DR. VICTOR FAZIO SYMPOSIUM SEPT 17–18, 2021, NEW YORK (SPECIAL SUPPLEMENT)

Endoscopic Therapy for Pouch Leaks and Strictures: A Systematic Review

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BACKGROUND: Patients with ulcerative colitis refractory to medication or familial adenomatous polyposis may require ileal pouch-anal anastomosis after a colectomy. IPAA is generally well tolerated. However, patients can experience posttreatment complications, including pouch strictures and leaks. Medical therapy has a limited role in mechanical fibrotic strictures, whereas surgery is invasive and costly. In the past few decades, endoscopic therapies have provided a less invasive and less costly intervention for pouch strictures and leaks.

OBJECTIVE: This systematic literature review aimed to describe the status of advancements in endoscopic therapy for pouch leaks and strictures.

DATA SOURCES: The sources used were PubMed and Cochrane databases.

STUDY SELECTION: Studies between January 1990 and January 2022, in any language, were included. Articles regarding surgical management or pouches other than adult ileal pouch-anal anastomosis were excluded.

INTERVENTIONS: Endoscopic management of acute and chronic leaks and strictures ileal pouch-anal anastomosis was included.

MAIN OUTCOME MEASURES: Successful management (including persistent leak or stricture, pouch failure, subsequent endoscopy, or surgery) was measured.

RESULTS: Sixty-one studies were included in this review, including 4 meta-analyses or systematic reviews, 11 reviews, 17 cohort studies, and 18 case series.

LIMITATIONS: The limitations include qualitative review of all study types, with no randomized controlled studies available.

CONCLUSION: Ileal pouch-anal anastomosis leaks are various in configuration, and endoscopic therapies have included clipping leaks at the tip of the "J" as well as endoscopic sinusotomy. Endoscopic therapies for pouch strictures have included endoscopic balloon dilation, endoscopic stricturotomy, and endoscopic stricturoplasty, which are now considered first-line therapies for pouch strictures. Endoscopic balloon dilation has shown safety and efficacy in single, short, and straight strictures and endoscopic stricturotomy for refractory long, fibrotic, anastomotic strictures. Endoscopic therapies can delay or prevent invasive surgeries. Key tenets of successful endoscopic therapy include patient and lesion candidacy, an experienced endoscopist, and adequate rescue surgery plans.

Funding/Support: None reported.

Financial Disclosure: Dr Shen reports educational grants and personal fees from AbbVie and Janssen; receiving personal fees from Takeda; receiving consulting fees from AbbVie, Janssen, and Takeda.

Presented at the Dr Victor Fazio Symposium in Diagnosis and Management of Ileal Pouch Disorders, Columbia University Irving Medical Center/New York Presbyterian Hospital and International Ileal Pouch Consortium, New York, NY, September 17 to 18, 2021.

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Dis Colon Rectum 2022; 65: S92–S104
DOI: 10.1097/DCR.0000000000002538

KEY WORDS: Anastomotic leaks; Balloon dilation; Clipping; Electroincision; Endoscopy; Familial adenomatous polyposis; Ileal pouch; Restorative proctocolectomy; Sinus; Stricture; Stricturoplasty; Stricturotomy; Ulcerative colitis.

Ileal pouch-anal anastomosis (IPAA) is the procedure of choice following proctocolectomy in patients with medically refractory ulcerative colitis (UC), colitis-associated neoplasia, or familial adenomatous polyposis who require colectomy.[1] Various configurations of pouches have been constructed, including the J, S, W, H, T, and K, with the J-pouch being the most commonly fashioned.[1,2] Ileal pouch-anal anastomosis (IPAA) allows patients to defecate

from the natural anal route, rather than use an abdominal stoma such as Brooke ileostomy or continent ileostomies.[3] Patients with IPAA report improvement in their quality of life relative to other treatments, including Brooke ileostomy, continent Kock ileostomy, or medically treated UC.[3–8]

On the other hand, patients with IPAA can experience various post-IPAA complications or adverse sequelae, with some leading to pouch failure.[1,9] The reported frequency of post-IPAA complications is as high as 60%.[4,10,11] Strictures and acute or chronic anastomotic or suture-line leaks are the most common structural complications of IPAA or continent ileostomies. Leaks are most common at anastomosis sites, the tip of the "J," and stoma closure sites.[9,12,13] In a large study following 3707 patients with UC, indeterminate colitis (IC), or Crohn's disease (CD) post-IPAA for a median of 7 years, 5.2% of patients experienced strictures and 4.8% experienced anastomotic leaks within the first 90 days of their IPAA, and 11.2% experienced strictures and 1.7% experienced anastomotic leaks after 90 days.[4]

