Comparative study between open and laparoscopic total proctocolectomy with ileal pouch-anal anastomosis for ulcerative colitis: a propensity score-matched study

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Background
The purpose of the study was to compare laparoscopic vs open restorative total proctocolectomy with ileal pouch-anal anastomosis (TPC-IPAA) for ulcerative colitis regarding safety, feasibility, and postoperative outcome.
Patients and methods
This is a propensity score-matched study of cases that underwent TPC-IPAA for ulcerative colitis from February 2009 to December 2017. The data were collected from a prospectively maintained web-based hospital registry. Cases were distributed TPC-IPAATPC-IPAA into two classes depending on the form of method: group I (open TPC-IPAA) and group II (laparoscopic TPC-IPAA).
Results
The duration of the operation was significantly longer in the laparoscopic group (P=0.0001). The length of the wound is significantly longer in the open group (P=0.0001). Postoperative pain was significantly less in the laparoscopic group. Patients in the laparoscopic group started oral intake earlier than the open group (P=0.0001). The incidence of overall postoperative morbidity was 39.3% in the laparoscopic group compared with 60.7% in the open group (P=0.11). Functional outcomes and postoperative anorectal manometry were comparable between both the groups.
Conclusion
Laparoscopic TPC-IPAA was equivalent to open TPC-IPAA in terms of health and viability. Laparoscopic TPC-IPAA showed superior postoperative cosmoses, less postoperative pain, earlier resumed oral intake, but with longer operating time.

Keywords:
lanal incontinence, pouchitis, ulcerative colitis

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Introduction

Ulcerative colitis (UC) is a chronic disease with repeated attacks and major morbidity [1]. In general, the disease develops during the second and third decades of life with chronic bloody diarrhea which may hinder the patients' daily activities. The introduction of new immunomodulatory drugs such as infliximab (tumor necrosis factor-α) and adalimumab has greatly enhanced the outcomes of pharmacological management of UC. However, a fraction of patients still require surgical treatment [2].

Despite the development of medical drugs for UC, surgery would be required for ∼20% of the patients. Total ileal pouch-anal proctocolectomy (TPC-IPAA) is often the technique of choice, and the long-term findings are acceptable with respect to practical outcome and improved quality of life [1,2].

UC surgical control is retained for patients who do not respond to medical attention or who experience serious hemorrhage, toxic megacolon, perforation, or cancer [3]. As the disease affects the rectum above the dentate line and spreads proximally throughout the colon, TPC-IPAA is the cornerstone of surgical management [4]. As one of the most extensive colorectal procedure, TPC-IPAA has its own reported set of complications such as pouchitis, anastomotic strictures, and small bowel obstruction [5]. Traditionally open TPC-IPAA had some disadvantages, including the need for a generous midline incision for sufficient visibility, and the difficulty of performing a full proctectomy owing to

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the narrow bony pelvis with difficult visualization of the pelvic floor and anorectal junction [6].

Over the past 25 years, the evolution of laparoscopic surgery and advances in laparoscopic techniques and the experience of the surgeons have helped to carry out laparoscopy in colorectal surgery [7]. Several open-vs-laparoscopic research studies found that the laparoscopic technique substantially improved surgical outcomes and reduced hospital stay [8–13]. The magnified surgical field of laparoscopy allowed precise surgical resections and preservation of important structures especially in limited fields as the pelvis. However, regarding TPC-IPAA, the effects of laparoscopy on the length of hospital stay, overall morbidity, and mortality are still controversial [14–18]. The aim of the study was to compare laparoscopic vs open restorative TPC-IPAA for UC regarding safety, feasibility, postoperative outcome, urogenital, sexual function, and quality of life.

