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Early postoperative outcomes of diverting loop ileostomy closure surgery following laparoscopic versus open colorectal surgery

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Abstract

Background Although diverting loop ileostomy (DLI) formation reduces the consequences of anastomotic leak and may also decrease the incidence of this severe complication, DLI closure can result in significant complications. The laparoscopic approach in colorectal surgery has numerous benefits, including reduced length of stay (LOS), less wound infection, and better cosmesis. The aim of this study was to determine whether a laparoscopic approach at the time of the ileostomy creation has a beneficial effect on the outcomes of ileostomy closure.

Methods A retrospective analysis of an IRB-approved prospective database was performed for all patients who underwent DLI closure between 2010 and 2017. Patients' demographics, operative reports, and postoperative course were reviewed. Statistical analyses were performed using SPSS software and included descriptive statistics, Chi-square for categorical variables, and Student's *t* tests for continuous variables. Skewed variables were compared using the non-parametric Mann–Whitney *U* test. Regression analysis for overall complications and LOS were preformed to further assess the impact of laparoscopy.

Results We identified 795 patients (363 females) who underwent DLI reversal surgery. The surgical approach in the index operation was laparoscopy in 65% of patients. Conversion to laparotomy at the ileostomy closure occurred in 6.1% of patients. The overall complication rate was lower and the LOS was shorter for patients who underwent DLI closure following laparoscopic surgery. Laparoscopy at the index operation was also associated with a lower incidence of postoperative ileus and a lower estimated blood loss (EBL) at the time of DLI reversal. Multivariate regression analysis found laparoscopy to have significant benefits compared to laparotomy for overall complications and for LOS.

Conclusion Ileostomy closure following laparoscopic colorectal surgery offers benefits including reductions in LOS and overall complications.

Keywords Diverting loop ileostomy · Laparoscopy · Ileostomy closure

Background

Diverting loop ileostomy (DLI) is commonly performed to protect the anastomosis in a variety of colorectal procedures. Although DLI offers benefits, it has its own potential reversal-related complications such as ileus, small bowel obstruction, anastomotic leak, and abscess [1–6]. The primary aim of this study was to determine whether a laparoscopic approach at the time of colorectal, coloanal, or ileoanal anastomosis and DLI creation has advantages on the outcomes of DLI closure. The rationale for this proposed benefit is that larger incisions in the initial (DLI creation) operation expose the patient to more intra-abdominal adhesions, thus making the second (DLI reversal) surgery more demanding with increased risks for conversion to laparotomy, postoperative ileus, and small bowel obstruction. Although there are multiple series that report on the outcomes of ileostomy closure surgery, there are less robust data comparing the postoperative outcomes in ileostomy closure surgery following laparoscopic versus open surgery at the index operation [30]. Hiranyakas et al. reported the Cleveland Clinic Florida experience of 351 patients who underwent laparoscopic or open colorectal surgery followed by ileostomy closure surgery from 2008 to 2010. In this prior series from our department, operative time (OT), length of stay (LOS), and overall

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complication rate were lower in the laparoscopy group [7]. To the best of our knowledge, our is the largest series that compares the impact of laparoscopy versus laparotomy during colorectal surgery on DLI closure.

Materials and methods

Study population

This retrospective study was approved by the Institutional Review Board at Cleveland Clinic Foundation. A retrospective analysis of our institutional computerized registry was performed. Patients who underwent elective DLI closure surgery following creation of DLI during proctectomy or total proctocolectomy from 2010 to 2017 at Cleveland Clinic Florida were included. Patients who met any of the following criteria or diagnosis were excluded: mere ileostomy creation, emergency surgery, redo or revision surgery, hand assisted colectomy, end ileostomy formation, colostomy formation, and metastatic cancer. Subsequently, the medical records of all patients who met the inclusion criteria were reviewed and data were uploaded into a REDCap database.

