




Continent ileostomy: short- and long-term outcomes of a forgotten procedure

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The study was approved by the Ethics Committee of the Medical Association of Saarland, Germany (ID 24/15) and the Ethics Committee of the University of Rostock, Germany (registration number A 2015-0040). Patients provided verbal consent for analysis of their medical records.

Abstract

Background: Continent ileostomy (CI) aims to provide control of gas and faecal evacuation; however, it is rarely performed. This paper reports on outcomes of CI in a large single-surgeon series.

Methods: All consecutive patients who underwent CI between 1986 and 2015 were reviewed. Patients were classified according to the CI procedure (single stage versus two stage) and according to the underlying disease conditions (inflammatory bowel disease (IBD) versus no IBD). Primary outcome measures were early mortality and complications requiring surgical revision within 30 days (group Ia), those requiring surgical revision within 1–12 months (group Ib), and long-term complications after more than 12 months (group II). Secondary outcome measures were pouch survival and quality of life (QoL) assessed using questionnaires for occupational, sports, sexual, and travel activities; patients undergoing CI after conversion from ileostomy. Analyses were performed using descriptive statistics and Kaplan–Meier curves for the long-term outcomes.

Results: Sixty-two consecutive patients (28 men, 34 women) who underwent CI were reviewed, including 48 with IBD, and 14 without inflammatory conditions. Mean(s.d.) follow-up was 14.4 (9.5) (range 1–30) years. Twenty-seven patients (44 per cent) developed group I complications, of which 25 were corrected successfully. Two patients dropped out of the analysis: one who died from sepsis and the other owing to pouch loss attributed to unsolvable nipple complications. Of the remaining 60 patients, 23 (38 per cent) developed between one and five group II complications. The cumulative probability of reoperation was 54 per cent at 25 years. Overall, pouch survival was achieved in 90 per cent. The two-stage approach led to significantly fewer complications in group Ia (single stage versus two stage: 8 of 25 versus 2 of 37; $P = 0.005$), whereas complication rates in group Ib (5 of 23 versus 14 of 37) and group II (9 of 23 versus 14 of 37) were similar. Four CIs failed because of IBD complications. CI pouch and function were preserved in all patients without IBD, whereas in the group with IBD 2 of 31 with ulcerative colitis and 2 of 17 with Crohn's colitis lost the CI owing to severe intractable inflammatory complications. In 16 patients who had conversion from ileostomy to CI, QoL improved significantly above precolectomy levels in all domains

Conclusions: CI remains an alternative to conventional ileostomy. Although affected by high reoperation rates, it has the benefit of a high rate of pouch survival.

Introduction

The technical evolution of proctocolectomy is one of the most interesting chapters in surgery. Over the past seven decades, the choice of methods in the historical sequence has changed from conventional ileostomy (IS) over continent ileostomy (CI) to restoration of the normal defaecation pathway by ileal pouch–anal anastomosis (IPAA)¹. CI was introduced in 1969 in an attempt to preserve the functionality and body image of the surgically treated patient requiring proctocolectomy², and the procedure was adopted widely thereafter³. However, IPAA soon became the standard, as the more function-preserving approach. Furthermore, the surgical community collectively considered the

overall complication rates of CI to be unacceptably high⁴. CI is known to be a very demanding surgical procedure owing to the challenging learning curve, but also because of the additional mandatory surgical skills for long-term preservation of function. After introduction of CI in the Surgical University Hospital in Homburg, Germany, in 1986⁵, the procedure was pursued in the Surgical Department of the MediClin Müritzklinikum in Waren, Germany, between 2003 and 2015. Because of the prolonged experience with this approach, a national referral centre for CI as an alternative to IS was established there. CI as an option has since been discussed with all suitable patients with an IS, regardless of the underlying condition, including Crohn's disease⁶. The

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aim of this study was to critically appraise long-term outcomes and quality of life (QoL) after CI, focusing on both short- and long-term complications of the procedure.

