Inflammatory Bowel Diseases, 2022, **28**, 1332–1337
https://doi.org/10.1093/ibd/izab320
Advance access publication 18 January 2022
Original Research Articles - Clinical

The Cumulative Incidence of Pouchitis in Pediatric Patients With Ulcerative Colitis

Ellen Cowherd, MD,[*] Matthew D. Egberg, MD, MPH, MMSc,[†,‡,§] Michael D. Kappelman, MD, MPH,[†,‡,§] Xian Zhang, PhD,[‡] Millie D. Long, MD, MPH,[†,‡,¶] Amy L. Lightner, MD,[‖] Robert S. Sandler, MD, MPH,[‡,¶] Hans H. HerfarthMD, PhD,[†,‡,¶] and Edward L. Barnes, MD, MPH[†,‡,¶]

From the [*]Department of Pediatrics, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA;
[†]Multidisciplinary Center for Inflammatory Bowel Diseases, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA;
[‡]Center for Gastrointestinal Biology and Disease, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA;
[§]Division of Pediatric Gastroenterology, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA;
[¶]Division of Gastroenterology and Hepatology, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA; and
[‖]Digestive Disease and Surgery Institute, Cleveland Clinic Lerner College of Medicine, Cleveland, Ohio, USA.

Address correspondence to: Edward L. Barnes, MD, MPH, Division of Gastroenterology and Hepatology, University of North Carolina at Chapel Hill, Campus Box #7080, 130 Mason Farm Road, Chapel Hill, NC 27599-7080 (edward_barnes@med.unc.edu).

Background: Despite highly effective therapies, many children develop medically refractory ulcerative colitis (UC) and undergo proctocolectomy with ileal pouch–anal anastomosis (IPAA). We sought to determine the incidence, risk, and burden of pouchitis in the first 2 years following the final stage of IPAA in pediatric UC patients.

Methods: Within the IQVIA Legacy PharMetrics Adjudicated Claims Database, we identified pediatric patients with UC who underwent proctocolectomy with IPAA between January 1, 2007, and June 30, 2015. We utilized International Classification of Diseases–Ninth Revision–Clinical Modification or International Classification of Diseases–Tenth Revision–Clinical Modification codes to identify patients with UC and Current Procedural Terminology codes to identify colectomy and IPAA. Continuous variables were compared using *t* tests and Wilcoxon rank sum testing, while categorical variables were compared using chi-square testing.

Results: A total of 68 patients with an IPAA were identified. In the first 2 years following IPAA, the cumulative incidence of pouchitis was 54%. Patients with pouchitis required more outpatient visits in the first 2 years after IPAA (mean 21.8 vs 10.2; $P = .006$) and were more likely to be hospitalized compared with patients without pouchitis (46% vs 23%; $P = .045$). Patients with pouchitis also demonstrated higher mean total costs in year 1 and year 2 ($27 489 vs $8032 [$P = .001$] and $27 699 vs $6058 [$P = .003$], respectively).

Conclusions: Our findings confirm the high incidence of pouchitis demonstrated in earlier single-center studies of pediatric patients undergoing proctocolectomy with IPAA for UC. Identification of risk factors for pouchitis would be useful to optimize early intervention.

Lay Summary

Among a geographically diverse patient population from the United States, we demonstrated that over half of pediatric patients undergoing proctocolectomy with ileal pouch–anal anastomosis for ulcerative colitis will develop pouchitis in the first 2 years after surgery.

Key Words: ileal pouch-anal anastomosis, pouchitis, administrative claims, J-pouch

Introduction

Pediatric ulcerative colitis (UC) is an immune-mediated inflammatory condition affecting the large intestine that is characterized by episodes of abdominal pain, diarrhea, and poor oral intake. Despite significant advances in medical therapies for UC, nearly 20% of patients will require surgery within the first 5 years following diagnosis owing to growth failure, steroid dependency, or medically refractory disease.[1] In these cases, the procedure of choice is a staged total proctocolectomy with restorative ileal pouch–anal anastomosis (IPAA).[2] While a staged IPAA is safe with regard to perioperative morbidity, short- and long-term complications remain, with the most common being pouchitis.[2-4]

Pouchitis is defined by clinical symptoms of bloody or nonbloody diarrhea, or abdominal pain and endoscopically visible inflammation of the ileal reservoir, although the term represents a wide spectrum of disease states including both acute and chronic presentations.[5] In the majority of patients, acute pouchitis resolves following a course of antibiotics. However, an estimated 26% of pediatric patients with acute pouchitis will progress to chronic pouchitis.[4] Chronic pouchitis has been associated with a significant burden of disease, often necessitating frequent medication changes, outpatient office visits, and endoscopic procedures.

