Ileal Pouch Anal Anastomosis

Analysis of Outcome and Quality of Life in 3707 Patients

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Background: Ileal pouch anal anastomosis (IPAA) is the treatment of choice for chronic, medically refractory mucosal ulcerative colitis, indeterminate colitis, familial adenomatous polyposis (FAP), and a select group of patients with Crohn's disease.

Aim: We report outcomes, complications, and quality of life (QOL) in a cohort of 3707 patients treated at our institution from January 1984 to March 2010.

Methods: Data were collected from a prospectively maintained database and chart review of 3707 consecutive primary IPAA cases. Patient demographics, postoperative complications, functional outcomes, and QOL data were available. Follow-up consisted of clinical examination with assessment of pouch function and QOL.

Results: A total of 3707 patients underwent primary pouch and 328 underwent redo pouch surgery. Postoperative histopathological diagnoses were mucosal ulcerative colitis (n = 2953, 79.7%), indeterminate colitis (n = 63, 1.7%), FAP (n = 223, 6%), Crohn's disease (n = 150, 4%), cancer/dysplasia (n = 97, 2.6%), and others (n = 221, 6.0%). Early perioperative complications were encountered in 33.5% of patients with a mortality rate of 0.1%. Excluding pouchitis, late complications were experienced by 29.1% of patients. Of those patients who had IPAA at our institution, pouch failure occurred in 197 patients (5.3%). During a median follow-up of 84 months, 119 patients (3.2%) required excision of the pouch, 32 (0.8%) had a nonfunctioning pouch, and 46 patients (1.2%) had redo IPAA. Functional outcomes and QOL were good or excellent in 95% of patients and similar in each histopathological subgroup.

Conclusions: IPAA is an excellent option for patients with MUC, IC, FAP , and select patients with Crohn's disease.

Keywords: complications, ileal pouch, outcomes, quality of life

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Ileal pouch-anal anastomosis (IPAA), first described by Parks and Nicholls in 1978,[1] is the surgical approach of choice in medically refractory mucosal ulcerative colitis, indeterminate colitis, familial adenomatous polyposis (FAP), and a highly select subset of patients with Crohn's disease.[2–6] Pouch configuration can include 2 (J), 3 (S), or 4 (W) loops of small intestine for creation of the ileal reservoir.[7] The "double stapled" ileal J pouch-anal anastomosis is the criterion standard pouch-anal anastomosis,[8–10] with mucosectomy and hand-sewn anastomoses reserved for patients with dysplasia or cancer.[10,11] Historically, IPAA was performed with a diverting ileostomy as part of a 2 or 3-stage procedure but recently, in select cases, a restorative procedure without a diverting ileostomy may be considered.[12–14] IPAA remains a technically demanding procedure and may be associated with major perioperative morbidity including pelvic sepsis, which may influence long-term pouch function and quality of life (QOL).[15,16] Pouch function is generally excellent with a slight diminution occurring at long-term follow-up.[3,5,17,18] The incidence of long-term complications such as small bowel obstruction and pouchitis after IPAA is well described, and early reports suggest that the laparoscopic approach may be associated with fewer long-term complications.[19,20] Early pouch failure is rare but approaches 5% to 7% 10 years after surgery.[5,21] The objective of this analysis is to report functional outcomes, complications, and QOL in the largest published series of IPAA in the literature.

METHODS

Study Cohort

After institutional review board approval, all patients who underwent restorative proctocolectomy and IPAA at the Cleveland Clinic, Cleveland, OH, between 1983 and 2010 were identified. Data were recorded in a prospectively maintained institutional review board–approved database and included patient demographics, duration and extent of disease, surgical history, preoperative clinical and pathological diagnoses, and age at surgery. Details on the surgical procedure, postoperative length of hospital stay, final pathological diagnosis, peri- and postoperative morbidity, and mortality were also recorded. In March 2010, we reclassified our cases of indeterminate colitis on the basis of pathological and clinical findings. Briefly, cases categorized as indeterminate colitis had mixed features of both mucosal ulcerative colitis and Crohn's disease. Features considered representative of indeterminate colitis included histopathological features typical of mucosal ulcerative colitis that also had suspicious features of Crohn's disease. These included combinations of poorly developed mural lymphoid aggregates remote from ulcers in otherwise classical mucosal ulcerative colitis, true granulomas in otherwise classical mucosal ulcerative colitis, fulminant disease ulcerating essentially all of the colonic mucosal surface and thereby precluding identification of transmural discrete lymphoid aggregates remote from ulcers, backwash ileitis in the absence of pancolitis, strictures in otherwise typical mucosal ulcerative colitis, upper gastrointestinal tract disease (excluding terminal ileitis) in otherwise classical mucosal ulcerative colitis, and rectovaginal fistulizing disease in otherwise classical mucosal ulcerative colitis (Downs-Kelly et al, unpublished data, 2012). Both early (within 90 days of IPAA or closure of loop ileostomy in those in whom an ostomy was used at the time of IPAA) and late (≥90 days after IPAA or closure of loop ileostomy) complications were documented, including septic complications (anastomotic leak, pelvic sepsis, and pouch-related fistula), stricture, pouchitis, small bowel obstruction, wound infection, and pouch failure. Long-term functional outcomes and QOL were also recorded. We used strict criteria for definition of early and late postoperative complications after IPAA (Table 1).