Methods

Patients

All consecutive patients who underwent CI at the Surgical University Hospital in Homburg, Germany, between 1986 and 2003, and at the MediClin Müritzklinikum (teaching hospital and referral Centre for pouch surgery) in Waren, Germany, between 2003 and 2015, were reviewed. Physically and psychologically fit and comprehensively informed patients had consented to a primary (in the context of proctocolectomy) or secondary (conversion of pre-existing conventional IS) CI construction. Patients who underwent conversion from IPAA to CI were excluded from this series, because the indications, challenges, and underlying conditions require separate analysis. The medical records were reviewed and the outcome parameters entered into a database for statistical analysis. The variables reviewed included: underlying disease, urgency, and indication for primary proctocolectomy, rationale for constructing a CI, age in relation to underlying disease course, and age at the time of CI.

Procedures were categorized on the basis of the pre-existing clinical conditions. Single-stage procedures referred to CI construction (without pre-existing IS) at the time of primary proctocolectomy or completion proctectomy after subtotal colectomy. The two-stage approach encompassed conversion of an existing IS (with or without completion (procto)colectomy) to CI regardless of the underlying diagnosis.

Technique of continent ileostomy construction

Figure 1 provides a step-by-step illustration of the current technique. Although the general principle of small bowel intussusception and fixation to form a valve has remained the same, technical modifications have been implemented over time. Importantly, pouch design shifted from the original K-pouch to the S-pouch design in 1991–1995. Additionally, stabilization of the nipple valve, the most vulnerable step of the procedure, was improved from use of three staple lines with a double-row linear stapler to two staple lines with use of a four-row knifeless linear cutter in 2001. Additionally, fixing the outer cuff of the nipple valve to the pouch wall with a third line of knifeless linear cutter instead of a single line with a stapler was implemented in the same year.

Follow-up

During preoperative consultations and before discharge from hospital, all patients were thoroughly informed about the expected outcome and management of CI, which involves entire control of continence by emptying the intra-abdominal reservoir via regular intubation⁷. In addition, all patients received educational material regarding dietary and management recommendations. Long-term follow-up recommendations were based only on the underlying disease, in accordance with the European Crohn's and Colitis Organization (ECCO) guidelines for inflammatory bowel disease (IBD)⁸ or European Hereditary Tumor Group (EHTG)⁹ guidelines for familial adenomatous polyposis. Follow-up was ensured by the responsible surgeon, even after his transition from the university hospital to the teaching hospital, without interruption until 2015. During this time, contact was made by telephone until 2000, followed by e-mail thereafter. In 2017, follow-up was actively supplemented by a telephone interview and

an online survey of available and willing patients until December 2017 (end of follow-up).

Outcome measures

Primary outcomes of interest were the short- and long-term complications of the procedure, categorized as:

group Ia—early complications occurring within 30 days, including those requiring immediate surgical revision (anastomotic leak and vascularization issues leading to valve-related complications) and postoperative death;

group Ib—complications occurring between 30 days and 12 months, and requiring elective surgical revision, either stoma- or nipple valve-related; and

group II—long-term complications occurring after 12 months.

Secondary outcomes were overall CI pouch survival and QoL assessment. For this analysis, patients received an e-mail invitation for an online survey in December 2017. The survey was based on the WHOQOL-BREF^{10,11} and an individual questionnaire with questions about occupational, sports, sexual, and travel activities.

Data analysis and statistical analysis

Descriptive statistics were used to analyse the overall cohort. Subgroups of patients (based on CI procedures and underlying disease) were compared for early and late complications, and for QoL results. Groups were compared using the χ^2 test or the t test. Cumulative probability rates were determined by Kaplan-Meier analysis, and log rank testing was used to verify statistical significance. The level of statistical significance was defined as $P < 0.050$. Statistical analyses were done using SPSS® (IBM, Armonk, NY, USA).

