Original article

Outcome after restorative proctocolectomy and ileal pouch–anal anastomosis in children and adults

K. Diederen[1], S. S. Sahami[3], M. M. Tabbers[1], M. A. Benninga[1], A. Kindermann[1], P. J. Tanis[3], M. W. Oomen[3], J. R. de Jong[2] and W. A. Bemelman[3]

Departments of [1]Paediatric Gastroenterology and Nutrition and [2]Paediatric Surgery, Emma Children's Hospital, Academic Medical Centre, and [3]Department of Surgery, Academic Medical Centre, Amsterdam, The Netherlands

Correspondence to: Dr K. Diederen, Department of Paediatric Gastroenterology and Nutrition, Emma Children's Hospital, Academic Medical Centre, Meibergdreef 9, 1105 AZ Amsterdam, The Netherlands (e-mail: k.diederen@amc.uva.nl)

Background: **Studies comparing the outcome of ileal pouch–anal anastomosis (IPAA) in children and adults are scarce. This complicates decision-making in young patients. The aim of this study was to compare adverse events and pouch function between children and adults who underwent IPAA.**

Methods: **This cross-sectional cohort study included all consecutive children (aged less than 18 years) and adults with a diagnosis of inflammatory bowel disease or familial adenomatous polyposis who underwent IPAA in a tertiary referral centre between 2000 and 2015. Adverse events were assessed by chart review, and pouch function by interview using a pouch function score (PFS).**

Results: **In total, 445 patients underwent IPAA: 41 children (median age 15 years) and 404 adults (median age 39 years), with a median follow-up of 22 (i.q.r. 8–68) months. Being overweight ($P = 0{\cdot}001$), previous abdominal surgery ($P = 0{\cdot}018$), open procedures ($P < 0{\cdot}001$) and defunctioning ileostomy ($P = 0{\cdot}014$) were less common among children than adult patients. The occurrence of anastomotic leakage, surgical fistulas, chronic pouchitis and Crohn's of the pouch was not associated with paediatric age at surgery, nor was pouch failure. The development of anastomotic strictures was associated with having IPAA surgery during childhood (odds ratio 4·22, 95 per cent c.i. 1·13 to 15·77; $P = 0{\cdot}032$). Pouch function at last follow-up was similar in the children and adult groups (median PFS 5·0 *versus* 6·0 respectively; $P = 0{\cdot}194$).**

Conclusion: **Long-term pouch failure rates and pouch function were similar in children and adults. There is no need for a more cautious attitude to use of IPAA in children based on concerns about poor outcome.**

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Introduction

Restorative proctocolectomy (RPC) with ileal pouch–anal anastomosis (IPAA) is the surgical treatment of choice for ulcerative colitis that is refractory to therapy, and unclassified inflammatory bowel disease (IBD) without evidence of anorectal or ileal disease[1,2]. It is also used as prophylactic treatment for patients with familial adenomatous polyposis (FAP)[1,3]. This procedure has the potential to restore function after resection of the rectum.

IBD emerging during childhood has been reported to be more severe, with more extensive inflammation and aggressive disease behaviour, and eventually a higher risk of colectomy, than adult-onset IBD[4,5]. The 5-year surgery rate in childhood-onset ulcerative colitis can be as high as 26 per cent, compared with approximately 16 per cent for adult-onset ulcerative colitis[6]. Although colectomy is inevitable and potentially life-saving in patients with IBD who have refractory acute severe colitis, the timing of colectomy in those with chronic ongoing disease is still a topic of discussion[7]. In patients with FAP, the onset of polyps has been noted within a broad age range (4–35 years)[8] and the timing of IPAA surgery has not yet been standardized[9,10]. The decision to operate on children with IBD and FAP involves balancing the risk of complications of ongoing disease against the surgical risk and functional implications associated with IPAA as well as the risk of having a stoma. Families and surgeons may therefore be reluctant to opt for IPAA during childhood. The main controversy in children is the timing of RPC with IPAA, and whether this should be performed during childhood or delayed to adulthood.