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TABLE 1. Definitions and Diagnostic Criteria for Complications Related to IPAA Procedure

Anastomotic leak
- The demonstration of a defect in the anastomosis at endoscopy, operation, or contrast enema, or the presence of a presacral sinus originating from the anastomosis on imaging studies, including gastrograffin enema and computed tomographic scan within 3 mo of loop ileostomy closure for a staged IPAA or within 3 mo of IPAA where a loop ileostomy was not used

Anastomotic stricture
- The presence of a narrowing at the anastomosis on digital examination that required dilation in the outpatient clinic or operating room. Clinically significant anastomotic stricture is defined as those requiring dilation in the operating room in patients who developed symptoms of outlet obstruction.

Pouch-related fistula
- An abnormal passage or sinus from the pouch to another surface or organ.

Pelvic sepsis
- Any infective process in the peripouch area, detected during the investigation of clinical symptoms. This includes all abscess formations associated with or without anastomotic leak and/or further development of chronic sinus with cavity, or fistulae detected by clinical or radiological means.

Small bowel obstruction
- Diagnosed on the basis of any 1 of the following criteria:
  - Patient presented with at least 3 of the following 5 symptoms: nausea, abdominal pain, vomiting, abdominal distension, and absence of flatus and/or stool in the previous 24 h
  - Plain x-ray or contrast studies favor obstruction
  - The discharge diagnosis of the patient is recorded as small bowel obstruction
  - The diagnosis of intestinal obstruction has been confirmed by radiological investigations, such as contrast studies or computed tomography, or at operation

Wound infection
- Any purulent drainage, erythema, or induration at the wound, or when extra care is needed to nurse the wound, including packing, dressings, or antibiotics.

Pouchitis
- Pouchitis was defined as a clinical presentation with typical symptoms of pouchitis (increased number and looser consistency of bowel movements compared with baseline, rectal bleeding, urgency, incontinence, and/or abdominal or pelvic cramps) and at least 1 abnormal pouch endoscopy during one of these symptomatic episodes. Pouchitis was further categorized into acute and chronic pouchitis.
- Acute pouchitis was defined as the presence of all of the following criteria: (1) 3 or fewer episodes of pouchitis per year, (2) symptoms lasting <4 wk at a time with each episode, (3) symptoms responding to short courses (14 d) of antibiotics, and (4) at least 1 pouch endoscopy showing endoscopic and histological inflammation of the pouch during one of these episodes of pouchitis.
- Chronic pouchitis was defined as the presence of one or more of the following criteria: (1) 4 or more episodes of pouchitis per year, (2) active symptoms lasting continuously for >4 wk despite antibiotic therapy, or (3) chronic antibiotic or anti-inflammatory therapy to control symptoms of pouchitis.[22]

Pouch bleeding
- Defined as the passage of blood or clots transanally or into an ileostomy bag, with or without hypotension.

Pouch failure
- The need for construction of a permanent stoma, with or without excision of the ileoanal pouch, or abdominoperineal reconstruction for complications.

Pouch revision
- Includes pouch repair with or without repeat IPAA or abdominoperineal pouch reconstruction with repeat IPAA.

Surgical Technique

All IPAA operations were performed at the Cleveland Clinic by 16 surgeons. All the surgeons used a uniform technique of IPAA as previously described.[23] Three surgeons performed 61.4% of procedures.

Patient Follow-Up

All patients were routinely followed up at 3 months and 1 year postoperatively, and annually thereafter. At follow-up visits, a complete history and physical examination were performed and each patient was administered 2 questionnaires. The first is the Cleveland Clinic Pelvic Pouch Questionnaire, a self-administered, structured questionnaire that determines functional outcomes after IPAA. This tool determines information regarding bowel frequency (number of bowel movements per 24 hours), urgency (inability to defer bowel movements for more than 15 minutes), fecal incontinence (inadvertent passage of liquid or solid stool), stool seepage (soiling during day or night), use of pads, and dietary, social, work, and sexual restrictions. To determine patients' QOL post-IPAA, we used the Cleveland Global Quality of Life instrument that has been extensively validated and deemed to be reliable, responsive, and correlates well with the 36-Item Short Form Health Survey.[24] This tool asks patients to rate their current QOL, health, and energy levels on a scale of 0 to 10 (0: worst; 10: best). The cumulative score is divided by 30 to determine the ultimate Cleveland Global Quality of Life score.

Statistical Analysis

Data were analyzed using the software package PASW 18.0 for Windows. Descriptive statistics were computed for all variables. Distribution of the data was checked for normality using the Kolmogorov-Smirnov test; parametric data are presented as the mean ± standard deviation and analyzed using the Student 2-sample *t* test for any 2-sample comparisons and analysis of variance, followed by the Tukey HSD post hoc test, where appropriate. Differences between proportions and categorical variables were determined using the χ^2 test. All tests were 2-tailed and results with a P value of <0.05 were considered statistically significant.