Patients and methods

It is a retrospective data study of all patients having UC TPC-IPAA at the Mansoura University Gastrointestinal Surgical Center from February 2009 to December 2017. The data were retrieved from a prospectively maintained web-based hospital registry since 2000. The research included all patients scheduled for elective TPC-IPAA, except those with prior laparotomy, bowel resection, reported liver cirrhosis, or pregnancy. After a thorough explanation of the essence of the UC and future treatment with its morbidities, informed consent was signed from all the cases involved in the report. The institutional review board (IRB) had approved this report. For this, a score-matched analysis of inclination was done. The cases were divided into two groups of patients based on the form of approach: group I (open TPC-IPAA) and group II (laparoscopic TPC-IPAA).

Operative procedures

After a multidisciplinary team decision, patients were prepared for surgery. They underwent full laboratory investigations, including checks for complete blood picture, and liver and kidney function tests. Ultrasound of the abdomen was routinely performed in all cases. All patients were evaluated shortly before surgery by colonoscopy to exclude any malignancies. Steroid-dependent patients were maintained on steroids throughout the perioperative period with gradual withdrawal after surgery.

Open total proctocolectomy with IPAA

A generous midline incision was used. Resection was started with the right colon and proceeded distally. The rectum was resected to the pelvic floor stage using a T-shaped surgical stapler after confirmation of complete proctectomy by a simultaneous digital rectal examination. Then a J-pouch 15 cm in length was fashioned from the terminal ileum using linear staplers followed by a side-to-end pouch-anal anastomosis using a circular stapler. A loop ileostomy proximal to the pouch was then exteriorized.

Laparoscopic total proctocolectomy with IPAA

The patient was placed at supine with the legs separated on the operating table. After the creation of pneumoperitoneum using a Veress needle, we adopted a five-port approach. The optical port was situated above the umbilicus (10 mm). A 12 mm port between the umbilicus and the anterior upper iliac spine was inserted into the right iliac fossa at midway at the proposed site of the ileostomy. Another 12 mm port was inserted at the left iliac fossa midway between the umbilicus and the left anterior superior iliac spine. Two 5 mm ports were inserted in the right and left upper quadrants for assistance.

The first phase of the procedure was commenced with the surgeon standing between the patient's legs and the monitor on the right side of the patient's upper extremity. Lateral traction on the ileocecal junction was done to help identify the ileocolic pedicle, which was divided after securing with clips. Mobilization of the ascending colon and the hepatic flexure was then done by a medial to lateral approach. Care was taken not to injure the duodenum or the head of the pancreas. The lesser sac was then opened with dissection of the gastrocolic omentum throughout the length of the transverse colon. Then the middle colic vessels were clipped and divided. Dissection of the transverse mesocolon from the lower border of the pancreas was then done followed by mobilization of the splenic flexure of the colon.

The second stage of the operation was continued with the surgeon standing on the patient's right side, with the patient's monitor at the patient's left lower leg. Mobilization of the sigmoid and descending colon was carried out in a medial to lateral approach, identifying the left ureter to avoid its injury. Then the inferior mesenteric pedicle was divided between clips 2 cm away from the aorta to avoid injury of the nerve plexus. Dissection continued down the sacral promontory to the presacral fascia to mobilize the rectum posteriorly. Mobilization of the rectum all around continued till visualization of the levator ani muscle. A digital rectal examination was done to

confirm complete rectal mobilization. The division of the anorectal junction was carried on with articulating linear endo staplers. The extraction of the specimen was done through the right iliac fossa port after a slight extension or through a Pfannenstiel incision (supplementary video).

After the exteriorization of the specimen and division of the terminal ileum, a 15 cm ileal J-pouch was fashioned with the insertion of the anvil of the circular stapler. The pouch-anal anastomosis was done by a 33 mm circular stapler. A diverting loop ileostomy was the exteriorized through the extraction site, and a pelvic drain was placed.

Postoperative care

All patients received intravenous antibiotics, omeprazole, and continue steroid injection for patients who were taken it preoperatively.