Data collection

The patients' demographics, including age, gender, American Society of Anesthesiologists (ASA) score, and diagnosis during the initial surgery were retrieved from the patient's medical record. The surgical approach was defined as laparoscopy or laparotomy. Timing of surgery, intraoperative complications, conversion to midline laparotomy, and estimated blood loss (EBL) were obtained from the DLI closure surgery report. Outcome measures including LOS, overall and specific complications, as well as readmission and mortality were obtained from the patient's medical record. Overall complication was defined as having any of the specific complications including ileus, small bowel obstruction (SBO), abscess, surgical site infection (SSI), leak, blood transfusion, acute renal failure, deep vein thrombosis, pulmonary embolus, arrhythmia, pneumonia, urinary tract infection, myocardial infarction, and stroke. Ileus was defined as a failure to pass gas or stool or the inability to tolerate a diet at postoperative day four or later. SBO was defined as any of the above-described symptoms with radiologic confirmation of mechanical obstruction. Abscess was defined by radiologic imaging and anastomotic leak was defined as any disruption of the anastomosis proven by radiology at reoperation. No classification of leak was used in this study. Subsequently, complications were subdivided using the Clavien–Dindo classification into 2 groupsL the first included grade I and II and the second included grade III and IV.

Surgical technique

Patients were scheduled for DLI closure following confirmation of a healed colorectal, coloanal, or ileoanal anastomosis using digital rectal examination (DRE), flexible sigmoidoscopy, and gastrograffin enema study (GGE). At the time of surgery, a circular incision around the ileostomy was made through skin, subcutaneous fat, and fascia. The ileostomy was dissected from the surrounding tissues, and adhesions were lysed until adequate mobilization of both proximal and distal loops of small bowel was achieved. At the discretion of the surgeon, if mobilization of the ileostomy could not be safely achieved through the stoma incision due to severe adhesions or inadequate visualization, the operation was converted to midline laparotomy. Ultimately, a stapled side-to-side anastomosis was performed.

Statistical analysis

Statistical analyses were performed using SPSS software. Simple descriptive analyses were performed including mean and standard deviation (SD) for normally distributed factors and median and 25–75 percentiles for skewed factors. Univariate analysis comparing outcomes of DLI surgery following laparoscopy or laparotomy were undertaken using Chi-square for categorical variables and Student's t tests for continuous variables. Skewed variables (EBL, OT, LOS) were compared using the non-parametric Mann–Whitney U test. In order to assess the impact of laparoscopy at the index surgery among other preoperative factors, we performed a regression analysis to the overall complication rate and LOS. Multivariate logistic regression analysis was performed for overall the complication rate and multivariate regression analysis was performed for LOS. p values lower than 0.05 were considered statistically significant.

Results

A total of 795 patients [363 females; mean age 53 (SD = 16) years] who underwent DLI closure were identified. Diagnoses for the index surgery were rectal cancer, inflammatory bowel disease (IBD), diverticulitis, Familial Adenomatous Polyposis (FAP), and others in 45, 42, 10, 2, 0.7% respectively. The surgical approach in the initial surgery was laparoscopy in 65% ($n = 516$) of patients. Ileostomy closure was performed through a local incision around the stoma with a success rate of 93.9%. Conversion to midline laparotomy occurred in 6.1% of patients. The median operative time was 82 min and median LOS was 4 days. The overall complication rate was 32% (Clavien–Dindo 3 and 4–6.9%), readmission rate 10%, and mortality rate 0.2%. The most common complication was ileus (15%) followed by SBO (4%). The leak rate following ileostomy closure was 2.1% (Table 1).

There were no significant differences between the two groups relative to age, gender, BMI, initial diagnosis, prior pelvic/abdominal radiation, ASA score, and time between surgeries (Table 2). Significantly better outcomes were noted following laparoscopy for EBL (median 20 vs 25 ml; $p = 0.014$), LOS (medians 4 vs 5 days; $p = 0.001$), overall complication rate (24% vs 34%; $p = 0.002$) and postoperative ileus rate (13 vs 19%; $p = 0.02$) (Table 3). No significant differences were observed for mortality, OT, conversion to laparotomy, other complications, and readmission.