Medical therapy is often insufficient and limited in managing pouch strictures and leaks due to the mechanical nature of these complications. Hence, endoscopic approaches have been developed to provide a treatment that is more definitive than medicine but less invasive and costly than surgery with reduced complication and pouch failure risk.[14] Endoscopic therapies for IPAA complications include endoscopic balloon dilation (EBD), endoscopic stricturotomy (ESt), endoscopic stricturoplasty (ESTx), endoscopic septectomy, and endoscopic stenting. EBD, ESt, and ESTx are now considered firstline therapy to address certain pouch strictures.[14–16] Medical therapy may control inflammation to help prevent strictures, and surgery is more definitive; hence, medical, endoscopic, and surgical therapies should be considered for patients, with surgery reserved as a last resort given its invasive nature with a higher risk of complications.[1]

IPAA leaks can be managed via various modalities including radiographical or surgical draining of abscesses, delaying ileostomy closure, serial examination under anesthesia (EUA), and observation.[17,18] However, recent endoscopic modalities of therapy have been developed including using clips at the tip of the "J" for leaks at that site and endoscopic sinusotomy.[17,18]

In this systematic review, we summarize the available literature on the diagnosis, classification, and management of pouch strictures and leaks to assist clinicians in taking care of patients with ileal pouches.

METHODS

We performed a literature search for articles using PubMed and Cochrane databases. Search criteria included "pouch," "stricture," "leak," "endoscopic," and "ileal pouch-anal anastomosis" in titles and abstracts from January 1990 to January 2022. Searches with Boolean operators were used to find more relevant articles (eg, "pouch" AND "endoscopic" AND "stricture"). We did not impose any language restrictions. Duplicates were removed. Initially, we included all articles with titles and abstracts that were relevant to aspects of the endoscopic management of pouch complications. These articles were read in full to screen for relevancy. References of relevant articles were scanned to identify further articles of interest to our review. All article types were included, such as systematic reviews, reviews, and original articles. Exclusion criteria included articles regarding surgical pouches other than IPAA, articles focusing on how to construct a pouch surgery and pediatric pouches, and articles regarding surgical management. Given that endoscopic management of pouch leaks and strictures is a highly specialized topic and the articles extracted were highly heterogeneous; no meta-analysis was performed.

RESULTS

Search results identified 39 articles, and scanning their references identified an additional 22 articles. In total, 61 articles were included in this review (Fig. 1). These articles included 2 meta-analyses, 2 systematic reviews, 11 reviews, 17 cohort studies, 2 case-control studies, 18 case series, 5 case reports, and 3 guidelines. There were no randomized clinical trials.

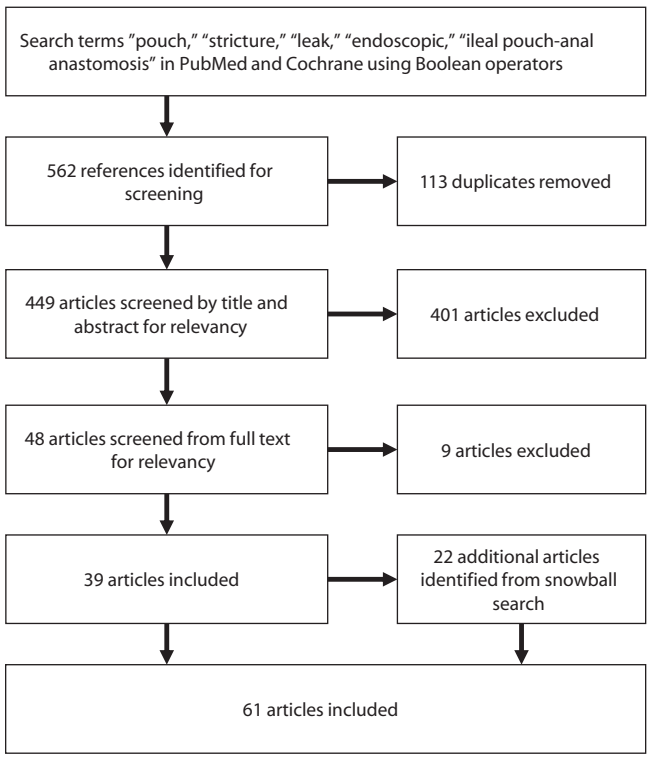

FIGURE1. Preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow diagram.

