Original article

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# Outcome of restorative proctocolectomy with an ileo-anal pouch for ulcerative colitis: effect of changes in clinical practice

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## Abstract

**Aim** Surgery for ileal pouch–anal anastomosis (IPAA) has evolved over time, especially since the introduction of laparoscopy. The aim of this retrospective study was to report the impact of surgical evolution on outcome over a period of 25 years.

**Method** All patients who had IPAA surgery for ulcerative colitis from 1990 to 2015 at the University Hospitals of Leuven were included. Patients were divided into three period arms (period A 1990–1999; period B 2000–2009; period C 2010–2015). The main outcome measure was anastomotic leakage.

**Results** A total of 335 patients (58.8% male) with a median age of 39 years (interquartile range 32–49 years) at surgery were included. Median follow-up was 5 years (interquartile range 2–10 years). Overall anastomotic leakage (grades A–C) was 14.9%. A significant decrease in leakage rate was observed over time (from 21.4% in period A to 12.1% in period B to 10.0% in period C; $P = 0.04$). The defunctioning ileostomy rate at the time of pouch construction decreased from 91.7% (period A) to 40.3% (period B) to 11.1% (period C) ($P < 0.001$). We observed an increase in the use of laparoscopy (23.9% in period A *vs* 72.6% in period B, *vs* 84.4% in period C; $P = 0.001$) and a shift to a modified two-stage procedure (4.1% in period A, *vs* 66.7% in period C; $P < 0.0001$). In a monocentric study with some of the data retrieved retrospectively it was not possible to account for the impact of preoperative nutritional status (weight loss, serum albumin level) or disease burden. Other outcome factors were not measured, for example sexual function and fecundity.

**Conclusion** A higher rate of laparoscopic IPAA surgery, together with a shift towards modified two-stage procedures, was associated with a lower leakage rate despite a reduction in the use of defunctioning ileostomy.

**Keywords** Ulcerative colitis, ileo-anal pouch surgery

**What does this paper add to the literature?**
In our knowledge, this is one of the first studies describing a 25-year experience of surgery for ileal pouch–anal anastomosis in a single centre. This paper describes an evolution of practice with an important positive impact on postoperative morbidity.

## Introduction

Despite improved medical therapy for ulcerative colitis (UC), about 20% of patients will require surgery [1,2]. Restorative proctocolectomy with ileal pouch–anal anastomosis (IPAA) is often the procedure of choice and generally results in an acceptable long-term functional outcome and improved quality of life [3]. However, postoperative morbidity remains considerable and is partly influenced by the experience of the surgical team [4–6].

Considerable changes have occurred in the surgical management of UC over the last 25 years: a more integrated medical and surgical approach, the implementation of laparoscopy and an increase in primary pouch surgery omitting defunctioning ileostomy. Short-term postoperative complication rates after IPAA vary between 28% and 58% and ultimate pouch failure

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should be limited (5–15%) [7–9]. Pelvic sepsis, including anastomotic leak, is the most serious complication of IPAA and is one of the main causes of pouch failure.

The objective of this study is to show the evolution of ileoanal pouch surgery over a 25-year period with emphasis on minimally invasive approaches, staging of the procedure and morbidity (anastomotic leakage).

## Method

### Study cohort

All consecutive patients undergoing a restorative proctocolectomy for UC from 1990 to 2015 at the University Hospital of Leuven (tertiary referral centre) were identified using an institutionally approved database (data from 1990 to 2009 were recorded retrospectively, while data from 2010 to 2016 were recorded prospectively in a dedicated registry). Approval was obtained from the medical ethical committee. The following demographic data were analysed: sex, age at diagnosis, duration of disease before surgery, age at surgery, smoking status. Details on the surgical procedure included: indication for surgery, number of stages, presence of a defunctioning ileostomy, surgical approach and medication at the time of pouch surgery (or during the last 3 months prior to surgery), including steroids (> 20 mg), cyclosporine and anti-tumour necrosis factor-α (anti-TNF). Three time intervals were chosen to assess the trends in the surgical treatment over this 25-year period: period A (1990–1999), period B (2000–2009) and period C (2010–2015). All patients were followed for at least 1 year.

