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HOW-I-DO-IT ARTICLE

Hand-assisted hybrid laparoscopic–robotic total proctocolectomy with ileal pouch–anal anastomosis

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Abstract
Purpose Few studies have reported minimally invasive total proctocolectomy with ileal pouch–anal anastomosis (IPAA) for ulcerative colitis (UC) and familial adenomatous polyposis (FAP). We herein report a novel hand-assisted hybrid laparoscopic–robotic technique for patients with FAP and UC.
Methods Between February 2010 and March 2014, six patients underwent hand-assisted hybrid laparoscopic–robotic total proctocolectomy with IPAA. The abdominal colectomy was performed laparoscopically with hand assistance through a transverse suprapubic incision, also used to fashion the ileal pouch. The proctectomy was carried out with the da Vinci Surgical System. The IPAA was hand-sewn through a transanal approach. The procedure was complemented by a temporary diverting loop ileostomy.
Results The mean hand-assisted laparoscopic surgery (HALS) time was 154.6 (±12.8) min whereas the mean robotic time was 93.6 (±8.1) min. In all cases, a nerve-sparing proctectomy was performed, and no conversion to traditional laparotomy was required. The mean postoperative hospital stay was 13.2 (±7.4) days. No anastomotic leakage was observed. To date, no autonomic neurological disorders have been observed with a mean of 5.8 (±1.3) bowel movements per day.
Conclusions The hand-assisted hybrid laparoscopic–robotic approach to total proctocolectomy with IPAA has not been previously described. Our report shows the feasibility of this hybrid approach, which surpasses most of the limitations of pure laparoscopic and robotic techniques. Further experience is necessary to refine the technique and fully assess its potential advantages.

Keywords Robotic proctectomy · Hand-assisted laparoscopic surgery · Ileal pouch–anal anastomosis · Inflammatory bowel disease · Familial adenomatous polyposis

Introduction

Total proctocolectomy with ileal pouch–anal anastomosis (IPAA) is the surgical approach of choice for ulcerative colitis (UC) refractory to medical management. It is also recommended as a prophylactic procedure in patients diagnosed with familial adenomatous polyposis (FAP) [1, 2]. Minimally invasive surgical techniques have recently been used to perform large bowel resections for the treatment of both malignant and benign colonic diseases, including FAP and UC. In fact, several studies have demonstrated that minimally invasive colorectal surgery has several advantages over open surgery, including earlier return of bowel function, reduced postoperative pain, and better cosmetic results [3, 4]. However, even if laparoscopy has become very popular for colon surgery and is largely used also in rectal surgery, laparoscopic total proctocolectomy with IPAA has not had the same dissemination mostly because of the intrinsic technical limitations of the laparoscopic approach in the deep pelvis and the steep learning curve [5, 6]. The enhanced surgical

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dexterity offered by robotic assistance is expected to overcome some of the limitations of conventional laparoscopy, thus improving the acceptance of minimally invasive techniques in colorectal surgery. While increasingly more manuscripts are being published about the use of robot-assisted proctectomy for rectal cancer, we found few studies about the use of robotic assistance in total proctocolectomy for UC and none for FAP. The aim of this study was to describe our surgical technique and the early results of hand-assisted hybrid laparoscopic–robotic total proctocolectomy with restorative IPAA for patients diagnosed with FAP or UC.

Materials and methods

Patients

This is a retrospective study on a prospectively collected database. Between February 2010 and March 2014, six patients diagnosed with FAP ($n=5$) or UC ($n=1$) underwent hand-assisted hybrid laparoscopic–robotic total proctocolectomy with restorative IPAA. The five patients with FAP had a large number of rectal adenomas (more than 20 adenomas), without extracolonic manifestations, whereas patient with UC had severe inflammatory involvement and ulcerations of the rectal wall all the way to the dental line unresponsive to medical treatment (mesalazine, corticosteroids, immunosuppressive, and biological drugs).

Exclusion criteria included evidence of preoperative large bowel malignancy, aggressive fibromatosis, and previous colon resections. Another selection criterion was the assignment of the robotic technique based on the limited availability of the Da Vinci System due to the fact that this system is shared with other surgical Units and with other surgical indications in our General Surgery Unit.