While more than 50% of adult patients with UC undergoing IPAA will be diagnosed with pouchitis, the incidence

Received for publication: August 6, 2021. Editorial Decision: September 20, 2021

rate of pouchitis in the pediatric UC population following IPAA has varied widely among published studies.[6-15] Improved data regarding pouchitis are critical to patient risk stratification and management decisions, and the scarcity of research in children impedes our understanding of outcomes after IPAA. Historically, pediatric data are either derived from small single-center studies or extrapolated from adult studies, both of which have limitations.

Administrative claims databases can address limitations of prior research designs by providing longitudinal, patient-level healthcare data including inpatient, outpatient, and pharmacy claims for a large, geographically diverse population sample. The utility of administrative claims data is particularly apparent when studying the epidemiology of inflammatory bowel disease (IBD), especially rare outcomes such as pouchitis in which large sample sizes are necessary. To this end, a recently developed case-finding definition for the identification of patients with pouchitis in administrative claims data has allowed for more generalizable evaluations of the epidemiology and outcomes among adult patients undergoing IPAA for UC.[16,17] This definition utilizes data that are readily available in administrative claims, including clinical diagnoses and medication prescriptions.

In this study, we sought to determine the incidence of pouchitis, the risk factors associated with pouchitis, and the burden of disease in the first 2 years following the final stage of IPAA in a sample of pediatric UC patients with commercial insurance.

Methods

Data Source

The IQVIA Legacy PharMetrics Adjudicated Claims Database is an administrative claims data source containing longitudinal de-identified pharmacy, hospital, and medical claims that has previously been described as representative of the U.S. commercially insured population.[18] During the study period (January 1, 2007, to July 1, 2016), 78 million individuals from approximately 100 health plans were represented. The Institutional Review Board at the University of North Carolina at Chapel Hill determined this study to be exempt.

Patient Selection

All pediatric patients (<18 years of age) with at least 6 months of continuous health plan enrollment prior to colectomy were eligible for inclusion. Colectomy had to occur between January 1, 2007, and June 30, 2015. We used validated and previously published criteria to identify all patients who underwent proctocolectomy followed by an IPAA for UC. International Classification of Diseases (ICD) and medication coding were used to identify patients with UC.[18,19] Current Procedural Terminology (CPT) coding was used to identify patients undergoing proctocolectomy with IPAA (Supplemental Table 1). The final stage of surgery, which represented the index date for the study, was defined using previously published criteria using the CPT coding.[16] At least 6 months of continuous enrollment prior to and 1 year following the final stage of surgery were required for inclusion in the study.

Outcome Measures

Patients that developed pouchitis were identified using a previously validated case-finding definition.[16,17] In administrative claims, this case-finding definition has a sensitivity of 97%, with a specificity of 77% and a positive predictive value of 74%.[16]

The primary outcome was the cumulative incidence of any pouchitis within the first 2 years after IPAA. We also evaluated multiple secondary outcomes including the incidence of isolated acute pouchitis (defined as a single episode of pouchitis) and the incidence of recurrent pouchitis (defined as 1 or more recurrent episodes of pouchitis during the 2-year follow-up period). Additionally, we evaluated the frequency of a change in diagnosis to Crohn's disease (CD). This was identified by the presence of an ICD–Ninth Revision–Clinical Modification or ICD–Tenth Revision–Clinical Modification code for CD on at least 3 separate occasions after IPAA. We also compared healthcare resource utilization during the follow-up period among patients with and without pouchitis, including hospitalizations, emergency department (ED) and outpatient clinic visits, pouchoscopy procedures, and subsequent IBD-related surgeries. Total allowed costs within the first 2 years after IPAA were evaluated on a per-year basis.