### Morbidity

Both early (within 90 days of IPAA) and late (90 or more days after IPAA or after closure of diverting ileostomy) complications were recorded (anastomotic leak, pelvic abscess, anastomosis stricture, pouchitis, small bowel obstruction, pouch failure). Anastomotic leakage was defined as a defect in the anastomosis diagnosed by either endoscopy, examination under anaesthesia or imaging and was graded A, B or C according to Rahbari *et al.* [10]. Grade A leaks do not require any therapeutic intervention and are often referred to as radiological leaks. Grade B leaks require a therapeutic intervention but do not need any laparoscopy or laparotomy. Most typically, grade B leaks are treated by transanal or percutaneous drainage. Grade C leaks have the largest clinical impact and require redo-laparoscopy or laparotomy. The presence of any sepsis into the pelvis, including the presence or not of anastomotic leakage, was defined as pelvic abscess. Anastomotic stricture was defined as narrowing of the distal anastomosis, requiring dilation. Pouchitis was diagnosed by both clinical presentation and endoscopic findings (hyperaemic and/or haemorrhagic friable and granular mucosa with excessive mucopurulent areas and superficial erosions). Small bowel obstruction was defined as the association of symptoms (nausea, abdominal pain, vomiting, abdominal distension, absence of flatus) and the presence of bowel distension on imaging, in the first postoperative year. Finally, pouch failure was defined as the need for pouch excision or permanent diversion.

### Surgical technique

All IPAA operations were performed at the University Hospital Gasthuisberg in Leuven, Belgium. All patients underwent a double-stapled (94.9%) or hand-sewn (5.1%) IPAA. Surgery was performed in either one, two or three stages depending on the nutritional status of the patient, the intake of steroids and biologicals and intraoperative considerations (short mesentery, difficult anastomosis or other technical issues) [11,12]. Two-stage procedures included two different scenarios: a proctocolectomy with IPAA with diverting loop ileostomy or a total colectomy with terminal ileostomy and in a second stage a completion proctectomy with IPAA without loop ileostomy, the so-called modified two-stage procedure. A three-stage procedure was only performed if technical difficulties occurred at the second stage.

Patients with no ileostomy had daily C-reactive protein (CRP) measurements. CRP should drop at day 3, and if not a proctoscopy was performed. A transanal tube was left in the pouch for 2–3 days to allow decompression.

Indications were categorized as elective or urgent. Urgent procedures were defined as surgeries performed at the time of hospitalization at the gastrointestinal unit to treat an intractable flare or acute severe colitis.

### Statistical analysis

Categorical data are presented as frequencies and percentages. Continuous data are presented as median with interquartile range (IQR) according to distribution. Comparisons were realized using $\chi^2$ and Fisher exact tests for qualitative variables and Wilcoxon or Kruskal–Wallis tests for quantitative variables. The association between baseline characteristics and the probability of anastomotic leakage was assessed using univariate analysis by $\chi^2$ test for qualitative variables and Wilcoxon test for quantitative variables. Variables with $P < 0.2$ were included in a stepwise multivariate analysis to identify

independent predictive factors of anastomotic leakage using Forward's variable selection method. The odds ratios (ORs) derived from these analysis are presented with 95% confidence intervals (CIs) and the respective *P*-values. Statistical significance was set at $P \leq 0.05$. Data were analysed using SAS v.9.3 (SAS Institute, Inc., Cary, North Carolina, USA).

## Results

### Patients and procedures

Between 1990 and 2015, 335 consecutive patients (197 male, 58.8%) underwent IPAA for UC at our institution. Their demographic and clinical characteristics are listed in Table 1. One hundred and twenty-one (36.1%) patients had IPAA surgery in period A, 124 (37.0%) in period B and 90 (26.9%) in period C. The median age at surgery was 39 (IQR 32–49) years and increased over time [period A, 37 (IQR 28–44); period B, 39 (IQR 33–52); period C, 41 (IQR 35–50); $P = 0.001$], in accordance with an increase in median duration in years between UC diagnosis and IPAA surgery [overall, 5.4 (IQR 2–13); period A, 3.7 (IQR 1.9–8.2); period B, 6.4 (IQR 2–14.9); period C, 9.7 (IQR 3–14); $P = 0.001$]. Surgical indications were: intractable disease (80.3%), toxic megacolon (6.3%), acute haemorrhage (1.5%), carcinoma (6.9%) and dysplasia (5.1%). Surgery was urgent in 88 cases (26.3%). The need for urgent surgery decreased over the three periods (31.4% in period A *vs* 30.5% in period B *vs* 10.9% in period C; $P < 0.0005$). Median follow-up was 5 years (IQR 2–10).