Recent studies have reported high rates of adverse events[11,12], but satisfactory functional outcomes and

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quality of life after IPAA in children[13–15], comparable to outcomes in adults[16,17]. However, there is a paucity of studies directly comparing outcomes in patients who had RPC with IPAA during childhood or adulthood[14,18,19]. Moreover, these studies investigated solely patients with IBD[18], reported short-term outcomes only[14] or included a small number of patients[14,19]. The aim of the present study was to compare adverse events and pouch function in children and adult patients who underwent IPAA surgery.

Methods

This retrospective cohort study included all eligible paediatric (aged less than 18 years at pouch surgery) and adult (aged 18 years or more at pouch surgery) patients with a diagnosis of IBD (ulcerative colitis, Crohn's disease or unclassified IBD) or FAP who underwent IPAA surgery in the Academic Medical Centre (AMC) (Amsterdam, The Netherlands) between January 2000 and January 2015. The diagnosis of IBD was confirmed by colonoscopy with histological confirmation. The diagnosis of FAP was established by genetic testing and confirmed by a positive genetic test in more recent cases. Approval from the local medical ethics review committee was obtained.

Ileal pouch–anal anastomosis procedure

The AMC is a tertiary referral centre for pouch surgery. IPAA was performed by the same highly experienced team of colorectal surgeons, consisting of paediatric and colorectal surgeons, with at least one of three senior supervising surgeons present during each operation. Patients underwent one-, (modified) two- or three-stage procedures, depending on the diagnosis and the time period[20]. Modified two-stage procedures were mainly used in patients with IBD, because of the high risk of anastomotic leak in those treated with biological agents[20]. A 29-mm diameter stapling gun was used in all patients. Some patients with FAP had a mucosectomy and handsewn anastomosis, based on the presence of dysplasia in the anal transition zone[21].

Data collection

Patients who underwent IPAA were identified from a prospectively maintained surgical database. Additional data on patient characteristics and surgical variables were obtained by retrospective chart review. Preoperative variables extracted were: age, sex, preoperative diagnosis, duration of disease, previous abdominal surgery (before RPC), BMI and ASA fitness grade. Disease duration was defined as the time between diagnosis and pouch surgery. Overweight was defined as a BMI exceeding 25 kg/m^2. The ASA grade was dichotomized with a cut-off point of III, based on previous literature and clinical relevance[22]. Preoperative use of immunomodulators, steroids and anti-tumour necrosis factor (TNF) α therapy was documented. Preoperative steroid use was defined as any use of steroids within 12 weeks before surgery. Preoperative anti-TNF-α use was defined as infusion within 12 weeks before surgery, based on the half-life of this agent[23].

Surgical variables included: primary proctocolectomy or completion proctectomy, surgical approach (laparoscopic or open), type of pouch created, type of pouch–anal anastomosis (handsewn or stapled), urgency of RPC (scheduled or emergency), creation of a defunctioning ileostomy, perioperative blood transfusion, duration of surgery and postoperative duration of hospital stay. The moment of enrolment during the study period was calculated from January 2000. This was considered relevant as changes in management over time may influence outcomes. A laparoscopic approach was defined as a total laparoscopic IPAA, or laparoscopic RPC with hand-assisted laparoscopic IPAA (via Pfannenstiel incision).

Definition of adverse events

Adverse events were anastomotic leakage, fistula related to the surgery, anastomotic stricture, (chronic) pouchitis, Crohn's of the pouch and pouch failure. Anastomotic leakage was defined as any defect at the anastomotic site confirmed on imaging, examination under anaesthesia or at surgical reintervention (requiring radiological placement of a pelvic drain, transanal lavage, endosponge placement or ileostomy creation). A symptomatic stricture at the pouch–anal anastomosis that required dilatation was diagnosed as anastomotic stricture. Crohn's of the pouch was diagnosed if there were non-surgery-related perianal fistulas, granulomas on histology, or inflammation and ulceration in the afferent limb or in the small bowel on endoscopy in the absence of non-steroidal anti-inflammatory drug use[24], in patients with IBD with or without a diagnosis of Crohn's disease before IPAA surgery. Pouchitis was diagnosed when the modified Pouchitis Disease Activity Index score was at least 5[25]. Pouchitis was subclassified as chronic pouchitis when the patient failed to respond to a 4-week course of a single antibiotic (metronidazole or ciprofloxacin), requiring prolonged therapy of at least 4 weeks comprising two or more antibiotics, oral or topical 5-aminosalicylate, corticosteroid therapy or oral immunomodulator therapy[26,27]. Pouch failure was defined by formation of a permanent ileostomy, excision of the ileoanal pouch, or pouch-related death during follow-up.

