

Laparoscopic and open reversal of Hartmann's procedure—a comparative retrospective analysis

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Abstract

Background Restoration of intestinal continuity after Hartmann's procedure has traditionally required laparotomy. This study compares our experience with laparoscopic and open reversal of Hartmann's procedure.

Study design All laparoscopic and open Hartmann's reversal procedures performed between January 1998 and June 2006 were reviewed. Patients with laparoscopic reversal were retrospectively matched by age, body mass index (BMI), and indication to controls with open reversal. Demographic data, perioperative course, and postoperative complications were documented.

Results We identified 41 patients who underwent laparoscopic reversal of Hartmann's procedure and these were matched to 41 patients with open reversal. The groups had similar average age and BMI. The predominant indication for surgery in both groups was diverticular disease. Conversion to laparotomy occurred in eight patients (19.5%), and was due to dense adhesions or difficulty in identification of the rectal stump. Adhesions were significantly greater in the conversion group ($p < 0.05$), and the rectal stump was not marked in any of these cases. The most common short-term complications were ileus and surgical site infection. There were no anastomotic leaks and no mortalities. The mean operative times in the laparoscopic

and open groups were 193 versus 209 min, respectively ($p = 0.33$). The laparoscopic group had a significantly lower estimated blood loss of 166 versus 326 mL ($p < 0.0005$), shorter time to bowel function return (4.1 versus 5.2 days, $p < 0.05$), and a shorter hospital stay (6.4 versus 8.0 days, $p < 0.05$). The major complication rate was also significantly lower in the laparoscopic group than in the open group (4.8% versus 12.1%, $p < 0.05$).

Conclusions Laparoscopic reversal of Hartmann's procedure is a safe and practical alternative to open reversal. It can be performed with similar operative time, fewer complications, and a faster recovery time. Conversion during the reversal procedure was significantly impacted by severity of adhesions and marking of the rectal stump.

Key words Hartmann's procedure · Reversal · Laparoscopy · Colostomy closure

Abbreviations

BMI	body mass index
LAHR	laparoscopic-assisted Hartmann's reversal
OHR	open Hartmann's reversal
PCA	patient-controlled analgesia
SICU	surgical intensive care unit

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In 1923, a French surgeon named Henri Albert Hartmann described an end colostomy procedure for the treatment of proximal rectal cancer [1]. Although originally indicated for carcinomas of the lower sigmoid and upper rectum, the procedure is used today for a variety of indications, mainly perforated diverticulitis, ischemic colitis, and colonic obstruction. Other indications include traumatic perforations, volvulus, inflammatory colitis, and anastomotic leaks

[2]. After recovery from the initial surgery, colostomy reversal and restoration of bowel continuity is indicated in selected patients. This second-stage procedure requires a major abdominal surgery and is associated with a low but real mortality rate and a significant morbidity rate ranging from 10 to 50% [3–5].

Minimally invasive techniques for colorectal surgery have evolved since the early 1990 s. Advantages of the laparoscopic approach in colectomies such as decreased morbidity, postoperative pain, hospital stay, and faster return to normal activity [6–10] have led to the application to other procedures such as reversal of Hartmann's procedure. Several small series have reported successful laparoscopic assisted Hartmann's reversal (LAHR) [11–13], and a recent systematic review has confirmed that minimally invasive benefits apply for LAHR [14]. Nevertheless, the data comparing laparoscopic and open Hartmann's reversal is limited. The aim of this study is to present a teaching university hospital's experience with LAHR and compare short-term outcomes with those of open reversal.

Patients and methods

After the approval of the Institutional Review Board of the Mount Sinai School of Medicine, we searched the medical record database of the Mount Sinai Medical Center for keywords "colostomy closure," "Hartmann's procedure," "reversal of Hartmann's colostomy," and "large bowel stoma closure" for patients >18 years of age who were admitted between January 1998 and June 2006. Charts were reviewed to identify patients post Hartmann's procedure who underwent subsequent closure of colostomy, and all patients who underwent reversal of a left or end sigmoid colostomy were included. Exclusion criteria were: previous nonresectional end colostomy, reversal of loop or transverse colostomies, the presence of concomitant procedures, and resection of more than 10 cm of proximal sigmoid or colon at the time of closure. To maintain an intent-to-treat analysis all patients who began with laparoscopy were included in the laparoscopic group, even if converted.