Frequency of Pouch Stricture and Anastomotic Leaks

Common complications of IPAA include leaks and strictures.[1,19] First, in the immediate 90-day postoperative period, around 4.8% of patients may experience anastomotic leaks, whereas 5.2% of patients experience strictures, according to a study following 3707 patients with UC, IC, or CD of the colon after their IPAA for a median of 7 years (Table 1).[4] Immediate postoperative leaks commonly present with symptoms of sepsis; 34% of patients with pelvic sepsis had anastomotic leaks.[20]

In that study following 3707 patients, 1.7% of patients experienced late (≥90 d after IPAA) anastomotic leaks.[4] Leaks are most common at anastomosis sites or the tip of the "J," a vulnerable location for leaks.[9,12,13] Another location is at the stoma closure site. Symptomatic or asymptomatic anastomotic leaks that occur in the early postoperative stage (<3–6 months) are likely technical. Late-onset anastomotic leaks that can present with abscess, sepsis, fistulas, or sinuses usually reflect the presentation of the underlying disease process, particularly CD of the pouch. Other contributing factors to late-onset stricture or anastomotic leaks are the use of nonsteroidal anti-inflammatory drugs, trauma, excessive weight gain, or even placement of mesh in the abdominopelvic area.

The study following 3707 patients found that 5.2% of patients experienced late strictures.[4] Strictures are a fairly common late complication of IPAA[21–23]; a different study reported a 20-year cumulative probability of stricture ranging from 39% to 79% in patients with UC, IC, or CD.[11] Strictures are known to lead to pouch failure, requiring pouch excision or permanent diversion in reported rates ranging from 3% to 17% of patients.[24–31]

Clinical Presentations of Pouch Leaks and Strictures

Patients with pouch strictures may present with nonspecific gastrointestinal symptoms, including abdominal pain, nausea, vomiting, early satiety, bloating, dyschezia, or incomplete evacuation. Patients may also have dehydration, blood in their stools, urgency, postobstructive diarrhea, obstipation, small-bowel obstruction, small intestinal bacterial overgrowth, or gastroesophageal reflux disease.[1] If patients have been suffering from persistent strictures, they may have malnutrition, weight loss, and anemia.[1] Patient with small intestinal bacterial overgrowth or fecal stasis may respond to antibiotic therapy, which can be mistakenly diagnosed as having pouchitis. On the other hand, patients can be asymptomatic or present with anything from minimal to severe symptoms. Symptoms do not necessarily correlate with objective findings; patients may be asymptomatic but present with characteristic endoscopic and imaging findings.[1]

Post-IPAA leaks may occur most commonly in the anastomosis, the tip of the "J," and then also in the pouch body or stoma closure site.[17,32] The tip of the "J" of the pouch is vulnerable to leaks; it contains the distal ileum sealed with a stapler sometimes with reinforcement sutures.[9] A large retrospective study of 1424 patients with IPAA at a single center found that 9.9% (141 patients) had leaks with 130 presenting with symptoms.[32] Patients present variably, with the most common presenting symptoms including abdominoperineal pain and fever, followed by gluteal or perianal abscess or drainage, diarrhea, weight loss, and pelvic or perianal pain.[17,32] Patients presenting acutely after an IPAA often present with symptoms related to pelvic sepsis or abscess.[1,2]

Diagnosis and Classification of Pouch Leaks and Strictures

Clinical presentations often provide clues for the diagnosis of inflammatory and/or structural disorders of the ileal pouch. A combined assessment of clinical, laboratory, imaging, endoscopic, or, in some cases, intraoperative evaluations is often needed for the accurate diagnosis, classification, and management of structural complications of the ileal pouch (Fig. 2).

Accurate assessment of clinical presentations is important for diagnosis and differential diagnosis of ileal pouch disorders. The symptomatology can be categorized into clusters (Fig. 2).

Laboratory Evaluation

We periodically perform laboratory tests with markers for infection, inflammation, and nutrition such as complete blood counts, comprehensive metabolic panel, C-reactive protein, sedimentation rate, iron, vitamin D, and vitamin B12.

Diagnostic Endoscopy

Endoscopy assists in the diagnosis in addition to the delivery of therapy. At the time of endoscopy, a digital examination of the anus and pouch-anal anastomosis should be done to assess the resting sphincter tone, strictures, fistulas, or abscesses.[16] Strictures should be photodocumented and characterized, noting landmarks of the ileal pouch.[16] Pouchoscopy with or without fluoroscopic guidance can help diagnose and assess the location, depth, and other characteristics of a pouch leak.[17,33] Pouchoscopy with a soft-tip guide wire is often useful for the assessment of nontraversable stricture, acute or chronic anastomotic leaks, and fistula (Fig. 3A). There is a recent grade C consensus recommendation to pay attention to areas prone to leaks during pouchoscopy, including suture or staple lines, the tip of the "J," or posterior wall of the pouch-anal anastomosis suture line.[16] A large retrospective study classified post-IPAA leaks into 6 categories, including pouch-anal anastomosis leak with or without abscess, pouch-cutaneous fistula, pouch-vaginal fistula (PVF), radiologic leak, and pouch leak (those that arose from the pouch itself rather than from the pouch-anal anastomosis).[32]