Results

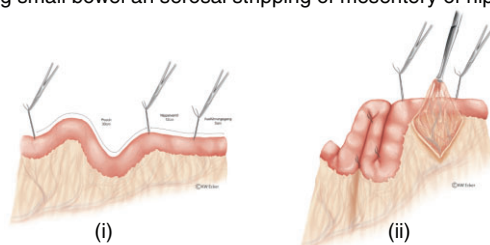
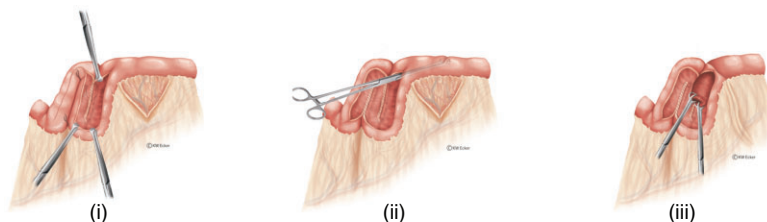
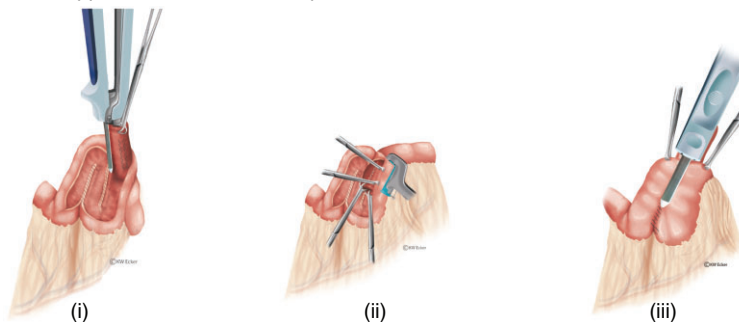
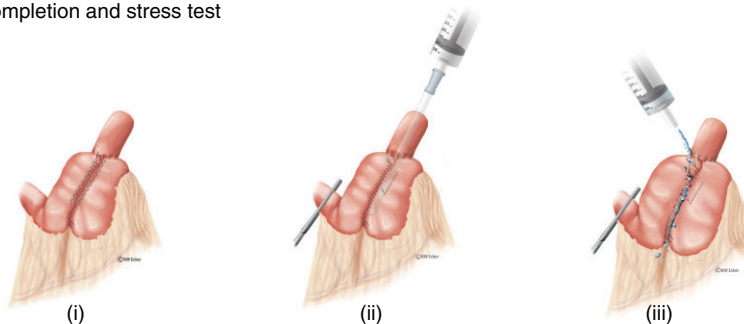
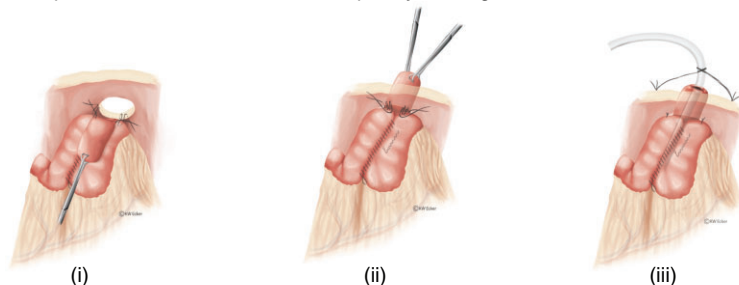
Patients

Sixty-two patients (34 women and 28 men) were treated with CI over the study interval, and all were included in the data analysis. Forty-eight (77.4 per cent) presented with chronic inflammatory bowel disease (IBD), of which 17 (35.4 per cent) had Crohn's colitis. Among the remaining 14 patients, familial adenomatous polyposis was the most common diagnosis. Twenty-five patients (40.3 per cent) had primary surgery, whereas 37 (59.7 per cent) had already undergone subtotal colectomy or proctocolectomy (Table 1).

The majority of patients (80.6 per cent) presented with complete bodyweight data and had a normal BMI, whereas seven had a BMI lower than 20 kg/m²; of note, obesity is an exclusion criterion for CI. Patients were investigated for concomitant disease or medication. However, only 55 had complete medical records. Overall, 42 (76.4 per cent) did not require steroids or other immunosuppressive drugs at the time of surgery.