After identifying the laparoscopic group, the open cases were carefully reviewed. From the open group, an equivalent number of controls were selected after matching by age group (within 5 years), body mass index (BMI), and indication for the initial Hartmann's procedure. Data collected for both groups included demographics, indication for initial surgery, comorbidities (cardiovascular, diabetes, renal or pulmonary disease, and other carcinoma), operative events including conversions, and postoperative course. All complications, reoperations, and readmissions up to 30 days after were recorded.

Details of the initial Hartmann's procedure were recorded. All procedures performed for diverticulitis were given a Hinchey class of 1–4. Whether the rectal stump was marked or not was also noted. Marking consisted of either suturing the stump to the abdominal wall or placement of lengthy, nonabsorbable sutures in the stump.

In both the index procedure and at the reversal procedure, the need for splenic mobilization and the use of closed suction drains were recorded. Adhesions at the reversal procedure were graded by the surgeon as none (0), mild (1), moderate (2), or severe (3). The use of anti-adhesive materials at the index procedure was also documented.

Surgical procedure

The interval between the original procedure and the Hartmann's reversal was determined by each attending surgeon and the patient. Documented considerations included patient's preference, findings on initial procedure, as well as metabolic and overall clinical status. Results of preoperative evaluation of the colon by colonoscopy or barium enema were recorded. All patients underwent preoperative mechanical bowel preparation and enemas to clear the rectal stump.

Prior to anesthetic induction, pneumatic compression boots were placed in all cases, and intravenous antibiotics were given approximately 30 min preoperatively. A urinary catheter was routinely inserted and patients were placed in either split-legged or modified lithotomy position. Video monitors were placed on the left side of the patient, with the surgeon and assistant standing on the right. Initial port insertion was accomplished by the open Hasson technique in the right lateral abdomen. Two to three additional ports were used in the upper abdomen and right lower quadrant as needed. Lysis of adhesions was done to allow mobilization of the colostomy and identification of the rectal stump. This was carried out using scissors, monopolar diathermy, or ultrasonic activated devices according to surgeon's preference. When necessary to identify the rectal stump, a dilator, stapling device or sigmoidoscope was inserted into the rectum. The colostomy was freed from the abdominal wall and the anvil of a circular stapling device was inserted into the lumen. The colostomy was then delivered into the abdomen, and either a 12-mm trocar placed at this site or fascial closure performed. Mobilization of the left colon, splenic flexure, and resection of proximal sigmoid or left colon were done as needed. A transanal, end-to-end anastomosis was performed using a circular stapling device. Anastomotic integrity was confirmed by using insufflations of air and colored saline. Hand-assisted technique was not used in any case. The open technique has been described in detail

previously [15, 16], and included mobilization of the colostomy, laparotomy through the previous abdominal midline incision, and a similar transanal, stapled anastomosis as the laparoscopic approach.

Postoperatively, all patients were encouraged to ambulate on postoperative day 1. Pain management included intravenous patient-controlled analgesia (PCA) and early conversion to oral medication. Clear diet was usually started on postoperative day 1 and solid intake was initiated after passage of flatus or bowel movements. A nasogastric tube was inserted only for clinical and radiographic evidence of ileus. Patients were discharged when solid diet was tolerated and pain was well controlled on oral medications.

Statistical analysis

To identify differences between the laparoscopic and open reversal groups, univariate analysis with chi-square, *t*-test, or Fisher's exact test was used to compare groups by demographic, complication, and postoperative course criteria. Statistical calculations were completed using statistical software SPSS version 11.5 (SPSS, Inc., Chicago, IL) and a *p* value <0.05 was considered to represent statistical significance for all comparisons.

Results

A total of 295 patients were initially identified by the database search. From this group, 41 cases met the study inclusion criteria for laparoscopic-assisted Hartmann's reversal (LAHR). Of the remaining 254 patients who underwent open Hartmann's reversal (OHR), 153 were excluded: 34 had previous nonresectional colostomy, 43 had a transverse colostomy, 44 had concomitant surgery, and 32 patients were excluded for resection of more than 10 cm of proximal sigmoid or colon. From the remaining 101 patients, we selected the 41 open cases who best matched the laparoscopic cases by the criteria described above. A summary of the demographic data and clinical characteristics is presented in Table 1. The most common indication in both groups was diverticulitis. Other indications included perforation, obstructing colorectal carcinoma, volvulus (four patients), anastomotic leak (three patients), ischemic colitis (three patients), trauma (two patients), Fournier's gangrene (two patients), and recto-vaginal fistula (one patient). Evaluation of the rectal stump and remaining colon prior to surgery was documented in 72 patients (88%). Seven of these patients (10%) underwent barium enema, and the 65 other patients (90%) were evaluated by full colonoscopy.