Covariates

Patient demographics including age at the index date, sex, and year of surgery were evaluated. We analyzed multiple clinical variables that have been associated with an increased risk for pouchitis including primary sclerosing cholangitis and *Clostridioides difficile* infection.[20] Where available, we evaluated the use of IBD-specific medications in the 6 months prior to colectomy. Finally, among patients developing pouchitis, we analyzed the time to development of the first episode of pouchitis.

Follow-up

For each patient included in this study, the follow-up period began on the date of the final surgery. Follow-up continued until 1 of the following events occurred: discontinuation of insurance coverage, >2 years from the index date, or death.

Statistical Analysis

Descriptive statistics were used to compare baseline demographic and clinical characteristics between patients with pouchitis and those who did not develop pouchitis. Mean ± SD is used to report continuous variables, and comparisons were made using *t* tests and Wilcoxon rank sum testing. Raw values with percentages are used to report categorical variables. Comparisons between categorical variables used Fisher exact and chi-square testing. In the evaluation of costs, generalized linear modeling was utilized, assuming a gamma distribution and a log-link. In all analyses, 2-sided *P* values of .05 or less were considered statistically significant. Analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC, USA).

Results

From a database of 79 665 591 patients, 68 pediatric patients were identified with an IPAA using ICD and CPT codes as described previously (with surgery and follow-up occurring between January 1, 2007, and July 1, 2016). Among all patients in the cohort, the mean age was 13.1 ± 3.8 years and 43% were female. Thirty-seven (54%) patients developed pouchitis during the study period. Twenty-two (32%) patients had

Table 1. Demographic and clinical characteristics of pediatric patients with and without pouchitis in the 2 years following an IPAA

	Patients Without Pouchitis (n = 31)	Patients With Pouchitis (n = 37)	*P* Value
Age, y	12.2 ± 4.2	13.9 ± 3.3	.058
Female	11 (35)	18 (49)	.274
Clostridioides difficile infection in 6 mo prior to colectomy with IPAA	1 (3)	1 (3)	.899
Primary sclerosing cholangitis	0 (0)	3 (8)	.105
Diagnosis of colon cancer or dysplasia in 6 mo prior to colectomy with IPAA	4 (13)	1 (3)	.108
Residence region			.317
Northeast	7 (23)	4 (11)	
Midwest	11 (35)	21 (57)	
South	7 (23)	7 (19)	
West	6 (19)	5 (14)	
Pay type			.329
Commercial plan	18 (58)	27 (73)	
Medicaid	8 (26)	3 (8)	
Self-insured	1 (3)	5 (14)	
Unknown/missing	4 (13)	2 (5)	
Year of index date			.217
2007	2 (6)	0 (0)	
2008	5 (16)	3 (8)	
2009	3 (10)	8 (22)	
2010	5 (16)	10 (27)	
2011	6 (19)	7 (19)	
2012	3 (10)	1 (3)	
2013	1 (3)	5 (14)	
2014	2 (6)	1 (3)	

Values are mean ± SD or n (%).
Abbreviation: IPAA, ileal pouch–anal anastomosis.

acute pouchitis and 15 (22%) had recurrent pouchitis. There were no statistically significant differences in patient demographics between those pediatric patients with and without pouchitis, including comparisons of age, sex, and region of the United States (Table 1).

IBD-specific medication use in the 6 months prior to initial stage of surgery was examined between patients without pouchitis and patients with pouchitis. We found no significant differences in the use of mesalamine, sulfasalazine, balsalazide, immunomodulators (azathiopurine, mercaptopurine, or methotrexate), tacrolimus, anti-tumor necrosis factor alpha therapies, prednisone, and budesonide by presence of pouchitis (Table 2).

When comparing resource utilization after IPAA, those patients with pouchitis demonstrated a greater mean number of outpatient visits in the first 2 years after IPAA (21.8 vs 10.2; P = .006) and were significantly more likely to experience an inpatient hospitalization compared with patients without pouchitis (46% vs 23%; P = .045) (Table 3). Patients with pouchitis were also numerically more likely to have an ED visit during the study period than patients without pouchitis (49% vs 26%; P = .054). Six (9%) patients had more than 3 ICD codes for CD during the first 2 years after IPAA (5 [14%] patients with pouchitis and 1 [3%] patient without pouchitis; P = .136). Only 1 (1%) patient required an IPAA excision during the study period.