RESULTS

During the study period, 4035 patients underwent IPAA at our institution. Of these, 3707 patients (1631 women and 2076 men) had a primary restorative proctocolectomy and IPAA, with 328 patients having a redo pouch anal anastomosis. Of the primary IPAA cases, histopathological diagnoses were mucosal ulcerative colitis (n = 2953, 79.7%), Crohn's disease (n = 150, 4%), indeterminate colitis (n = 63, 1.7%), FAP (n = 223, 6.0%), and cancer/dysplasia (n = 97, 2.6%). In 221 cases (6.0%) that had an IPAA at our institution, histopathology data were unavailable as the original total abdominal colectomy was carried out at outside institutions. A total of 32 patients had a preoperative diagnosis of Crohn's disease, with the remainder being diagnosed incidentally (postoperative histopathology of proctectomy specimen) or at follow-up. Subset analysis revealed that of these 32 patients, the only difference in perioperative morbidity or long-term outcome to date has been an increased incidence of small bowel obstruction (34.38% vs 17.77%, $P = 0.027$). Pouchitis, anastomotic leak/pelvic sepsis, and pouch failure were no different from those with other preoperative diagnoses. Criteria for postoperative diagnosis of Crohn's disease have previously been described by our group.[6] Patient demographics are summarized in Table 2. Ages at diagnosis and surgery and body mass indices were similar between histopathological subgroups. The mean length of stay after IPAA was 7.8 ± 4.3 days and median follow-up was 84 months (range, 24–156 months). Table 3 demonstrates details of the operative procedures

TABLE 2. Characteristics of 3707 Patients* Undergoing Restorative Proctocolectomy and IPAA by Disease Type (Mean ± Standard Deviation, Unless Otherwise Stated)

	Mucosal Ulcerative Colitis	Indeterminate Colitis	Crohn's Disease	FAP	Cancer/ Dysplasia	Other	Total
N (%)	2959 (79.8)	63 (1.7)	150 (4.1)	223 (6.0)	97 (2.6)	215 (5.8)	3707
Age at diagnosis, y	29.7 ± 12.5	28.9 ± 11.6	27.8 ± 11.8	24.4 ± 10.7	35.3 ± 15.6	28.66 ± 12.9	29.4 ± 12.6
Age at surgery, y	38.4 ± 13.2	40.2 ± 12.1	38.3 ± 12.4	31.9 ± 12.4	47.1 ± 13.4	36.9 ± 14.0	38.2 ±13.3
Sex							
Female, n (%)	1266 (42.8)	33 (52.4)	77 (51.3)	106 (47.5)	42 (43.3)	108 (50.2)	1632 (44.0)
Male, n (%)	1693 (57.2)	30 (47.6)	73 (48.7)	117 (52.5)	55 (56.7)	107 (49.8)	2075 (56.0)
BMI, kg/m^2	25.5 ± 5.0	25.4 ± 5.1	24.9 ± 5.2	25.3±5.7	26.8 ± 4.7	25.3 ± 5.2	25.5 ± 5.1
Follow-up months (median, IQR)	84 (24–156)	84 (54–114)	102 (48–201)	84 (24–138)	24 (1–48)	72 (24–132)	84 (24–156)
LOS, d	7.64 ± 4.1	5.83 ± 2.3	8.2 ± 4.6	8.48 ± 4.0	8.7 ± 6.5	8.34 ± 6.4	7.75 ± 4.3

*Excludes patients who were undergoing revision IPAA.
BMI indicates body mass index; IQR, interquartile range; LOS, length of stay.

TABLE 3. Characteristics of 3707 Patients* Undergoing Restorative Proctocolectomy and IPAA by Disease Type [N (%)]

	MUC	IC	Crohn's Disease	FAP	Cancer/Dysplasia	Other	Total
N	2959 (79.8)	63 (1.7)	150 (4.1)	223 (6.0)	97 (2.6)	215 (5.8)	3707
Resection type							
Total proctocolectomy	1807 (61.1)	42 (66.7)	108 (72.0)	156 (70.0)	83 (85.6)	59 (27.4)	2255 (60.8)
Completion proctectomy	1152 (38.9)	21 (33.3)	42 (28.0)	67 (30.0)	14 (14.4)	156 (72.6)	1452 (39.2)
Pouch type							
J	2647 (89.5)	59 (93.7)	128 (85.3)	188 (83.9)	90 (92.8)	195 (90.7)	3306 (89.2)
S	307 (10.4)	4 (6.4)	21 (14.0)	35 (15.7)	7 (7.2)	11 (5.1)	385 (10.4)
W	1 (0.03)	0	0	0	0	0	1 (0.03)
Diverting ileostomy	2658 (89.8)	56 (88.9)	133 (88.7)	157 (70.4)	89 (91.8)	175 (81.4)	3268 (88.2)
Laparoscopic approach	172 (5.8)	1 (1.6)	3 (2.0)	30 (13.5)	24 (24.7)	10 (4.7)	240 (6.5)
Anastomosis type							
Double stapled	2573 (87.0)	55 (87.3)	117 (78.0)	168 (75.3)	80 (82.5)	193 (89.8)	3186 (85.9)
Handsewn	386 (13.0)	8 (12.7)	33 (22.0)	55 (24.7)	17 (17.5)	22 (10.2)	521 (14.1)