All patients received an extensive explanation of the procedure and were provided with an informed consent form. The study was approved by the Institutional Review Board of the University of Pisa. All patients underwent the procedure by surgeons with wide experience in the laparoscopic and robotic treatment of colorectal diseases.

Preoperative imaging was achieved by colonoscopy with multiple polyp biopsies; patients diagnosed with FAP also underwent upper endoscopy, ocular fundus examination, CT scan to rule out desmoids, and mandible radiography.

For assessing male sexual function, the International Index of Erectile Function (IIEF) questionnaire 17 was adopted [7], and for female sexual function, the Female Sexual Function Index (FSFI) questionnaire was adopted [8]. These are 15-item, self-administered questionnaires that analyze 5 factors: erectile function (sexual function for female), orgasmic function, sexual desire, intercourse satisfaction, and overall satisfaction. For evaluating urinary tract symptoms and the impact on quality of life, the ICIQ-FLUTS and the ICIQ-MLUTS questionnaires were used, respectively [9]. Fecal incontinence was also assessed using Wexner Continence Grading scale [10]. The fecal continence/defecation clinical outcomes were evaluated with the modified fecal incontinence quality of life (mFIQL) score, a single 14-item composite scale derived from lifestyle, coping, and behavior items [11].

Patients completed the questionnaires regarding their sexual, urinary, and continence function before surgery, at 1 month after stoma closure, and at 6 months and 1 year after surgery.

Patient information including age, sex, disease, surgical history, surgical procedures, length of hospital stay, and postoperative complications such as ileus, wound infection, anastomotic leakage, pulmonary infections, and re-admission were collected from patient charts and entered into a database. Patients were checked 1, 2 weeks, and 1 month after discharge with a physical exam and blood tests. Just before ileostomy closure, the patients were checked for absence of anastomotic dehiscence and stenosis by contrast enema at 2 month after surgery. After stoma closure, patients were seen in the outpatient clinic at 7, 14 days and then monthly in order to assess functional outcome. Patients received endoscopic surveillance after six months and 1 year after ileal pouch creation and then it continued yearly. Continuous variables are given in the text as a mean value (±standard deviation).

Surgical procedure

We utilize a hand-assisted laparoscopic–robotic hybrid approach. The procedure can be divided into three phases. The first phase consists of a hand-assisted laparoscopic surgery (HALS) colectomy as well as an extracorporeal preparation of the ileal pouch. The second phase entails the robotic proctectomy carried out with the da Vinci Surgical System (Intuitive Surgical, Sunnyvale, CA, USA). The third phase involves specimen extraction and IPAA execution through a perineal approach. The procedure is complemented by a diverting loop ileostomy.

First phase: hand-assisted laparoscopic colectomy and extracorporeal preparation of the pouch

Patients are placed in the modified lithotomy position, with the hips straightened and the knees flexed. The abdomen is entered via a small transverse suprapubic incision and a GelPort device (Applied Medical, Rancho Santa Margarita, CA, USA) is applied to the wound. We then place a 12-mm port through the hand port, establish pneumoperitoneum to 12 mmHg (Fig. 1), and insert four additional trocars under visualization: a 12-mm port in the umbilical region, an 11-mm port each in the right and left pararectal sites, and an 8-mm port in the left flank (Fig. 2). Colonic mobilization is

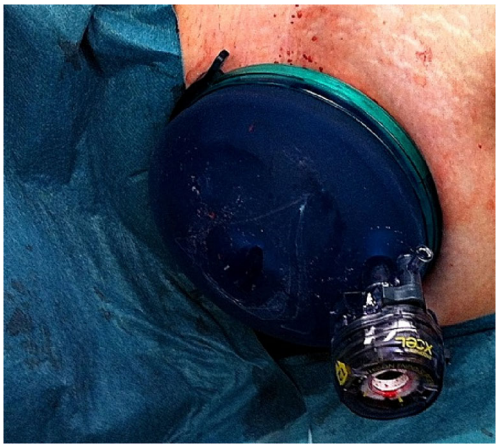

Fig. 1 Gelport with trocar for optic positioned at the right side of the hole dedicated for the left hand