Abdominal drains were measured postoperatively and removed once drainage stopped. Abdominal ultrasonography was conducted on intra-abdominal samples only with clinical uncertainty.

Patients resumed oral fluids as soon as bowel motions were heard and ileostomy was adequately functioning. Patients were cleared when a normal diet was accepted.

Follow up

Patients were then followed up at 1, 3, and 6-month intervals 1 week after discharge. Follow-up included clinical assessment (frequency, bleeding/rectum, and mucous discharge), quality of life, and colonoscopic follow-up for complaining patients.

Assessment

The primary result was the length of stay in hospital. Working time, blood loss, quality of life, conversion rate, early morbidity, morphine requirement, urogenital function, re-exploration, time to restart oral intake, mortality, and costs were secondary end points.

Statistical analysis

Categorical variables are viewed as proportions, and the χ^2 test was compared. Continuous variables are expressed as medians and measured by *t*-testing. All statistical analyses were two-sided, and *P* value less than 0.05 was considered significant. SPSS version 17 (SPSS Inc., Chicago, IL, USA) was use for analysis.

Age, sex, frequency of diarrhea, bleeding per rectum, mucous anal discharge, BMI, diabetes mellitus, preoperative albumin level, preoperative hemoglobin level corticosteroid therapy, immunosuppressive therapy, and an indication of surgery were introduced in a multivariate logistic regression to generate propensity scores, demonstrating the chance of a patient experiencing TPC with IPAA. Then, a score-matched test of inclination was performed to generate matched pairs by the nearby neighboring system with equivalent 1 : 1 and no caliper for complete identical.

Results

A total of 56 patients who underwent TPC-IPAA for UC were included during the above study period. Patients in both groups were split similarly (28 patients each).

Patients' demographics and preoperative data are demonstrated in Table 1. Both groups were comparable regarding age, sex, and preoperative BMI. The main indication for surgery in both groups was the failure of medical treatment.

Results in terms of operative and postoperative parameters are shown in Table 2. The operative time was significantly longer in the laparoscopic group ($P<0.001$). There were no conversions in the laparoscopic group. Postoperative pain was significantly less in the laparoscopic group, with significantly less postoperative analgesia ($P<0.001$). In the laparoscopic group, patients resumed oral intake 1 day earlier than the open group ($P<0.001$).

Postoperative complications are shown in Table 3. The incidence of overall postoperative morbidity was 39.3% in the laparoscopic group compared with 60.7% in the open group, with no significant difference between both groups ($P=0.11$). One patient in the open group was complicated by significant pouch bleeding, which was managed by surgically. All stomas were generally closed 3 months after the operation; however, two patients (one in each group) required early reversal of the ileostomy after 3 weeks owing to stoma retraction with skin excoriation. Results regarding functional outcomes (anorectal and genitourinary) were comparable among both groups. Results for preoperative and postoperative anorectal manometry were comparable between the groups, as shown in Table 4.

Discussion

First introduced in 1992, laparoscopic TPC for UC has not spread broadly because of the struggle of the technique and the difficult clinical characteristics of UC as an inflammatory sickness. However, the

