Minimally Invasive Therapy. 2011; Early Online, 1–6

informa
healthcare

ORIGINAL ARTICLE

Robotic-assisted laparoscopic surgery for restorative proctocolectomy with ileal J pouch-anal anastomosis

RODRIGO PEDRAZA[1,2], CHIRAG B. PATEL[1,2], DIEGO I. RAMOS-VALADEZ[1,2], ERIC M. HAAS[1,2]

[1]*Colorectal Surgical Associates, LTD, L.L.P. Houston, Texas, and* [2]*Division of Minimally Invasive Colon and Rectal Surgery, Department of Surgery, University of Texas Medical School at Houston, Houston, Texas, USA*

Abstract

Restorative proctocolectomy (RP) with ileal pouch-anal anastomosis (IPAA) is the surgical procedure of choice for chronic ulcerative colitis (CUC). Robotic-assisted laparoscopic surgery (RALS) has been shown to have its greatest merits in colorectal procedures involving the pelvis. The aim of this study was to evaluate the safety and feasibility of RP with IPAA using an innovative robotic technique. A total of five consecutive patients underwent RALS RP with IPAA between August 2008 and February 2010. Patient demographics, intraoperative parameters, and postoperative outcomes were tabulated and assessed. Surgery was indicated for medically intractable CUC in three patients (60%), CUC-related dysplasia in one patient (20%) and CUC-related adenocarcinoma in one patient (20%). An ileal pouch-anal anastomosis was successful in all five cases. The mean operative time was 330 min and estimated blood loss was 200 cc. There were no intraoperative complications or conversions. The mean length of hospital stay was 5.6 days and no patients developed major postoperative complications. RALS is an innovative technique offering technical and visual advantages to the colorectal surgeon and can be offered for those who are seeking restorative proctolectomy for chronic ulcerative colitis.

Key words: *Robotic surgery, colorectal surgery, ileal pouch, restorative proctocolectomy, minimally invasive surgery*

Introduction

Restorative proctocolectomy (RP) with ileal pouch-anal anastomosis is the procedure of choice for those requiring surgery for chronic ulcerative colitis (CUC) (1,2). Elective RP with ileal pouch-anal anastomosis is most commonly offered to those with recalcitrant disease and dysplastic and/or neoplastic disease, whereas the primary indications for emergent intervention include fulminant colitis and toxic megacolon (1).

The procedure is usually performed in two stages, in which total proctocolectomy, ileoanal anastomosis, and diverting loop ileostomy are performed as the first stage, followed by a second stage consisting of ileostomy reversal. Nevertheless, in selected cases, the procedure may be performed in one stage, wherein restorative proctocolectomy with ileoanal anastomosis is accomplished without the creation of loop ileostomy. In many emergent cases, a three-stage approach – consisting of subtotal colectomy (stage 1), completion proctocolectomy with ileal pouch-anal anastomosis and diverting loop ileostomy (stage 2), and finally ileostomy closure (stage 3) – is performed.

Minimally invasive restorative proctocolectomy with ileal pouch-anal anastomosis has been reported using conventional and hand-assisted laparoscopic surgical techniques (3–5). Robotic-assisted laparoscopic surgery is an emerging minimally invasive modality that was first performed for colorectal procedures in 2001 (6). This approach has gained enthusiasm, especially with regard to procedures involving restricted cavities such as the pelvis. However, there are no previous reports evaluating robotic-assisted laparoscopic surgery (RALS) for restorative proctocolectomy with ileal J pouch-anal anastomosis (IPAA) for those with CUC. The purpose of this study was to evaluate the intraoperative and short-term outcomes following robotic-assisted laparoscopic restorative

Correspondence: E. M. Haas, 7900 Fannin Street, Suite 2700, Houston, TX, 77054, USA. Fax: (713) 790-0616. E-mail: ehaasmd@houstoncolon.com

ISSN 1364-5706 print/ISSN 1365-2931 online
DOI: 10.3109/13645706.2010.536355

proctocolectomy with ileal J pouch-anal anastomosis and to determine safety and feasibility of this innovative approach.

Material and methods

The study was approved by the Institutional Review Board. Five unselected, consecutive patients with CUC requiring surgical resection were scheduled for RALS RP with IPAA between August 2008 and February 2010 and make up the cohort of the study. After obtaining informed consent, the procedures were performed by a board-certified colorectal surgeon with extensive experience in laparoscopic procedures. Patient characteristics, intraoperative parameters, and 30-day postoperative outcomes were recorded and assessed.