TABLE 1. Frequency and management of pouch leaks and strictures*

Authors and published year	*Frequency of complication*	*Number of patients with IPAA, N*	*Notes on endoscopic treatment type and success*
Leaks			
Ahmed Ali et al, Dis Colon Rectum, 2012	2% with anastomotic pouch sinus in a median duration between surgery and the initial diagnosis of the sinus was 6 months (interquartile range, 2–22.5)	2286	Initial management: 51% underwent observation, 20% drainage, 18% unroofing of the sinus tract, 7% sinus closure, and 4% diverting ileostomy. A total of 62% required subsequent treatment, 60% achieved sinus healing, and 33% pouch failure. Observation as initial management had highest healing rate of 65%
Fazio et al, Ann Surg, 2013	1.7% experienced leaks ≥90 d after IPAA	3707	Data on endoscopic treatment N/A
Fazio et al, Ann Surg, 1995	0.9% anastomotic leak at ≥30 days of IPAA	1005	Data on endoscopic treatment N/A
Kochhar and Shen, Endosc Int Open, 2017	N/A, inclusion criteria were patients with leaks at the tip of the "J"	12	Endoscopic over-the-scope clipping system, with 66.6% having complete closure of the leak documented by endoscopy confirmed with guidewire and/or contrasted pouchogram, and 33.3% with persistent leak requiring surgery
Lan et al, Gastrointest Endosc, 2019	N/A, inclusion criteria were patients with sinuses	226	Endoscopic sinusotomy, 53% achieved complete healing of the sinus, and 16% with partial healing. Subsequent surgery in 24% of patients treated with endoscopic sinusotomy
Raval et al, Ann Surg, 2007	9.9% experienced leaks	1424	Initial management was nonoperative treatment for all patients, with 80% success rate. Afterward, surgical therapies included transanal repair, laparotomy with direct suture repair, and combined abdominoperineal pouch reconstruction
Strictures			
Chapman et al, Arch Surg, 2005	4.2% at 1 y, 10.1% at 3 y, 13.5% at 5 y, and 20.0% at 10 y	2002	Data on endoscopic treatment N/A
Fazio et al, Ann Surg, 2013	11.2% experienced strictures ≥90 d after IPAA	3707	Data on endoscopic treatment N/A
Fazio et al, Ann Surg, 1995	11.8% anal stricture at ≥30 d of IPAA	1005	Data on endoscopic treatment N/A
Fumery et al, Inflamm Bowel Dis, 2018	N/A, inclusion criteria were patients who developed stricture, at a median of 4.6 y after IPAA	88	Endoscopic balloon dilation (EBD) in all patients. 98% technical success and 0% complications. Of those who had obstructive symptoms, 95% saw clinical improvement and 5% required pouch surgery. 25% were hospitalized after EBD. 45% complete disappearance of pouch stricture, 35% persistent passable strictures without related symptoms, and 15% diverting stoma due to resistant CD of the pouch
Hahnloser et al, Br J Surg, 2007	39% in chronic UC patients, 48% in indeterminate colitis, and 79% in CD, at 20 years after IPAA	1885	Data on endoscopic treatment N/A
Körsgen et al, Int J Colorectal Dis, 1997	13.3% ileoanal stenosis	180	Data on endoscopic treatment N/A
Lan et al, Surg Endosc, 2021	N/A, inclusion criteria were patients with pouch inlet or afferent limb strictures	200	20% were treated with endoscopic stricturotomy, and 80% and 13.2% with EBD. 21%–22% comparable subsequent surgery rate. 0% in endoscopic stricturotomy group developed pouch failure, compared with 5.6% in EBD group

(Continued)