Early complications

Table 2 summarizes group I complications. Twenty-seven patients (43.5 per cent) developed early complications; two patients were included in both groups Ia and Ib. Group Ia comprised 10 patients, of whom nine had intra-abdominal emergencies and a one wound abscess. The revisional procedures were all performed as emergency (6) or urgent (4) operations in the setting of life-threatening complications such as peritonitis and sepsis. Satisfactory rescue was only possible in 7 of 10 patients. The three unsuccessful cases included one patient who died from sepsis, one who required a permanent ileostomy without the

a Folding small bowel an serosal stripping of mesentery of nipple valve segment**b** Construction of posterior wall of S-pouch and nipple valve intussusception**c** Stabilization of nipple valve and fixation to pouch wall**d** Pouch completion and stress test**e** Attachment of pouch to abdominal wall and temporary drainage fixation**Fig. 1** Kock continent ileostomy procedure

a Folding, marking, and positioning of small bowel and serosal stripping of mesentery of nipple valve segment. The three structural segments (outlet, nipple valve, pouch) are measured and marked (i). Meticulous triangular removal of the peritoneum on both sides of the valve segment (ii). **b** Construction of the posterior wall of the S-pouch and intussusception of the nipple valve. The first posterior wall suture of the S-pouch is completed (i). After adding the second posterior wall suture, the valve segment is grasped with a Babcock clamp from the luminal site (ii), and the nipple valve is created by intussusception of the ileum and interiorized into the reservoir (iii). **c** Stabilization of the nipple valve and fixation to the anterior wall of the pouch. Internal stabilization of the nipple valve is achieved by applying two strictly paramesenterially positioned rows of staple sutures with a bladeless linear cutter (i). Fixation of the outer cuff of the nipple valve to the anterior pouch wall can be done before the suture of the anterior wall with a linear stapler (ii) or after the anterior wall suture with a knifeless linear cutter directly on to the suture (iii). **d** Completion of the pouch and stress test. Pouch construction is completed using interrupted sutures (telescope securing sutures) between the outlet segment and pouch shoulder (i). After clamping the afferent loop, an ileostomy catheter is advanced into the pouch via the nipple valve and the pouch is filled with air (ii). Valve competence is demonstrated by missing air loss after removal of the catheter and the tightness of the sutures by missing air bubbles when exposed to water (iii). **e** Attachment of the pouch to the abdominal wall and fixation of the temporary continuous drainage system. For indispensable secure attachment of the pouch to the abdominal wall, interrupted sutures with non-resorbable material are placed between the pouch and the abdominal wall laterally (i) and medially (ii) to the abdominal opening. At the end of the operation, a special ileostomy catheter is inserted into the reservoir and fixed to the skin with sutures (iii). It is positioned correctly when it can be easily irrigated and the irrigation fluid flows out spontaneously.

Table 1 Patient characteristics

	No. of patients* (n = 62)
Underlying disease	
Ulcerative colitis	31 (50.0)
Crohn's colitis	17 (27.4)
Familial adenomatous polyposis	11 (17.7)
Other non-inflammatory	3 (4.8)
Urgency of colectomy	
Elective	55 (88.7)
Urgent	6 (9.7)
Emergency	1 (1.6)
Indications for colectomy‡	
Refractory to medical treatment	47 (75.8)
Intraepithelial neoplasia	11 (17.7)
Carcinoma	6 (9.7)
Toxic megacolon	4 (6.5)
Massive bleeding	2 (3.2)
Perforation	2 (3.2)
Reasons for choice of CI	
Contraindication to IPAA§	19 (30.6)
Refused IPAA	16 (25.8)
Contraindication to IS¶	17 (27.4)
Refused IS	10 (16.2)
Procedures	
Primary CI construction (1 stage)	25 (40.3)
Secondary CI construction (2 stage)	37 (59.7)
Age (years)†	
Onset of disease (n = 62)	26.4(12.9)
Proctocolectomy and CI construction (n = 25)	40.7(13.6)
Primary colectomy (n = 37)	33.3(9.5)
Secondary CI construction (n = 37)	42.2(10.7)

*With percentages in parentheses unless indicated otherwise †values are mean(s.d.). ‡Seventy-two different indications in 62 patients. §Forty-two contraindications in 19 patients: carcinoma (5), anal destruction (13), incontinence (16), and technical problems in performing ileal pouch-anal anastomosis (IPAA) (8). ¶Eighteen contraindications in 17 patients: skin complications (5), problems with stoma appliances (8), and stoma complications (5). CI, continent ileostomy; IS, conventional ileostomy.

option for pouch/nipple renewal, and one patient in whom fistula closure failed with the requirement for repeated reconstructive surgery at a later date.