Surgical technique

A total of three 8 mm and two 12 mm trocars were utilized (Figure 1). The specimen extraction site consisted of a suprapubic Pfannenstiel mini-incision. Once docked, the robot-patient configuration consisted of three robotic arms for instruments, a camera arm, and an accessory port for the surgical assistant (Figure 2).

A hybrid procedure combining conventional laparoscopy for the abdominal portion (colectomy) of the surgery and robotic approach for pelvic dissection (proctectomy) was performed. Laparoscopic lysis of adhesions was achieved, followed by identification and division of the colic branch of the ileocolic artery and establishment of a retroperitoneal plane. After takedown of the hepatic flexure, the middle colic vessels and the right colic artery were divided. Takedown of the gastrocolic omentum provided entrance to the lesser sac. At this point, the splenic flexure was taken down followed by ligation of the inferior mesenteric vein and artery.

The da Vinci® robot (Intuitive Surgical, Inc., Sunnyvale, CA, USA) was then docked. A mesorectal plane was established with optimal visualization allowing for preservation of pelvic autonomic nerves. The dissection was continued posteriorly to Waldeyer's fascia to the level of the levator ani muscles, laterally through the lateral stalks taking care to remain in the pararectal plane, and anteriorly through the rectovaginal septum (female) or Denonvillier's fascia (male). The rectum was transected at the anorectal junction using a laparoscopic reticulating stapling device. The mobilized colon and rectum were extracorporealized through an Alexis® wound retractor (Applied Medical, Rancho Santa Margarita, CA, USA) and a J pouch was fashioned. Under direct robotic visualization, the ileoanal anastomosis was performed and the integrity of the anastomosis was evaluated. Diverting loop ileostomy was performed 20 cm proximal to the J pouch.

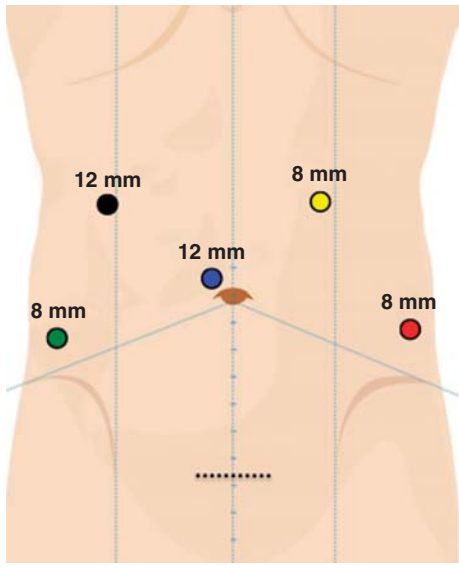

Figure 1. Port placement and specimen extraction site.

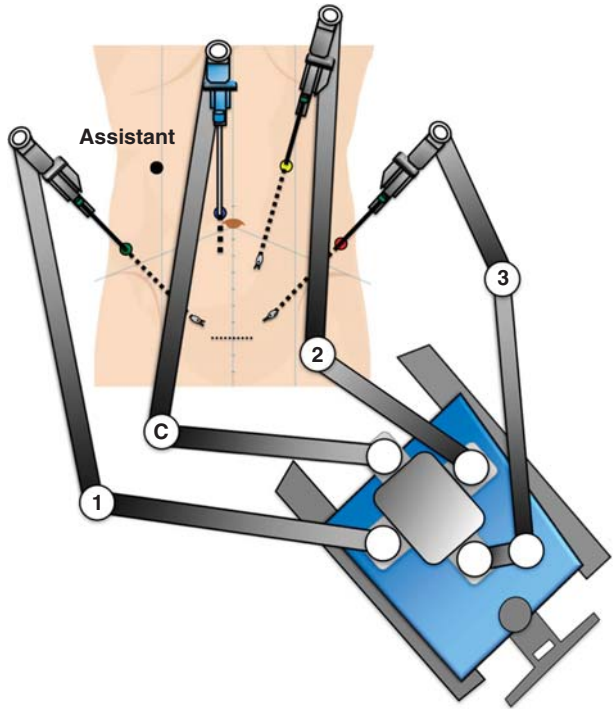

Figure 2. Robotic arm docking. Robotic arms 1, 2, and 3 are used for instrumentation and the camera arm is placed to the right of the umbilicus. Note accessory port in the right upper quadrant for the assistant.