accomplished in a clockwise direction using the hand-assisted laparoscopic technique. Dissection is carried out with the left hand through the hand port. Meanwhile, the laparoscope is inserted into the trocar positioned in the GelPort, and an energy-delivery device held in the right hand is inserted through the left pararectal trocar. The gonadal vessels, right ureter and kidney, duodenum, and pancreas are identified during this process. The ileocolic pedicle is divided, and the medial colonic vessels are sealed near the colonic wall with a 5-mm LigaSure Blunt Tip device (Covidien, Boulder, CO, USA) with a Force-Triad Generator (Valleylab, Boulder, CO, USA). Patients are then placed in the reverse Trendelenburg position, and the omentum is separated from its colonic attachments. Continuing with the hand-assisted technique and without any changes in trocar positions or settings, the operating surgeon pull the transverse colon down to expose the avascular plane between the omentum and transverse colon. After reaching the splenic flexure, the surgeon continues from the same position to mobilize the left colon up to the rectosigmoid junction. After ligation of the left colonic vessels, the mesentery is dissected over the left kidney fascia. This maneuver allow for prompt identification of the left ureter. Finally, dissection of the left paracolic gutter is accomplished, leading to the end of colonic mobilization. The ileum is then transected.

The small bowel is fully mobilized all the way to the ligament of Treitz in order to be able to fashion the pouch through the suprapubic incision and avoid tension on the ileoanal anastomosis. In case of too short ileal mesenterium, we also perform multiple small transverse incisions on the peritoneum of the mesentery and a selective section of vessels under transillumination without interruption of visceral vascular supply.

After deflating the pneumoperitoneum, the terminal ileum is exteriorized through the Pfannenstiel incision, and a J-pouch is created by repeated application of a linear stapler (Echelon Flex, 60 mm; Ethicon, Cincinnati, OH, USA) to obtain a reservoir length of about 17 cm (Fig. 3).

Second phase: robotic proctectomy

The patient is then placed in the Trendelenburg position, and the da Vinci Si Surgical System is docked between the patient's legs with the third arm positioned on the left of the patient. For the right-handed instrument, we use a monopolar forceps through an 8-mm robotic trocar positioned in the GelPort. For the left-handed instrument, we use a bipolar single-fenestrated grasper through an 8-mm robot-specific trocar positioned in the left 11-mm trocar (trocar-in-trocar technique). The third arm is docked at the left pararectal site in the same way. Patient and robot positions after docking are shown in Fig. 4. An assistant provide suction and retraction through the 11-mm right flank trocar. A mesorectal plane is established with optimal visualization, allowing for preservation of the pelvic anatomic nerves. The dissection is continued posteriorly to Waldeyer's fascia and down to the level of the levator ani muscles, laterally through the lateral stalks while taking care to remain in the pararectal plane, and anteriorly through the rectovaginal septum (female) or Denonvilliers' fascia (male) with complete mobilization of the rectum until the sphincter is clearly visible.

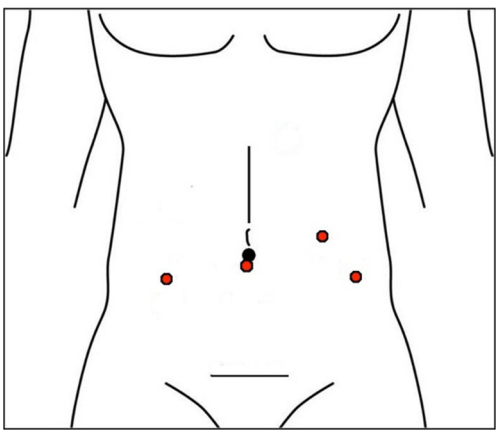

Fig. 2 Port placement throughout the entire operation

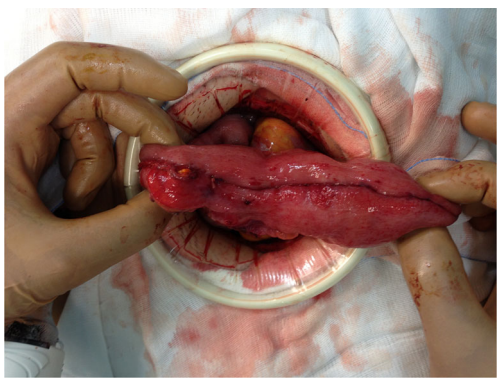

Fig. 3 The J-pouch created by repeated application of a linear stapler (Echelon Flex, 60 mm; Ethicon, Cincinnati, OH USA)