Table 1 Demographic data

	Laparoscopic TPC [*n* (%)]	Open TPC [*n* (%)]	*P* value
Age (years)	31.5 (18–53)	31.5 (17–55)	0.98
<35	16 (57.1)	17 (60.7)	0.79
>35	12 (42.9)	11 (39.3)	
Sex			
Male	13 (46.4)	13 (46.4)	1
Female	15 (53.6)	15 (53.6)	
BMI			0.75
>25	22 (78.6)	23 (82.1)	0.73
<25	6 (21.4)	5 (17.9)	
Disease duration (months)	44 (6–180)	48 (6–144)	0.92
Diabetes	2 (7.1)	2 (7.1)	1
Steroid therapy	20 (71.4)	21 (75)	0.76
Immunosuppressive drug	12 (42.9)	11 (39.3)	0.79
Diarrhea	28 (100)	28 (100)	1
Median frequency (times/day)	7 (4–12)	7 (4–11)	0.95
<6	5 (17.9)	4 (14.3)	0.72
>6	23 (82.1)	24 (85.7)	
Bleeding/rectum	24 (85.7)	23 (82.1)	0.72
Mucus discharge	21 (75)	20 (71.4)	0.76
Preoperative hemoglobin	8 (7–12)	9 (7–12)	0.79
<10	16 (57.1)	15 (53.6)	0.79
>10	12 (42.9)	13 (46.4)	
Serum albumin (g/dl)	3.4 (2.4–4.2)	3.4 (2.5–4.3)	0.79
<3.5	18 (64.3)	17 (60.7)	0.86
>3.5	10 (35.7)	11 (39.3)	
Indication of surgery			
Failure medical treatment	14 (50)	14 (50)	0.75
Dysplasia	11 (39.3)	9 (28.6)	
Growth retardation	0	2 (7.1)	
Stricture	1 (3.6)	1 (3.6)	
Extracolonic manifestation	2 (7.1)	2 (7.1)	

TPC, total proctocolectomy.

evolution of surgical technology and accumulation of the surgical experience helped the gradual spread of laparoscopic TPC [7,12,19,20]. In the literature, several studies compared open vs laparoscopic TPC-IPAA; however, most of them compared open vs hand-assisted laparoscopic TPC, with only a few comparing open vs totally laparoscopic TPC-IPAA for UC [9,13,15,21,22].

In this study, the surgical and functional outcomes of 28 totally laparoscopic and 28 open TPC-IPAA cases matched by age, sex, and operative management only for UC were compared. Other background patient characteristics, demographics, and prior medical history were similar in both groups.

Although the operative time was significantly lengthier in the laparoscopic group, the early postoperative advantages for the patients in the laparoscopic group were evident in terms of significantly less pain with less need for analgesics, early resumption of oral intake, and better cosmesis owing to smaller incision length. Recently, three meta-analyzes comparing open and laparoscopic TPC-IPAA for UC and family adenomatous polyposis have shown similar findings with respect to operational (operational time and blood loss) and short-term (hospital mortality and postoperative morbidity) outcomes [23–25]. However, in 2010, Fajardo *et al.* [26] compared 55 laparoscopic TPC cases with 69 open cases and reported no significant difference regarding intraoperative loss of blood, blood transfusion, postoperative analgesic use, overall morbidity, restart of bowel function, hospital duration, and readmission levels. However, this study also showed that cases in the laparoscopic IPAA group underwent ileostomy recontinuation an average of 24.1 days sooner than patients in the open group (P=0.045). In 2013, a randomized controlled trial (LapCon Pouch trial) compared 21 laparoscopic with 21 open TPC-IPAA cases for UC. They reported insignificant difference between both groups concerning postoperative pain, hospital stay, or functional outcomes [27].

Table 2 Intraoperative and postoperative data

	Laparoscopic TPC	Open TPC	*P* value
Length of operation	6 (5–7)	4 (4–6)	0.0001
Amount of blood loss	100 (100–600)	150 (100–800)	0.73
Postoperative ICU	1 (1–2)	1 (1–2)	0.052
Amount of drainage	250 (100–800)	500 (300–1700)	0.0001
WBC count POD1	8 (4–23)	9.5 (4–21)	0.38
WBC count POD3	8 (4–19)	8 (4–15)	0.44
Hemoglobin POD1	11 (10–12)	10.5 (9–12)	0.19
Hemoglobin POD 3	11 (10–12)	10.5 (7–12)	0.15
Serum albumin POD1	2.6 (2.2–3.1)	2.3 (2–2.8)	0.0001
Serum albumin POD3	2.9 (2.2–3.5)	2.6 (2–3.2)	0.02
Postoperative pain POD1	6 (5–8)	8 (7–9)	0.0001
Postoperative pain POD3	3 (2–6)	6 (5–7)	0.0001
Postoperative analgesic POD1	22 (78.6)	28 (100%)	0.01
Postoperative analgesic POD3	8 (28.6%)	12 (42.9%)	0.27
Time to resume oral intake	2 (2–5)	3 (3–6)	0.0001
Length of the wound (cm)	6 (2–6)	30 (25–33)	0.0001
Hospital stay	4 (3–17)	5 (4–16)	0.09

TPC, total proctocolectomy; WBC, white blood cells.