Reporting of parameters

Intraoperative (operative time and estimated blood loss) and postoperative (return of oral intake, recovery of bowel function, and length of stay) outcomes refer to the stage of the procedure in which the restorative proctocolectomy and ileal J pouch-anal anastomosis were performed (i.e., first stage in the two-stage procedure and second stage in the three-stage procedure). For the two-stage procedure, the total operative time includes both laparoscopic colectomy and robotic completion protocolectomy with ileal J pouch-anal anastomosis. Docking time (DT) and surgeon console time (SCT) represent the robotic portion of the procedure. With regard to the three-stage procedures, the total operative time includes the initial laparoscopic lysis of adhesions followed by the robotic procedure in the pelvis. Estimated blood loss was not recorded separately for the laparoscopic and robotic portions of the operation.

Statistical analysis

Data analysis was performed using Intercooled Stata version 9.2 (Stata Corporation, College Station, TX, USA). Results are presented as mean ± standard deviation.

Results

Patient characteristics

Three females and two males underwent the robotic procedure. Mean age was 45.8 years (range 32–62 years), body mass index was 24.2 kg/m^2 (range: 22.9–27.4 kg/m^2), and the median American Society of Anesthesiologists (ASA) score was 3. Surgery was indicated for medically intractable CUC in three patients (60%), for dysplasia-associated lesion or mass (DALM) in one patient (20%), and for CUC-related adenocarcinoma in one patient (20%) (Table I). Three patients (60%) had a history of systemic corticosteroid therapy within one month prior to surgery. The RP with IPAA procedures were performed in three stages in four patients (80%) and in two stages in one patient (20%).

Intraoperative outcomes

The mean operative time was 330 min (range: 270–390 min) and consisted of 16.8 min for robot docking time (DT, range: 11–45 min) and 122 min for surgeon console time (SCT, range: 70–150 min). Robotic DT and SCT accounted for 5.0% and 38.6% of the total operative time (OT), respectively. The mean estimated blood loss (EBL) was 200 cc (range: 100–400 cc). For the DALM and malignant cases, the number of extracted lymph nodes was 27 and 15, respectively, and the specimen length was 86.0 cm and 17.5 cm, respectively. There were no intraoperative complications and none of the procedures required conversion to open or another minimally invasive modality (Table II).

Postoperative results

During the postoperative period the return of oral intake was achieved in a mean of 2.0 days (range: 1–3 days). The return of bowel function, as evidenced by presence of flatus or bowel movements, was noted in a mean of 2.4 days (range: 2–4 days). Two patients developed complications: Dehydration and ileus requiring readmission, and presacral fluid collection managed percutaneously and without surgical intervention. The mean length of hospital stay (LOS) was 5.6 days (range: 3–10 days). There were no operative reinterventions and no postoperative mortality was encountered in this series (Table III).

Table I. Patient characteristics.

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Mean
Age (years)	48	39	62	48	32	45.8 ± 11.3
Gender	Female	Female	Male	Female	Male	Female (60%) Male (40%)
BMI (kg/m^2)	23.3	27.4	22.9	23.1	24.4	24.2 ± 1.9
ASA	3	2	3	3	2	2.6 ± 0.5
Indication for surgery	Refractory CUC	CUC with DALM	Refractory CUC	CUC with adenocarcinoma	Refractory CUC	CUC (60%) CUC + dysplasia (20%) CUC + adenocarcinoma (20%)
Corticosteroid therapy[§]	No	No	Yes	Yes	Yes	Yes (60%)

Data are presented as mean ± standard deviation. ASA = American Society of Anesthesiologists score; BMI = body mass index; CUC = chronic ulcerative colitis; DALM = dysplasia associated lesion or mass. [§]Within one month preoperatively.

Table II. Intraoperative parameters.

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Mean
Surgery mode	3-stage	2-stage	3-stage	3-stage	3-stage	3-stage (80%) 2-stage (20%)
Total operative time (min)	360	390	300	270	330	330 ± 47.4
Laparoscopic (non-robotic) time (min (percent[¥]))	210 (58.3%)	313 (80.3%)	153 (51.0%)	111 (41.1%)	169 (51.2%)	191.2 ± 76.8 (56.4%)
DT (min)	45	7	12	9	11	16.8 ± 15.9
SCT (min)	105	70	135	150	150	122 ± 34.4
Robotic time [DT + SCT] (min (percent[¥]))	150 (41.7%)	77 (19.7%)	147 (49.0%)	159 (58.9%)	161 (48.8%)	138.8 ± 35.0 (43.6%)
Estimated blood loss (cc)	200	200	400	100	100	200 ± 122.5
Lymph node extraction	19	27	43	15	19	24.6 ± 11.2
Specimen length (cm)	17.0	86.0	66.5	17.5	34.5	44.3 ± 30.8
Complication (rate)	No	No	No	No	No	0%
Conversion (rate)	No	No	No	No	No	0%

Data reported as mean ± standard deviation. [¥]As a percent of total operative time. DT = robotic docking time, SCT = surgeon time at robotic console.