TABLE 1. Continued

Authors and published year	*Frequency of complication*	*Number of patients with IPAA, N*	*Notes on endoscopic treatment type and success*
Lan and Shen, Inflamm Bowel Dis, 2017	N/A, inclusion criteria were patients with inflammatory bowel disease with strictures	85, of which 55.3% had J-pouch, 7% other pouch; in pouch patients, 22 strictures in pouch inlet (17.3%), 25 in afferent limb (19.7%), 3 in middle of the pouch body (2.4%), and 24 in pouch anastomosis (18.9%)	NKSt in all patients. Mean interval between initial NKSt and subsequent endoscopic treatment 7 ± 6.8 months. On univariate analysis, stricture length >4 cm more likely to receive multiple NKSt, and degree 1 stricture more likely to require only one session. Subsequent surgery in 13 patients (15.3%), of which 5 (38.5%) had diverting loop ileostomy (4 with J-pouch, 1 with S- pouch) and 2 (15.4%) patients had pouch resection and redo pouch
Senapati et al, Int J Colorectal Dis, 1996	14.2% in handsewn anastomoses and 39.6% in stapled anastomoses, at unspecified time	266, of which 218 were handsewn and 48 stapled	Data on endoscopic treatment N/A
Shen et al, Am J Gastroenterol, 2004	N/A, inclusion criteria were patients with inlet and/or outlet (pouch-anal anastomosis) strictures	19	EBD, 100% technical success and 47% with second EBD at 8 wk, of which 55% underwent third EBD at 16 wk. Improvement in symptom and quality of life scores at scheduled 8- and 16-wk follow-up. No complications. One patient failed endoscopic and medical therapies and underwent surgery
Shen et al, Inflamm Bowel Dis, 2011	N/A, inclusion criteria were patients with pouch strictures	150	EBD, 0.46% perforation rate and 0.98% transfusion-requiring bleeding rate. 5-, 10-, and 25-y pouch retention rates of 97%, 90.6%, and 85.9%. 87.3% pouch success at median follow-up time of 9.6 y
Wu et al, J Gastrointest Surg, 2013	N/A, inclusion criteria were patients with pouch strictures	167	16 (9.6%) surgical stricturoplasty and 151 (90.4%) EBD. Mean follow-up 4.1 ± 2.6 y. 55.1% with stricture recurrence; 12.6% with pouch failure. Multivariate analysis: no difference between stricturoplasty vs EBD in overall pouch survival, stricture-free survival, or procedure-associated complications

*Case reports excluded. Some articles do not focus on treatment or success of treatment. Table sections inputted based on availability in an article.
CD = Crohn's disease; EBD = endoscopic balloon dilation; IPAA = ileal pouch-anal anastomosis; IQR = interquartile range; NKSt =needle knife stricturotomy; wk = week; y = year.

Imaging

Abdominopelvic imaging should routinely be performed in patients suspected of pouch strictures or leaks. Imaging includes computed tomography (CT), CT enterography (CTE), magnetic resonance imaging (MRI), magnetic resonance enterography, small bowel follow-through, barium defecography, and gastrografin enema (GGE) (Figs. 3B–E).[1,16]

CTE, magnetic resonance enterography, and GGE are more accurate than regular CT or MRI for the evaluation of pouch strictures. A study evaluating the accuracy of various endoscopic and imaging modalities found that GGE, MRI, and pouch endoscopy had accuracy rates of >90%, whereas CTE had a rate of 74% for diagnosing inlet or afferent strictures. All modalities were similar in diagnosing outlet strictures with accuracy rates of 87.9% to 92.3%.[34] Another study found GGE to be 100% sensitive (6/6) and 92% specific (33/36) in finding post-IPAA strictures at an anastomotic diameter of ≤8 mm.[35] GGE appears to be particularly useful in diagnosing ileal pouch strictures. The use of multiple diagnostic modalities can increase the diagnostic yield.[1] It is yet unclear if and how ultrasound elastography could aid in characterizing IPAA strictures.

To help diagnose and assess the characteristics of a leak in the pouch, imaging such as GGE, MRI, and EUA should be used.[20] MRI of the pelvis is more accurate than CT in the evaluation of anastomotic leaks, fistulas, or abscesses. Overall, post-IPAA leaks can be diagnosed by reviewing clinical presentation, endoscopic findings, and imaging.[17]

Examination Under Anesthesia

An EUA is useful in the diagnosis and management of strictures at the anastomosis, anopouch ring, presacral sinuses, perianal abscesses or fistulas, and PVF.

