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Laparoscopic Hartmann Reversal: A Single Center Five-Years' Experience

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Introduction

Since 1921, when the french surgeon Henry Albert Hartmann described the technique of recto-sigmoidal resection with end left colostomy and closure of the rectal stump, such operation begun to be used to treat or palliate patients with rectosigmoid pathologies such as rectosigmoid cancer, perforated diverticulitis and more. Along the decades, Hartmann Procedure (HP) became very popular in the emergency setting because of its feasibility and rapidity, with a low rate of associated complications also in the hands of less experienced surgeons. After almost one century this operation is still successfully performed in emergency settings if primary colorectal anastomosis is believed not to be safe by the operating surgeon or frankly contraindicated [1]. To date, HP has been the most diffuse operation to be performed when acute peritonitis of colonic origin (perforated tumors, complicated diverticulitis, bowel ischemia, traumatic colon injury) is diagnosed in frail patients.

Since HP causes considerable physical and psychological distress associated to terminal colostomy with complications and suboptimal quality of life, the restoration of bowel continuity is a challenge. The Hartmann Reversal (HR) refers to the closure of the end colostomy, mobilization of the proximal stump and restoration of bowel continuity by colorectal anastomosis. This challenging surgical operation is associated with significant morbidity (22,9-68,4%) and even mortality (0-5%) rate thus an accurate patient selection is mandatory. The main complications of HR are wound infection, anastomotic leakage, anastomotic stenosis, sepsis, and fistula formation, and to date a substantial proportion of patients (up to 74%) may be left with a permanent stomia due to impossibility to restore the intestinal continuity. Predictive factors for achieving HR include younger age, male gender, low ASA score, and benign pathology. However, there are no established guidelines for deciding whenever or not to restore bowel continuity after HP. This decision is generally based on the surgeon's discretion and the general clinical conditions. Also the best timing of reversal remains a challenge [2]. To reduce the surgical trauma and adhesions related to the traditional open approach and to decrease perioperative morbidity and mortality, laparoscopy was introduced either in the emergency setting to perform HP and, later, in order to restore the bowel continuity performing a Laparoscopic Hartmann reversal (LHR) [3]. With the increased proficiencies in laparoscopic surgery, HP and HR procedures also began to be performed using laparoscopic techniques. However, to date, the application of laparoscopic surgery in HR is still a matter of debate. In the present paper we report our four years single center experience with the aim to evaluate the effectiveness of laparoscopic approach in terms of complications, length of hospitalization, recovery of bowel postoperative motility, and with the ultimate goal to determine the optimal timing of operation.

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Material and methods

This is a retrospective, single center study evaluating all the patients who underwent HP and HR between January 1st, 2018 and January 30th 2023 at General Surgery Unit, Ospedale Unico della Versilia, Azienda USL Toscana-nordovest. The following parameters were recorded for all patients: age, gender, ASA score, comorbidities, number of days between HP and HR, laparoscopic or open HR, length of hospital stay after HR, 30- days readmission, mortality and complication rate according to Clavien-Dindo classification. Previous surgical treatments, intra and post-operative complications, interval to reversal, length of stay and bowel function recovery were evaluated. Our primary outcomes were 30 days readmission (for reoperation, anastomotic leakage or stricture, post-operative ileus, wound infection) and 30 days mortality. The secondary outcomes were the length of hospital stay and the timing of reversal related to complication rate.

All patients before HR underwent barium enema and endoscopy through the end colostomy to explore the remnant colon. No bowel preparation was administered. Antibiotic prophylaxis with metronidazole and cefazoline was performed in all patients 30 minutes before surgery.

Rectal enema and endoscopy were performed in all patients before surgery to examine the rectal stump; no bowel preparation was administered. Antibiotics were infused 1 hour before the skin incision. The patients were positioned in the Lloyd-Davis position the surgeons standing on the right side. The first port entry was created above the umbelicus with a 12 mm-trocar according to the Hasson technique. Two additional port entries were created: a 12 mm trocar in the right superior paramedian position and another 12 mm trocar in right lower quadrant were placed. Lysis of the adesions was performed with scissors in order to minimize the risk of electrical current bowel injury. Once the adesiolysis was performed and the rectal stump identified the colostomy was mobilized and excised. A purse string suture was performed, and the anvil of the circular stapler placed in the proximal colon. Colo-rectal anastomosis, according to the Knight and Griffen's technique was accomplished in all cases and then checked by hydropneumatic test and in the last three patients, intraoperative indocyanine green (ICG) was used to assess intestinal microcirculation before and after stapling.