Discussion

We report our initial experience utilizing robotic technology for this challenging colorectal procedure. The utilization of RALS has been shown to provide several benefits in the field of colorectal surgery, particularly for procedures involving pelvic anatomy. This approach offers advantages over open and other minimally invasive techniques, including 3D visualization and 10-fold magnification, which may enhance identification and preservation of critical pelvic anatomical structures including autonomic nerves and perforating vessels (7–9) (Figure 3). Moreover, robotic instrumentation effectively eliminates surgeon tremor and provides fine motion scaling (10). The pulley system at the tip of the robotic instrumentation results in wristed movement with additional degrees of freedom that is ideal for tissue dissection in the deep and confined pelvis (9,10). Furthermore, recent studies have demonstrated that RALS provides benefits when compared to the conventional laparoscopic approach in regards to shorter LOS, lower conversion and complication rates, and improved macroscopic grading in the evaluation of the surgical specimen (11,12).

In this series, the colectomy portion of the procedure was performed laparoscopically. The robotic portion involved the rectal and pelvic anatomy because it is most beneficial in these areas and does not require repositioning of the robotic arms once the robot has been docked (13). The J pouch was fashioned extracorporeally through a Pfannenstiel incision, while the ileal pouch-anal anastomosis was performed intracorporeally utilizing the robotic approach.

There was a reduction in robotic DT between the first case (45 min) and the last four cases (range: 7–12 min). This was probably due to dependence

Table III. Postoperative outcomes.

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Overall
Return of oral intake (days)	1	3	2	2	2	2.0 ± 0.6
Recovery of bowel function (days)	2	4	2	2	2	2.4 ± 0.9
Complication (rate)	No	Pelvic fluid collection	No	No	Dehydration and ileus	2 (40%)
Reoperation (rate)	No	No	No	No	No	0%
LOS (days)	3	10	5	5	5	5.6 ± 2.6
Readmission (rate)	No	No	No	No	Yes	1 (20%)
Mortality (rate)	No	No	No	No	No	0%

Data reported as mean ± standard deviation. LOS = length of hospital stay.

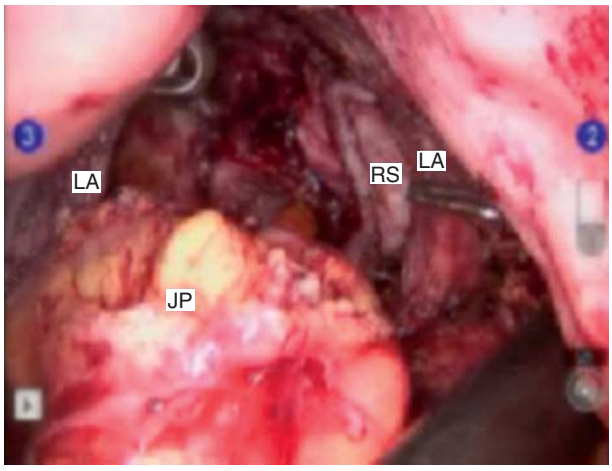

Figure 3. Intraoperative image demonstrating visualization afforded by robotic system (LA = levator ani, JP = J-pouch, RS = rectal stump).

of DT on surgeon learning. Surgeon console time increased from the first two cases (105 min and 70 min, respectively) to the remaining three cases (range: 135–150 min). Yet, the total operative time decreased from the first two cases (360 min and 390 min, respectively) to the remaining three cases (range: 270–330 min), indicating increased proportion of the procedure accounted for by robotic approach over the course of the series. In the DALM and malignant cases, margins were negative and adequate lymph node extraction was achieved (14,15).

With regard to postoperative outcomes, one patient developed a postoperative pelvic fluid collection that was successfully managed with conservative measures without requiring reintervention. This patient was noted to have the longest LOS (ten days); the mean LOS for the remaining four patients was 4.5 days. This patient ultimately underwent a successful reversal of the ileostomy at 2.5 months following the index procedure. Another patient required readmission secondary to dehydration and small bowel ileus. This patient's symptoms resolved with intravenous hydration and she was discharged in two days' time.