*Excludes patients who were undergoing revision IPAA.
MUC indicates mucosal ulcerative colitis; IC, indeterminate colitis.

performed; 2255 patients (60.2%) had a proctocolectomy; of these, 2049 (90.9%) had a diverting loop ileostomy and 206 (9.1%) had a single-stage procedure. A total of 1452 patients underwent a 3-stage procedure (subtotal colectomy/end ileostomy, followed by IPAA with loop ileostomy, and finally closure of ileostomy). A diverting loop ileostomy was used at the time of pouch construction (following total proctocolectomy or completion proctectomy in those who had a prior total abdominal colectomy for acute colitis) in 88.1% of patients; those having IPAA for FAP being significantly more likely to have a 1-stage procedure with omission of a diverting ileostomy than other histological subgroups ($P < 0.001$). A total of 2255 patients [the majority of patients (89.5%)] had a J pouch-anal anastomosis fashioned. Laparoscopic IPAA has been practiced at our institution since 2006, and to date, 240 patients have had a minimally invasive IPAA. At long-term follow-up, outcomes were no different for patients having undergone laparoscopic IPAA; specifically, the perioperative complication rate and rate of pouch failure were no different.[19] A stapled pouch-anal anastomosis was created in 3152 patients (85%), with the remainder having a handsewn or single-stapled anastomosis. Patients undergoing IPAA for FAP, cancer/dysplasia, and Crohn's disease were more likely to have a handsewn anastomosis with mucosectomy than patients with mucosal ulcerative colitis ($P < 0.01$).

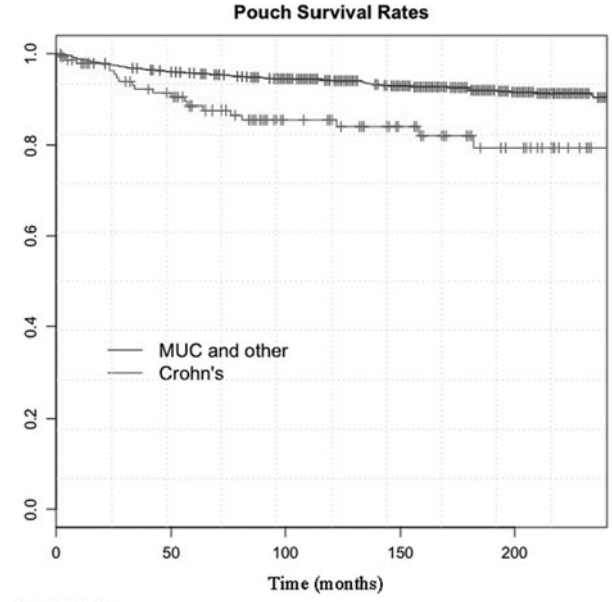
The mortality rate in the perioperative period (<30 days) was 0.1% (n = 4). Causes of mortality included pouch necrosis and sepsis, drug addiction and overuse, myocardial infarction, and pulmonary embolus. The readmission rate at the median follow-up of 84 months was 34.4%; 14.9% of patients required a subsequent laparotomy during long-term follow-up for various complications. Of those patients requiring laparotomy, 41.2% presented with acute small bowel obstruction. Excluding pouchitis, 1243 early complications were experienced, with a further 1077 late complications observed (Table 4). During the study period, 197 patients had pouch failure (5.3%); 119 patients (3.2%) ultimately required excision of their ileal pouch, 32 patients (0.9%) with pouch failure had redo IPAA, and 46 (1.2%) had a nonfunctioning pouch with a proximal diverting ileostomy. Pouch failure occurred at a median of 30 months after primary IPAA. Histopathological diagnoses for patients needing pouch excision were mucosal ulcerative colitis (n = 50), indeterminate colitis (n = 14), Crohn's disease (n = 49), FAP (n = 4), and unknown (n = 15). Twenty-two patients (0.6%) opted for a continent ileostomy. Pouch retention rates at 10 years were similar for mucosal ulcerative colitis and indeterminate colitis with 95% of patients having an intact, functioning pouch (at risk: mucosal ulcerative colitis, n = 1360; indeterminate colitis, n = 30). Only 80% of those with Crohn's disease (at risk: n = 59) had a functioning pouch a median of 10 years after primary IPAA (Fig. 1).

Indications for pouch excision included pouch fistulae (n = 27), pouch dysfunction (n = 13), recurrent pouchitis (n = 21), pelvic

TABLE 4. Complications Among Patients Undergoing Restorative Proctocolectomy and IPAA by Disease Type (Mean ± Standard Deviation, Unless Otherwise Stated)