In an analysis of costs in the first 2 years after IPAA, patients who developed pouchitis demonstrated higher total costs in year 1 and year 2 compared with those patients without pouchitis (mean $27 489 vs $8032 [$P$ = .001] and $27 699 vs $6058 [$P$ = .003], respectively) (Table 4). Additionally, patients who developed pouchitis demonstrated higher costs related to outpatient physician visits and pharmacy-related costs.

Discussion

This study utilized administrative claims to analyze the burden of pouchitis among a geographically diverse sample of pediatric patients undergoing proctocolectomy with IPAA for UC. In analyzing administrative claims data, we have the ability to analyze outcomes across a broad population of patients throughout the United States. These approaches also allowed us to demonstrate that pouchitis is a significant complication for many pediatric patients with UC who undergo IPAA. Over 50% of pediatric patients developed pouchitis within the first 2 years after IPAA, resulting in a significant burden for both patients and the healthcare system. Given the multiple geographic regions represented in this study, the incidence rate identified in this study can provide a more generalizable estimate to inform preoperative discussions with patients regarding the potential development of pouchitis after IPAA for UC.

Table 2. Inflammatory bowel disease–specific medication use in the 6 months prior to colectomy

	Patients Without Pouchitis (n = 31)	Patients With Pouchitis (n = 37)	*P* Value
Mesalamine	12 (39)	17 (46)	.548
Sulfasalazine	3 (10)	3 (8)	.820
Balsalazide	2 (6)	5 (24)	.340
Immunomodulator (azathioprine, mercaptopurine, or methotrexate)	13 (42)	19 (51)	.438
Tacrolimus	2 (6)	2 (5)	.855
Anti-TNF therapy (adalimumab, certolizumab, golimumab, or infliximab)	9 (29)	10 (27)	.854
Prednisone	17 (55)	24 (65)	.400
Budesonide (MMX and enteral release)	0 (0)	3 (8)	.105

Values are n (%).
Abbreviations: anti-TNF, anti-tumor necrosis factor alpha; MMX, multimatrix.

Table 3. Comparison of healthcare resource utilization between pediatric patients with and without pouchitis in the 2 years following an IPAA

	Patients Without Pouchitis (n = 31)	Patients With Pouchitis (n = 37)	*P* Value
Number of office visits during the first 2 y after IPAA	10.2 ± 9.26	21.8 ± 20.5	.006
More than 1 hospitalization	7 (23)	17 (46)	.045
More than 1 ED visit	8 (26)	18 (49)	.054
IPAA excision	0 (0)	1 (3)	.356

Values are mean ± SD or n (%).
Abbreviations: ED, emergency department; IPAA, ileal pouch–anal anastomosis.

Table 4. Comparison of costs in the first 2 years after ileal pouch–anal anastomosis among patients who developed pouchitis and those who did not

	Patients Without Pouchitis (n = 30)	Patients With Pouchitis (n = 36)	*P* Value
Year 1			
Total costs	$8032 ± $16 712	$27 489 ± $41 235	.001
Inpatient admission	$4060 ± $15 070	$14 522 ± $35 628	.311
Emergency department	$170 ± $471	$204 ± $11 810	.775
Outpatient physician's office	$655 ± $564	$1632 ± $2515	.001
Pouchoscopy	$4 ± $24	$287 ± $1080	.192
Pharmacy	$195 ± $292	$2338 ± $4743	<.001
Antibiotic specific	$15 ± $85	$15 ± $70	.317
Year 2			
Total costs	$6058 ± $25 952	$27 699 ± $41 474	.003
Inpatient admission	$3976 ± $13 688	$7413 ± $15 933	.678
Emergency department	$61 ± $729	$214 ± $703	<.001
Outpatient physician's office	$511 ± $5396	$2458 ± $4399	<.001
Pouchoscopy	$5 ± $366	$448 ± $1073	.086
Pharmacy	$191 ± $5121	$4462 ± $9849	<.001
Antibiotic specific	$0 ± $0	$18 ± $47	<.001

Values are mean ± SD. Two patients with missing cost data were excluded from analyses.