In a five-years period, between January 2017 and January 2022, a series of 65 consecutive patients underwent HP, 39 (60%) of these patients underwent HR, 29 (74.3%) with a laparoscopic approach, while 10 (25.7%) by laparotomy. Seven conversions to laparotomy were recorded (24.2%). Among these, five patients showed an hostile abdomen due to extensive intestinal adhesions for previous open abdominal surgery with consequent impossibility to enter the peritoneal cavity; in two cases air leak after the hydropneumatic test made the manual reconstruction of the colorectal anastomosis compulsory. All conversions occurred in patients that underwent HP in open surgery. A diverting ileostomy was constructed in 3 of these cases, none in the LHR group.

The population under study included 21 males and 18 females, with a mean age of 66.6 years (59-86). 28 patients underwent HP for complicated diverticulitis with fecal peritonitis (71.80 %) in urgency setting: 9 patients underwent HP for perforated sigmoid or rectal carcinoma (23.10%) or for colorectal carcinoma in elective setting (in patients with high ASA score (>4) and multiple comorbidities that contraindicate colorectal anastomosis with or without stoma diversion), and 2 patients underwent HP for iatrogenic sigmoid perforation during other surgical procedures (robotic prostatectomy, and laparoscopic nodular endometriosis resection).

Mean features of the population object of study are reported in Table 1.

Table 1: Clinicopathological characteristics of PEACs in comparison with MCC.

Age (range, years)	42 - 86
Gender (M, F, %)	21 (53.8) 18 (46.2)
Pathology (n, %) • Complicated diverticulitis with fecal peritonitis • Perforated sigmoid or rectal carcinoma • Iatrogenic sigmoid perforation	 28 (71.8)9 (23.1)2 (5.1)
Surgical procedure (n, %) • Laparoscopic Hartmann's Reversal • Open Hartmann's Reversal	 29 (74.3)10 (25.7)
Conversion to open technique (n, %)	7 (24.2)
Causes of conversion (n, %) • Extensive intestinal adhesions • Positive anastomosis air leak test	 5 (71.4)2 (28.6)
Diverting ileostomy (n, %)	3 (7.7)
Mean time between HP and HR (range, days)	34 - 544

HP: Hartmann's procedure; HR: Hartmann's Reversal.

Mean time between HP and HR was 202, 62 days (34 min vs 544 max): mean time of reversal in the LHR group was 190 days (34 min vs 544 max), in contrast with mean time of reversal in the open HR (OHR) group that was 319 days (118 min vs 483 max), suggesting a connection between time interval between HP and HR and conversion from laparoscopic to laparotomic operation.

Differences between the OHR group and the LHR group in terms of operation time, recover bowel motility, length of hospital stay and 30-days readmission are reported in (Table 2). No statistically significative differences were found in terms of operation time and 30-days readmission, instead length of hospital stay (p=0.0018) and recover bowel motility (p=0.0044) were quicker in the LHR group.

Table 2: Main intra- and postoperative outcomes.

	OHR	LHR	p value
Mean operative time (minutes)	242,94 ± 94,24	180,57 ± 64,32	0.0189
Return to normal bowel function (days)	5,06 ± 1,69	3,52 ± 1,17	0.0018
Length of hospotalization (days)	10,4 ± 5,58	6,4 2,37	0.0044
Readmission	2	1	0.7092
30 days mortality	0	0	

OHR: Open Hartmann's Reversal; LHR: Laparoscopic Hartmann's Reversal.

Table 3: Stratification of the postoperative complications occurred in the population object of study according to Clavien-Dindo classification.