	Mucosal Ulcerative Colitis	Indeterminate Colitis	Crohn's Disease	FAP	Cancer/ Dysplasia	Other	Total
N	2959 (79.8)	63 (1.7)	150 (4.1)	223 (6.0)	97 (2.6)	215 (5.8)	3707
Early Complications							
Pelvic sepsis	186 (6.3)	3 (4.8)	13 (8.7)	8 (3.6)	10 (10.3)	16 (7.4)	236 (6.4)
Anastomotic leak	143 (4.8)	2 (3.2)	7 (4.7)	10 (4.5)	7 (7.2)	9 (4.2)	178 (4.8)
Hemorrhage	106 (3.6)	0 (0)	2 (1.3)	6 (2.7)	4 (4.1)	9 (4.2)	127 (3.4)
Wound infection	214 (7.2)	3 (4.8)	7 (4.7)	21 (9.4)	11 (11.3)	19 (8.8)	275 (7.4)
Small bowel obstruction	144 (4.9)	5 (7.9)	8 (5.3)	10 (4.5)	4 (4.1)	15 (7.0)	186 (5.0)
Pouch fistula	37 (1.3)	1 (1.6)	2 (1.3)	5 (2.2)	1 (1.0)	3 (1.4)	49 (1.3)
Stricture	156 (5.3)	2 (3.2)	9 (6.0)	4 (1.8)*	1 (1.0)	20 (9.3)	192 (5.2)
Late complications							
Small bowel obstruction	389 (13.2)	5 (7.9)	20 (13.3)	40 (17.9)	5 (5.2)†	19 (8.8)	478 (12.9)
Pelvic sepsis	81 (2.7)	2 (3.2)	5 (3.3)	7 (3.1)	1 (1.0)	9 (4.2)	105 (2.8)
Pouch fistula	80 (2.7)	2 (3.2)	12 (8.0)‡	4 (1.8)	1 (1.0)	10 (4.7)	109 (2.9)
Anastomotic leak	45 (1.5)	2 (3.2)	3 (2.0)	4 (1.8)	3 (3.1)	6 (2.8)	63 (1.7)
Stricture	331 (11.2)	11 (17.5)	21 (14.0)	17 (7.6)	9 (9.3)	26 (12.1)	415 (11.2)
Pouchitis	1063 (35.9)	25 (39.7)	46 (30.7)	43 (19.3)§	12 (12.4)‖	67 (31.2)	1256 (33.9)
Chronic pouchitis	503 (17.0)	15 (23.81)	23 (15.3)	11 (4.9)¶	4 (4.1)**	34 (15.8)	590 (15.9)
Pouch failure	151 (5.1)	3 (4.8)	20 (13.3)††	8 (3.6)	1 (1.0)	14 (6.5)	197 (5.3)

*$P = 0.03$, mucosal ulcerative colitis vs FAP.
†$P = 0.03$, mucosal ulcerative colitis vs cancer.
‡$P < 0.001$, mucosal ulcerative colitis vs Crohn's disease.
§$P = 0.011$, mucosal ulcerative colitis vs FAP.
‖$P < 0.001$, mucosal ulcerative colitis vs cancer.
¶$P < 0.001$, mucosal ulcerative colitis vs FAP.
**$P = 0.001$, mucosal ulcerative colitis vs cancer.
††$P < 0.001$, mucosal ulcerative colitis vs indeterminate colitis.



Survival Rates

patients at risk	0 months	20 months	40 months	60 months	80 months	100 months	120 months
Crohn's	150	134	111	96	87	59	59
Indeterminate	63	53	52	52	46	36	30
MUC	2959	2408	2000	1987	1733	1477	1360

FIGURE 1. Comparison of pouch survival after IPAA for Crohn's disease versus other histological subtypes.

sepsis (n = 12), anastomotic separation (n = 9), stricture (n = 10), incontinence (n = 7), cancer (n = 7), small bowel obstruction (n = 2), bowel infarction/ischemia (n = 2), and other (n = 20). Cox regression analysis revealed that the variables independently associated with pouch failure included a final pathology of Crohn's disease (hazard ratio: 2.0, 95% confidence interval: 1.2–3.3, $P = 0.01$), older age at surgery (older than 70 years) (hazard ratio 3.7, 95% confidence interval: 1.4–10.2, $P = 0.01$], undergoing completion of a proctectomy (hazard ratio: 1.8, 95% confidence interval: 1.2–2.5, $P = 0.001$), or mucosectomy (hazard ratio: 2.1, 95% confidence interval: 1.5–2.9, $P < 0.001$) during IPAA, or the development of an anastomotic leak (hazard ratio: 1.7, 95% confidence interval: 1.2–2.6, $P = 0.008$), pelvic sepsis (hazard ratio: 3.3, 95% confidence interval: 2.2–4.8, $P < 0.001$), or pouch fistulae (hazard ratio: 4.5, 95% confidence interval: 3.1–6.6, $P < 0.001$) postoperatively.

Early pelvic sepsis occurred in 236 patients (6.3%), including peripouch abscess with or without anastomotic leak, pouch sinuses, or fistulae. Early anastomotic dehiscence or leak occurred in 178 (4.8%), with late leaks observed in 63 patients (1.7%). Pouch hemorrhage was infrequent; 127 patients (3.4%) developed pouch bleeding. Early anastomotic strictures were observed in 192 patients (5.2%) and late strictures in 415 patients (11.2%). Those patients having IPAA for mucosal ulcerative colitis and Crohn's disease were statistically more likely to develop an early anastomotic stricture ($P = 0.011$) than patients with FAP, cancer, and dysplasia. Pouch fistulae were observed in 158 patients overall; the incidence of fistulae was similar between histological subgroups within the first 90 days but late fistulae were significantly more likely among patients with Crohn's disease than among other histological subgroups (odds ratio: 3.16, $P = 0.001$). Similarly, patients with Crohn's disease were more likely to develop pouch failure than other diagnoses ($P < 0.001$). Specifically, patients

with Crohn's disease were 2.85 times and 3.08 times more likely to develop pouch failure than those with mucosal ulcerative colitis and indeterminate colitis, respectively. Of 663 patients (17.9%) who developed small bowel obstruction, 270 (40.7%) required operative intervention.

