ORIGINAL CONTRIBUTION

Abnormal Pouchogram Predicts Pouch Failure Even in Asymptomatic Patients

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BACKGROUND: Anastomotic complications after restorative total proctocolectomy with IPAA for ulcerative colitis alter functional outcomes and quality of life and may lead to pouch failure. Routine contrast enema of the pouch assesses anastomotic integrity before ileostomy reversal, but its clinical use is challenged.

OBJECTIVE: The purpose of this research was to assess the relationship among preoperative clinical characteristics, abnormal pouchography, and long-term pouch complications.

DESIGN: This was a retrospective chart review.

SETTINGS: The study was conducted at a tertiary care center between 2000 and 2010.

PATIENTS: Ulcerative colitis patients with IPAA undergoing pouchography before ileostomy closure were included.

MAIN OUTCOME MEASURES: Patient demographics, incidence of pouch-related complications, and findings on pouchogram were recorded. Primary outcome was *pouch failure*, defined as excision or permanent diversion of the ileoanal pouch. Independent predictors of pouch failure were determined by multivariate regression.

RESULTS: A total of 262 patients with ulcerative colitis were included. Contrast extravasation was seen in 27 patients (10.3%): 14 (51.9%) were clinically asymptomatic at the time of pouchogram. Six (22.2%) of 27 patients with extravasation developed pouch failure despite normalization of the pouchogram before ileostomy closure. Forty patients (15.3%) were found to have pouch-anal anastomotic stenosis; only 1 developed pouch failure. Pre-IPAA serum albumin and hemoglobin levels were inversely associated with contrast extravasation (serum albumin: OR = 0.42; hemoglobin: OR = 0.77; $p < 0.05$). Contrast extravasation was associated with delayed takedown operation (average = 67 d), increased risk (OR = 5.25; $p < 0.01$), and shorter time (median = 32.0 vs 72.5 mo; HR = 5.88; $p < 0.05$) to pouch failure, as well as increased risk of pouch-related complications ($p < 0.05$).

LIMITATIONS: The study was limited by its retrospective nature and small number of patients who developed pouch failure.

CONCLUSIONS: Pouchography before ileostomy takedown is useful in identifying patients with ulcerative colitis at risk for postoperative complications. Radiologic resolution of IPAA-related leak does not reliably predict healing; caution is warranted in this subgroup. See **Video Abstract** at http://links.lww.com/DCR/A818.

KEY WORDS: Ileal pouch anal anastomosis; Pouchography; Ulcerative colitis.

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Since the inception of restorative IPAA in the 1970s, rates of pouch failure and pelvic sepsis have continued to improve, falling from 6.8% and 9.5% in 2005

to 4.3% and 7.5% in 2012.[1,2] Despite these advances, <50% of patients still experience complications, with some requiring salvage surgery or pouch excision with permanent ileostomy.[1,2] Anastomotic disruption occurs in 2% to 8% of all patients undergoing IPAA for ulcerative colitis (UC).[3–6] The sequelas of these anastomotic leaks are wide ranging, from asymptomatic incidental findings on imaging studies to life-threatening sepsis. Even when asymptomatic, pelvic infections can significantly impair functional outcomes and quality of life and ultimately lead to pouch failure.[7]

In many centers, pouchography (contrast enema of the pouch) is routinely performed before ileostomy reversal to confirm anastomotic integrity and evaluate for pouch-specific complications, including anastomotic leak, staple line dehiscence, stricture, or fistula. Routine use of pouchography aims to capture asymptomatic patients with subclinical leaks before restoring continuity. Recent studies, however, suggest that this practice may be unnecessary because of the poor sensitivity and specificity of the test.[8–13] Furthermore, there are little data regarding patient-specific factors that predict positive findings on pouchogram.

We hypothesized that there remains a clinically meaningful incidence of patients who have abnormal pouchography without clinical symptoms before ileostomy closure; this, in turn, may be associated with an increased risk for preventable long-term pouch-related complications, including pouch failure.

