SURGICAL TECHNIQUES

Laparoscopic reversal of Hartmann's procedure: A single-center experience

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Abstract

Introduction: Laparoscopic reversal of Hartmann's procedure (LHR) is considered a technically complex major surgical procedure. We present a retrospective analysis of a single-institution experience that assesses the treatment patterns and outcomes of patients who underwent LHR.
Materials and Surgical Technique: The study involved patients who underwent LHR between January 2004 and December 2017. All patients had previously undergone a conventional Hartmann's procedure for acute complicated diverticulitis or cancer. Patients were placed in a supine position with their legs spread apart and their left arm out to the side. Access into the abdomen was obtained through open laparoscopy, with a 12-mm trocar for a 30° laparascope inserted at the periumbilical site. We placed between three and five trocars depending on the level of operative difficulty encountered. The first surgical step was to dissect any existing adhesions, and then rectal mobilization was systematically performed to ensure the feasibility of the end-to-end anastomosis and to avoid bladder injury. The stoma was mobilized on the level of the abdominal wall and then freed from the fascia. We used a circular stapler to reestablish a tension-free anastomosis. Over 13 years, 20 patients underwent LHR. No patient required a temporary colostomy or ileostomy.
Discussion: Reversal of Hartmann's procedure involves high operative morbidity and mortality, and usually only relatively young and healthy patients are eligible for reversal. Our results are consistent with previously published literature regarding the advantages of LHR compared to the conventional technique. However, high-level evidence is still needed.

Introduction

In 1921, Henri Hartmann, a French surgeon, first described a new technique for the treatment of rectal cancer (1). This procedure consisted of a sigmoidectomy followed by a terminal colostomy and closure of the rectal stump. However, Hartmann never considered the possibility of restoring intestinal continuity. In 1950, Boyden presented results with the closure of the colostomy (2), and in 1993, Anderson *et al.* published the first report of a laparoscopically assisted Hartmann's reversal (HR) (3). Today, Hartmann's procedure (HP) is the standard operation for the treatment of complicated left side colon diseases. However, restoration of bowel continuity after HP is still considered a major surgical procedure; it carries serious risk of significant morbidity, with reported anastomotic leakage rates ranging from 4% to 16% and mortality up to 10% (4).

Colostomy reversal and restoration of bowel continuity is only for selected patients. A substantial proportion of patients (up to 74%) may be left with a permanent stoma because of the impossibility of restoring their intestinal continuity for several reasons. However, it is difficult to compare data because different pathologies lead to colostomy and subsequent laparoscopic recanalization of the bowel (e.g. diverticulitis, sigmoid volvulus, and carcinomas), and few case studies are available in the literature.

Laparoscopic surgery, through the use of circular stapling devices aims to reestablish intestinal continuity with small incisions, reduced postoperative pain, reduced hospital stays, and early return to activity while reducing anastomotic leakage.

Our study examined the intraoperative and postoperative clinical outcomes of patients undergoing laparoscopic reversal of Hartmann's procedure (LHR) in the Section of General and Thoracic Surgery at Sant'Anna Hospital in Ferrara (Italy).

Materials and Surgical Technique

This is a retrospective, single-center study using a prospectively maintained colorectal surgery database. We herein present 20 cases in which LHR was performed at the General Surgery Department at Sant'Anna Hospital in Ferrara, Italy.

These 20 patients underwent conventional HP between 2004 and 2017 for acute complicated diverticulitis or cancer. Other indications for HPs were excluded. Before LHR, several factors were considered, such as comorbidities associated with increased postoperative morbidity and mortality (i.e. ASA class, disseminated malignancy, pulmonary disease, preoperative sepsis, and poor functional and nutritional status).

Of the 20 patients who underwent LHR, 10 were men and 10 were women. The average BMI was 26 kg/m^2 (range, 20–34 kg/m^2).

In the preoperative assessment, patients underwent an anatomical evaluation (i.e. barium enema, CT-colonography [CTC], or endoscopy) of the remaining proximal colon and rectal stump. Normally, we performed CTC to measure the length of the stump. When it was longer than 10 cm, we proceeded with laparoscopic surgery. When the stump was not recognizable or too short on CTC (less than 10 cm), we performed a laparotomic intervention using palpation to feel the rectal stump. Around 40% of patients were not recanalizable, and it was almost always because of problems related to the rectal stump.