Overall, 63 (18.9%) patients had a one-stage procedure, 132 patients (39.4%) a two-stage procedure, 101 (30.1%) a modified two-stage procedure and 39 (11.6%) a three-stage procedure. The different types of staged surgery are summarized in Fig. 1.

About 4% of patients underwent a restorative proctocolectomy without defunctioning loop ileostomy in one stage in period A, compared with 30.6% in period B and 22.2% in period C (A *vs* C, $P < 0.001$). The rate of two-stage procedures decreased over the three time intervals from 71.9% in period A to 30.6% in period B to 7.8% in period C (A *vs* C, $P = 0.001$), with an important shift towards a modified two-stage approach (4.1% in period A *vs* 29.1% in period B *vs* 66.7% in period C) (A *vs* C, $P < 0.001$). A three-stage procedure was performed in 19.8% of cases in period A, while only 9.7% of the patients underwent this sequence in period B and 3.3% in period C ($P < 0.0001$).

The rate of laparoscopy increased significantly over time, ranging from 23.9% in period A, to 72.6% in period B, and 84.4% in period C (A *vs* C, $P < 0.0001$).

From periods A to C fewer patients were taking any kind of anti-inflammatory drug at the time of pouch surgery. Steroids were taken by 62.9% of patients, decreasing significantly over the three periods (80.0% in period A, 75.8% in period B, 23.3% in period C; $P < 0.0001$). The use of cyclosporine increased initially (18.6% in period A *vs* 31.5% in period B), but decreased later in period C (1.1%) ($P < 0.0001$). A comparable evolution was observed for the use of anti-TNF over the three periods (13.2% in period A, 59.7% in period B, and 22.2% in period C; $P < 0.0001$).

### Mortality and short-term morbidity

One patient died postoperatively (0.3%). This 61-year-old man developed hypovolaemic shock (pelvic haematoma) with cardiac arrest 24 days after IPAA construction. Short-term postoperative morbidity occurred in 28.3% of patients ($n = 95$) (Table 2). Early pelvic abscess occurred in 17 patients (5.1%). In 13 cases (76.5%) there was no associated anastomotic fistula. The overall anastomotic leakage rate was 14.9% ($n = 50$) throughout the study period. We observed a progressive decrease in the leakage rate over time (21.4% in period A, 12.1% in period B and 10.0% in period C; $P = 0.04$). All severities of anastomotic leakage decreased over the three periods (Fig. 2). However, these findings were not statistically significant. The early small bowel obstruction rate was 12.2% ($n = 41$), including postoperative ileus. We observed a decreasing rate over the three periods from 17.3% to 4.4% ($P = 0.02$). Other early postoperative complications are summarized in Table 2.

After univariate analysis, factors associated with anastomotic leakage were male gender ($P = 0.04$) and period A (OR = 2.16, 95% CI 1.18–3.97, $P = 0.01$). A modified two-stage procedure was associated with a lower risk of anastomotic leakage (OR = 0.39, 95% CI 0.17–0.87, $P = 0.02$) (Table 3). After multivariate analysis, male gender (OR 2.4, 95% CI 1.1–5.0, $P = 0.02$) and pouch at first surgery (OR = 5.35, 95% CI 1.02–28.1, $P = 0.05$) were the only independent factors associated with anastomotic leakage. On the other hand, laparoscopy was associated with a decreased rate of anastomotic leakage (OR 0.5, 95% CI 0.3–1.0, $P = 0.04$).