Fig. 4 Patient and robot positions after docking during proctectomy

Third phase: perineal phase

A Lone Star Retractor System (CooperSurgical, Trumbull, CT, USA) is positioned, and the dentate line is exposed. The incision is made exactly at the dentate line level. Trans-anal rectal transection is performed leaving a little muscular cuff of rectum to surround the pouch, and the entire specimen is exteriorized through the anus to avoid any possible contamination of abdominal cavity with the handling of the rectum (Fig. 5). After that, the pouch is carried on to the pelvis with a hand in the gel port, across the Pfannestiel incision, and grasped through the anus with an a-traumatic forceps. The IPAA is hand-sewn transanally using one layer of eight interrupted absorbable sutures (Fig. 6). Finally, a temporary diverting ileostomy is created in the right lower quadrant at the site of the right pararectal trocar incision (Fig. 7).

Results

During the study period, one patient with UC and five patients with FAP were considered for hand-assisted hybrid laparoscopic–robotic-assisted total proctocolectomy with restorative IPAA. The patients comprised three males and three females. Their mean age was 29.6 (±8.1) years. The patients' characteristics are listed in Table 1. The mean HALS time was 154.6 (±12.8) min whereas the mean robotic time was 93.6 (±8.1) min. The mean blood loss, estimated by surgical suction containers, was 50.3 (±16.5) mL. No patients underwent perioperative blood transfusions. No conversion to traditional open surgery was necessary. Nerve-sparing proctectomy was performed in all patients. No intraoperative surgical complications or deaths occurred. Surgical pathology revealed no evidence of malignancy. The mean hospital length of stay was 13.2 (±7.4) days. The postoperative course was uneventful with the exception of one patient who developed a paralytic ileus which resolved with supportive therapy.

Stoma closure was undertaken after a mean of 3.3 (±1.2) months. During a mean follow-up period of 20.3 (±14.9) months, no patients experienced nighttime bowel movements or the need to adjust meal times to accommodate bowel movements. There was no late fistula in any of the cases. All patients were continent for stools and flatus without using medications. The mean pouch frequency was 5.8 (±1.3) times per day. Although patients initially complained of liquid stools, they had semisolid stools by 1 month after ileostomy closure and did not suffer from urgency. Despite an initial reduction of sexual, urinary function, all parameters assessed in the questionnaires progressively improved, and 6 months and 1 year after surgery, the values were similar to these measured before surgery (Table 2). All men were able to achieve erection

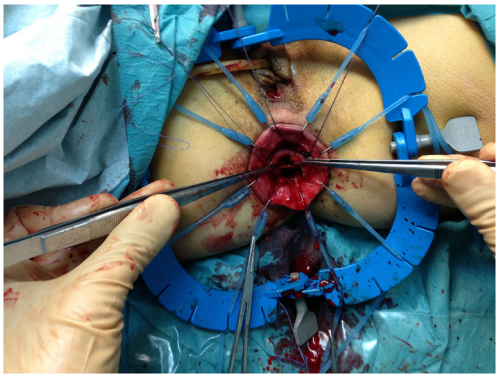

Fig. 6 Ileal pouch–anal anastomosis fashioned at the dentate line using interrupted absorbable sutures

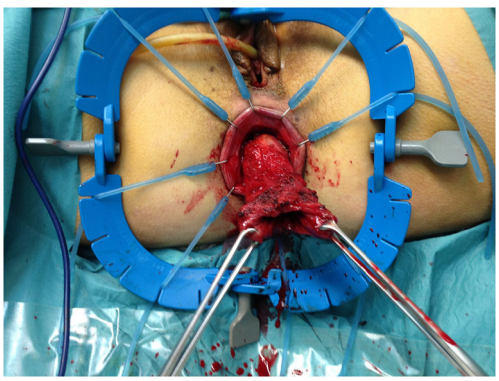

Fig. 5 Trans-anal specimen extraction

Fig. 7 Final postoperative results; the ileostomy was performed through the right pararectal port

Table 1 Patient characteristics and perioperative aspects

Case	Sex	Age	Pathology	BMI, Kg/m^2	HALS time, min	Robotic time, min	Blood loss, mL	Length of stay, days	Postoperative complications	Pouch frequency
1	M	19	FAP	23.9	176	105	75	24	Ileus	6
2	M	27	UC	28.2	145	93	57.5	15		8
3	F	25	FAP	30.1	163	99	50	11		4
4	F	42	FAP	32	154	95	25	19		6
5	M	35	FAP	28.7	148	88	45	6		5
6	F	30	FAP	25.6	142	82	55	5		6