Patients underwent bowel preparation (including enemata to empty the rectal stump) approximately 24 h before surgery, and they also received preoperative broad spectrum parenteral antibiotics and subcutaneous low-molecular-weight heparin.

The mean operating time was 176 min (range, 115–330 min). For 19 of the 20 patients, the laparoscopic procedure was performed as planned, but in one case, LHR was not possible because of massive intra-abdominal adhesions. In all cases anastomosis required the transanally introducing a stapler, extracorporeally positioning the anvil, reintroducing the bowel into the abdomen, and completing an intracorporeal anastomosis.

No anastomotic dehiscence, postoperative complications, or mortality occurred. None of the patients required a blood transfusion during the surgery. All were allowed clear fluids beginning on postoperative day 2. Normal bowel activity was present within 3–5 days. No patient required a temporary colostomy or an ileostomy, and they suffered reduced postoperative pain as a result of the minimal wounding. Length of hospital stay ranged from 4 to 11 days, with an average of 7 days. Patients receiving a bladder catheter before surgery retained it on average until postoperative day 3 (range, 1–12 days). Late postoperative complications occurred in three cases (hematoma, $n = 1$; incisional hernia, $n = 2$). No other complications were reported in the 6 months to 3 years of follow-up (Table 1).

In the LHR surgeries, patients were placed in a supine position with legs spread apart and their left arm out to the side. A urinary catheter and a nasogastric tube were inserted. Access into the abdomen was obtained through open laparoscopy, with a 12-mm trocar for 30° laparoscope inserted at the periumbilical site. Pneumoperitoneum was then established.

We placed three to five trocars depending on the level of operative difficulty encountered. Dissecting adhesions from the anterior abdominal wall enabled the placement of additional ports in the right upper quadrant and the right iliac fossa. The first surgical step was to dissect any existing adhesions. The small bowel was mobilized from the left iliac fossa and out of the pelvis. Care was taken to identify the gonad vessels and left ureter in the left paracolic gutter, at the pelvic brim, and on the pelvic side wall. We used a probe to explore the rectal stump and revealed it by opening the pelvic peritoneum that often covers it. Rectal mobilization was systematically performed to ensure the feasibility of the end-to-end anastomosis and to avoid bladder injury. A rectal probe was used to identify the rectal stump and to verify the actual possibility of creating a secure anastomosis. In the majority of cases, a splenic flexure mobilization was performed to ensure a free-tension anastomosis. The stoma was then mobilized on the level of the abdominal wall and freed from the fascia. Afterward, the colostomy was excised, and the bowel was mobilized out of the abdomen. A stapler anvil was introduced into the proximal colon by purse-string suturing. The nos. 29 and 31 circular staplers were the most frequently used. The bowel was returned to the abdominal cavity, which was then closed. A circular stapler was introduced into the rectum to fashion the anastomosis, and colorectal end-to-end anastomosis was performed mechanically without stoma diversion. The donuts were checked, a leak test was

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Table 1 Laparoscopic reversal of Hartmann's procedure performed at Sant'Anna Hospital (Ferrara, Italy) between January 2004 and December 2017

Parameters	Data	$n^{\dagger}$	Total patients
Gender	Men	10	20
	Women	10	
BMI	<20 kg/m^2	1	18‡
	20-25 kg/m^2	9	
	25–30 kg/m^2	5	
	>30 kg/m^2	3	
ASA score†	I	2	20
	II	10	
	III	8	
Average age (years)	66 (range, 44–87)		20
Laparoscopic surgery	Average intervention duration (min)	176	20
	Laparotomy conversion	1	
	Intensive care	1	
Pathology	Diverticulitis	10	20
	Tumor	7	
	Trauma	2	
	Volvulus	1	
Average time from first intervention (days)	201 (range, 80–666)		20
Average postoperative hospitalization duration (days)	7 (range, 4–11)		17‡
Complications	Anastomotic leakage	0	20
	Re-intervention	1 (for bleeding)	
	No recanalization	1 (abdominal adhesions)	
	Infection	1 (abdominal abscess)	

†All figures are frequencies except unless otherwise noted.
‡All data are not available.

performed by filling the pelvis with saline and insufflating the rectum with air. In all interventions, a tension-free anastomosis was systematically obtained.