PATIENTS AND METHODS

Patients

We conducted a retrospective review of our prospectively maintained pouch database. The study was approved by the University of Chicago Institutional Review Board (16–0489). The database includes all of the patients who provide informed consent. We included patients with a preoperative histopathologic diagnosis of UC who were ≥18 years of age and underwent restorative proctocolectomy with IPAA and a diverting ileostomy between January 2000 and December 2010 and who underwent subsequent pouchography before ileostomy reversal. Patients with a preoperative diagnosis of indeterminate colitis or Crohn's colitis were excluded.

Data

Patient-related data recorded included sex, age at initial colectomy surgery, surgical technique (open versus laparoscopic), operating surgeon, date of UC diagnosis, family history of IBD, smoking status, preoperative medications (5-aminosalicylates products, steroids, immunomodulators, or biologics), nutritional parameters (hemoglobin and albumin), history of *Clostridium difficile* colitis at any time before colectomy (corroborated by positive stool toxin assay or polymerase chain reaction when available), and major medical comorbidities. We also noted the incidence of pouch-specific complications, including pelvic abscess, fistula, anastomotic leak, stricture, wound infection, pelvic sepsis, pouchitis or cuffitis, and the postoperative diagnosis of Crohn's disease. Importantly, a diagnosis of Crohn's disease was recorded based on review of clinic notes stating the clinical impression of the treating surgeon and/or gastroenterologist rather than strictly based on histopathologic criteria.

In addition, we made note of all findings on pretakedown pouchography. Abnormal findings recorded included extraluminal gas, mass effect, increased presacral width, anastomotic stenosis, and contrast extravasation. Pouchography was usually performed ≈6 to 8 weeks after IPAA and the ileostomy takedown at 3 months after the index surgery. Patients with an anastomotic leak or sinus were typically managed expectantly if they had no symptoms, and ileostomy closure was delayed until repeat pouchogram demonstrated radiographic healing. Additional imaging such as CT scan, examination under anesthesia, or pouch endoscopy was performed at the discretion of the operating surgeon. Symptomatic patients underwent percutaneous or transanastomotic drainage, antibiotic therapy, and other ancillary procedures as indicated.

Indications for pouchography were noted to differentiate symptomatic patients who underwent imaging as a diagnostic modality from their asymptomatic counterparts, in whom pouchography was used as a routine before ileostomy closure. All of the studies were reviewed by one of the authors (P.H.S.); in instances where the findings were equivocal or uncertain, the images were reviewed with an experienced GI radiologist (A.D.).

Note was made of readmissions for pouch-specific complications and repeat pouch surgeries, including revisions, temporary or permanent diversion, and pouch excisions. Data were maintained in Health Insurance Portability and Accountability Act of 1996–compliant Microsoft Excel software (Microsoft, Redmond, WA).

Outcomes

The primary outcome was *pouch failure*, defined as pouch excision and/or creation of a permanent diverting ileostomy. All of the preoperative characteristics were analyzed for potential association with this outcome.

Statistical Analysis

Patient characteristics were compared between the pouch failure and no failure groups. Multivariate logistic regression models were constructed to determine independent predictors of pouch failure and abnormal findings of interest on pouchography. All of the variables significant at