M male, *F* female, *BMI* body mass index, *FAP* familial adenomatous polyposis, *UC* ulcerative colitis, *HALS* Hand-Assisted Laparoscopic Surgery

postoperatively, and none reported retrograde ejaculation. Female patients did not report dyspareunia or micturition. Regarding the impact of incontinence symptoms on patients' quality of life, the mFIQL score increased early after surgery, but in all patients, it decreased progressively, and 1 year after the intervention, the value was comparable to that measured before surgery. In UC patients, the 1-year mFIQL score was better than the preoperative status.

Histologic examination did not reveal rectal mucosa in all patients during the endoscopic surveillance.

Discussion

Since the introduction of the da Vinci Surgical System in the early 2000s, its field of application has rapidly increased, and currently, its use is gaining acceptance in rectal surgery [12, 13]. In fact, several features make the da Vinci Surgical System particularly suitable for work in the narrow confines of the pelvis. One of the benefits is a stable, surgeon-controlled camera that is operated entirely by the surgeon at the console and that allows for optimized visualization with an increased depth of field. In contrast to laparoscopy, which provides a two-dimensional view on a monitor and 2-fold magnification, the robotic system features a three-dimensional view and 10-fold image augmentation. Another technological advantage of robotic surgery is the computerized instrumentation, which eliminates tremor and provides motion scaling, thus affording extreme accuracy in manipulating deep structures. Moreover, the EndoWrist technology provides instruments that are capable of hand-like motions previously impossible with conventional laparoscopic equipment. Finally, ergonomic hand and body positioning at the robotic console provides a comfortable operating position for the surgeon [14]. The enhanced optics and fine tissue manipulation afforded by the robotic approach reportedly assist in identification and preservation of critical pelvic structures [3]. Therefore, robotic systems may improve the utilization of minimally invasive techniques in rectal resection by reducing the ergonomic and technical challenges of laparoscopic tissue handling, dissection, and visualization, which is of particular importance in confined spaces such as the pelvic cavity [15]. In this setting, the robotic optical and operative attributes are maximally actualized while the laparoscopic pitfalls are avoided, thus making pelvic surgery the optimal scenario for the adaptation of the robotic platform.

Since Pigazzi et al. [16] demonstrated the safety and feasibility of the robotic technique for low anterior rectal resection, robotic technology has slowly gained popularity in colon and rectal cancer surgery. Nevertheless, there are scant data on the role of the robotic platform in the UC or FAP, with the exception of occasional case reports and small descriptive series [17–19]. A characteristic feature of these diseases is the young age at presentation. Because patients requiring surgery are generally young, active, and highly motivated individuals, they are good candidates for minimally invasive surgery because cosmesis is of paramount importance in this particular age group. Hence, by reducing the physical and especially psychological impacts of surgery, minimally invasive surgery may represent an appealing alternative [20, 21]. Moreover, these young patients not only have an intrinsic risk of requiring additional surgical procedures for problems such as adhesions, desmoid tumors, and duodenal carcinoma but also have a 30 to 35 % risk of small bowel obstruction that could possibly be reduced by laparoscopy. Thus, the potential benefits of minimally invasive surgery appear to be quite evident [22].

Laparoscopic total proctocolectomy was first described in the early 1990s [23]. Pedraza et al. in 2011 [17] and McLemore et al. in 2012 [18] described the first hybrid robotic–laparoscopic proctocolectomies for UC without hand assistance. The authors demonstrated that this technique was feasible and safe. In a more recent case-matched study, Miller et al. [19] compared robotic and laparoscopic proctectomy among patients with UC who underwent prior laparoscopic total abdominal colectomy. The authors showed that the benefits of the robotic approach in this setting included avoidance of complications related to major laparotomy and a postoperative course similar to that of conventional laparoscopy with regard to perioperative outcomes, complications, and short-term outcomes. To the best of our knowledge, our experience

Table 2 Functional outcomes using IIEF /FSFI questionnaire, FLUTS/MLUTS questionnaire, Wexner, and mFIQL score. All values are given as a mean (±standard devation)

Male patients (n=3)