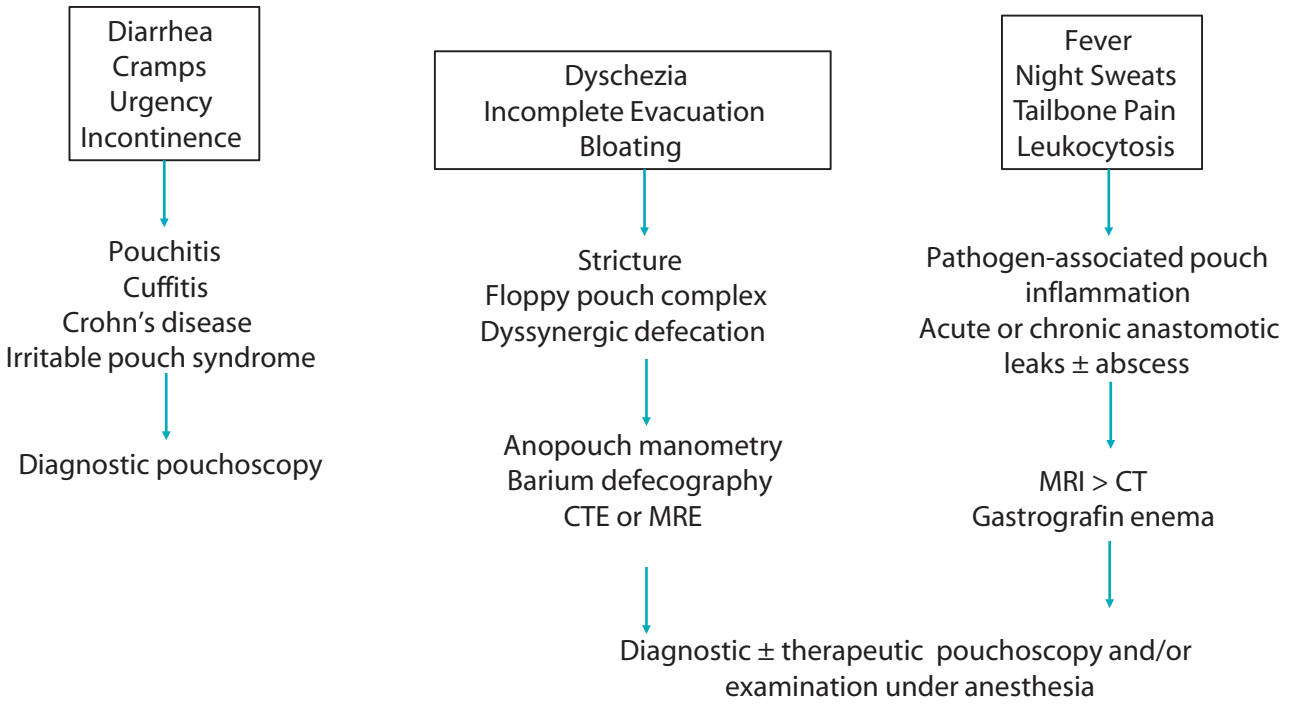

FIGURE 2. Management algorithm for pouch disorders. CTE = computed tomography enterography; MRE = magnetic resonance enterography.