Although there has been conflicting data on the incidence of pouchitis among pediatric patients, our finding is consistent with recent studies of pouchitis in both pediatric and adult patients with an IPAA for UC.[6-8,17] This study was specifically designed to evaluate the incidence of pouchitis within the first 2 years of IPAA, given the high turnover of commercial insurance coverage among patients in the United States.[21] The lifetime burden of pouchitis, particularly among patients that undergo an IPAA as a child, is likely significantly higher, given that approximately 80% of patients report pouchitis symptoms at some point after IPAA for UC.[22] A recent multicenter retrospective study from the IBD Porto group of the European Society for Paediatric Gastroenterology, Hepatology and Nutrition also demonstrated a high rate of pouchitis (67%) with a median follow-up of 40 months from surgery.[4] The high incidence

of pouchitis and the potential for developing chronic inflammation of the pouch suggests that pediatric clinicians and researchers should be vigilant in their approaches for identifying strategies for both the prevention of and treatment for pouchitis.

In a recent analysis of adult patients undergoing IPAA for UC using the same database, we demonstrated a similar overall incidence of pouchitis in the first 2 years after IPAA (48%).[17] As in our current study, adult patients with pouchitis also experienced a higher cost burden following colectomy (data not shown). Although the sample size prevents test of statistical significance when comparing outcomes among the pediatric and adult populations, the overall evaluations would suggest that pouchitis has a major impact among pediatric and adult patients undergoing IPAA for UC.

We identified no significant differences in demographics, IBD-related medication use prior to surgery, or antibiotic use after surgery in patients with pouchitis and without. Given the burden of pouchitis among pediatric patients undergoing IPAA, future studies should aim to identify clinically actionable predictors of pouchitis to allow clinicians to identify patients at higher risk for developing pouchitis, and potentially intervene to prevent these complications.

We also demonstrated that 9% of patients will have ICD coding consistent with a switch in diagnosis to CD within the first 2 years of IPAA. An estimated 10% of adult patients undergoing IPAA for UC will develop CD of the pouch[23]; however, our findings within the first 2 years of IPAA indicate that this rate may be even higher among pediatric patients. Standardizing the diagnostic criteria of CD of the pouch in adult and pediatric patients will be critical to understanding the true impact of this inflammatory condition of the pouch, as well as strategies for earlier intervention.

Administrative claims data offer several strengths in the study of many disease states, including IBD.[18,24] In particular, when studying outcomes after IPAA, it is important to contrast the generalizability of studying data in which all 4 U.S. Census regions are represented with prior single-center evaluations of the natural history after IPAA.[7,20,25] Although prior single-center studies have laid an important foundation for understanding pouchitis and other complications after IPAA, data from the current study are nationally representative of the commercially insured population in the United States. These data confirm both the high incidence of pouchitis demonstrated in earlier single-center studies and the significant impact on individual patients after an IPAA for UC.[2,3,7,20,25,26] Importantly, this study also demonstrates the utility of administrative claims data as a resource for studying inflammatory conditions of the pouch. This allows for the longitudinal assessment of inpatient hospitalizations, ED visits, and outpatient visits as well as comparisons of use patterns between patients who develop pouchitis and those who do not. In the current study, these data allowed for important demonstrations of the increase in outpatient visits and hospitalizations among patients who developed pouchitis across a geographically diverse patient population. These treatment patterns and the resultant increased costs experienced by patients with pouchitis should provide further evidence for the need to explore strategies for earlier intervention and potentially preventive measures in this population.

Despite the strengths of using administrative claims to perform our analyses, this study does have limitations. First, the development the pouchitis case-finding definition did not include children in the validation cohort; however, because the treatment patterns for pouchitis are similar among pediatric and adult patients with pouchitis,[2,5,27] we would expect the case-finding definitions to demonstrate comparable performance in both populations. Nevertheless, there remains the potential for misclassification, particularly among those patients identified as having pouchitis. The sample size of our study was relatively small, particularly when compared with adult populations using administrative claims data. In particular, the limited number of patients that developed pouchitis prevented the use of multivariable analysis in our examination of factors associated with a diagnosis of pouchitis. However, it is also important to view the sample size in comparison with other studies of pouch outcomes among pediatric patients, in which our sample size is comparable, if not large.[7,8,25,26] This remains a study only of commercially insured patients, and thus patients with federally based programs and the uninsured are not represented.