Period	Erectile range (0–30)	Orgasmic range (0–10)	Desire range (2–10)	Satisfaction range (0–15)	Overall range (2–10)	VS range (0–20)	IS range (0–24)	Ws range (0–20)	mFIQLs range (0–100)
Before surgery	19.2±7.1	8.5±2.8	8.4±1.5	7.6±3.6	7.2±1.3	1.4±1.2	0.1±0.3	3.1±0.7	26.2±5.6
1 month after stoma closure	13.6±5.6	7.1±2.3	7.2±1.6	5.6±2.9	6.1±1.2	5.2±1.4	4.2±1.2	7.3±1.7	47.4±11.8
6 months after surgery	16.3±5.6	8.2±2.3	8.2±1.6	6.8±2.8	8.5±1.2	2.5±1.6	2.3±0.7	4.1±1.3	30.6±8.1
1 year after surgery	17.2±6.3	8.2±2.5	8.2±1.0	7.1±3.5	8.5±1.3	2.2±1.2	1.8±1.1	4.1±0.8	29.3±7.2

Female patients (n=3)

Period	Desire range (1.2–6)	Arousal range (0–6)	Lubrification range (0–6)	Orgasm range (0–6)	Satisfaction range (0.8–6)	Pain range (0–6)	VS range (0–12)	IS range (0–20)	FS range (0–20)	Ws range (0–20)	mFIQLs range (0–100)
Before surgery	4.8±1.2	4.3±0.8	4.3±0.3	4.8±0.2	5.2±1.2	0±0	1.1±1.6	1.1±1.3	4.2±1.2	0±0	21.5±2.9
1 month after stoma closure	3.6±0.8	3.6±0.6	4.1±0.3	3.6±0.3	4.4±0.8	0±0	2.3±1.7	1.2±1.1	5.4±1.5	7.2±1.5	44.6±7.4
6 months after surgery	4.2±1.8	3.9±0.6	4.3±1.1	4.4±0.6	5.2±0.8	0±0	1.2±1.6	1.1±1.2	4.5±1.5	2.5±1.0	33.7±6.3
1 year after surgery	4.2±1.2	4.3±1.0	4.3±0.8	4.4±0.6	5.2±1.0	0±0	1.1±1.8	1.1±0.7	4.3±1.8	2.3±1.1	31.3±6.1

VS voiding symptoms, *FS* filling symptoms, *IS* incontinence symptoms, *Ws* Wexner score for fecal incontinence, *mFIQLs* fecal incontinence quality of life score

is the first in which robotic proctectomy has been described in patients diagnosed with FAP.

Total mesorectal excision procedure is questionable for UC disease because associated potentially with more sexual and functional problems then the conservative mucosal resection. The only patient with RCU included in the study had a very severe inflammatory involvement and ulcerations of the rectal wall all the way to the dental line so that full removal of the diseased mucosa followed by a hand-sewn ileal-anal anastomosis was considered a better approach than the "double-stapling technique" [24] in order to avoid leaving severely disease mucosa at risk for postoperative cuffitis and neoplastic degeneration.

The aim of the present study was to describe our surgical technique and report our experience with minimally invasive surgical treatment of patients diagnosed with FAP and UC. We utilized a laparoscopic–robotic hybrid approach starting with hand-assisted laparoscopy. The use of the GelPort through the suprapubic incision, which is already necessary for creation of the J-pouch, is useful because hand assistance facilitates colonic mobilization and simplifies surgical maneuvers. This is particularly important in such a complex procedure.

The present series is highly selected, but in our preliminary experience, we have noted several potential advantages of the hybrid robotic–laparoscopic technique, which should deserve confirmation in a larger series including also control groups. In fact from our data, although limited by the small sample, the operative time, complications, and functional aspects are promising when compared with the major recent reports published in literature about laparoscopic total proctocolectomy [25–31]. The comparative results are shown in the Table 3.