A total of 19 patients had group Ib complications. Complications affected the stoma site (7) or the nipple valve (14); two patients presented with combined problems. All stoma complications were treated successfully with limited surgery at the stoma site, however, in four patients this correction was performed with a simultaneous laparotomy and nipple valve repair. The underlying nipple complications were either related to nipple shortening or necrosis owing to a deteriorated blood supply (7). In an additional seven patients it was necessary to close a fistula that surrounded the valve base causing incontinence. All 19 elective revisional procedures were successful in terms of both functional restoration and cosmetic results. At the end of the first postoperative year, 60 of the 62 original patients (97 per cent) had perfect pouch function. Seven patients (18 per cent) presented with a large amount of mucous discharge originating in the valve, which was not related to the continence function, but required use of a thicker pad or stoma cap.

Long-term complications

Sixty patients entered the second postoperative year with the CI functioning perfectly and were available for long-term follow-up. Over a mean(s.d.) follow-up of 1410 (range 1–30) years, twenty-three patients (38 per cent) required between one and five revisions owing to late complications (Table 3). These long-term complications were allocated to four different sites (stoma, nipple

valve, pouch, and afferent loop). A total of 80 different individual complications were treated surgically in 42 procedures (combined occurrence of complications at predilected sites) with a maximum of five revisions for a single patient, which occurred twice in this series.

Stoma complications were mostly corrected simultaneously at the time of a more severe situation requiring abdominal surgery. Nipple valve complications occurred in 18 patients (30 per cent) (Table 4), corresponding to a cumulative probability of 43 per cent after 30 years. In contrast, all non-valve-related complications were observed in 20 patients (33 per cent), corresponding to a cumulative probability of 54 per cent. Nevertheless, all nipple valve complications (regardless of severity and occurrence in the sequence of complications) were repaired successfully with no compromise regarding perfect function.

Complications of the pouch and small intestine were inherent to the underlying inflammatory complications of the corresponding IBD and dealt with according to the standards of care. The pouch could not be preserved in four patients because of severe therapy-resistant pouchitis in ulcerative colitis, and severe ulcerative and fistula-forming complication in Crohn's colitis. Because the risk of recurrence of these therapy-refractory inflammatory complications was considered too high, a second pouch was not an option.

Long-term pouch preservation and quality of life

At the end of the observation period, five patients had died and eight were lost to follow-up. All of these had previously confirmed full functionality of the CI. Overall, the CI continued to provide complete continence in 56 patients at last contact during long-term follow-up. This allows for some mucous discharge, but excludes malfunction such as incontinence, leakage and intubation problems, or complications of the underlying disease requiring surgical care.

Thirty-four patients participated in the online survey (response rate 72.3 per cent) for QoL assessment. Comparing the WHOQOL-BREF scores with those of a normal population, the physical score was lower (59.3 versus 80.3), the psychological score was of the same order of magnitude (72.3 versus 73.8), and the social (76.2 versus 73.1) and environmental scores (83.8 versus 77.0) were even higher^{10,11}. Of note, 16 patients (43.2 per cent) who had received CI as a conversion from an ordinary ileostomy answered the questionnaire for intraindividual comparison of QoL before colectomy, with ileostomy, and with CI. All four areas of QoL (occupation, sports, travel, and sexual activity) were rated below average before colectomy and worsened further after ileostomy. After conversion of the ileostomy to CI, all values were assessed as being above average, with moderate to good scores (Fig. 2). This improvement was statistically significant in all areas ($P < 0.050$).