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Table 1 Demographic and surgical characteristics of children and adult patients who underwent ileal pouch–anal anastomosis surgery

	Children (*n* = 41)	Adults (*n* = 404)	*P***
Age at surgery (years)*	15 (13–17)	39 (30–47)	–
Sex ratio (M : F)	23 : 18	219 : 185	0·870
Overweight (BMI > 25 kg/m^2)	3 of 38 (8)	117 of 351 (33·3)	0·001
Smoking	3 of 38 (8)	55 of 373 (14·7)	0·331
Previous abdominal surgery	1 (2)	63 (15·6)	0·018
Diagnosis†			0·231
Ulcerative colitis	22 (54)	259 (64·1)	
Unclassified IBD	3 (7)	44 (10·9)	
Crohn's disease	2 (5)	13 (3·2)	
Familial adenomatous polyposis	14 (34)	88 (21·8)	
ASA fitness grade III	0 (0)	13 (3·2)	0·620
Immunomodulators ever	15 of 39 (38)	128 of 317 (40·4)	0·864
Preoperative anti-TNF-α therapy†	0 of 39 (0)	14 of 383 (3·7)	0·629
Preoperative steroids†	1 of 37 (3)	34 of 384 (8·9)	0·345
Emergency surgery	2 of 41 (5)	27 of 394 (6·9)	1·000
Completion proctectomy‡	25 (61)	201 (49·8)	0·192
Primary defunctioning ileostomy	4 (10)	109 (27·0)	0·014
Type of pouch			0·144
J-pouch	39 (95)	342 (85·7)	
Other§	2 (5)	57 (14·1)	
Missing	0	5	
Laparoscopic colectomy	38 (93)	223 (55·2)	< 0·001
Handsewn anastomosis	4 of 40 (10)	18 of 385 (4·7)	0·142
Duration of hospital stay after IPAA (days)*¶	10·0 (8·0–14·0)	10·0 (8·0–13·0)	0·828††
Duration of follow-up (months)*	21 (6·0–50·0)	22·0 (8·0–63·5)	0·328††
Moment of enrolment during study interval (years)*#	10·0 (5·0–13·0)	8·0 (4·0–12·0)	0·077††

Values in parentheses are percentages unless indicated otherwise; *values are median (i.q.r.). †Within 3 months of surgery. ‡An ileostomy was constructed in all patients who underwent completion proctectomy. §W-, B- or S-pouch. ¶Data missing for four patients. #Calculated from January 2000. IBD, inflammatory bowel disease; TNF, tumour necrosis factor; IPAA, ileal pouch–anal anastomosis. **Fisher's exact test, except ††Mann–Whitney *U* test.

Functional outcome

All eligible patients were contacted by telephone, with a maximum of three attempts, to answer questions on pouch function during the previous month using the pouch function score (PFS)[28]. The PFS is a seven-item scoring system based on symptoms that influence quality of life (24-h and nocturnal stool frequency, urgency, major and minor incontinence, antidiarrhoeal and antibiotic therapy). The score ranges from 0 to 30, with higher scores indicating worse pouch function.