Pouchitis was diagnosed on the basis of a combination of patient-reported symptoms and endoscopic and histological findings. At least 1 episode of pouchitis was experienced by 33.88% of patients (1256/3707), with 590 (15.9%) having chronic pouchitis, defined as more than 3 attacks of pouchitis in a 12-month period.

During the study period, IPAA has undergone several technical modifications. During the early stages of this procedure, we constructed a handsewn pouch-anal anastomosis; from 1988 onward, we routinely used the double-stapled technique for constructing the pouch-anal anastomosis. In analyzing outcomes between these 2 cohorts, we noted that the rate of anastomotic leak was higher in the handsewn group (9.21% vs 6.06%, $P = 0.009$). Similarly, the rates of postoperative hemorrhage (6.9% vs 3.83%, $P = 0.002$), anastomotic stricture (23.03% vs 15.29%, $P = 0.001$), pouch fistulae (12.67% vs 8.47%, $P = 0.002$), obstruction (22.65% vs 17.14%, $P = 0.003$) were higher in patients undergoing a hand-swen pouch-anal anastomosis. The pouch failure rate (12.09% vs 4.21%, $P = 0.0001$) and need for redo IPAA (12.28% vs 4.21%, $P = 0.001$) were higher in the handsewn group. At long-term follow-up, cumulative incidences for pouch neoplasia at 5, 10, 15, 20, and 25 years were 0.9%, 1.3%, 1.9%, 4.2%, and 5.1%, respectively. Thirty-eight patients (1.19%) had pouch neoplasia, including 11 (0.36%) with adenocarcinoma of the pouch and/or the anal-transitional zone, 1 (0.03%) with pouch lymphoma, 3 with squamous cell cancer of the anal-transitional zone, and 23 with dysplasia (0.72%). In the Cox model, the risk factor associated with pouch neoplasia was a preoperative diagnosis of ulcerative colitis–associated cancer or dysplasia, with adjusted hazard ratios of 13.43 (95% confidence interval: 3.96–45.53; $P < 0.001$) and 3.62 (95% confidence interval: 1.59–8.23; $P = 0.002$), respectively. Mucosectomy did not protect against pouch neoplasia.[25]

QOL assessment and functional outcomes are summarized in Table 5. The QOL response rates for patients with a mean follow-up of 1, 4, and 10 years were 62.6%, 64.8%, and 48.6%, respectively. The total number of patients who answered a functional outcomes questionnaire, at some point in time, was 3224 (87%). Overall functional outcomes and QOL were similar for mucosal ulcerative colitis when compared with FAP, Crohn's disease, and indeterminate colitis (Table 6). Notably, 10 years after surgery, those with indeterminate colitis had more bowel movements (median = 9) than those with mucosal ulcerative colitis (median = 7).

TABLE 5. Cleveland Global Quality of Life Scores (Median, Range) for Patients With Ulcerative Colitis, Crohn's Disease, and Indeterminate Colitis at 1, 5, and 10 Years

	Mucosal Ulcerative Colitis	Indeterminate Colitis	Crohn's Disease	FAP
N				
1 y	1673	35	86	101
5 y	1757	45	89	112
10 y	1312	28	71	98
Quality of life				
1 y	9 (1–10)	8 (4–10)	9 (4–10)	9 (3–10)
5 y	9 (1–10)	9 (1–10)	9 (4–10)	9 (3–10)
10 y	9 (1–10)	9 (3–10)	8 (2–10)	9 (1–10)
Quality of health				
1 y	9 (1–10)	8 (3–10)	9 (4–10)	9 (3–10)
5 y	9 (1–10)	9 (1–10)	9 (3–10)	9 (3–10)
10 y	9 (1–10)	8 (3–10)	9 (4–10)	9 (1–10)
Level of energy				
1 y	8 (1–10)	8 (4–10)	8 (4–10)*	8 (1–10)
5 y	8 (1–10)	7 (1–10)	8 (3–10)	8 (2–10)
10 y	8 (1–10)	7 (1–10)	8 (1–10)	8 (1–10)
Happiness with current medical situation				
1 y	10 (1–10)	9 (3–10)	10 (5–10)	10 (2–10)
5 y	10 (1–10)	9 (1–10)	10 (1–10)	10 (2–10)
10 y	10 (1–10)	9 (2–10)	10 (1–10)	10 (1–10)
Dietary restrictions				
1 y	31.6%	31.4%	33.7%	36.73%
5 y	27.9%	40.0%	45.5%†	30.1%
10 y	23.9%	29.6%	29.0%	24.2%
Social restrictions				
1 y	12.8%	17.7%	10.0%	9.8%
5 y	14.0%	11.1%	8.2%	10.0%
10 y	12.5%	14.3%	11.8%	13.7%
Work restrictions				
1 y	12.1%	11.8%	10.0%	11.1%
5 y	13.5%	11.1%	14.3%	12.0%
10 y	11.7%	25.0%	11.9%	14.6%
Sexual restrictions				
1 y	14.3%	6.3%	11.0%	8.9%
5 y	13.9%	18.2%	14.3%	12.8%
10 y	13.0%	15.4%	20.9%	10.3%