### Long-term morbidity

The overall long-term postoperative morbidity rate was 27.2% (Table 4). Long-term postoperative complications were anastomotic stricture (14.3%), small bowel obstruction (11.3%) and pouchitis (41.5%). We

**Table 1** Preoperative characteristics of 335 consecutive ileal pouch–anal anastomosis (IPAA) procedures for ulcerative colitis.

| | Overall population ($n$ = 335) | Period A ($n$ = 121; 36.1%) | Period B ($n$ = 124; 37.0%) | Period C ($n$ = 90; 26.9%) | $P$-value |
|---|---|---|---|---|---|
| Sex | | | | | |
| Male | 197 (58.8) | 78 (64.5) | 63 (50.8) | 56 (62.2) | 0.07 |
| Female | 138 (41.2) | 43 (35.5) | 61 (49.2) | 34 (37.8) | |
| Median age at diagnosis (years) (IQR) | 30 (23–39) | 29 (23–36) | 30 (23–40) | 31 (24–40) | 0.22 |
| Median age at time of IPAA surgery (years) (IQR) | 39 (32–49) | 37 (24–44) | 39 (33–52) | 41 (35–50) | 0.001 |
| Median duration between diagnosis and IPAA surgery (years) (IQR) | 5.4 (2–13) | 3.7 (1.9–8.2) | 6.4 (2–14.9) | 9.7 (3–14) | 0.002 |
| Smoking status | | | | | |
| Nonsmoker (%) | 221 (66.0) | 66 (54.6) | 73 (58.9) | 82 (91.1) | <0.0001 |
| Active smoker (%) | 31 (9.2) | 19 (15.7) | 8 (6.4) | 4 (4.4) | |
| Ever-smoker (%) | 114 (34.0) | 55 (45.4) | 51 (41.1) | 8 (8.9) | |
| Extra-intestinal manifestation prior to surgery (at least one) | 121 (36.1) | 57 (47.1) | 42 (34.7) | 22 (18.2) | 0.003 |
| Peripheral arthritis | 25 (7.5) | 15 (12.4) | 9 (7.2) | 1 (1.1) | |
| Spondylarthropathy | 4 (1.2) | 3 (2.5) | 1 (0.8) | 0 | |
| Arthralgia | 51 (15.2) | 24 (19.8) | 18 (14.5) | 9 (10.0) | |
| Erythema nodosum | 5 (1.5) | 2 (1.6) | 3 (2.4) | 0 | |
| Pyoderma gangrenosum | 3 (0.9) | 0 | 3 (2.4) | 0 | |
| Uveitis | 2 (0.6) | 2 (1.6) | 0 | 0 | |
| Conjunctivitis | 4 (1.2) | 3 (2.5) | 1 (0.8) | 0 | |
| (Epi)scleritis | 3 (0.9) | 1 (0.8) | 2 (1.6) | 0 | |
| Primary sclerosis cholangitis | 19 (5.7) | 1 (0.8) | 8 (6.4) | 10 (11.1) | |
| Aphthous stomatitis | 6 (1.8) | 2 (1.6) | 4 (3.2) | 0 | |
| Indications for surgery (%) | | | | | |
| Intractable disease | 267 (79.7) | 102 (84.3) | 99 (79.8) | 66 (73.3) | 0.009 |
| Toxic megacolon | 21 (6.3) | 8 (6.6) | 8 (6.4) | 5 (5.6) | |
| Acute haemorrhage | 5 (1.5) | 5 (4.1) | 0 | 0 | |
| Dysplasia | 21 (6.3) | 1 (0.8) | 9 (7.3) | 11 (12.2) | |
| Carcinoma | 16 (4.8) | 4 (3.3) | 5 (4.0) | 7 (7.8) | |
| Urgent surgery (%) | 88 (26.3) | 38 (31.4) | 40 (30.5) | 10 (10.9) | 0.0005 |

Values are given as no. (%) unless otherwise stated.