TABLE 1. Patient characteristics and IPAA outcomes

Characteristics and outcomes	*All*	*Pouch failure*	*No failure*	*p*
Total patients, n	262	18	244	
Age at colectomy, mean ± SD, y	36.4 ± 11.8	43.0 ± 13.1	35.9 ± 11.5	0.039
Sex, n (%)				0.457
Men	157 (60)	9 (50)	148 (61)	
Women	105 (40)	9 (50)	96 (39)	
Disease duration, median (IQR), mo	70 (20.0–136.5)	70 (23.7–198)	70 (20.0–132.2)	0.259
BMI, mean ± SD, kg/m^2	24.9 ± 4.8	23.9 ± 8.3	24.6 ± 4.4	0.195
Smoking status at surgery, n (%)				0.662
Never	168 (64)	10 (56)	158 (65)	
Former	77 (29)	7 (39)	70 (29)	
Current	17 (7)	1 (6)	16 (7)	
Comorbidities, n (%)				
Diabetes mellitus	6 (2)	0 (0)	6 (2)	1
PSC	15 (6)	2 (11)	13 (5)	0.275
Ankylosing spondylitis	6 (2)	2 (11)	4 (2)	0.057
Family history, n (%)				
UC	32 (12)	1 (6)	31 (13)	0.707
Crohn's disease	21 (8)	0 (0)	21 (9)	0.376
Previous *Clostridium difficile* infection, n (%)	37 (14)	3 (17)	34 (14)	0.727
Surgical technique, n (%)				0.628
Open	159 (61)	10 (56)	149 (61)	
Laparoscopic	103 (39)	8 (44)	95 (39)	
Preoperative laboratory tests, mean ± SD				
Albumin, g/dL	3.6 ± 0.8	3.3 ± 0.6	3.6 ± 0.8	0.206
Hemoglobin, g/dL	11.9 ± 2.2	10.9 ± 1.8	12.0 ± 2.3	0.033
Pouchography indication, n (%)				0.011
Screening	211 (80)	10 (56)	201 (82)	
Diagnostic	51 (20)	8 (44)	43 (18)	

IQR = interquartile range; PSC = pouch-specific complications; UC = ulcerative colitis.

the univariate level ($p < 0.1$) were included in the multivariate model.

A multivariate Cox proportional hazards model was constructed to determine factors influencing time to pouch failure. All of the variables significant at the univariate level ($p < 0.1$) were included in the multivariate model.

Continuous variables were compared using *t* test (parametric) or Mann–Whitney *U* (nonparametric) test. Categorical variables were compared using the χ^2 or Fisher exact test. All of the statistical analyses were performed using R version 3.20 statistical software (https://www.r-project.org/, Vienna, Austria).

RESULTS

We identified 418 patients who underwent IPAA during the study period by 3 surgeons. Of these patients, 262 patients met inclusion criteria. Forty patients were excluded for having a diagnosis other than UC, 52 patients did not have diverting loop ileostomies, and 63 patients did not have pouchogram reports on file. These patients generally lived remotely and had their pouchograms performed at other institutions or in rare cases did not receive a preileostomy closure pouchogram. Patients who did not have pouchogram data on file were, on average, younger than those who did have pouchogram data on file (32.3 ± 10.2 vs 36.4 ± 11.8; $p = 0.007$), but other clinical and demographic characteristics were similar. There was also no difference in the risk of pouch failure in the excluded patients as compared with the study cohort (9.5 vs 6.9%; $p = 0.43$).

Demographic and preoperative clinical characteristics of the patients are summarized in Table 1. Of the 262 patients included in the study, 212 (81%) were asymptomatic and underwent a routine screening pouchogram before ileostomy reversal; 51 patients (19%) had pouchograms ordered as a diagnostic test because of concerning symptoms or physical findings. The most common indications were fever, abdominal pain, nausea, small bowel obstruction, anastomotic stenosis, and abnormal findings on abdominal or pelvic imaging (eg, CT scan). Patients in the diagnostic group had significantly higher rates of abnormal findings on pouchogram, such as contrast extravasation, as compared with the asymptomatic group (25.5% and 6.6%; $p < 0.001$). The abnormal findings on pouchography are summarized in Table 2.