Table 1 Demographics and clinical data

Demographics	Laparoscopic group (<i>n</i> = 41)	Open group (<i>n</i> = 41)	<i>p</i> value
Sex (male:female)	20:21	21:20	0.50
Age, years (mean, range)	58.49 (33–85)	63.73 (26–82)	0.11
BMI, kg/m ² (mean, range)	26.78 (19.5–40.8)	26.78 (19.5–40.8)	0.65
No. of comorbidities (mean, range)	1.58 (0–6)	1.75 (0–6)	0.37
No. of previous surgeries (mean, range)	1.45 (1–4)	1.66 (1–6)	0.29
Time to reversal, days (mean, range)	148.73 (41–962)	231.50 (43–647)	0.02
Indication for Hartmann's procedure			
Diverticulitis	24	23	0.50
Perforation	9	6	0.28
Colorectal carcinoma	2	3	0.50
Other	6	9	0.30

Table 2 Perioperative data

Perioperative data	Laparoscopic group (<i>n</i> = 41)	Open group (<i>n</i> = 41)	<i>p</i> value
Operative time, min (mean, range)	193.1 (89–460)	209.2 (57–335)	0.33
Blood loss, ml (mean, range)	166.6 (50–900)	326.6 (50–950)	0.0003
Time to bowel movement, days (mean, range)	4.2 (2–5)	5.3 (3–17)	0.023
Time to solid diet, days (mean, range)	4.6 (2–9)	5.8 (2–10)	0.009
Length of stay, days (mean, range)	6.5 (3–16)	8.1 (4–22)	0.026

LAHR was attempted in 41 patients and converted to laparotomy in 8 patients (19.5%) due to dense adhesions or failure to identify the rectal stump. In three of these cases a stapling device that was inserted into the rectum failed to assist in identification of the rectum. In the other five cases dense adhesions were encountered and were the reason for conversion. There were significant differences in length of surgery, estimated blood loss, length of stay, and time to bowel function (Table 2).

Postoperative morbidity was 37.8%, most commonly surgical site infection and ileus (Table 3). Ileus was defined as the need for nasogastric tube decompression in the postoperative period. Two patients in the open group required reoperation: one for debridement of a deep surgical site infection, and another who developed an incarcerated inguinal hernia on postoperative day 3. Two other patients in this group were admitted to the surgical intensive care unit (SICU) postoperatively. One of these patients had severe pulmonary comorbidities and required

short postoperative mechanical ventilation. The second patient was admitted to SICU for observation for 24 h due to the surgeon's request because of the patient's age and comorbidities. Three (7.3%) major complications occurred in the OHR (deep vein thrombosis and reoperations) and one (2.4%) major complication occurred in the LAHR group (enterocutaneous fistula). The overall complication rate in the LAHR was significantly lower than in the OHR group (26.8% versus 47.8% $p < 0.05$). There were no anastomotic leaks, uretral injuries or intrabdominal abscesses in this series, and there were no mortalities.

Findings at both the index and the reversal procedures were analyzed to compare differences between the laparoscopic completed and converted groups. These are summarized in Table 4. No statistically significant difference was found when these criteria were compared between the LAHR and the OHR. Anti-adhesive material at the index procedure was used in only one case.

Table 3 Postoperative complications

Complication	Laparoscopic group ($n = 41$)		Open group ($n = 41$)	p value
	Completed ($n = 33$)	Converted ($n = 8$)		
None	27 (81.8%)	3 (37.5%)	21 (51.2%)	0.040
Minor				
Ileus	3 (9.0%)	1 (12.5%)	7 (17.1%)	0.331
Surgical site infection	2 (6.0%)	4 (50%)	8 (19.5%)	0.557
Pneumonia	–	–	2 (4.9%)	0.021
Atelectasis	–	–	3 (7.3%)	
Urinary retention	–	–	1 (2.4%)	0.314
Arrhythmia	–	–	1 (2.4%)	0.314
Blood transfusion	1 (3.0%)	–	1 (2.4%)	1.00
Pseudomembranous colitis	–	–	2 (4.9%)	0.152
Intensive care stay	–	–	2 (4.9%)	0.152
Major				
Deep vein thrombosis	–	–	1 (2.4%)	0.314
Re-operation	–	–	2 (4.9%)	0.152
Enterocutaneous fistula	1 (3.0%)	–	0	0.314