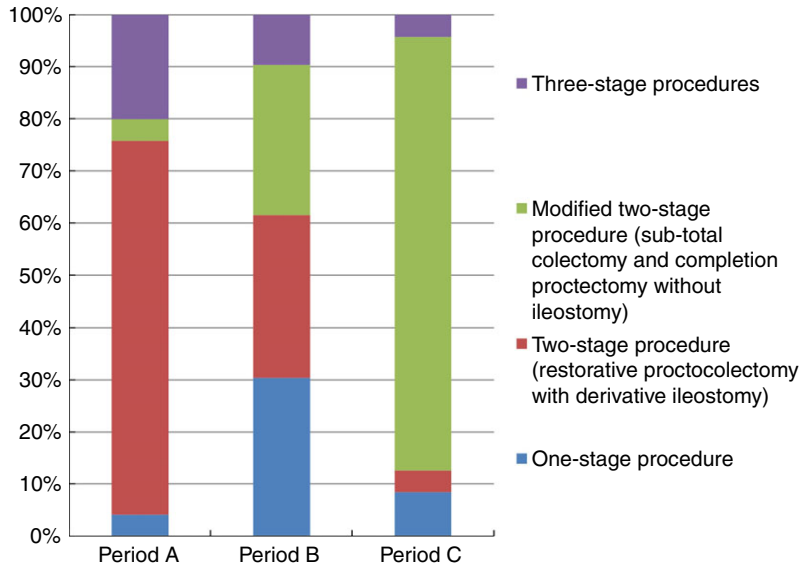


**Figure 1** Evolution of technical aspects of the ileal pouch–anal anastomosis procedure over the 25-year period.

**Table 2** Early postoperative morbidity after ileal pouch–anal anastomosis.

| Complications | *n* (%) | Period A | Period B | Period C | *P*-value |
|---|---|---|---|---|---|
| Anastomotic leak | 50 (14.9) | 26 (21.5) | 15 (12.1) | 9 (10.0) | 0.04 |
| Small bowel obstruction | 41 (12.2) | 22 (18.2) | 17 (13.7) | 2 (2.2) | 0.02 |
| Pelvic abscess | 17 (5.1) | 4 (3.3) | 9 (7.2) | 4 (4.4) | 0.35 |
| Haemorrhage | 14 (4.2) | 5 (4.1) | 6 (4.8) | 3 (3.3) | 0.94 |
| Pelvic haematoma | 6 (1.8) | 1 (0.8) | 2 (1.6) | 3 (3.3) | 0.51 |
| Venous thromboembolism | 5 (1.5) | 5 (4.1) | 0 | 0 | 0.01 |
| Pancreatitis | 2 (0.6) | 2 (1.6) | 0 | 0 | 0.17 |
| Pouch necrosis | 2 (0.6) | 1 (0.8) | 0 | 1 (0.1) | 0.53 |

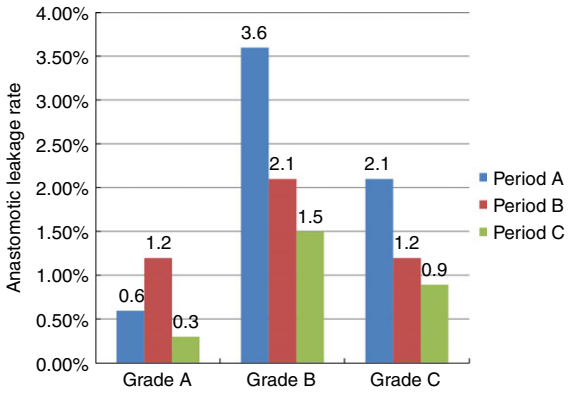


**Figure 2** Distribution of the anastomotic leakage rate of each grade, according to pouch construction period.

observed a decreased anastomotic stricture rate over the three periods, but the difference was not statistically significant (from 15.7% to 7.8%, $P = 0.13$). The rate of small bowel obstruction at 1-year follow-up dropped significantly in the last period (from 17.3% to 4.4%, $P = 0.02$). Moreover, patients with a diverting ileostomy ($n = 171$) had an increased risk of small bowel obstruction at 1 year (OR = 8.32, 95% CI 3.2–21.8, $P < 0.0001$).

At least one episode of acute pouchitis was experienced by 41.5% of patients (139/335). This rate remained stable over the three periods (45.4% in period A, 39.5% in period B, 38.9% in period C; $P = 0.54$).