A total of 27 patients (10.3%) were found to have contrast extravasation on their index pouchography. These patients had a significantly longer time between pouch operation and ileostomy takedown operation than patients

TABLE 2. Abnormal findings on pouchography

Findings	*All*	*Pouch failure*	*No failure*	*p*
Total patients, n	262	18	244	
Contrast extravasation, n (%)	27 (10)	6 (33)	21 (9)	0.005
Pouch anal stenosis, n (%)	40 (15)	1 (6)	39 (16)	0.32
Increased presacral width, n (%)	2 (1)	1 (6)	1 (0)	0.13
Pseudodiverticulum, n (%)	3 (1)	1 (6)	2 (1)	0.19
Mass effect, n (%)	1 (0)	0 (0)	1 (0)	1
Pouchocele, n (%)	2 (1)	0 (0)	2 (1)	1

without extravasation (median = 162 vs 95 d; $p < 0.001$; Fig. 1). Six (22.2%) of 27 patients with contrast extravasation went on to have pouch failure; all of these patients had a repeat pouchogram before ileostomy closure that had suggested healing of the leak (Table 3).

The overall rate of pouch failure in our study group was 6.9% (15.7% of patients with abnormal pouchogram and 4.7% of patients with normal pouchogram). We sought to determine whether there was a correlation between abnormal findings on pouchography and the risk of pouch failure. Contrast extravasation was found to be a significant predictor of pouch failure (OR = 5.25 (95% CI, 1.46–17.10); $p < 0.01$). A Kaplan–Meier curve (Fig. 2) demonstrated an increased risk of failure over time for patients with a finding of contrast extravasation; the median time to pouch failure was 32 months in patients with contrast extravasation and 72.5 months in patients without a history of a leak on pouchography ($p < 0.01$, log-rank test). Contrast extravasation remained associated with shorter time to pouch failure in a multivariate Cox proportional hazards analysis (HR = 6.01 (95% CI, 1.34 – 27.00); $p < 0.05$).

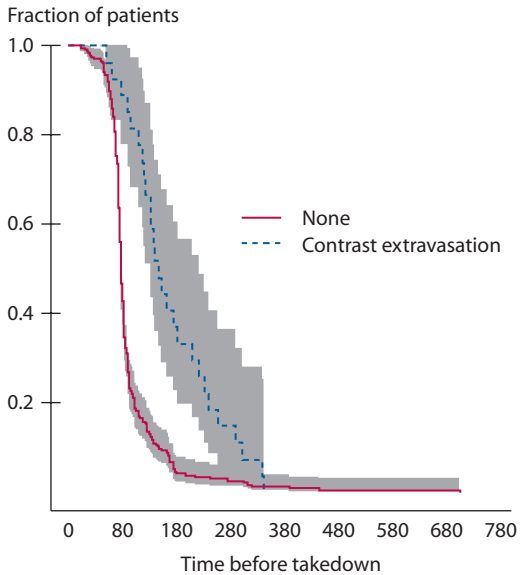

FIGURE 1. Survival curves demonstrating pouch healing time in days for patients with normal or abnormal pouchograms (log-rank test, $p < 0.001$). SEM is shown in gray. There were no censored events.

The multivariate model controlled for age, sex, surgical technique, and preoperative characteristics significant at the univariate level (Table 4; log-rank test $p < 0.05$). Higher BMI and contrast extravasation were associated with pouch failure.

There was no association between the extent of the anastomotic sinus and pouch failure (sinus length, pouch failure: 27.4 mm; sinus length, no failure: 16.1 mm; $p = 0.22$). Additional clinical variables associated with increased risk of pouch failure were older age at the time of surgery (mean = 43.0 vs 35.9 y; $p < 0.05$) and preoperative serum hemoglobin levels (mean = 11.9 vs 10.9; $p < 0.05$).

Regarding clinical factors, lower preoperative albumin and hemoglobin levels were significantly associated with contrast extravasation in multivariate logistic regression models (hemoglobin: OR = 0.72 (95% CI, 0.62–0.95), $p = 0.016$; albumin: OR = 0.40 (95% CI, 0.20–0.85), $p = 0.010$). There was high collinearity between the 2 laboratory measurements (patients with low hemoglobin also had low albumin), so each model was constructed independently.