Indeed, by merging the two techniques, the surgeon is able to maximize the advantages of each method while avoiding its specific drawbacks. In fact, one of the strength of laparoscopy is its flexibility, allowing the operating surgeon to quickly span over wide operative fields while easily repositioning the patient and using gravity for retraction. In proctocolectomy, hand-assisted colonic mobilization is therefore straightforward [32]. The use of robotic assistance in this phase does not seem to provide significant advantage, in the average patient, while could impede the flow of the operation because of the need to reposition the patient and the bulky robotic tower. Robotic assistance, on the other hand, is particularly rewarding when working in deep and narrow spaces, such as the pelvis. The steady stereotactic view of the high definition robotic camera facilitates identification of anatomic planes as well as the tiny autonomic nerves. Further, the miniaturized robotic instruments, having seven degrees of freedom, allow the operating surgeon to gently dissect tissues and place sutures, when necessary, even in the deepest portions of a male pelvis. Therefore, besides retaining all well-known clinical advantage of minimally invasive surgery (i.e., functional and cosmetic benefits), this hybrid technique

Table 3 Characteristics of patients and perioperative aspects of our series compared with standard laparoscopic proctocolectomy with IPAA for FAP or UC reported in recent literature

Author (year)	# cases	Age years (mean)	HALS	OOT min (mean)	CR (%)	POS days (mean)	POC (%)	Incontinance 1 year follow-up (%)	Stool per day 1 year follow-up (mean)
Lefevre (2009) [25]	38	40	No	314	11 %	15	27 %	26 %	6
Fichera (2009) [26]	73	36	No	335	NR	8	29 %	20 %	7
Goede (2011) [27]	30	39	No	210	7 %	7	25 %	5 %	4
Dolejs (2011) [28]	100	37	Yes	434	NR	6	NR	NR	NR
Duff (2012) [29]	53	35	No	NR	0 %	7	24 %	13 %	7
Kim (2012) [30]	40	43	Yes	300	0 %	11	16 %	NR	NR
Schiessling (2013) [31]	21	36	NR	313	23 %	12	28 %	NR	NR
Present series	6	29	Yes	247	0 %	13	16 %	0 %	6

FAP familial adenomatous polyposis, *UC* ulcerative colitis, *HALS* Hand-assisted laparoscopic surgery, *OOT* overall operative time, *CR* conversion rate, *POS* postoperative stay, *POC* postoperative complications, *NR* not reported

enables the surgeon to perform, with great ease, the dissection of all bowel segments in the laparoscopic phase and nerve-sparing, sphincter-saving dissection in the deep pelvis using robotic assistance. Since one incision is required to fashion the J-pouch and retrieve the specimen, we decide to use it for hand assistance. Little doubt exists that hand assistance improves surgical dexterity by restoring tactile feedback and facilitating tissue retraction/exposure [33]. Our functional results, in terms of sexual and urinary dysfunction as well as intestinal continence are promising but deserve confirmation in larger studies.

The mean length of hospital stay in the present series was longer than expected based on the rate and severity of postoperative complications. This may be cultural [34, 35] with patients expecting to leave hospital only when fully recovered and needing little outpatient care. Giulianotti reported a difference of 16 days in the median length of hospital stay between patients in Italy and the USA [35].

Another drawback is that we were not able to accurately estimate the additional costs required by robotic assistance. It is reasonable to assume that direct operative costs were increased as compared to pure laparoscopy or open surgery. However, in other pelvic operations, such as radical prostatectomy [36], in which functional results are key for quality of life and may be rewarding in terms of indirect costs, robotic assistance has found one of its main field of use. Meaningful evaluation of this difficult issue, deserve specific studies with well defined outcome measures, clearly identified comparative treatments, and exact definition of direct and indirect costs.

In conclusion, we believe that hybrid laparoscopic–robotic proctocolectomy with IPAA is an appealing alternative to laparoscopy and open surgery in selected patients with FAP or UC. No previous reports have described the combination of hand-assisted laparoscopy and robotic assistance in this demanding operation. Further studies are necessary to define the advantages of this new approach for minimally invasive proctocolectomy.

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Authors' contributions *Study concept and design:* Morelli, Guadagni, Pisano, Mariniello, Furbetta, D'isidoro, Caprili, Marciano, Boggi, Di Candio and Mosca. *Acquisition of data:* Morelli, Guadagni, Pisano, D'isidoro, Caprili, Furbetta, Marciano and Mariniello. *Analysis and interpretation of data:* Morelli, Boggi, Di Candio and Mosca. *Drafting of the manuscript:* Morelli, Guadagni and Mariniello. *Critical revision of the manuscript for important intellectual content:* Morelli, Boggi, Di Candio and Mosca,.

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