The overall rate of pouch failure was 5.9% ($n = 20$), decreasing in the latest period (7.4% in period A *vs* 7.2% in period B and 2.2% in period C), but this difference was not statistically significant ($P = 0.22$). Reasons for pouch failure were: micropouch with proximal stenosis, malignancy in the transition zone, rectovaginal fistula, evacuation problems, chronic pouchitis, pouch necrosis, persistent postradiotherapy pelvic abscess, high

**Table 3** Risk factors for anastomotic leakage (univariate analysis, $n$ = 335).

| | No anastomotic leak ($n$ = 285) | Anastomotic leak ($n$ = 50) | Odds ratio (95% CI) | $P$-value |
|---|---|---|---|---|
| Male gender | 161 (56.5%) | 36 (72.0%) | 1.98 (1.02–3.83) | 0.04 |
| Median age at diagnosis (years) (IQR) | 29 (23–39) | 31 (24–38) | | 0.48 |
| Median duration between diagnosis and surgery (years) (IQR) | 5.0 (2–12.9) | 6.6 (3.0–14) | | 0.23 |
| Smoking status | | | | |
| Smoking prior to IPAA surgery | 97 (34.0) | 17 (34.0) | 0.99 (0.58–1.88) | 0.99 |
| Active smoking at IPAA surgery | 28 (9.8) | 3 (6.0) | 0.58 (0.17–2.00) | 0.39 |
| Surgical procedure | | | | |
| One-stage procedure | 52 (18.2) | 11 (22.0) | 1.26 (0.60–2.63) | 0.53 |
| Two-stage procedure (restorative proctocolectomy with derivative ileostomy) | 108 (37.9) | 24 (48.0) | 1.51 (0.82–2.77) | 0.18 |
| Modified two-stage procedure (subtotal colectomy and completion proctectomy without ileostomy) | 93 (32.6) | 8 (16.0) | 0.39 (0.17–0.87) | 0.02 |
| Three-stage procedure | 32 (11.2) | 7 (14.0) | 1.28 (0.53–3.10) | 0.57 |
| Pouch at first surgery | 160 (56.1) | 35 (70.0) | 1.82 (0.92–3.75) | 0.07 |
| Laparoscopic procedure | 171 (60.0) | 24 (48.0) | 0.61 (0.34–1.12) | 0.11 |
| Period | | | | |
| Period A (1990–1999) | 95 (33.3) | 26 (52.0) | 2.16 (1.18–3.97) | 0.01 |
| Period B (2000–2009) | 109 (38.2) | 15 (30.0) | 0.69 (0.36–1.32) | 0.27 |
| Period C (2010–2015) | 81 (28.4) | 9 (18.0) | 0.55 (0.25–1.18) | 0.13 |
| Early small bowel obstruction | 34 (16.2) | 7 (17.1) | 1.20 (0.50–2.88) | 0.68 |

Values are given as no. (%) unless otherwise stated.

**Table 4** Long-term morbidity after ileal pouch-anal anastomosis.

| | Overall population | Period A | Period B | Period C | *P*-value |
|---|---|---|---|---|---|
| Small bowel obstruction at 1 year of follow-up | 41 (12.2) | 21 (17.3) | 16 (12.9) | 4 (4.4) | 0.02 |
| Anastomotic stricture | 48 (14.3) | 19 (15.7) | 22 (17.7) | 7 (7.8) | 0.13 |
| Pouchitis | 139 (41.5) | 55 (45.4) | 49 (39.5) | 35 (38.9) | 0.54 |
| Pouch failure | 20 (5.9) | 9 (7.4) | 9 (7.2) | 2 (2.2) | 0.23 |

output, pouch fibrosis and pouch prolapse. Despite a dysfunctional pouch, four patients were able to undergo a redo-pouch with good functional results. Therefore, a pouchectomy with a permanent ileostomy was necessary for only 16 patients (4.8%).

## Discussion

The first IPAA surgery for UC was described by Parks and Nicholls in 1978 and has since been subject to technical improvements [13]. The aim of these changes is to decrease postoperative morbidity and to improve quality of life, body image and postoperative recovery [14,15]. In the present series, a number of remarkable trends were observed. First of all, a significant increase in modified two-stage procedures, delaying pouch construction, was found (in period A, 91.7% of our patients had a derivative loop ileostomy, compared with only 11.1% in period C). This approach allowed patients to recover from their illness, to optimize their nutritional status and to be weaned from any medication before pouch construction, while avoiding ileostomy-specific morbidity (anastomotic leakage, risk of dehydration eventually leading to renal failure and increased risk of small bowel obstruction) [16,17]. Moreover, we showed by multivariate analysis that pouch construction at first surgery was associated with a higher risk of anastomotic leakage. This is in line with previous studies which described a higher rate of postoperative morbidity, except in highly selected patients [18–20]. More remarkable is the observation of a decreasing leakage rate along with a decreasing defunctioning stoma rate. If no technical difficulties occur at the second stage protective ileostomy is not performed. This was supported by the fact that a defunctioning ileostomy does not prevent anastomotic leakage, as described in previous studies [15,21,22].