Table 4 Comparison of completed LAHR and converted to open LAHR

Operative parameter	Laparoscopic group ($n = 41$)			Open group ($n = 41$)
	Completed ($n = 33$)	Converted ($n = 8$)	p value	
No. of previous surgeries (mean)	1.44	1.5	0.81	1.66
Hinchey class at index procedure for diverticulitis (mean)	3.44	3.6	0.60	2.82
No. of cases with marking of rectal stump	5 (15.1%)	0 (0%)	0.04	0 (0%)
No. of cases with splenic mobilization at index procedure	5 (15.1%)	2 (25%)	0.61	8 (19.5%)
No. of cases with splenic mobilization at reversal procedure	6 (18.1%)	3 (37.5%)	0.29	8 (19.5%)
Adhesion grading at reversal procedure (mean)	1.91	2.75	0.02	2.19
No. of cases using drains at index procedure	12 (36.4%)	3 (37.5%)	1.00	8 (19.5%)

Discussion

Reversal of Hartmann's colostomy offers the obvious advantage of intestinal continuity, but historically has required a major abdominal surgery with prolonged recovery. The morbidity with open Hartmann's reversal (OHR) is reported at 4–43%, with a wound infection rate of 5–24%, and anastomotic dehiscence seen in up to 12% [3–5, 17–19]. The mortality rate in OHR ranges from 0 to 4% [16]. Given these potential risks, 40–60% of the patients do not undergo colostomy reversal after Hartmann's procedure. With the development of minimally invasive surgery, these morbidity rates may be reduced. The advantages of smaller incisions, decreased postoperative pain, shorter recovery time, and early return to normal activity, have been well described [6–10]. LAHR can offer a clear advantage over OHR in cases that require mobilization of the splenic flexure by avoiding an upper abdominal incision and its potentially increased respiratory complications [20, 21]. LAHR also allows clear view of the sigmoid and descending colon so unnecessary dissection can be avoided.

In 1993, Gorey et al. and Anderson et al. described an early experience with laparoscopically assisted Hartmann's reversal (LAHR) [11, 12]. Since then, case reports and small series of LAHR have followed, with only four single-institution and one multicenter retrospective studies with more than 15 cases [22–25] available in the literature (Table 5). Review of this literature reveals a lack of consensus regarding preferred surgical technique. Some authors advocate insertion of the initial port in the colostomy site once it is reduced into the abdomen. This approach allows safe access to the peritoneum. Most studies report safe entry with the Hasson technique in the upper midline left to the rectus sheath or at the right side, as was done in most cases of this study, with no complications. Once initial access to the peritoneal cavity is accomplished, however, lysis of adhesions and correct identification of the rectal stump can be challenging. To

assist in identifying the rectal stump, several methods have been described, including placement of nonabsorbable sutures at the initial procedure, or insertion of dilators, a stapling device, or even a sigmoidoscope [11, 14]. Failure to identify the rectal stump is the most commonly reported reason for conversion to laparotomy [14, 22–25], and in our study this was the cause for seven of the eight conversions. Manipulation of the rectal stump with a stapling device failed to avoid conversion in three of these eight patients.

In order to identify risk factors for conversion to open surgery, we compared the cases that were completed laparoscopically to the eight cases that were converted to open. We identified two statistically significant differences between the groups (Table 4): marking of the rectal stump at index procedure and lower adhesion grade at the reversal procedure were both associated with higher completed laparoscopic surgery. There were no significant differences between the groups in the severity of disease at the index procedure, the extent of the surgery as noted by Hinchey class, placement of drains or splenic mobilization. This indicates the difficulty of predicting adhesion formation simply by using previous severity of disease or extent of surgery as potential markers. In addition, a surgeon performing a Hartmann's procedure should mark the rectal stump either by leaving long nonabsorbable sutures at the staple line or suture the stump to the abdominal wall, as this can facilitate identification during the reversal procedure, especially if performed laparoscopically. Anti-adhesive materials such as Seprafilm (Genzyme Corporation, Cambridge, MA) have demonstrated a significant decrease in adhesions [26], but were used in only one patient at the index procedure. While it is reasonable to recommend its use at the index procedure, we cannot confirm or refute its utility with our study. Moreover, the use of Seprafilm is not recommended over a staple line and it should not be placed over the rectal stump [27].