Subgroup comparison

Surgical procedures and underlying diseases were compared as subgroups with regard to complications and pouch survival. The results are summarized in Tables 5 and 6. The surgical procedures only had an influence on immediate postoperative complications in group Ia, which occurred significantly less frequently after secondary CI construction (2 of 37 patients) than after primary CI construction (8 of 25). In contrast, underlying diseases had a marked, although not significant, influence on late complications in group II and thus on pouch survival. As both parameters are subject to temporal dynamics, life table analyses were undertaken (Figs. 3 and 4). After surpassing the first year, the risk of

Table 2 Early complications (group I)

	No. of patients	Treatment	Outcome
Group Ia (n = 62)	10	Urgent revision 10	Successful 7
Peritonitis/abscess	2	Relaparotomy 2	Death 1
Pouch ischaemia	2	Redo surgery 2	Failure 1
NV necrosis	1	NV reconstruction 1	
NV fistula	1	Fistula closure 1	Failure 1
Ileus	3	Adhesiolysis 3	
Soft tissue abscess	1	Drainage 1	
Group Ib (n = 60)*	19	Elective revision 19	Successful 19
Stoma complications†	7		
Stenosis	3	Local repair 3	
Retraction	1	Local repair 1	
Parastomal hernia	3	Local repair 3	
NV complications	14		
Total necrosis	1	NV reconstruction 1	
Partial necrosis, nipple shortening	6	NV reconstruction 6	
Fistula	7	Fistula closure 5	
		NV reconstruction 2	

*Including one non-lethal failure in group Ia. †Five of seven patients also had complications of the nipple valve (NV), resulting in a total of 19 patients in group Ib.

Table 3 Late complications (group II)

Sequence	No. of patients	Overall no. of procedures*	Site of revision			
			Stoma	Nipple valve	Pouch	Afferent loop
First revision	23 (38.3)	38	10	18	6	4
Second revision	11 (18.3)	23	4	14	3	2
Third revision	4 (6.7)	12	2	7	1	2
Fourth revision	2 (3.3)	4	0	4	0	0
Fifth revision	2 (3.3)	2	0	2	0	0
All procedures	42	79	16	45	10	8

Values in parentheses are percentages based on cohort of 60 patients with perfect function after the first postoperative year. *Multiple complications were possible in a patient at the time of revision.

Table 4 Complications leading to first to fifth revision surgery in the long term, and associated repair procedures

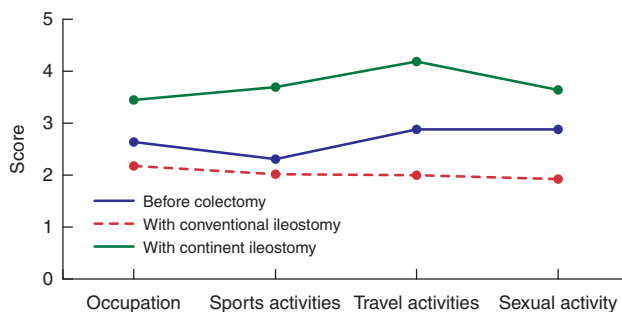
Site and type of complication	No. of procedures	Surgical procedures
Stoma	16	
Retraction, stenosis	13	Local plastic correction 13
Abscess, fistula	2	Drainage + fistula closure 2
Parastomal hernia	1	Hernia repair 1
Nipple valve	46	
Sliding/prolapse	41	Restabilization of existing valve 11
		Reconstruction of valve from afferent loop 19
		Reconstruction of valve from oral loop 11
Fistula	5	Fistula closure 2
		Fistula closure protected by loop ileostomy 2
		Reconstruction of valve from afferent loop 1
Pouch	10	
Pouchitis	2	Pouch resection + permanent ileostomy 2*
Displacement	2	Replacement and fixation 2
Fistula	6	Fistula closure 4
		Pouch resection + permanent ileostomy 2*
Afferent loop	8	
Stenosis	2	Ileal resection + anastomosis 1
		Bypass between prestenotic ileum and pouch 1
Fistula	6	Ileal resection + anastomosis 4
		Excision and stricture plasty 2
Total	80	

*Pouch preservation was not possible in four patients; the other 76 revisional procedures were successful.