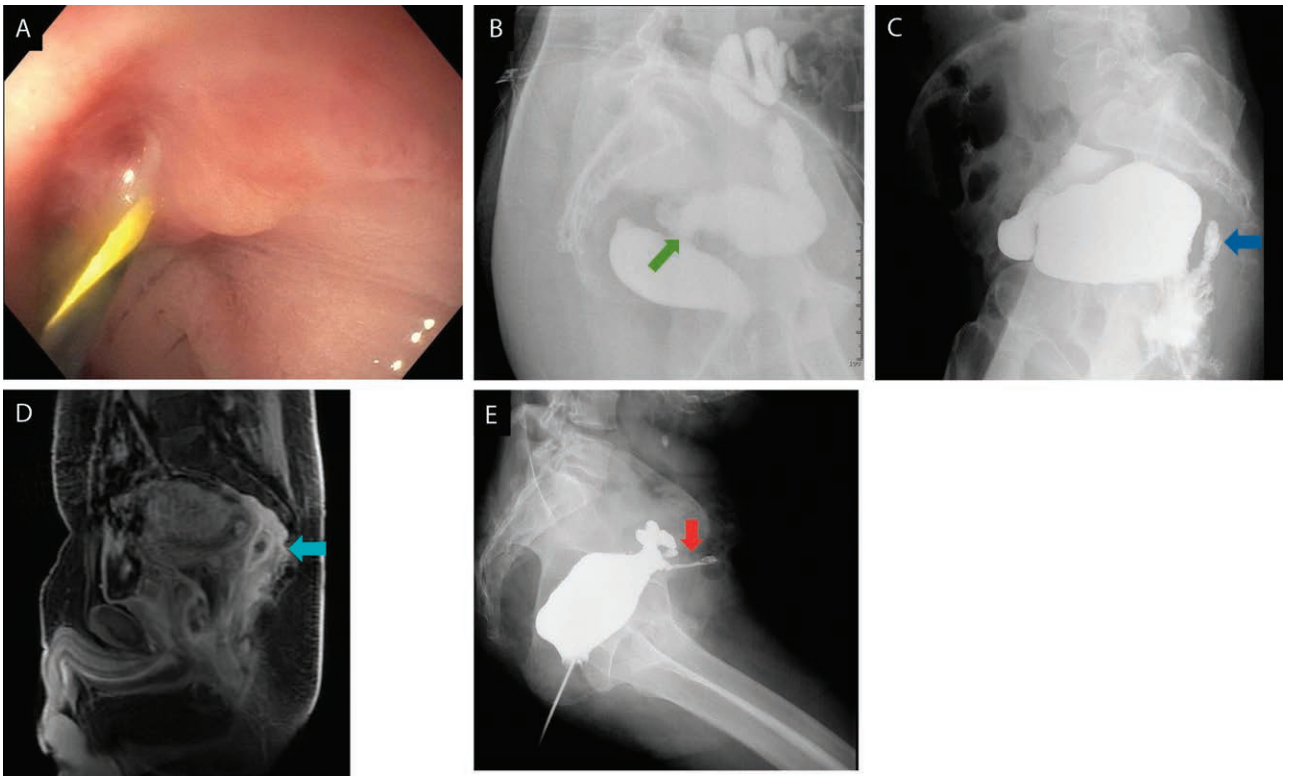

FIGURE 3. Endoscopic and imaging evaluation of pouch leaks and strictures. A, Detection of an anastomotic leak with endoscopic guide wire. B, Pouch-anal anastomotic stricture (green arrow) with a long cuff on gastrovgrafin enema. C and D, Presacral sinus on gastrografin enema and MRI (blue arrows). E, A leak at the tip of the "J" leading to enterocutaneous fistula (red arrow) on gastrografin enema.

TABLE 2. Classification of pouch leaks

Category	*Subcategory*
Symptomatology	Dry
	Draining
	Abscess ± systemic symptoms
Acute leaks (<90 days postoperative)	Abscess or phlegmon
	Sepsis
Chronic leaks(≥90 days postoperative)	Fistula with or without abscess
	Sinus with or without abscess
Location[15]	Stoma closure site
	The tip of the "J"
	Vertical pouch staple line
	Anastomosis
Target organ or space	Presacral space
	Perianal
	Peripouch
	Vagina, prostate, and bladder
	Skin
Length	Short ≥ 3 cm
	Long < 3 cm
Depth/thickness	Shallow ≤ 2 cm
	Deep > 2 cm
Number[15]	Single
	Multiple
Inflammation near the primary orifice[15]	Absent
	Present
Concurrent strictures	Absent
	Present
Complexity	Simple track
	Complex: multiple or branched tracks, the presence of concurrent abscesses, or sepsis
Malignant potential	Benign
	Malignant

TABLE 3. Classification of pouch strictures

Category	*Subcategory*
Etiology[1]	Primary (*de novo*)
	Secondary
	Anastomotic
	Medicine-related (non-steroidal anti-inflammatory drugs)
Location[15]	Ileostomy closure site (side-to-side or end-to-end)
	Afferent limb
	Pouch inlet
	Pouch body
	Pouch-anal anastomosis
	Anopouch ring or anal transition zone
	Nipple valve or exit conduit in the continent ileostomy
Source[15]	Extrinsic (such as pouch prolapse and pouch twist)
	Intrinsic
Malignant potential	Benign
	Malignant
Inflammatory component[36]	Inflammatory
	Fibrotic
	Mixed inflammatory and fibrotic
Number[1]	Single
	Multiple
Length[1]	Short (<4–5 cm)
	Long (≥4–5 cm)
Characteristics	Ulcerated
	Web-like
	Spindle-shaped
	Angulated
	Symmetry
	Circumferential asymmetry
	Longitudinal asymmetry
Degree of severity	No stricture
	Mild (passage of scope with mild resistance)
	Moderate (passage of scope with moderate resistance)
	Severe (nontraversable pinhole stricture)
Complexity[1]	Simple (isolated stricture)
	Complex (associated with fistula, sinus, abscess, angulation, and radiation)

Classification of Leaks and Strictures

Pouch leaks can be classified by category, symptomatology, chronicity, associated features, location, target organ or space, length, depth/thickness, number, inflammatory component, presence of concurrent strictures, abscesses, fistulas, and malignant potential (Table 2).

Pouch strictures may form due to inflammatory or mechanical causes. They can be classified by etiology, location, source, number, length, inflammation, malignant potential, degree of severity, complexity, and other characteristics (Table 3).[1,15,36]

General Principles of Endoscopic Therapy

Many of the general goals, preparations, equipment, personnel, and backup plans are similar for pouch leaks as for pouch strictures. Endoscopic approaches provide a treatment that is more definitive than medicine but less invasive and costly than surgery with reduced complications and pouch failure risk.[14] The goals of endoscopic therapy include: 1) symptom relief, 2) delaying or preventing surgery, 3) preventing pouchitis or enteritis from fecal stasis, and 4) possibly preventing fistulas proximal to the stricture.[1] Given these goals, as symptomatology and objective findings do not necessarily correlate, endoscopic therapy may be given based on objective findings of endoscopy.[1]

General Principles

Certain patients may require more discretion when scheduling endoscopy. For example, those who have malnutrition, comorbidities, or the use of systemic corticosteroids are at a higher risk for endoscopic complications and may benefit from postponement or avoidance of endoscopic therapy.[1] Primary sclerosing cholangitis is associated with portal hypertension, thrombocytopenia, and coagulopathy and, hence, may present an increased risk for bleeding.[37]

Therefore, the risks and benefits of the intervention must be considered in a case-by-case scenario.