Conclusions

In conclusion, the risk of developing pouchitis is high after an IPAA for UC among pediatric patients. Many pediatric patients with UC will continue to experience a significant inflammatory burden of disease, despite undergoing what is often viewed as a curative surgery in the form of proctocolectomy for UC. Future efforts should attempt to identify novel and actionable predictors of pouchitis in this population.

Supplementary data

Supplementary data is available at *Inflammatory Bowel Diseases* online.

Acknowledgments

The statements, findings, conclusions, and opinions contained and expressed in this manuscript are based in part on data obtained under license from the IQVIA Legacy PharMetrics Adjudicated Claims Data, All Rights Reserved. The statements, findings, conclusions, views, and opinions contained and expressed herein are not necessarily those of IQVIA or any of its affiliated or subsidiary entities.

Funding

This research was supported by grants from the Crohn's and Colitis Foundation (Grant No. 567497) and the National Institutes of Health (Grant Nos. K23DK127157-01 and P30DK034987).

Conflicts of Interest

M.D.K has served as a consultant for AbbVie, Takeda, Janssen, Pfizer, and Eli Lilly and has received research support from AbbVie and Janssen. M.D.L. has served as a consultant for AbbVie, UCB, Takeda, Janssen, Pfizer, Salix, Valeant, Theravance, Roche, Genentech, Lilly, BMS, Calibr, Prometheus, and Target Pharmasolutions and has received research support from Pfizer and Takeda. A.L.L. has served as a consultant for Takeda and Mesoblast. H.H.H. has served as a consultant for Alivio, AMAG, BMS, Boehringer, ExeGi

Pharma, Finch, Gilead, Janssen, Lycera, Merck, Otsuka, Pfizer, PureTech, and Seres and has received research support from Allakos, Artizan, and Pfizer Biosciences. E.L.B. has served as a consultant for AbbVie, Takeda, and Target Pharmasolutions. E.C., M.D.E., X.Z., and R.S.S. have no relevant disclosures or conflicts of interest.