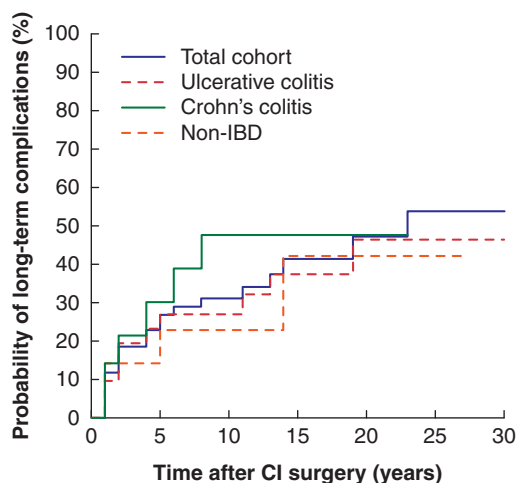
Table 5 Subgroup analysis of complication rates: primary versus secondary construction

	Primary construction	Secondary construction	P†
Group Ia	8 of 25	2 of 37*	0.005
Group Ib	5 of 23	14 of 37	0.190
Group II	9 of 23	14 of 37	0.222

*Two patients were lost from from group 1a (sepsis-related mortality and pouch loss). † χ^2 test.

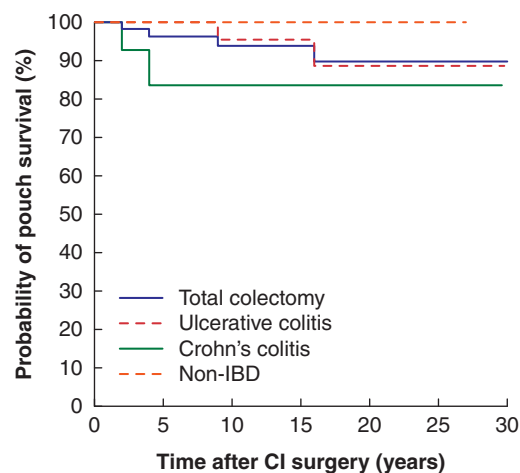
**Fig. 2** Comparison of living conditions at different times in the patient's history

1, Bad; 2, rather bad; 3, moderate; 4, good; 5, very good.

**Fig. 3** Cumulative probability of long-term complications requiring reoperation in relation to underlying disease

IBD, inflammatory bowel disease; CI, continent ileostomy.

subsequent operations was assessed as follows. The probability of any reoperation increased almost linearly after the first year and reached 50 per cent after 16 years and 54 per cent after 25 years. Based on the underlying disease (Fig. 2), the probabilities of reoperation after 10 years were calculated at 27 per cent for ulcerative colitis at, considerably higher at 51 per cent for Crohn's disease, and 23 per cent for non-inflammatory conditions. After 20 years, the cumulative rates were 38, 51, and 42 per cent respectively. Although a trend was evident, the differences did not

**No. at risk**

	60	46	36	24	17	11	6
Total colectomy	60	46	36	24	17	11	6
Ulcerative colitis	31	26	21	14	11	8	4
Crohn's colitis	15	10	7	6	4	3	2
Non-IBD	14	10	8	4	2	1	0

Fig 4 Cumulative probability of pouch-survival in relation to the underlying disease

IBD, inflammatory bowel disease; CI, continent ileostomy.

Table 6 Subgroup analysis of complication rates by underlying disease

	Ulcerative colitis	Crohn's colitis	Non-IBD	P*
Group Ia	5 of 31	3 of 17	2 of 14	0.831
Group Ib	10 of 31	6 of 15	3 of 14	0.108
Group II	11 of 31	8 of 15	4 of 14	0.111

IBD, inflammatory bowel disease. * χ^2 test.

reach statistical significance ($P=0.230$). In the long term, CI pouch and function were preserved in all 14 patients who had non-IBD, whereas among those with IBD, 2 of 31 patients with ulcerative colitis and 2 of 17 with Crohn's colitis lost the CI because of severe intractable inflammatory complications. The overall cumulative pouch survival rate in patients with IBD decreased slowly after the first postoperative year to 90 per cent by the 15th year, remaining constant thereafter for the follow-up of 30 years. For Crohn's colitis, the rate of CI preservation dropped to 85 per cent in the first 5 years, but remained constant thereafter. Despite the expected trend towards much higher rates of CI preservation and fewer complications in patients with non-IBD compared with those who had ulcerative or Crohn's colitis, these differences did not reach statistical significance.