Wash-out was performed and hemostasis confirmed. A 24-Fr drain was placed in the pelvis. Pneumoperitoneum was released and the trocars removed. The surgical access was finally closed.

Our surgical scheme involved the following steps in order:

- anatomical evaluation
- bowel and patient preparation
- open laparoscopy, pneumoperitoneum, and trocar insertion
- adhesion dissection
- rectal mobilization
- splenic flexure mobilization
- stoma mobilization
- stapler anvil introduction
- colorectal end-to-end transanal anastomosis
- leak test.

Discussion

Usually, HP is performed as a temporary emergency procedure for left-sided colonic pathology when conditions are not ideal for a primary anastomosis. It has been accepted as a curative procedure in emergencies for obstructive and perforated left bowel. HP has the advantage of removing the diseased bowel during the first stage of the procedure without risk of primary anastomotic leakage, thereby eliminating anastomotic, perineal, and functional problems.

Originally described for distal colon cancer complicated by bowel obstruction, HP has evolved over the years, with its current main indications being benign pathologies, such as diverticulitis (4–9). In developed regions, such as North America and Europe (9), the introduction of widespread screening programs for colorectal cancers and advanced endoscopic techniques, such as the placement of endoluminal stents, has relegated HP's application primarily to emergency interventions for inflammatory diseases or iatrogenic perforations (6–10).

Because HP's role as an emergency surgery is controversial, several other therapeutic alternatives have emerged, limiting its use. Alternative surgical strategies such as lavage with primary anastomosis, primary anastomosis with proximal diversion ileostomy, and primary anastomosis with proximal diversion colostomy have had better results than HP in terms of morbidity and mortality (11,12). Ileostomy reversal and colostomy reversal each has considerable morbidity, ranging from 4.6% to 34%, with anastomotic leakage occurring in

0%–2.2% of patients (13). Moreover, 0%–16.7% of colostomies and ileostomies are never reversed because of patient refusal, general inoperability, tumor progression, or anal sphincter insufficiency (14). However, it is noteworthy that this compares favorably with the reversal rate of 44% after HP (4). Despite the documented morbidity and mortality associated with HR, HP remains a favored procedure in emergencies in which primary anastomosis is considered unsafe. ASA classification and old age are frequently reported as a reason to abstain from reversal (15).

Unfortunately, the majority of patients with a colostomy after HP are too old and are considered ASA III or higher. Therefore, a large group of patients is left with a permanent stoma mainly because reversal is considered risky due to their fragile state of health. Patient choice is also a substantial factor that affects the HR. Many patients are keen to avoid further surgery and its associated risks, and they are able to experience a good quality of life with their stoma (5,16).

The subsequent restoration of intestinal continuity is desirable to improve patients' quality of life, but it can be technically challenging. The optimal timing for the reversal is controversial, but operative difficulties appear to be lower after a delay of 15 weeks (6). Conventionally, HR is performed by the open method and typically requires a laparotomy. It is associated with considerable morbidity and mortality, and one-third of patients have a permanent colostomy (18,19). Advances in laparoscopy and stapler technology are changing the attitude of surgeons and have made HR safer and easier, resulting in an increase in the reversal rate (6).

Many different laparoscopic procedures have been described in the literature, but the ideal laparoscopic technique and the comparative advantages of each procedure are still matters of debate. The principle common to all techniques is a tension-free intracorporeal stapled anastomosis. This is ensured by the mobilization of the splenic flexure and the division of the left colonic vessels, which were performed in all of our patients.

To determine the feasibility of LHR, we usually perform diagnostic laparoscopy first and introduce ports to assess the severity of adhesion and to assess the rectal stump. The introduction of the circular stapler into the rectum helps in the identification and mobilization of the rectal stump. Other authors perform the mobilization of the colostomy first and then use the colostomy site as a first port or a standard umbilical port (17).