References

1. Van Limbergen J, Russell RK, Drummond HE, et al. Definition of phenotypic characteristics of childhood-onset inflammatory bowel disease. *Gastroenterology.* 2008;135:1114-1122.
2. Turner D, Ruemmele FM, Orlanski-Meyer E, et al. Management of paediatric ulcerative colitis, part 1: ambulatory care-an evidence-based guideline from European Crohn's and Colitis Organization and European Society of Paediatric Gastroenterology, Hepatology and Nutrition. *J Pediatr Gastroenterol Nutr.* 2018;67:257-291.
3. Drews JD, Onwuka EA, Fisher JG, et al. Complications after proctocolectomy and ileal pouch–anal anastomosis in pediatric patients: a systematic review. *J Pediatr Surg.* 2019;54:1331-1339.
4. Orlanski-Meyer E, Topf-Olivestone C, Ledder O, et al. Outcomes following pouch formation in paediatric ulcerative colitis: a study from the Porto Group of ESPGHAN. *J Pediatr Gastroenterol Nutr.* 2020;71:346-353.
5. Quinn KP, Lightner AL, Faubion WA, et al. A comprehensive approach to pouch disorders. *Inflamm Bowel Dis.* 2019;25:460-471.
6. Dipasquale V, Mattioli G, Arrigo S, et al. Pouchitis in pediatric ulcerative colitis: a multicenter study on behalf of Italian Society of Pediatric Gastroenterology, Hepatology and Nutrition. *Dig Liver Dis.* 2019;51:1551-1556.
7. Koike Y, Uchida K, Inoue M, et al. Predictors for pouchitis after ileal pouch–anal anastomosis for pediatric-onset ulcerative colitis. *J Surg Res.* 2019;238:72-78.
8. Rinawi F, Assa A, Eliakim R, et al. Predictors of pouchitis after ileal pouch–anal anastomosis in pediatric-onset ulcerative colitis. *Eur J Gastroenterol Hepatol.* 2017;29:1079-1085.
9. Ozdemir Y, Kiran RP, Erem HH, et al. Functional outcomes and complications after restorative proctocolectomy and ileal pouch anal anastomosis in the pediatric population. *J Am Coll Surg.* 2014;218:328-335.
10. Pakarinen MP, Natunen J, Ashorn M, et al. Long-term outcomes of restorative proctocolectomy in children with ulcerative colitis. *Pediatrics.* 2009;123:1377-1382.
11. Shannon A, Eng K, Kay M, et al. Long-term follow up of ileal pouch anal anastomosis in a large cohort of pediatric and young adult patients with ulcerative colitis. *J Pediatr Surg.* 2016;51:1181-1186.
12. Koivusalo A, Pakarinen MP, Rintala RJ. Surgical complications in relation to functional outcomes after ileoanal anastomosis in pediatric patients with ulcerative colitis. *J Pediatr Surg.* 2007;42:290-295.
13. Patton D, Gupta N, Wojcicki JM, et al. Postoperative outcome of colectomy for pediatric patients with ulcerative colitis. *J Pediatr Gastroenterol Nutr.* 2010;51:151-154.
14. Knod JL, Holder M, Cortez AR, et al. Surgical outcomes, bowel habits and quality of life in young patients after ileoanal anastomosis for ulcerative colitis. *J Pediatr Surg.* 2016;51:1246-1250.
15. Dharmaraj R, Dasgupta M, Simpson P, et al. Predictors of pouchitis after ileal pouch–anal anastomosis in children. *J Pediatr Gastroenterol Nutr.* 2016;63:e58-e62.
16. Barnes EL, Kochar B, Herfarth HH, et al. Creation of a case-finding definition for identifying patients with acute pouchitis in administrative claims data. *Clin Gastroenterol Hepatol.* 2021;19:842-844.e1.
17. Barnes EL, Herfarth HH, Kappelman MD, et al. Incidence, risk factors, and outcomes of pouchitis and pouch-related complications in patients with ulcerative colitis. *Clin Gastroenterol Hepatol.* 2021;19:1583-1591.e4.
18. Kappelman MD, Rifas-Shiman SL, Kleinman K, et al. The prevalence and geographic distribution of Crohn's disease and ulcerative colitis in the United States. *Clin Gastroenterol Hepatol.* 2007;5:1424-1429.
19. Bernstein CN, Blanchard JF, Rawsthorne P, et al. Epidemiology of Crohn's disease and ulcerative colitis in a central Canadian province: a population-based study. *Am J Epidemiol.* 1999;149:916-924.
20. Hoda KM, Collins JF, Knigge KL, et al. Predictors of pouchitis after ileal pouch–anal anastomosis: a retrospective review. *Dis Colon Rectum.* 2008;51:554-560.
21. Long MD, Hutfless S, Kappelman MD, et al. Challenges in designing a national surveillance program for inflammatory bowel disease in the United States. *Inflamm Bowel Dis.* 2014;20:398-415.
22. Barnes EL, Herfarth HH, Sandler RS, et al. Pouch-related symptoms and quality of life in patients with ileal pouch–anal anastomosis. *Inflamm Bowel Dis.* 2017;23:1218-1224.
23. Barnes EL, Kochar B, Jessup HR, et al. The incidence and definition of Crohn's disease of the pouch: a systematic review and meta-analysis. *Inflamm Bowel Dis.* 2019;25:1474-1480.
24. Kappelman MD, Rifas-Shiman SL, Porter CQ, et al. Direct health care costs of Crohn's disease and ulcerative colitis in US children and adults. *Gastroenterology.* 2008;135:1907-1913.
25. Huang CC, Rescorla FJ, Landman MP. Clinical outcomes after ileal pouch–anal anastomosis in pediatric patients. *J Surg Res.* 2019;234:72-76.
26. Dukleska K, Berman L, Aka AA, et al. Short-term outcomes in children undergoing restorative proctocolectomy with ileal-pouch anal anastomosis. *J Pediatr Surg.* 2018;53:1154-1159.
27. Barnes EL, Lightner AL, Regueiro M. Perioperative and postoperative management of patients with Crohn's disease and ulcerative colitis. *Clin Gastroenterol Hepatol.* 2020;18:1356-1366.