Complication according to Clavien-Dindo classification (stage)	Population (n=39; n, %)	Open Hartmann's Reversal (n=17; n, %)	Laparoscopic Hartmann's Reversal (n=22; n, %)	p value
0	28 (71.8)	10 (5.9)	18 (81.8)	0.2211
1	5 (12.8)	2 (11.7)	3 (13.6)	0.8624
2	2 (5.1)	2 (11.7)	0 (0)	0.3577
3a	3 (7.7)	2 (11.7)	1 (4.5)	0.8157
3b	1 (2.6)	1 (5.9)	0 (0)	0.8958
4	0 (0)	0 (0)	0 (0)	>0.999
5	0 (0)	0 (0)	0 (0)	>0.999

Table 4: Difference between the two groups.

	LHP	OHP	Marginal row Totals	p value
LHR	14 (9.03) [2.74]	8 (12.97) [1.91]	22	0.001
OHR	2 (6.97) [3.55]	15 (10.03) [2.47]	17	
Marginal column totals	16	23	39 (Grand Total)	

LHR: Laparoscopic Hartmann Reversal; LHP: Laparoscopic Hartmann Procedure; OHR: Open Hartmann Reversal. OHP: Open Hartmann Procedure.

Postoperative complications were classified according to Clavien-Dindo classification, are reported in (Table 3). No statistically significative differences were found between the two groups examined.

Blood transfusions were needed after gross hematuria occurred in a female patient who was then diagnosed with hemorrhagic cystitis after cystoscopy. Only one anastomotic leak was reported in the OHR group (Clavien-Dindo 3b) and treated with redo anastomosis with diverting stoma in 6th postoperative day. One patient was readmitted because of late bleeding form the anastomosis and treated with endoscopic electrocauterization. Other complications reported were pneumonia (1 case in LHR group), surgical site infection (2 cases in the OHR group), and one left ureteral injury occurred in the OHR group detected intraoperatively and treated with ureteral stenting removed after 3 months with no consequences.

All patients that underwent LHP, underwent LHR (n=14; 87.5%) except two cases that needed conversion to OHR due to extensive intestinal adhesions; on the other hand, patient that underwent HP with laparotomic approach, only in 8 cases out of 23 received LHR (34.7%) with a statistically significant difference between the two groups (p= 0.001) (Table 4).

Discussion

Surgical treatments of complicated diverticulitis, according to the most recent guidelines, has been adjusted according to the classification in localized complicated diverticulitis, diverticular abscess or diffuse peritonitis While small diverticular abscess (<4-5 cm) may be treated by antibiotics alone, patients with large abscesses (>4-5 cm) can be treated by percutaneous drainage combined with antibiotic treatment [4]. Although some Authors described a high success rate for non-operative management in patients with acute diverticulitis and pneumoperitoneum excluding those with hemodynamic instability, large amount of distant intraperitoneal air is associated with an high rate of failure. According to the LADIES trial, in cases of perforated diverticulitis with purulent or fecal peritonitis, emergency operative treatment is standard practice and HP remains the favored option for most surgeons [5]. Nevertheless, the success of HP worldwide along decades, nowadays its popularity seems to decrease since many authors suggested to accomplish a primary colorectal anastomosis even in the case of a fecal peritonitis in selected cases. If it is true that in many experienced centers we observed in the recent years an increasing amount of colonic left resections successfully followed by a primary anastomosis with or without a diverting stoma also in urgency/emergency settings, it is true as well that in most of the largest series published on the treatment of acute diverticulitis, HP still represents the most commonly used technique because of its good results in terms of morbidity and mortality also when a laparoscopic approach is described.

Even if no significative differences could be found when comparing morbidity and mortality of primary anastomosis (PA) versus HP in this group of patients, HP is still worldwide considered the safest surgical treatment in colon perforation. In consideration of the large diffusion of laparoscopy among colorectal surgeons in the last decades, this approach was also extended to HP with the aim to minimize the surgical trauma, to reduce surgical site infections and future incisional hernia, to improve the toilette of the abdominal cavity, and to perform a more precise surgical procedure. Moreover, laparoscopy also bears the advantage of a reduction of the adhesions that the surgeon will potentially meet at the time of laparoscopic reversal, minimizing one of the most challenging pitfalls which generally discourage surgeons to face up to a reoperation, with the result of a well-known low rate of HR after HP. Additionally, the likelihood of reversal of end colosto-

mies after Hartmann's procedure has been reported to be lower (50-60%) than that of closure of defunctioning ileostomies after sigmoidectomy with primary anastomosis (85%), thereby increasing associated health-care costs and negatively affecting quality of life [5].