1-year follow-up: 2320 patients.
4-year follow-up: 2399 patients.
10-year follow-up: 1801 patients.
*$P = 0.036$; Crohn's disease vs ulcerative colitis.
†$P = 0.001$; mucosal ulcerative colitis vs Crohn's disease.

DISCUSSION

Since the conception of IPAA, surgery has offered patients with medically refractory mucosal ulcerative colitis, indeterminate colitis, FAP, and Crohn's disease an excellent QOL and good functional outcome. In this series, the largest in the published literature, we show that IPAA can be performed with low operative mortality, acceptable early and late morbidity, good functional outcomes, and good QOL for patients with inflammatory bowel disease and FAP. In total, 33.5% of patients had early operation-specific complications and a further 29.1% developed late complications. Despite this morbidity of almost 66%, the majority of our patients (96%) experienced a good QOL, similar to those reported from other high-volume institutions.[26,27]

Currently, there is no standard, accepted definition of pouchitis in the published literature. Our rate of pouchitis (33.8% of patients having at least 1 attack, with a further 15.9% incidence of chronic pouchitis) may appear high compared with other reports in the literature (Australasian group, 20%; Lahey Clinic, 18%; UK Multicentre group, 14%[4,18,28]), but this likely reflects our definition of pouchitis, longevity of follow-up, and patient interpretation of symptoms of pouchitis. We have used symptoms, such as malaise, fatigue, fever, anorexia, increased frequency of defecation, pouch bleeding, and urgency to define pouchitis in this series. Our rate of pouchitis is similar to that reported by the Mayo Clinic group, which demonstrated that at 10 years, 48% of patients with mucosal ulcerative colitis had at least 1 episode of pouchitis and this increased to 70% with 20-year follow-up.

Pouch failure rate after IPAA occurs in 6% to 12% of patients at long-term follow-up.[26,27,29,30]. In this series, 5.3% (n = 197) of pouches failed; 3.6% (n = 132) of cases required excision of the pouch and 1.4% (n = 53) had redo IPAA whereas 0.3% (n = 12) had a nonfunctioning pouch. The UK pouch study group has reported a pouch failure rate of 7.7% whereas Chapman and colleagues report

TABLE 6. Functional Outcomes (Median, Range) for Patients With Ulcerative Colitis, Crohn's Disease, and IC at 1, 5, and 10 Years

	Mucosal Ulcerative Colitis	Indeterminate Colitis	Crohn's Disease	FAP
BM total				
1 y	7 (1–28)	7 (3–12)	7 (2–17)	6 (2–20)*
5 y	7 (1–30)	8 (3–15)	7 (3–21)	6 (2–20)
10 y	7 (1–30)	9 (3–22)†	7 (3–25)	6 (2–24)
Pads (day)				
1 y	19.3%	29.1%	20.2%	11.1%
5 y	18.1%	32.6%‖	17.4%	13.4%
10 y	20.7%	25.9%	22.9%	14.7%
Pads (night)				
1 y	24.7%	35.3%	26.2%	16.0%
5 y	23.6%	30.3%	27.9%	14.2%
10 y	25.6%	26.9%	32.4%	16.3%
Urgency (never/rarely)				
1 y	57.3%	52.9%	61.1%	61.8%
5 y	60.9%	46.7%	61.4%	65.8%
10 y	67.4%	46.4%‡	71.4%	64.3%
Incontinence (never/rarely)				
1 y	80.5%	79.0%	85.3%	81.6%
5 y	78.4%	72.3%	77.1%	75.8%
10 y	80.6%	81.8%	77.3%	73.6%
Seepage (day or night)				
1 y	37.4%	31.6%	31.6%	27.2%
5 y	36.2%	36.2%	41.7%	31.1%
10 y	38.7%	33.4%	53.3%	29.3%§

Follow-up events are reported at 1, 5, and 10 years after RPC. The event closest to the predefined intervals was used if a patient had multiple follow-up assessments.

*$P < 0.001$ FAP vs ulcerative colitis.

†$P = 0.004$ indeterminate colitis vs ulcerative colitis.

‡$P = 0.036$ mucosal ulcerative colitis vs indeterminate colitis.

§$P = 0.017$ mucosal ulcerative colitis vs Crohn's disease.