Table 3 Postoperative complications

	Laparoscopic TPC	Open TPC	*P* value
Morbidity	11 (39.3)	17 (60.7)	0.11
Collection	2 (7.1)	2 (7.1)	1
Leakage	1 (3.6)	2 (7.1)	0.55
Intestinal obstruction	1 (3.6)	2 (7.1)	0.55
Chest infection	2 (7.1)	3 (10.7)	0.64
Wound infection	0	4 (14.2)	0.04
Pouch bleeding	0	1 (3.6)	0.31
Pouchitis	5 (17.9)	9 (32.1)	0.22
Retained rectum	3 (10.8)	4 (14.2)	0.33
Frequency/day	4 (3–11)	4 (3–11)	0.97
Anal incontinence	5 (17.9)	5 (17.9)	1
Minor	4 (14.3)	3 (10.7)	0.49
Major	1 (3.6)	2 (7.1)	
Incisional hernia	0	3 (10.7)	0.08
Anal stenosis	1 (3.6)	2 (7.1)	0.3
Enterocutaneous fistula	1 (3.6)	1 (3.6)	1
Re-exploration	3 (10.8)	4 (14.2)	0.33
Intestinal obstruction	1	2	0.87
Anal stenosis	1	0	
Enterocutaenous fistula	1	1	
Pouch bleeding	0	1	
Urine retention	2 (7.1)	1 (3.6)	0.55
Genital complications	5 (17.9)	4 (14.3)	0.72
Impotence	1	1	0.97
Premature ejaculation	1	1	
Dyspareunia	3	2	

TPC, total proctocolectomy.

In our study, we hypothesized that laparoscopy would allow better visualization of the pelvic floor and anorectal junction compared with the open approach, with fewer rates of retained part of the rectum. Although we found less incidence of retained part of the rectum after laparoscopic TPC (10.8%) compared with open approach (14.2%), this difference was not statistically significant. Regarding functional outcomes (motions per day, incontinence, and genitourinary outcomes), no substantial difference was observed between open and laparoscopic TPC-IPAA. This is similar to

Table 4 Manometeric prepocket and postpocket construction study

	Laparoscopic TPC	Open TPC	*P* value
Preoperative resting pressure	60 (40–90)	70 (40–150)	0.17
Postoperative resting pressure	55 (20–60)	55 (20–70)	0.71
P value	0.005	0.0001	
Preoperative squeeze pressure	110 (80–200)	130 (90–255)	0.34
Postoperative squeeze pressure	110 (60–220)	110 (60–230)	0.87
P value	0.048	0.001	
Pre-RAIR	19/19 (100%)	20/20 (100%)	1
Post-RAIR	14/15 (93.3%)	13/16 (81.3%)	0.32
P value	0.32	0.08	

RAIR, rectoanal inhibitory reflex; TPC, total proctocolectomy.

what was reported by a meta-analysis of 27 comparative studies published by Singh *et al.* [23] who concluded that laparoscopic and open approaches to RPC produced equivalent adverse event rates and long-term functional results.

Conclusion

In conclusion, we found that laparoscopic TPC-IPAA, although more time consuming, is safe, feasible, and superior to the open approach regarding the postoperative pain and wound complications, with better cosmesis. However, to confirm our results, more randomized controlled studies are needed.

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Conflicts of interest

There are no conflicts of interest.

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