Statistical analysis

The primary endpoint analysed was the difference in adverse outcomes between patients who had IPAA surgery during childhood and those who had the operation as adults. Secondary endpoints were the difference in total PFS and individual PFS components between these two groups. Continuous data are presented as median (i.q.r.), with analysis by means of Mann–Whitney *U* tests. Fisher's exact tests were used for binary and nominal data, and exact linear-by-linear test for ordinal data. If categorical data contained a category with zero counts, a χ^2 test for trend was used. Missing data were assumed to be missing at random. Multiple imputation, using a multivariable model with five imputations, was performed to adjust for missing values[29]. Univariable and multivariable logistic regression analyses were undertaken to identify factors associated with adverse outcomes. Variables with two-sided $P < 0{\cdot}100$ in univariable regression were considered for inclusion in multivariable analysis, which was additionally corrected for the moment of enrolment during the study period. Significance was set at $P < 0{\cdot}050$. Statistical analysis was carried out in SPSS® version 22 for Windows® (IBM, Armonk, New York, USA).

Results

A total of 445 consecutive patients underwent primary IPAA surgery between January 2000 and January 2015, including 41 children (23 boys, median age 15 (i.q.r. 13–17) years) and 404 adults (219 men, median age 39 (30–47) years). The primary diagnosis was similarly distributed between children and adult patients: 281 with ulcerative colitis (overall 63·1 per cent; children 54 per cent, adults

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Table 2 Adverse outcomes

	All patients ($n=445$)			Familial adenomatous polyposis ($n=102$)			Inflammatory bowel disease ($n=343$)		
	Children ($n=41$)	Adults ($n=404$)	P†	Children ($n=14$)	Adults ($n=88$)	P†	Children ($n=27$)	Adults ($n=316$)	P†
Anastomotic leakage	6 (15)	65 (16·1)	1·000	2 (14)	16 (18)	1·000	4 (15)	49 (15·5)	1·000
Pouch stricture	4 (10)	11 (2·7)	0·040	3 (21)	3 (3)	0·033	1 (4)	8 (2·5)	0·526
Fistulas related to pouch	1 (2)	26 (6·4)	0·496	1 (7)	9 (10)	1·000	0 (0)	17 (5·4)	0·380
Pouchitis	9 (22)	78 (19·3)	0·681	1 (7)	1 (1)	0·257	8 (30)	77 (24·4)	0·642
Chronic pouchitis	2 (5)	32 (7·9)	0·757	0 (0)	0 (0)	–	2 (7)	32 (10·1)	1·000
Crohn's of the pouch*	–	–	–	–	–	–	4 (15)	19 (6·0)	0·095
Pouch failure	3 (7)	25 (6·2)	0·735	1 (7)	4 (5)	0·530	2 (7)	21 (6·6)	0·700

Values in parentheses are percentages. *Among patients with inflammatory bowel disease; preoperative diagnosis in these patients: Crohn's disease, seven (2 children, 5 adults); unclassified inflammatory bowel disease, seven; ulcerative colitis 19. †Fisher's exact test.

Table 3 Multivariable analysis of variables influencing adverse events, including ileal pouch–anal anastomosis in childhood

	Odds ratio					
	Anastomotic leakage	Pouch stricture	Fistula	Chronic pouchitis	Crohn's of the pouch*	Pouch failure
IPAA during childhood	0·88 (0·35, 2·22)	4·22 (1·13, 15·77)‡§	0·63 (0·08, 5·21)	0·58 (0·13, 2·56)	3·07 (0·87, 10·82)	2·24 (0·59, 8·59)
Unclassified IBD or Crohn's disease					9·08 (3·68, 22·41)‡	
IBD			0·33 (0·13, 0·83)‡		n.a.	
ASA fitness grade III			5·83 (1·45, 23·52)‡			6·25 (1·59, 24·61)‡
Preoperative steroids				2·52 (0·96, 6·63)		2·05 (0·67, 6·30)
Preoperative anti-TNF-α therapy						
Completion proctectomy		3·44 (0·95, 12·41)				
Primary defunctioning ileostomy		2·91 (0·91, 9·32)	2·29 (0·94, 5·60)			
Handsewn anastomosis		4·27 (1·08, 16·93)‡	2·32 (0·55, 9·74)			
Laparoscopic procedure			0·35 (0·14, 0·87)‡			0·50 (0·21, 1·20)
J-pouch *versus* other†	3·19 (1·12, 9·06)‡					
Time from diagnosis to IPAA (months)	1·00 (1·00, 1·01)‡					