As expected, the rate of laparoscopy increased from 23.9% in period A to 84.4% in period C along with significantly lower rates of leakage and small bowel obstruction. There are various reasons to promote a laparoscopic approach. In a recent meta-analysis laparoscopy was shown to have already proven its efficacy in ulcerative colitis for both colectomy and restorative proctocolectomy in terms of cosmesis and postoperative recovery [23]. Moreover, laparoscopy preserves fertility in women [24] while maintaining long-term functional outcome of the pouch [25]. In our multivariate analysis, the laparoscopic approach appeared to reduce the risk of anastomotic leakage significantly. The laparoscopic approach is the standard approach in IPAA surgery in many centres and is currently performed in a safe and efficient manner [2]. More recently, the transanal completion proctectomy technique, assisted by single-port access at the ileostomy site, has been introduced. This approach aims to further decrease invasiveness in IPAA surgery [26].

The need for urgent surgery decreased over the three periods (31.4% in period A *vs* 30.5% in period B *vs* 10.9% in period C; $P < 0.0005$). This is probably a result of the improving medical options and a more timely surgical consultation. However, data to prove that were not available in our series.

Small bowel obstruction is one of the most frequent complications of restorative proctocolectomy and is reported to be in the range of 12–17% of all patients [27–29]. Restorative proctocolectomy is at increased risk due to the extensive dissection, and the combination of abdominal and pelvic dissection. As described in a previous study [17], the number of stages had an impact in our cohort on the number of adhesions, since the presence of a defunctioning ileostomy significantly increases the risk of later small bowel obstruction. Furthermore, patients undergoing a colectomy for UC by laparoscopy were shown to have fewer adhesions, allowing further laparoscopic completion surgery to proceed. We observed a significant decrease of small bowel obstruction over time ($P = 0.02$), along with an increase in rate of laparoscopic surgery and a decreasing use of defunctioning ileostomy.

We observed a decrease of venous thromboembolism in period C, probably explained by an increased awareness of the need of prolonged thrombo-prophylaxis in patients with inflammatory bowel disease, as such thrombo-prophylaxis is now the standard of care, as it is in severe acute colitis with bleeding.

At least one episode of acute pouchitis was experienced by 41.5% of patients. The risk of developing acute pouchitis remained relatively stable over all three periods. These results are in line with those from large studies describing pouchitis frequencies of up to 50% [8,30–37].

We noted a significantly increased age at time of performance of IPAA ($P = 0.001$), in parallel with a significantly increasing disease duration before surgery ($P = 0.02$). This evolution is possibly due to the introduction of novel medical options including anti-TNF and, more recently, vedolizumab. It could be thought that delaying surgery by exposing patients to an increasing number of different drug therapies would eventually worsen surgical outcome [1,38–40]. However, in this study preoperative medications was not found to be a risk factor for anastomotic leakage.

This study has some limitations. It is a monocentric study with some retrospective data. However, the data in the last period were registered prospectively and reflected a better outcome, which partly alleviates this bias. Moreover, it was not possible to account for the impact of preoperative nutritional status (weight loss, serum albumin level) or disease burden. Other outcome factors were not measured, for example sexual function and fecundity; these should be determined in a (multicentre) prospective study.

In conclusion, several important aspects of pouch surgery have changed over time and seem to reduce early postoperative morbidity. In our opinion the best approach is delayed pouch construction. Our move to this modified two-stage procedure, in parallel with an increasing rate of laparoscopy, was associated with reduction in the incidence of anastomotic leakage despite a significant decrease in the use of a defunctioning ileostomy.

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## Conflicts of interest

The authors declare no conflict of interest.

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