)	3 (9.1)	2 (1.1)	0.03
PE (n, %)	1 (3)	1 (0.6)	0.3
Anastomotic leak (n, %)	2 (6.1)	5 (2.8)	0.2
Surgical Site infection (n, %)	3 (9.1)	13 (7.3)	0.3
Postoperative ileus (n, %)	2 (6.1)	13 (7.3)	0.6
Reoperation (n, %)	1 (3)	14 (7.9)	0.3
30-day readmission, (n, %)	3 (9.1)	22 (12.4)	0.4

LOS length of stay, *SD* standard deviation, *UTI* urinary tract infection, *DVT* deep vein thrombosis, *PE* pulmonary embolus

general a more challenging laparoscopic procedure compared to a right or transverse colectomy. They did find an increased LOS in the prior midline laparotomy group, but their difference was not statistically significant likely due to decreased power from a smaller sample size similar the present study.

Vignali et al. published a larger case-match study with 91 patients in each group, undergoing colorectal resection for benign or malignant colorectal disease.[9] Their conversion rates were overall lower than what we found in the present study, with 16.5% converted in the PL group compared to 8.8% in the NPL group, which was not significant (p = 0.18). They also did not find a difference in the need for an additional trocar in the PL group. Similar to Aytac et al., the addition of right and left colectomies which comprised the majority of their procedures, likely explains the lower overall conversion rate and possibly no significant difference in the need for an additional trocar compared to our study. Similar to our study, they did not find a significant difference in overall complications between groups.

More recently, Haksal and colleagues compared patients with and without prior laparotomy undergoing sigmoid or rectal cancer resection.[10] They too reported that conversion rates were overall similar between groups, but on further analysis found that adhesions were more often the indication for conversion in the PL than NPL group. Similar to our study, the PL patients required an additional trocar more often than NPL patients, however, our overall rates of additional trocar placement were much higher (PL 33 vs. 12%, NPL 17% vs. 4%). This difference can likely be explained by the fact that the authors report that they often used four trocars for an APR and five for other cases. Our group typically uses four trocars for most cases including APR, LAR, and sigmoid colectomy so the overall number of trocars needed per case were probably similar or lower in our group. Surprisingly, the overall complication rates were higher in the NPL group; however, the differences between groups were not significant. Additionally, there were no differences in oncologic outcomes between groups, which like our findings, supports the use of laparoscopy in patients with previous laparotomy with colorectal cancers.

We acknowledge certain limitations to our study include it being a retrospective review. It is difficult to capture the inherent selection bias surgeons make when considering a laparoscopic approach in patients with prior laparotomy. This leaves us to ask which patients with prior laparotomy are not offered a laparoscopic approach? In general, it is our practice for most patients to start with laparoscopy as some parts of the dissection (i.e., splenic flexure mobilization) may be completed laparoscopically thus decreasing the length of laparotomy incision and extent of open dissection needed. Describing the extent of adhesion formation and lysis of adhesions required is important, but beyond the scope of our retrospective review and would be best evaluated in a prospective fashion. Due to our sample size, it is possible that certain prior laparotomy indications are associated with higher conversion rates, but that the present study is underpowered to detect small differences between groups. The surgeons included in this study have extensive laparoscopic experience which may limit the generalizability of our results. We also have not included long-term oncologic outcomes in this study which would provide further evidence that laparoscopy after laparotomy is safe for patients with sigmoid or rectal cancers. Despite these limitations, our study showed that a laparoscopic approach in patients with prior laparotomy did not increase overall complication rates and had comparable conversion rates, supporting the safety and feasibility of a laparoscopic approach in this population.

Conclusion

In patients with prior laparotomy requiring sigmoid colectomy or rectal resection for cancer, surgeons can expect that the dissection may often require the use of an additional trocar and an increased chance of converting to an open procedure. Conversion, however, does not represent failure on the surgeon's part, but rather sound surgical judgment that prioritizes patient safety. In this patient population, a laparoscopic approach affords comparable safety and short-term oncologic outcomes and we recommend its use when no other contraindications are present.

Authors' Contribution All the above authors meet the following conditions for authorship: (a) substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; (b)

drafting the article or revising it critically for important intellectual content; (c) final approval of the version to be published; and (d) agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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