Values in parentheses are 95 per cent confidence intervals. *Among patients with inflammatory bowel disease (IBD). †W-, B- or S-pouch. IPAA, ileal pouch–anal anastomosis; TNF, tumour necrosis factor; n.a., not applicable. Variables with $P \geq 0{\cdot}100$ in univariable analysis were excluded from multivariable analysis. ‡Significantly associated with outcome in multivariable logistic regression analysis ($P < 0{\cdot}050$), corrected for the moment of enrolment during the study period (calculated from January 2000). The factor IPAA during childhood was adjusted for all variables with $P < 0{\cdot}100$. §Additionally corrected for IBD *versus* familial adenomatous polyposis.

64·1 per cent), 47 with unclassified IBD (overall 10·6 per cent; children 7 per cent, adults 10·9 per cent), 15 with Crohn's disease (overall 3·4 per cent; children 5 per cent, adults 3·2 per cent) and 102 with FAP (overall 22·9 per cent; children 34 per cent, adults 21·8 per cent) (*Table 1*). The children were less frequently overweight (8 *versus* 33·3 per cent; $P = 0{\cdot}001$) and less likely to have a history of abdominal surgery before RPC (2 *versus* 15·6 per cent; $P = 0{\cdot}018$) (*Table S1*, supporting information) compared with adult patients. The procedure was more often performed laparoscopically (93 *versus* 55·2 per cent; $P < 0{\cdot}001$) with fewer defunctioning ileostomies constructed (10 *versus* 27·0 per cent; $P = 0{\cdot}014$) in children. Overall median duration of follow-up was 22 (i.q.r. 8–68) months. There was no difference in follow-up or moment of inclusion during the study period between children and adults. There were no pouch-related deaths during follow-up.

Adverse events

Anastomotic leakage, fistulas, (chronic) pouchitis and Crohn's of the pouch occurred in a similar proportion of children and adults (*Table 2*). Anastomotic strictures were more common among children (10 *versus* 2·7 per cent; $P = 0{\cdot}040$). This difference was mainly evident in patients with FAP (3 of 14 children *versus* 3 of 88 adults; $P = 0{\cdot}033$), and not in those with IBD (1 of 27 *versus* 8 of 316 respectively; $P = 0{\cdot}526$). Pouch failure occurred in 28 patients (6·3 per cent), with no significant difference between children and adult patients overall, or in the separate FAP and IBD subgroups.

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Table 4 Pouch function score at most recent follow-up

Component of pouch function score*	Children ($n = 29$)	Adults ($n = 253$)	P†
24-h stool frequency			0·008‡
0–5 (0)	13 (45)	66 (26·1)	
6–8 (2)	11 (38)	100 (39·5)	
9–10 (5)	5 (17)	45 (17·8)	
> 10 (9)	0 (0)	42 (16·6)	
Nocturnal stool frequency			0·119
≤ 1 (0)	20 (69)	135 (53·4)	
≥ 2 (2)	9 (31)	118 (46·6)	
Urgency			0·289
No (0)	18 (62)	181 (71·5)	
Yes (2)	11 (38)	72 (28·5)	
Major incontinence			0·530‡
Never (0)	21 (72)	204 (80·6)	
Rarely (1)	3 (10)	20 (7·9)	
Sometimes (2)	4 (14)	19 (7·5)	
Mostly (7)	0 (0)	1 (0·4)	
Always (9)	1 (3)	9 (3·6)	
Minor incontinence (seepage)			0·710‡
Never (0)	15 (52)	144 (56·9)	
Night (1)	10 (35)	69 (27·3)	
Day (1)	0 (0)	10 (4·0)	
Both (3)	4 (14)	30 (11·9)	
Antidiarrhoeal medication			0·018
No (0)	20 (69)	113 (44·7)	
Yes (2)	9 (31)	140 (55·3)	
Antibiotics			0·006
No (0)	22 (76)	236 (93·3)	
Yes (3)	7 (24)	17 (6·7)	
Median (i.q.r.) total score	5·0 (2·5–10)	6·0 (3·5–10·0)	0·194§

Values in parentheses are percentages unless indicated otherwise; *values in parentheses are score assigned to each response. Maximum total score is 30. †Fisher's exact test, except ‡χ^2 test for trend and §Mann–Whitney U test.