‖$P = 0.026$ indeterminate colitis vs mucosal ulcerative colitis.

a pouch failure rate of 5.9% with 10-year follow-up, irrespective of pathological diagnosis. In our cohort of patients, factors associated with pouch failure were pelvic sepsis, anastomotic leak, pouch fistulae, and Crohn's disease, which is consistent with what others have found.[27,29–31]

The overall anastomotic leak rate in this series was 6.5% (early 4.8%, late 1.7%). A meta-analysis of 4183 patients undergoing IPAA by Lovegrove et al[32] describes a leakage rate of 6.9%. In addition, Michelassi and colleagues demonstrate an anastomotic leakage rate after IPAA of 6.5% and the Mayo clinic series reported an anastomotic leakage rate of 7.3%.[31,33] The 6.3% rate of pelvic sepsis is in line with that reported in the literature, and a recent meta-analysis of outcomes after restorative proctocolectomy by Tekkis et al[5] reported a cumulative pelvic sepsis rate of 10.3% irrespective of proximal diversion. We have previously reported the major factors associated with pelvic sepsis: body mass index >30, pathological diagnoses of mucosal ulcerative colitis/indeterminate colitis and Crohn's disease, and blood transfusion.[34] Unfortunately, precise data relating to the type, duration, and timing of cessation of biological therapy with resultant impact on pelvic sepsis, anastomotic leakage rates, and pouch failure rates were not available. A proximal diverting ileostomy was performed in 88.1% of patients, those undergoing IPAA for FAP being significantly less likely to have a diverting ileostomy ($P < 0.01$). It is the usual practice at our institution to use a diverting ileostomy and only in select cases, under strict criteria, is an ileostomy omitted. In order for patients to qualify for a "1-stage" procedure, they must be in good health, well nourished, and off high-dose steroids in anticipation of surgery. Intraoperatively, the pouch-anal anastomosis must be tension-free have a good blood supply, intact anastomotic rings, and a negative air-leak test.[14] In our experience, a proximal diverting ileostomy does not protect against pelvic sepsis.[34] Several studies support our finding that proximal diversion does not prevent anastomotic leakage.[35,36] However, in contrast, these studies suggest that diverting ileostomy may reduce complications related to anastomotic leakage. Approximately 5.2% of patients developed an early anastomotic stricture, with 11.2% experiencing a late stricture. The majority of these strictures (341/56.1%) were anastomotic webs that responded to digital or instrumental dilatation in the office setting. Only 5 patients (0.1%) required reoperation (excision or reconstruction). Others have reported similar rates of stricturing of the pouch-anal anastomosis (10.7%–16.8%). The Mayo Clinic data report anastomotic stricture rates of 39%, 48%, and 79% for mucosal ulcerative colitis, indeterminate colitis, and Crohn's disease with 20-year follow-up.

Since 1988, we have used the stapled technique for IPAA, the anastomosis being fashioned 1 to 2 cm above the dentate line; our group has previously shown that the outcomes and pouch failure rates after anastomotic leakage are significantly better for stapled than handsewn anastomosis and thus, the handsewn technique is reserved for those with FAP or mucosal ulcerative colitis with coexisting dysplasia or cancer of the lower third of the rectum.[8,37]

The rate of postoperative small bowel obstruction in our experience is 17.9%, with 40% of these patients undergoing operative intervention. In the meta-analysis of functional outcomes and complications after handsewn or stapled IPAA by Lovegrove et al,[9] the cumulative incidence of small bowel obstruction was 16.5% at a short median follow-up of just over 2 years, with more than half of these patients (362/680, 53.3%) requiring surgery to relieve the obstruction. The Mayo Clinic experience suggests a small bowel obstruction rate approaching 40% with 20-year follow-up.[3]

A recent systematic review of QOL after IPAA showed that QOL improves 12 months after restorative proctocolectomy and is indistinguishable from the general population.[38] Hahnloser and colleagues[3] from the Mayo Clinic reported similarly high QOL scores in 1885 patients undergoing IPAA, and these scores were maintained 20 years after surgery. Similarly, Berndtsson et al[26] reported 94% satisfaction after IPAA, with a global QOL score similar to the general population. Data from the Lahey Clinic also support the high satisfaction rate after IPAA, with 94% of patients satisfied with outcomes after pouch surgery.[4]

QOL and functional outcomes after IPAA are generally excellent and confirm the data reported previously by our group.[2] QOL in terms of general health, energy levels, happiness with surgery, and outcomes did not vary between each histopathological subgroup. Ten years after surgery, patient satisfaction was excellent in each pathological subgroup. Ten years after surgery, 97.1% of patients with Crohn's disease, 93.6% with FAP, 92.6% with indeterminate colitis, and 96.3% of those with mucosal ulcerative colitis were happy with their decision to have IPAA. Similar results have been reported worldwide from major, high-volume institutions.[4,5,9,17,18] Full continence for stool and gas was present in 79.3% of our patients with 10-year follow-up, with 74.4% fully continent overnight. These results compare favorably with data from the Mayo Clinic group, which reports daytime and nighttime incontinence rates of 29% and 47%, respectively, for mucosal ulcerative colitis with a median follow-up of 11 years. In analyzing these data, we confirm findings from our previously published work that functional outcomes and QOL are generally excellent after IPAA. This retrospective analysis presents a

large number of patients undergoing restorative proctocolectomy for different pathological diagnoses and its strength lies in the longevity of follow-up.

In conclusion, we have shown that in a high-volume institution, IPAA is a safe procedure with excellent functional outcomes and QOL in patients who are highly satisfied with their outcome.

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