Discussion

CI—historically the prototype of IPAA—should not be seen as a competitor to IPAA, but rather as an alternative to IS. The deterioration of QoL, but also the underestimated rate of renal complications attributed to acute and chronic dehydration¹², should always be considered, especially for young and active patients with an IS.

For patients who do not have the option of preserving continence, previous analyses^{13,14} reported postoperative complications in 11.5 per cent after a single-stage procedure as opposed to only 4.6 per cent with a two-stage procedure. Contradictory

findings have been reported by others (13.0 versus 46.0 per cent and 10.0 versus 52.5 per cent)^{15,16}. The present results are consistent with a negative impact of a single-stage procedure. However, the authors consider the historical evidence insufficient to generally discourage single-stage CI construction. Specifically, advances in surgery and anaesthesiology in the interval reported must be acknowledged. Steroid therapy and obesity have been reported to enhance complications, although others¹⁸ have documented contradictory findings regarding steroids. However, obesity is considered a proven risk factor^{7,17}. Thus, it seems wise to recommend a two-step procedure in the event of concomitant steroid intake (dose-dependent).

Overall, questions regarding the design of the continent reservoir have not been addressed satisfactorily. Kock and colleagues exclusively used the double anisoperistaltic K design for pouch construction^{13,14,16}, whereas American authors implemented the S shape as first described by Fazio^{18–20}. The rationale argued is that, after folding a K-pouch, tension may be induced systematically on the front wall pouch closing suture. In the literature, abscesses, fistulas, and peritonitis have been reported in up to 10 per cent for this technique^{21–23}. In the personal experience of the authors' group, the decrease noted in group Ia complications over the years may be related to the change in design from K- to S-pouches. An additional advantage of the S design is the facilitation of endoscopic investigation for the readily accessible afferent loop, which is the predominant site for recurrences in Crohn's colitis²⁴.

Nevertheless, the nipple valve is the Achilles' heel of the operation. In the course of the evolution of CI, stapler stabilization and stapler fixation of the outer nipple cuff to the pouch wall has become an established standard in addition to so-called mesenteric stripping. Across a representative selection of studies^{13,16,18,20,25–27}, the crude rate of valve complications was 32 (range 13–66) per cent, which is comparable to the rate in the present series (30 per cent). Although some authors use linear staplers, others prefer knifeless linear cutters^{13,19}. Staplers, unlike cutters, have the disadvantage of a guide mandrel at the end of the cartridge, which causes punch-hole perforations that require dedicated closure in order to prevent fistula formation at the valve base. However, the authors' group has standardized the use of cutters, fashioning four parallel staple rows, as opposed to only two staple rows with linear staplers. Data from the literature have indicated that the cumulative probability of late nipple valve complications is 36, 46, 52, and 52 per cent at 5, 10, 15, and 20 years after operation respectively^{14,16,27,28}. In contrast, in the present case series, lower rates of 18, 23, 32, and 38 per cent were documented, with an overall probability of late nipple valve complications of 43 per cent.

Regarding the underlying disease and in light of controversial opinions regarding the suitability of pouch construction in Crohn's disease in general, some authors^{15,29,30} have more or less strictly excluded Crohn's colitis from CI surgery. However, a trend towards the acceptance of construction of an IPAA or CI in selected patients with Crohn's colitis has become apparent over the decades^{6,31,32}. In the present study, no difference was found between non-IBD and IBD concerning early complications of CI. However, selection of suitable patients with Crohn's colitis requires more prospective evaluation, although Crohn's colitis is not any longer considered a general contraindication to CI^{32,33}.

Several authors^{20,34,35} have focused on QoL before and after conversion of an ordinary ileostomy. However, a valid comparison with a healthy control group was lacking. Using the WHOQOL-BREF, CI scores were documented as only slightly

lower or equal to those for physical and psychological domains in a normal control population^{10,11}. Surprisingly, the social and environmental scores were found to be significantly higher than in the normal population. Interestingly, a recent study³⁶ reported no significant differences in QoL between IS, CI, and IPAA.

Given the results reported here, it should be stressed that CI is a complex procedure, which requires a systematic educational programme, operations under experienced surveillance, and further proctoring for implementation in new centres.

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