Patients with lower preoperative serum albumin and hemoglobin levels were more likely to receive a 3-stage procedure (total abdominal colectomy followed by IPAA with diverting ileostomy and ileostomy reversal; hemoglobin: OR = 0.79 (95% CI, 0.70–0.89), $p < 0.001$; albumin: OR = 0.22 (95% CI, 0.14–0.35), $p < 0.001$), as were patients with a diagnosis of fulminant colitis (OR = 12.26 (95% CI, 5.10–36.50), $p < 0.001$). When controlling for these factors, a 3-stage approach was associated with a decreased risk of contrast extravasation (OR = 0.90 (95% CI, 0.82–0.98), $p = 0.017$).

Major long-term pouch-related complications are summarized in Table 5. The outcomes that were most highly associated with pouch failure included anastomotic leak, development of a fistula or sinus tract, pelvic abscess requiring drainage, wound infection, prolapse, and subsequent diagnosis of Crohn's disease. Many of these postoperative complications were also associated with a finding of contrast extravasation on pouchography, including anastomotic leak ($p < 0.001$), fistula ($p < 0.001$), and pelvic abscess ($p < 0.05$).

DISCUSSION

This study demonstrates that a finding of contrast extravasation on preileostomy takedown pouchography is an independent predictor for pouch failure in patients with UC undergoing restorative proctocolectomy. This result is not surprising considering the well-established relationship

TABLE 3. Summary of patients with contrast extravasation and pouch failure

No.	*Initial pouchogram*	*Follow-up pouchogram*	*Takedown*	*Recorded reasons for failure*
1	12 wk postop 45 mm sinus tract	17 wk postop Normal	22 wk postop	Recurring strictures, chronic sinus formation; "consistent with Crohn's"
2	28 wk postop 11 mm sinus tract	33 wk postop Normal	35 wk postop	Chronic pouch inflammation; "consistent with Crohn's"
3	5 wk postop 55 mm sinus tract	13 wk postop Normal	13 wk postop	Chronic pelvic abscesses;. "consistent with Crohn's"
4	13 wk postop 12 mm sinus tract	21 wk postop Normal	21 wk postop	Chronic perianal fistulas, anovaginal fistula, and perianal abscesses; "consistent with Crohn's"
5	1 wk postop 11.5 mm sinus tract	12 wk postop 11 mm saccular pseudodiverticulum 21 wk postop 12 mm pseudodiverticulum 30 wk postop 12 mm pseudodiverticulum 35 wk postop Pseudodiverticulum now 1 mm	36 wk postop	Anastomotic dehiscence, chronic abscesses; "consistent with Crohn's"
6	19.5 wk postop 30 mm sinus tract	30 wk postop Normal	33 wk	Chronic abscesses/fistulas; "consistent with Crohn's"

Postop = postoperation.

between anastomotic leak and pouch failure.[1,3–6] However, we believe that this is the first demonstration of this relationship before ileostomy takedown even in asymptomatic patients. Since the diverted pouch has a much lower rate of symptomatic presentation and many leaks are subclinical in nature, it is important to screen even asymptomatic patients, because they may be at increased risk for pouch failure.[14–16] Other risk factors of pouch failure in this study are consistent with what has been reported in the literature and include pelvic sepsis and Crohn's disease of the pouch.[1]

It is noteworthy that all of the patients with abnormal findings on pouchography had their ileostomy takedown surgery delayed until their pouches/pouch-anal anastomo-