The reversal of HP (both laparoscopic and conventional techniques) can be difficult due to the tendency of Hartmann's segment to become densely adherent deep in the pelvis. In our experience, we have tried to solve this problem in several ways:

1. We have used CTC to radiologically assess all patients in anticipation of the HR to evaluate the length of the distal rectal stump and its distance from the colostomy.
2. During HR, we have introduced an additional trocar in the right side to bypass or lyse the adhesions and better control the operative space.
3. We have sutured the rectal stump to the anterior abdominal wall (only in cases of diverticular disease and obese patient) to facilitate its localization in the second step.

Some authors have reported the use of materials to cover the rectal stump in the first intervention of HP to avoid the formation of adhesions between the stump and the ileal loops (3). However, there is no high-level evidence to standardize this procedure. A recent review showed that LHR offers several advantages over open HR (OHR), including more rapid postoperative recovery, less postoperative pain, earlier restoration of bowel function, a more rapid return to a normal diet, and reduced morbidity (4). The rate of LHR is higher, and the procedure is safer and easier. The advent of the circular stapler and the advances in this technology have made HR possible even in older patients, a high-risk group. The incidence of anastomotic leakage is lower than after OHR. Adhesiolysis and localization of rectal stump are more easily accessed by laparoscopy than by the open method (4). Also, LHR involves less intraoperative blood losses, a lower wound infection rate, and a lower incidence of pelvic abscess and incisional hernia (4). However, the reduced surgical invasiveness and the clinical advantages of the laparoscopic approach do not seem to have increased the number of patients undergoing HR to the extent we would have expected. Factors limiting the application of LHR may include a large incisional hernia from the previous laparotomy and contraindications to general anesthesia and laparoscopy.

The present study described the clinical outcomes of patients who underwent LHR. Consistent with previously published literature, our study demonstrated that LHR is safe and feasible, with rapid postoperative recovery. LHR is associated with a shorter hospital stay and a lower incidence of postoperative complications than OHR. In our study, length of hospital stay was comparable to that reported in the literature (7 days [mean] vs 6.9 days), and the mortality and anastomotic dehiscence rates were 0%.

Although our sample size was small, the present results may be comparable with those of studies in the literature, which have an average mortality rate of 0.9% and an average anastomotic dehiscence rate of 1.2% (4). Furthermore, we had no intraoperative complications

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and only one conversion from LHR to OHR. This might have been related to the operating surgeon having had experience in a high-volume surgical center, which could have played an important role in his successfully performing this technically challenging intervention (20). LHR may have a higher intraoperative cost for surgical materials than OHR; however, this cost is outweighed by the lower expenses in the postoperative period given the reduced lengths of hospital stay and fewer complications.

In accordance with the literature, LHR appears to be a safe and feasible procedure for patients that offers the advantages of shorter hospital stays, lower complication rates, and lower costs than OHR. Although the available evidence supporting the superiority of LHR is mainly based on nonrandomized small studies, the laparoscopic approach may now be considered the gold standard technique for HR in high-volume colorectal surgical centers (4). HP provides a considerable risk of complications (mean, 16.3%; range, 3%–50%) and an overall mortality rate of 1%.

ASA classification and old age are frequently reported as reasons to abstain from HR. The majority of patients undergoing HR are considered ASA I–II. Unfortunately, most patients with a colostomy after HP are too old and are considered ASA III. Therefore, a large group of patients has a permanent stoma mainly because reversal is considered risky due to their fragile state of health. Based on the published literature, HR has a high operative morbidity and mortality and is performed in only 44% of patients. For the most part, only relatively young and healthy patients are eligible for reversal.

In conclusion, our results are consistent with the previously published literature on the advantages of LHR over the conventional technique. However, our series was small, so we were unable to make a conclusive case based on our data. Regardless, higher-level evidence is needed to determine whether LHR is indeed superior. A large multicenter prospective study or meta-analysis on ORH, LRH, and the factors adversely affecting HR could provide the evidence to allow for a more conclusive verdict.

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Ethical statement

This study conformed to the provisions of the 1995 Declaration of Helsinki (as revised in Brazil in 2013). Ethics committee approval was not necessary for this retrospective study.