In order to further assess the impact of laparoscopy at the index surgery on the outcome measures, we performed a regression analysis of all preoperative factors on overall complication and LOS. In multivariate logistic regression (Table 4) of risk factors for the postoperative overall complication rate, only ASA score ($p = 0.02$) and laparoscopy at the index surgery ($p = 0.01$) were significant. If the patient had a lower ASA score and had undergone a laparoscopic approach in the index surgery, the risk for overall postoperative complications was significantly decreased. In multivariate non-categorical regression analysis (Table 5) for postoperative LOS, we found that BMI ($p = 0.01$), ASA score ($p = 0.02$), and laparoscopy at the index surgery ($p = 0.001$) were significant. If patients had lower BMI, lower ASA score, and had undergone a laparoscopic approach in the index surgery, they had significantly lower LOS.

Discussion

The benefits of laparoscopy are well known, including shorter LOS, lower morbidity, and faster recovery [8–14]. Our study aimed to examine the advantages of the laparoscopic approach at the index surgery on the outcomes of DLI closure. The rationale for these proposed benefits is that larger incisions potentially expose the patient to more intra-abdominal adhesions with a higher risk for conversion to laparotomy, ileus, and SBO [15, 16].

DLI closure is associated with a significant complication rate. In our series the overall complication rate was 32% (7.2% Clavien–Dindo 3 and 4) and the mortality rate was 0.2%, which is in accordance with the literature [1–6, 17–23]. The conversion rate from local incision to midline laparotomy in our series was 6.2% which was also in accordance with the literature [1–6, 17]. Emergency surgery, reoperation, older age, higher BMI, and ASA score are all well-known risk factors for poor postoperative outcomes [24–29]. We included only elective surgeries and excluded reoperations in order to minimize the

Table 1 Patient demographics, operative, and postoperative outcomes

	$N = 795$ (%)
Mean age, years [SD]	53 (16)
Gender	
Male	432 (54.3)
Female	363 (45.7)
Mean Body mass index (kg/m^2) [SD]	24.5 [4.8]
American Society of Anesthesiologist Score (ASA score)	
1	50 (6.2)
2	604 (76)
3	136 (17.1)
4	5 (0.6)
Diagnosis	
Cancer	359 (45)
Inflammatory bowel disease	336 (42)
Diverticulitis	80 (10)
Familial Adenomatous Polyposis	15 (2)
Other	5 (0.7)
Prior pelvic/abdominal radiation	305 (38)
Approach in first surgery	
Laparoscopy	516(65)
Laparotomy	279(35)
Time between first surgery to ileostomy closure surgery (days)	188.3
Conversion to laparotomy	49 (6.1)
Mean operative time	90.3 [51]
Mean length of stay (days)	5.03 [5.2]
Postoperative complications	254 (32)
Ileus	120 (15)
Obstruction	32 (4)
Abscess	21 (2.6)
Surgical site infection	20 (2.4)
Leak	16 (2.1)
Blood transfusion	8 (1)
Acute renal failure	10 (1)
Deep vein thrombosis	4 (0.5)
Pulmonary embolus	1 (0.01)
Arrhythmia	7 (0.8)
Pneumonia	8 (1)
Urinary tract infection	9 (1)
Myocardial infarction	0 (0)
Stroke	0 (0)
Clavien–Dindo Score	
I–II	201 (25)
III–IV	59 (6.9)
Readmission	81 (10)
Mortality	2 (0.25)

Table 2 Preoperative comparison between laparoscopy and laparotomy groups

Diverting loop ileostomy creation approach	Laparoscopy (%)[SD]	Laparotomy (%) [SD]	*p* value
N	516 (65)	279 (35)	
Mean age (years)	52.1 [16]	54.6 [16.5]	0.07
Gender			0.16
Male	274	163	
Female	242	116	
Mean body mass index (kg/m^2)	24.51 [4.6]	24.51 [5.1]	1
Diagnosis			0.08
Cancer	241 (46.7)	118 (42)	
Inflammatory bowel disease	222 (43)	114 (41)	
Diverticulitis	43 (8.3)	37 (13)	
FAP	10 (2)	5 (2)	
Other	0	5 (2)	
Prior pelvic/abdominal radiation	201 (39)	104 (37.2)	0.6
ASA score			
1	31 (6)	19 (7)	0.08
2	405 (78.4)	199 (72)	
3	79 (15.3)	57 (20)	
4	1	4 (1)	
Time between first surgery to ileostomy closure surgery (days) [SD]	189 [56]	179 [65]	0.7