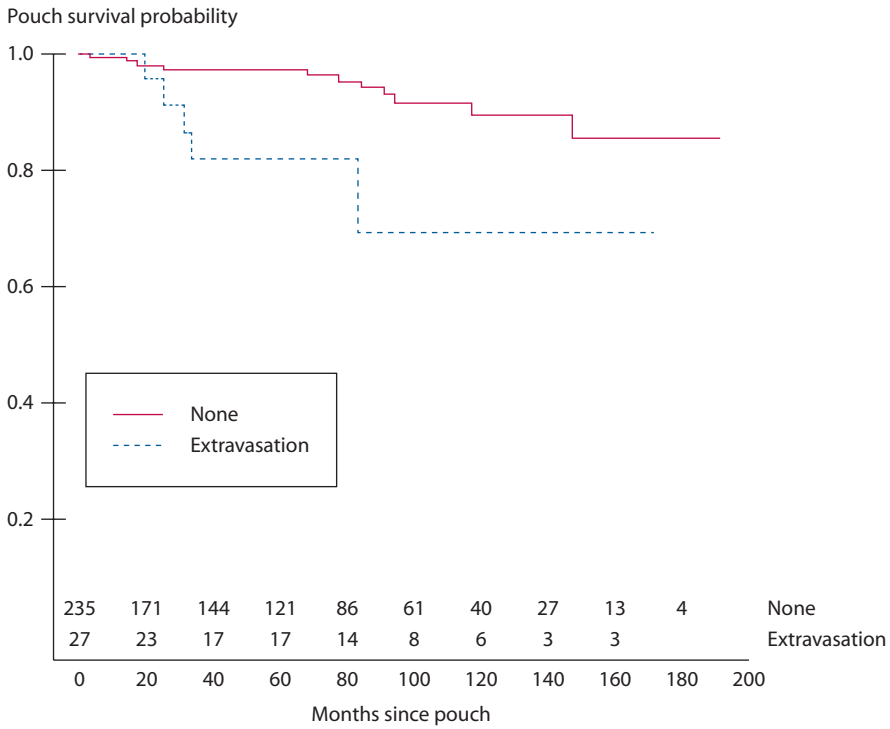

FIGURE 2. Kaplan–Meier curve demonstrating time to pouch failure by the presence of contrast extravasation on pretakedown pouchogram (log-rank test, $p < 0.01$). Each curve shows the proportion of patients with a functioning pouch. The number of uncensored observations at each time point is displayed above the x-axis.

TABLE 4. Cox proportional hazards model of risk factors for pouch failure

Covariate	*HR*	*95% CI*	*p*
Women	2.63	0.54–12.88	0.233
Age at surgery	1.04	0.97–1.11	0.296
BMI at surgery	1.16	1.02–1.32	0.027
Contrast extravasation	5.88	1.34–25.73	0.027

ses were clinically and radiographically healed (an average of 67 d). Despite apparent healing of the anastomosis and the purported suitability for ileostomy takedown, patients with abnormal pouchograms still tended to have inferior outcomes, and their risk for long-term complications and pouch failure was significantly increased. Whether this represents the occult persistence of an unhealed anastomosis, the impact of associated subclinical local sepsis, or other factors is unclear.

This is a particularly important finding and suggests that perhaps a longer delay, imaging with a complementary modality such as CT or MRI, second negative pouchogram, pouch endoscopy, and/or formal examination under anesthesia should be performed routinely in this cohort before ileostomy closure.[12,17,18] It also may support the notion that diversion alone may not be optimal treatment for a pouch-anal anastomotic leak, and at least some of these patients may benefit from a more aggressive surgical approach or other adjunctive modality, such as endoluminal vacuum therapy.[19,20]

Our data also demonstrate a relationship between lower precolectomy hemoglobin and albumin levels and an increased risk of contrast extravasation, suggesting that malnourished and medically deconditioned patients are indeed at higher risk of anastomotic complications. It is noteworthy that the patients who were clinically sicker (ie, who had the lowest albumin and hemoglobin levels or a diagnosis of fulminant colitis) were more likely to receive a 3-stage surgery, which was protective of contrast extravasation. This highlights the importance of preoperative laboratory values in helping select patients for preliminary subtotal colectomy.