Although most of the surgeon assume that all patients want to have colostomy take down, incidence of HR is still object of large debate in literature. Studies report that the rates of HR range from 4% to 85%, consisting mainly of benign pathologies, not considering malignant pathologies [6]. Other studies reports rate of declined reversal procedures up to 30% or even higher [6,7]. There is no consensus on the timing of the reversal of Hartmann's procedure in the literature: some studies report the most accurate time to perform HR is 6 months after HP in order to reduce morbidity and mortality, other studies report that time interval is not related higher mortality and morbidity [6]. In our study, median time interval between HP and HR was 208 days, and no differences in terms of rate of complications were found. Reversal is indeed one of the most complex surgical procedure associated with significant complications including intrabdominal septic complications, surgical site infections and other complications as urinary tract and respiratory infections. For these statements, the patients to enroll to HR should be considered among a low risk or extremely motivated population.

Patients declining reversal are reported to be older, had higher ASA grade, increased malignant pathology and underwent elective Hartmann's procedure more commonly [6].

One of the major risk of the procedure is related to the diffuse adhesions that the surgeon will face at the time of reversal with possible intestinal injury nowadays often related to the heat produced by energy devices. In fact, HR often requires an experienced surgical team due to the frequency of a "hostile" abdomen after the original HP. The diversion procedure is often performed in patients with peritonitis, bowel ischemia or infection, which makes the restoration of bowel continuity difficult owing to significant adhesions and difficulty in recognizing anatomical structures, including the rectal stump itself [8]. For this reason, even emergency HP, in hemodinamically stable patients, should be performed with laparoscopic tecnique because of the known lower incidence rate of post-operative adhesions. In LHR adhesion lysis must be performed with scissors and access to the abdomen must be performed by Hasson tecnique in order to minimize injuries of bowels which are frequently found to be stuck to the the abdominal wall. In most of cases the retrieval of the rectal stump is one of the most difficult steps in LHR. Many surgeons mark the rectal stump with long non-absorbable sutures to facilitate finding the rectal stump upon re-anastomosis, but there are no studies demonstrating postoperative benefit from the use of this technique [8].

Once the exploration of the abdomen has been accomplished and the pelvis explored, frequently small bowel loops stuck to the rectal suture are found. Gentle traction and scissor lysys must be done to free the rectum in order to avoid bowel tears. The rectal stump, generally dissected at the the promontory of the sacrum at the time of HP, is then isolated and resected at the peritoneal reflection. We prefer to stress the mobilization of the posterior rectum along the sacrum in order to allow an easier trans anal introduction of the stapler.

In our experience median length of hospital stay of patients submitted to LHR is shorter than in OHR patients and there is not statistically significant difference in blood loss and operation time. Only 3 patients received a loop ileostomy, all in the OHR group, according to the finding that patients submitted to LHR show a lower rate of diverting ileostomy as already reported. The reason for this is unclear but it is probably related to the surgeons' aim to improve the quality of life of patients who experienced a longlasting colostomy. Recovery of bowel motility was very quick allowing, in the last group of patients a faster discharge from the hospital. Additionally the differencies between LHR and OHR compared to HP approach showed a more incidence of LHR in patients that underwent primary resection in laparoscopic approach, according to literature that shows a decreased incidence of intestinal adhesions in all type of laparoscopic operations performed when compared to laparotomic approach.

Conclusions

LHR is a safer and more feasible procedure compared to open surgery in highly laparoscopically skilled surgeons. Conversion rate, morbidity and mortality are very low advising LHR as OHR; furthermore, patients that underwent LHR had lower hospital stay and quicker bowel recover. The safety and feasibility of LHR in experienced hands, could foster the resort to laparoscopic HP in case of peritonitis of colonic origin if resection with primary anastomosis is not adviced in emergency setting in order to enhance the reversal rate of the procedure. Authors suggest laparoscopic approach to be increased in primary resections (HP) even in complicated cases, if patient is stable, in order to increase LHR that is safer in patients that underwent HP in laparoscopic approach than laparotomic, and, has reported before, has better outcomes in terms of hospital stay and return to normal life.

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