It is our strong belief that a surgeon must readily convert to an open procedure if the dissection cannot be performed safely laparoscopically. The reported rate of conversion in larger series is 4–22%, and our 19.5% conversion rate is within this range. Also, the extent of distal or proximal sigmoid resection is not clearly distinguished in most studies [14, 22–25]. We chose to exclude patients who required more than 10 cm resection at the restorative operation as this may complicate the colostomy closure.

To date, only one study directly compared OHR and LAHR [14]. In 2006 Rosen et al. compared 22 LAHR to 22 OHR. As in our study, both of the groups in their study were similar in the demographic and clinical data, along with distinct advantage for LAHR—shorter time to bowel function, as well as shorter hospitalization. Similar to the results of Rosen et al., our study found that LAHR carries a

Table 5 Published studies of laparoscopic Hartmann's reversal (more than 15 cases)

Author	Year	N	Complication rate	Conversion rate (%)
Sosa [22]	1994	18	14%	22.2
Regadas [23]	1998	20	41%	15
Vacher [24]	2002	38	23.5%	15.7
Rosen [14]	2006	22	14%	9
		22	59%	
Khaikin [25]	2006	27	33%	14.8
Mazeh (this study)	2007	41	26.8% in LAHR	19.5
		41	48.7% in OHR	

lower morbidity rate than the OHR. This can be attributed to the advantages of laparoscopic surgery mentioned previously. We compared the two groups for age, body mass index (BMI), comorbidities, and the indication for the initial procedure, and found no statistically significant differences. Further subanalysis failed to identify any significant difference in the number of previous surgeries, the severity of disease at the Hartmann's procedure, and extent of surgery. The only significant difference between the groups was in the time to reversal, which was longer in the OHR group, however this difference was identified to be related to two patients with very long time to closure that was associated with other factors rather than severity of disease at index procedure. This addresses the concern that patient selection completely accounts for the reduced morbidity seen with LAHR in previous reports. Furthermore, we maintained an intent-to-treat analysis for LAHR patients that were converted to laparotomy. These patients had a higher surgical site infection rate than those that were not converted. This suggests that surgical site infection is not solely related to the colostomy site, but also associated with a long midline incision which is avoided in LAHR. Our study also confirms the widely accepted postoperative advantages of laparoscopic surgery of shorter time to bowel function and decreased length of hospital stay.

While interpreting the results of our analysis, it is important to consider the strengths and limitations of our study. This is a retrospective study that compares two non-randomized groups. The decision on surgical approach was based on a combination of patient and surgeon preferences. The considerations for each approach were not always readily apparent. Twenty-eight attending surgeons were included in this study. Fourteen surgeons with advanced laparoscopic training performed all of the LAHR cases. We did our best to avoid bias by matching the two groups by age, BMI, and indication for the initial Hartmann's procedure. Nevertheless, the OHR group had a significantly longer interval between the initial and reversal procedures than the LAHR group. It is not clear if this difference represents a major distinction between the populations or if it was just caused by two outliers in the open group, however, this finding was also demonstrated by Rosen et al. [14]. Moreover, the OHR group had a lower mean Hinchey score and a lower number of drains placed at the index procedure (Table 4). This may suggest that the severity of the initial episode was not a factor in determining which patient will undergo open or laparoscopic surgery.

The main strengths of this study are that it is the largest series of laparoscopic Hartmann's reversal to date and that it is the only second study to compare the results to open Hartmann's reversal (Table 5). It is needless to say that randomized controlled trials (preferably with fewer surgeons) are required to draw valid recommendations.

Conclusions

Laparoscopic reversal of Hartmann's procedure is a technically feasible alternative for restoration of intestinal continuity. In experienced hands, it carries minimal morbidity and decreased hospital stay. This study is the first to compare a large cohort of laparoscopic colostomy reversal with open colostomy reversal, with encouraging results and an acceptable conversion rate. Conversion to open during the reversal procedure did not depend on Hinchey score or number of prior surgeries, but was significantly impacted by presence of adhesions and marking of the rectal stump.

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