Although there are no reports evaluating the robotic approach for restorative proctocolectomy with IPAA, the outcomes in this study are similar to published reports involving conventional laparoscopic techniques. In 2006, Larson et al. reported the largest series to date, in which 100 patients underwent RP, with a mean OT of 333 min, postoperative complication rate of 33%, and mean LOS of three days (3). In 2008, Polle et al. reported on 35 cases of RP with IPAA, with a mean OT of 298 min, postoperative complication rate of 28%, and mean LOS of nine days (16). In 2009, Lefevre et al. reported on a series of 44 patients who underwent RP with IPAA, with a mean OT of 262 min, postoperative complication rate of 32%, and mean LOS of nine days (4). Based on these previous reports, the robotic approach reported in the present study achieved satisfactory outcomes with regard to OT (330 ± 47.4 min) and LOS (5.6 ± 2.6 days).

Based on this initial series, robotic surgery is a safe and feasible approach for those with CUC requiring surgery with restoration of bowel continuity. The robotic approach facilitated optimal visualization and surgical technique involving the confines of the pelvis, and resulted in results comparable to those previously reported with CLS approach.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

References

1. Grucela A, Steinhagen RM. Current surgical management of ulcerative colitis. Mt Sinai J Med. 2009;76:606–12.
2. Casillas S, Delaney CP. Laparoscopic surgery for inflammatory bowel disease. Dig Surg. 2005;22:135–42.
3. Larson DW, Cima RR, Dozois EJ, Davies M, Piotrowicz K, Barnes SA, et al. Safety, feasibility, and short-term outcomes of laparoscopic ileal-pouch-anal anastomosis: a single institutional case-matched experience. Ann Surg. 2006;243:667–70; discussion 70–2.
4. Lefevre JH, Bretagnol F, Ouaissi M, Taleb P, Alves A, Panis Y. Total laparoscopic ileal pouch-anal anastomosis: prospective series of 82 patients. Surg Endosc. 2009;23:166–73.
5. Tsuruta M, Hasegawa H, Ishii Y, Endo T, Ochiai H, Hibi T, et al. Hand-assisted versus conventional laparoscopic restorative proctocolectomy for ulcerative colitis. Surg Laparosc Endosc Percutan Tech. 2009;19:52–6.
6. Weber PA, Merola S, Wasielewski A, Ballantyne GH. Telerobotic-assisted laparoscopic right and sigmoid colectomies for benign disease. Dis Colon Rectum 2002;45:1689–94; discussion 95–6.
7. Spinoglio G, Summa M, Priora F, Quarati R, Testa S. Robotic colorectal surgery: first 50 cases experience. Dis Colon Rectum 2008;51:1627–32.
8. Kariv Y, Delaney CP. Robotics in colorectal surgery. Minerva Chir. 2005;60:401–16.
9. Ng KH, Lim YK, Ho KS, Ooi BS, Eu KW. Robotic-assisted surgery for low rectal dissection: from better views to better outcome. Singapore Med J. 2009;50:763–7.
10. Baik SH. Robotic colorectal surgery. Yonsei Med J. 2008;49:891–6.
11. Baik SH, Kwon HY, Kim JS, Hur H, Sohn SK, et al. Robotic versus laparoscopic low anterior resection of rectal cancer: short-term outcome of a prospective comparative study. Ann Surg Oncol. 2009;16:1480–7.
12. Baik SH, Ko YT, Kang CM, Lee WJ, Kim NK, Sohn Sk, et al. Robotic tumor-specific mesorectal excision of rectal cancer: short-term outcome of a pilot randomized trial. Surg Endosc. 2008;22:1601–8.

13. Park YA, Kim JM, Kim SA, Min BS, Kim NK, Sohn SK, et al. Totally robotic surgery for rectal cancer: from splenic flexure to pelvic floor in one setup. Surg Endosc. 2010;24: 715–20.
14. Nelson H, Petrelli N, Carlin A, Couture J, Fleshman J, Guillem J, et al. Guidelines 2000 for colon and rectal cancer surgery. J Natl Cancer Inst. 2001;93:583–96.
15. The Clinical Outcome of Surgical Therapy Study Group. A comparison of laparoscopically assisted and open colectomy for colon cancer. N Engl J Med. 2004;350:2050–9.
16. Polle SW, van Berge Henegouwen MI, Slors JF, Cuesta MA, Gouma DJ, Bemelman WA. Total laparoscopic restorative proctocolectomy: are there advantages compared with the open and hand-assisted approaches? Dis Colon Rectum 2008;51:541–8.