TABLE 5. Postoperative complications

Complications	*All*	*Pouch failure*	*No failure*	*p*
Total patients, n	262	18	244	
Anastomotic leak	20	4	16	0.04
Pelvic abscess	34	9	25	<0.0001
Perianal abscess	6	2	4	0.06
Intra-abdominal abscess	12	0	12	1.00
Fistula	33	11	22	<0.0001
Pouch-vaginal fistula	8	2	6	0.14
Sinus tract	19	5	14	0.005
Stricture	79	8	71	0.18
Wound infection	27	6	21	0.005
Prolapse	11	3	8	0.03
Pouchitis	120	10	110	0.47
Cuffitis	21	1	20	1.00
Crohn's disease	40	7	33	0.01
Pelvic sepsis	6	2	4	0.06

This study is also unique in differentiating between true screening pouchograms (those ordered on asymptomatic patients) and diagnostic pouchograms (those ordered on symptomatic patients as a diagnostic tool). This distinction is important, because few would question the appropriateness of radiologic assessment in patients with clinical symptoms suggesting an anastomotic complication. However, our data suggest that pouchography may also be important in patients who are clinically asymptomatic. Two of the 14 patients with clinically silent but radiographically demonstrable leaks progressed to pouch failure, as compared with 4 of the 13 patients with clinical symptoms.

The primary limitation of this study is in its retrospective nature, although many data points were in fact entered concurrent with care in our prospectively maintained pouch database. Our study is additionally limited by the relatively small number of patients who progressed to pouch failure (n = 27), because pouch failure is thankfully a relatively infrequent event. A multicenter collaborative database of high-volume centers would be helpful in this regard.

We also observed that all of the patients with extravasation who went on to lose their pouch were labeled at least at some point as having Crohn's disease of the pouch on the basis of clinical findings, most often fistulizing disease. We think it is far more likely that these patients actually lost their pouch because of anastomotic complications and pelvic sepsis. This highlights the nuances and potential complexities surrounding the overdiagnosis of Crohn's disease whenever things go awry in patients who develop fistulas or other pouch-related complications.[21] Review of operative reports and the imaging studies (eg, pouchography) around the time of surgery often provides critical clues to the etiology of pouch-related complications and enables optimal medical decision making (eg, redo pouch surgery or pouch excision as opposed to biologics for an erroneous diagnosis of Crohn's disease of the pouch).

Open and laparoscopic IPAA appeared to have similar rates of pouch loss. We and others have documented the safety of laparoscopic IPAA in appropriately selected patients.[22–24] Laparoscopic IPAA has been the preferred approach at our institution for many years now.

CONCLUSION

We have demonstrated the clinical use of routine pouchograms before ileostomy takedown procedures in patients with IPAA and have identified low albumin and low hemoglobin as predictive of pouch failure.