Multivariable analysis demonstrated that IPAA surgery during childhood was not associated with anastomotic leakage, fistulas, chronic pouchitis, Crohn's of the pouch (in patients with IBD) or with pouch failure (*Table 3*). Being of paediatric age at time of surgery was an independent risk factor for developing anastomotic strictures (odds ratio 4·22, 95 per cent c.i. 1·13 to 15·77; $P = 0·032$), after adjustment for the potential confounding variables type of diagnosis, defunctioning ileostomy, completion proctectomy, handsewn anastomosis and moment of enrolment during the study period. Anastomotic strictures were successfully treated by a single dilatation (endoscopic or manual) in all four children and eight of 11 adults. Details of patients with anastomotic strictures are recorded in *Table S2* (supporting information).

Pouch function score

In total, 29 children (78 per cent of 37 eligible patients) and 253 adults (69·7 per cent of 363) completed the PFS. Being overweight was less common, and laparoscopic colectomy and completion proctectomy were more prevalent among children (*Table S3*, supporting information). The moment of enrolment in children was later during the study period than for adult patients.

Patients who underwent IPAA during childhood had a lower 24-h stool frequency than those who had surgery during adulthood ($P = 0·008$) (*Table 4*). There was no difference in nocturnal stool frequency, urgency of defaecation and incontinence between groups (*Table 4*). Antidiarrhoeal medication use was less frequent in children than adults (9 of 29 *versus* 140 of 253; $P = 0·018$), whereas antibiotic treatment for pouchitis was used more frequently in children (7 of 29 *versus* 17 of 253; $P = 0·006$). There was no difference in total PFS between children and adults.

Discussion

In this study, paediatric age was not associated with an increased risk of most well known adverse events after IPAA creation, such as anastomotic leakage, surgical fistulas, pouchitis and Crohn's of the pouch. Nonetheless, IPAA surgery

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in childhood was an independent risk factor for anastomotic strictures of the pouch. Long-term pouch failure rates and pouch function were similar between children and adults who underwent IPAA surgery.

Parks and Nicholls[30] first described IPAA in 1978, and the first paediatric series was reported in the early 1990s[31]. Since then, only three studies[14,18,19] have published postoperative outcomes and debated whether surgery should be postponed until adulthood. An important factor that may influence pouch function is changes in anatomy during the adolescent growth period. In both male and female adolescents, the pelvis increases in width, whereas longitudinal growth ceases[32–34]. In addition, more severe disease characteristics in young patients with IBD[4,5] may influence the outcome of IPAA surgery.

In line with previous studies, rates of anastomotic leakage[14,18], fistula related to surgery[18] and chronic pouchitis[14,18] were not increased in children in the present study. The pouch failure rate was also similar in children and adults (7 *versus* 6·2 per cent), and corresponded to that reported in a recent meta-analysis[16] of adults with established ulcerative colitis or FAP (4·3 (95 per cent c.i. 3·5 to 6·3) per cent).

Strictures of the pouch, which all occurred at the level of the pouch–anal anastomosis, were more common in the paediatric group, predominantly owing to the higher rate among children with FAP. In a previous cohort with IBD, however, pouch stricture also occurred more frequently in children than adults (12·5 *versus* 5·8 per cent respectively; $P = 0{\cdot}008$)[18]. Various risk factors have been associated with the occurrence of pouch strictures, such as handsewn technique for IPAA[35], small diameter of the stapling gun, defunctioning ileostomy, anastomotic dehiscence and pelvic sepsis[36]. As expected, the present study showed a significant association between pouch strictures and handsewn anastomosis, and a trend towards an association with creation of a defunctioning ileostomy and completion proctectomy. As primary defunctioning ileostomy was less common in the paediatric group, fewer strictures might be expected in this group.