FAP familial adenomatous polyposis, *ASA* American Society of Anesthesiologists, *SD* standard deviation

Table 3 Outcomes of ileostomy closure following laparoscopy vs laparotomy

Diverting loop ileostomy creation approach	Laparoscopy (%) [SD]	Laparotomy (%) [SD]	*p* value
N	516 (65)	279 (35)	
Estimated blood loss (ml)	36.9 [55.7]	47.2 [83.3]	0.035
Operation time, minutes	92 [46]	87.2 [57.2]	0.73
Conversion to laparotomy	29 (5.6)	20 (7.1)	0.2
Length of stay, days	4.4 [4.3]	6 [6.8]	0.001
Postoperative complications	124 (24)	95 (34)	0.002
Ileus	68 (13)	53 (19)	0.02
Obstruction	18 (3.5)	13 (4.7)	0.46
Abscess	11 (2)	10 (3.6)	0.16
Surgical site infection	11 (2)	10 (3.6)	0.25
Leak	10 (2)	7 (2.5)	0.5
Transfusion	5 (1)	3 (1)	1
Clavien–Dindo score			0.54
I–II	108 (20)	78 (28)	
III–IV	30 (5.8)	20 (7)	
Readmission	52 (10)	34 (12)	0.2
Mortality	1 (0.001)	1 (0.003)	1

SD standard deviation

bias between the two groups. In our study, EBL, LOS, overall complication rate, and the incidence of ileus were significantly lower following ileostomy closure in patients in whom the index operation was performed laparoscopically. The advantages of laparoscopy on both overall complications and LOS was confirmed with a multivariate regression analysis. Only one prior series, also from our institution, compared the results of DLI closure following laparoscopy versus laparotomy. In this series from 2013, Hiranyakas et al. [7] reported on 351 patients who

Table 4 Multivariate Logistic regression analysis—postoperative complication rate

Preoperative factor	95% confidence interval		*p* value
	Lower bound	Upper bound	
Age	0.986	1.008	0.546
Gender	0.746	1.413	0.872
Body mass index (kg/m^2)	0.994	1.063	0.112
Diagnosis	0.828	1.731	0.339
Time between first surgery to ileostomy closure surgery	0.98	1.22	0.1
Prior pelvic/abdominal radiation	0.465	1.178	0.204
ASA score	0.404	0.819	0.002
Laparoscopy in first surgery	1.083	2.037	0.014

Table 5 Multivariate regression analysis

Preoperative factor	Effect size (*B*)	*p* value
Age	0.014	0.25
Gender	0.312	0.42
Body mass index (kg/m^2)	0.154	0.01
Time between first surgery and ileostomy closure surgery	0.003	0.1
Prior pelvic/abdominal radiation	0.2	0.52
ASA score	0.592	0.02
Laparoscopy at first surgery	− .26	0.001

LOS length of stay

underwent DLI closure between 2008 and 2010. Patients in the laparoscopy group had a significantly shorter mean operative time and LOS and a lower overall complication rate.

To the best of our knowledge, this publication includes the largest series to assess the impact of laparoscopy in the index colorectal surgery on postoperative outcomes following ileostomy closure surgery. This study provides useful information on the benefits of laparoscopy that extends from the index surgery to the ileostomy closure surgery. This information may also aid surgeons in educating their patients prior to ileostomy closure following laparoscopy vs laparotomy.

The limitations of the study include its retrospective nature and the fact that multiple colorectal surgeons (5) performed the procedures. In addition, given that reports of outcome measures are taken from the patients' files, documented by multiple caregivers, this may also contribute to variance in the report. It is also important to note that, although all DLI closure surgeries were performed at our institution, some of the DLI creation surgeries were performed at another facility.

Conclusions

Ileostomy closure following laparoscopic colorectal surgery offers benefits including reductions in ileus, length of stay, and overall complications.

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Compliance with ethical standards

Disclosures Drs. Yellinek, Krizzuk, Gilshtein, Moreno-Djadou, Barros de Sousa, Qureshi, and Wexner have no conflicts of interest or financial ties to disclose.

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