References

1. Hartmann H. New procedure for the removal of cancers of the terminal part of the pelvic colon. Nouveau procédé d'ablation des cancers de la partie terminale du colon pelvien Par M. Henri Hartmann, de Paris TRENTIÈME CONGRÈS DE CHIRURGIE STRASBOURG 1921: 411–413
2. Boyden AM. "The surgical treatment of diverticulitis of the colon", *Ann Surg* 1950; **132**(1): 94–109.
3. Anderson CA, Fowler DL, White S *et al*. Laparoscopic colostomy closure. *Surg Laparosc Endosc* 1993; **3**: 69–72.
4. van de Wall BJM, Draaisma WA, Schouten ES *et al*. Conventional and laparoscopic reversal of the Hartmann procedure: A review of literature. *J Gastrointest Surg* 2010; **14**: 743–752. https://doi.org/10.1007/ s11605-009-1084-3.
5. Walklett CL & Yeomans NP. A retrospective case note review of laparoscopic versus open reversal of Hartmann's procedure. *Ann R Coll Surg Engl* 2014; **96**: 539–542. https://doi.org/10.1308/003588414X14055925058238.
6. de' Angelis N, Brunetti F, Memeo R *et al*. Comparison between open and laparoscopic reversal of Hartmann's procedure for diverticulitis. *World J Gastrointest Surg* 2013; **5**: 245–251.
7. Golash V. Laparoscopic reversal of Hartmann procedure. *J Minim Access Surg* 2006; **2**: 211–215.
8. Roque-Castellano C, Marchena-Gomez J, Hemmersbach-Miller M *et al*. Analysis of the factors related to the decision of restoring intestinal continuity after Hartmann's procedure. *Int J Colorectal Dis* 2007; **22**: 1091–1096.
9. Wong WD, Wexner SD, Lowry A *et al*. Practice parameters for the treatment of sigmoid diverticulitis—Supporting documentation. *Dis Colon Rectum* 2000; **43**: 290–297.
10. Dumont F, Vibert E, Duval H *et al*. [Morbi-mortality after Hartmann procedure for peritonitis complicating sigmoid diverticulitis. A retrospective analysis of 85 cases.]. *Ann Chir* 2005; **130**: 391–399 (in French). https://doi.org/10.1016/j.anchir.2005.05.005.
11. Regenet N, Pessaux P, Hennekinne S *et al*. Primary anastomosis after intraoperative colonic lavage vs. Hartmann's procedure in generalized peritonitis complicating diverticular disease of the colon. *Int J Colorectal Dis* 2003; **18**: 503–507.
12. Landen S & Nafteux P. Primary anastomosis and diverting colostomy in diffuse diverticular peritonitis. *Acta Chir Belg* 2002; **102**: 24–29.
13. Abbas S. Resection and primary anastomosis in acute complicated diverticulitis, a systematic review of the literature. *Int J Colorectal Dis* 2007; **22**: 351–357.
14. Gastinger I, Marusch F, Steinert R *et al*. the Working Group Colon/Rectum Carcinoma. Protective defunctioning stoma in low anterior resection for rectal carcinoma. *Br J Surg* 2005; **92**: 1137–1142.
15. Banerjee S, Leather AJ, Rennie JA *et al*. Feasibility and morbidity of reversal of Hartmann's. *Colorectal Dis* 2005; **7**: 454–459.
16. Krouse RS, Herrinton LJ, Grant M *et al*. Health-related quality of life among long-term rectal cancer survivors with

an ostomy: Manifestations by sex. *J Clin Oncol* 2009; **27**: 664–4670.
17. Wigmore SJ, Duthie GS, Young IE *et al*. Restoration of intestinal continuity following Hartmann's procedure: The Lothian experience 1987-1992. *Br J Surg* 1995; **82**: 27–30.
18. Pearce NW, Scott SD, Karran SJ. Timing and method of reversal of Hartmann's procedure. *Br J Surg* 1992; **79**: 839–841.
19. Anania G, Santini M, Gregorio C *et al*. Laparoscopic colorectal resections performed over a seven-years period in a single Italian Centre. *G Chir* 2012; **33**: 259–262.
20. Joshi HM, Gosselink MP, Adusumilli S, Cunningham C, Lindsey I. Jones Incision-less reversal of Hartmann's procedure. *Tech Coloproctol 2014*; **18**: 843–846. https://doi.org/10.1007/s10151-014-1144-x. Epub 2014 Mar 29.

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