REFERENCES

1. Francone TD, Champagne B. Considerations and complications in patients undergoing ileal pouch anal anastomosis. *Surg Clin North Am*. 2013;93:107–143.
2. Ahmed Ali U, Keus F, Heikens JT, et al. Open versus laparoscopic (assisted) ileo pouch anal anastomosis for ulcerative colitis and familial adenomatous polyposis. *Cochrane Database Syst Rev*. 2009;(1):CD006267.
3. Akbari RP, Madoff RD, Parker SC, et al. Anastomotic sinuses after ileoanal pouch construction: incidence, management, and outcome. *Dis Colon Rectum*. 2009;52:452–455.
4. Nyam DC, Wolff BG, Dozois RR, Pemberton JH, Mathison SM. Does the presence of a pre-ileostomy closure asymptomatic pouch-anastomotic sinus tract affect the success of ileal pouch-anal anastomosis? *J Gastrointest Surg*. 1997;1:274–277.
5. Swain BT, Ellis CN. Fibrin glue treatment of low rectal and pouch-anal anastomotic sinuses. *Dis Colon Rectum*. 2004;47:253–255.
6. Ahmed Ali U, Shen B, Remzi FH, Kiran RP. The management of anastomotic pouch sinus after IPAA. *Dis Colon Rectum*. 2012;55:541–548.
7. Kiely JM, Fazio VW, Remzi FH, Shen B, Kiran RP. Pelvic sepsis after IPAA adversely affects function of the pouch and quality of life. *Dis Colon Rectum*. 2012;55:387–392.
8. Tsao JI, Galandiuk S, Pemberton JH. Pouchogram: predictor of clinical outcome following ileal pouch-anal anastomosis. *Dis Colon Rectum*. 1992;35:547–551.
9. Hrung JM, Levine MS, Rombeau JL, Rubesin SE, Laufer I. Total proctocolectomy and ileoanal pouch: the role of contrast studies for evaluating postoperative leaks. *Abdom Imaging*. 1998;23:375–379.
10. Malcolm PN, Bhagat KK, Chapman MA, Davies SG, Williams NS, Murfitt JB. Complications of the ileal pouch: is the pouchogram a useful predictor? *Clin Radiol*. 1995;50:613–617.
11. Brown JJ, Balfe DM, Heiken JP, Becker JM, Soper NJ. Ileal J pouch: radiologic evaluation in patients with and without postoperative infectious complications. *Radiology*. 1990;174:115–120.
12. Thoeni RF, Fell SC, Engelstad B, Schrock TB. Ileoanal pouches: comparison of CT, scintigraphy, and contrast enemas for diagnosing postsurgical complications. *AJR Am J Roentgenol*. 1990;154:73–78.
13. da Silva GM, Wexner SD, Gurland B, et al. Is routine pouchogram prior to ileostomy closure in colonic J-pouch really necessary? *Colorectal Dis*. 2004;6:117–120.
14. Mark-Christensen A, Brandsborg S, Laurberg S. Primary fecal diversion and bowel dysfunction in restorative proctocolectomy for ulcerative colitis: a nationwide cross-sectional study. *Int J Colorectal Dis*. 2018;33:223–229.
15. Sahami S, Buskens CJ, Fadok TY, et al. Defunctioning ileostomy is not associated with reduced leakage in proctocolectomy and ileal pouch anastomosis surgeries for IBD. *J Crohns Colitis*. 2016;10:779–785.
16. Shen B. Diagnosis and management of postoperative ileal pouch disorders. *Clin Colon Rectal Surg*. 2010;23:259–268.
17. Crema MD, Richarme D, Azizi L, Hoeffel CC, Tubiana JM, Arrivé L. Pouchography, CT, and MRI features of ileal J pouch-anal anastomosis. *AJR Am J Roentgenol*. 2006;187:W594–W603.
18. Sahi KS, Lee KS, Moss A, et al. MR Enterography of the ileoanal pouch: descriptive radiologic analysis with endoscopic and pathologic correlation. *AJR Am J Roentgenol*. 2015;205:W478–W484.
19. Keskin M, Bayram O, Bulut T, Balik E. Effectiveness of endoluminal vacuum-assisted closure therapy (endosponge) for the treatment of pelvic anastomotic leakage after colorectal surgery. *Surg Laparosc Endosc Percutan Tech*. 2015;25:505–508.
20. Gardenbroek TJ, Musters GD, Buskens CJ, et al. Early reconstruction of the leaking ileal pouch-anal anastomosis: a novel solution to an old problem. *Colorectal Dis*. 2015;17:426–432.
21. Lightner AL, Fletcher JG, Pemberton JH, Mathis KL, Raffals LE, Smyrk T. Crohn's disease of the pouch: a true diagnosis or an oversubscribed diagnosis of exclusion? *Dis Colon Rectum*. 2017;60:1201–1208.
22. Fichera A, Silvestri MT, Hurst RD, Rubin MA, Michelassi F. Laparoscopic restorative proctocolectomy with ileal pouch anal anastomosis: a comparative observational study on long-term functional results. *J Gastrointest Surg*. 2009;13:526–532.
23. Ahmed Ali U, Keus F, Heikens JT, et al. Open versus laparoscopic (assisted) ileo pouch anal anastomosis for ulcerative colitis and familial adenomatous polyposis. In: *Cochrane Database of Systematic Reviews*. Chichester, United Kingdom: John Wiley & Sons, Ltd; 2009.
24. Singh P, Bhangu A, Nicholls RJ, Tekkis P. A systematic review and meta-analysis of laparoscopic vs open restorative proctocolectomy. *Colorectal Dis*. 2013;15:e340–e351.