There was a trend towards children undergoing surgery more recently, which, in the context of evolution of the IPAA technique and complementary treatment options, may confound the association between having IPAA surgery in childhood and the occurrence of strictures. Therefore, all these confounding variables were corrected for in the multivariable analysis. The rate of anastomotic leakage was similar in the two groups and the diameter of the staple gun was standardized, so these factors could not have influenced the association between surgery during childhood and anastomotic stricture in the present analysis. It remains speculative why having IPAA surgery at a younger age is associated a greater likelihood of stricture development. It may be that the risk of mucosal tears is greater when a circular stapler is inserted in children, resulting in more anastomotic strictures. Currently, there is no consensus on the optimal stapler size for use in children undergoing IPAA and studies addressing this issue are lacking. A study in adults[37] reported a relationship between the occurrence of strictures and stapler diameter (stapler size 28–29 *versus* 31–33 mm).

Fortunately, treatment of anastomotic strictures is usually successful in clinical practice. In this study, all anastomotic strictures in children were treated successfully with a single dilatation. In another large cohort of 213 patients with IBD and FAP who developed anastomotic strictures, the majority of strictures required only a single dilatation (88 per cent)[35]. Recurring strictures may necessitate excision of the fibrotic ring, and corresponding advancement of the ileal mucosa to bridge the anastomotic mucosal gap[35]. However, routine digital and, if necessary, proctoscopic assessment of the pouch at the initial postoperative visit, or at the time of ileostomy closure, could identify early non-symptomatic strictures of the anastomosis and may potentially avert more invasive treatment.

Good long-term pouch function is an important factor that may reassure young patients who are facing pouch surgery, and is strongly associated with health-related quality of life[28,38]. In the present cohort, overall pouch function was comparable between children and adult patients, and equivalent to that in another study[38] of 196 adults with IBD (median PFS 6 (i.q.r. 3–11) of 30). Interestingly, children in the present cohort had a lower 24-h stool frequency than adults. The lower stool frequency, together with less frequent use of antidiarrhoeal medication, may indicate greater adaptive ability of the pouch during childhood. Treating physicians should, however, bear in mind that these results apply to patients treated in a specialized centre for IPAA surgery. A strong association between reoperation or excision of the pouch and the hospital volume of IPAA operations has been reported[39], suggesting that both children and adults requiring IPAA should be treated in specialized centres.

Children more frequently used antibiotics for pouchitis, but rates of pouchitis were similar to those among adult patients. An explanation for this apparent contradiction could be the different methods of determining antibiotic use and pouchitis. Cases of pouchitis were recorded throughout the follow-up (cumulative prevalence), whereas antibiotic use referred to the previous month, as reported by patients. Another explanation could be that children were more often treated based on symptoms alone, as in the

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authors' centre routine endoscopy is not used to monitor disease activity during follow-up in children. As symptoms of irritable pouch syndrome can resemble those of pouchitis, some children may have been overtreated.

Comparability between paediatric and adult cohorts in this study was achieved by a similar distribution of patient enrolment across the study period and additional correction for the moment of enrolment (surgery), and having all RCP and IPAA procedures performed by the same team of colorectal surgeons. A limitation of this study is its retrospective nature, which may have led to bias even though only objective and unmistakable adverse events were collected. Furthermore, patients in this study were referred nationally to the authors' specialized pouch centre, which may have resulted in those with more complex or advanced disease being included, making referral bias inevitable. Most importantly, the small number of adverse events hampered proper correction of the association between surgery in childhood and anastomotic stricture, with other potential confounders unaccounted for.

Long-term pouch failure rates and pouch function were comparable in children and adults, despite the increased risk of anastomotic strictures in children. This study has therefore provided evidence that children with an indication for RPC and subsequent IPAA can expect good pouch outcomes. There is no need for a more cautious attitude to undertaking these procedures in children based on concerns about poor outcome in the longer term.

Disclosure

The authors declare no conflict of interest.

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