Before endoscopic therapy, there are several considerations. A key to a successful and safe endoscopic procedure includes the proper setting and personnel—an experienced endoscopist and team, the proper equipment, a plan to aim at the targeted area, rescue plans in the event of bleeding, or perforation, and surgery backup.[1] In most cases, an outpatient setting with conscious sedation will be sufficient.[38] Patients must have adequate bowel preparation, preferably with polyethylene glycol.[1] The clinician should consider discontinuing antithrombotic agents or anticoagulants based on individualized patient risk. In addition, abdominal and pelvic imaging should be performed to characterize the leak or stricture before endoscopic therapy. This may include cross-sectional imaging including computed tomography enterography (CTE), magnetic resonance imaging (MRI), gastrografin enema (GGE), or small bowel series.[16] On-site fluoroscopy may be used to characterize defects undergoing endoscopic intervention.

During pouchoscopy, the endoscopist should be aware that due to the lack of large bowel, minimal air insufflation, preferably with carbon dioxide, will be needed.[1] For strictures, the endoscopist should pay attention to areas in the IPAA that are vulnerable to strictures to assess etiology and severity, including the stoma site, inlet, and anastomosis.[16] In addition, biopsies should be taken of the afferent limb, pouch body, and anal transitional zone or cuff.[1]

Postendoscopic therapy, patients should be observed for at least 30 minutes in the recovery suite, monitoring for signs of bleeding and perforation.[1] Prolonged therapeutic pouchoscopy may result in ileus, which can be prophylactically treated with a decompression tube (eg, use of 14- or 18-Fr nasogastric tube) at the recovery suite. They may be advised to stay near the hospital on the day of the therapeutic procedure as well.

Endoscopic Management of Leaks

Ileal pouch-anal anastomosis anastomotic leaks can be managed via various modalities including draining abscesses, delaying ileostomy closure, EUA, endoscopic clipping, and endoscopic sinusotomy.[17,18] The choice of endoscopic treatment modalities depends on the timing, location, and etiology of anastomotic leaks. For example, endoscopic closure with endoclips is more effective in treating acute anastomotic leaks than chronic anastomotic leaks. Endoscopic sinusotomy for presacral sinus can be performed in the wall-off sinus from chronic anastomotic leaks.

Immediate postoperative leaks can sometimes be managed conservatively as they can heal on their own over time. However, they are also often associated with symptoms related to pelvic sepsis.[2] Immediate post-IPAA pelvic sepsis and abscess occur in 5% to 20% of patients and lead to pouch failure in 30% of these patients.[2,39–41] In patients who did not have a defunctioning ileostomy constructed at the time of their pouch construction, most post-IPAA leaks are managed with pouch drainage with a rectal tube with antibiotics or observation.[32] Abscesses would be drained.[32] Most would heal using these conservative therapies, but those that do not heal would have operations including emergency diversion with a defunctioning ileostomy.[32]

Pelvic sepsis often requires surgery. As surgery is invasive with a high risk of complications, in those patients with post-IPAA, leaks refractory to conservative management above could be addressed with newer endoscopic therapies that have been developed. Although there are concerns about endoscopic intervention acutely after a surgical operation, an experienced endoscopist with surgical backup may attempt a rescue endoscopy.[16]

Endoscopic Closure

The timing of endoscopic closure of suture-line or anastomotic leak is the key. Acute leaks (ideally <90 days after the surgery) with fresh granulation tissue with no or minimal epithelization are more amenable for endoscopic clipping with through-the-scope clips or over-the-scope clips (OTSCs). Attempts of endoscopic closure should be made to close acute leaks at the tip of the "J" or transverse staple line at the side-to-side loop ileostomy closure site. Chronic leaks with fistula or sinus formation causing presacral sinus, PVF, or enterocutaneous fistula usually do not respond to endoscopic clipping. However, placement of an OTSC can be attempted for chronic leaks at the tip of the "J" or stoma closure site.

Endoscopic treatment of chronic leaks at the tip of the "J" can be challenging. The patients may present with a dry transmural fistula tract, pelvic sepsis, abscess, or with a fistula to adjacent organs (such as skin, bladder, or fallopian tubes). The leaks at the tip of the "J" have been historically treated with surgery. However, recently, 12 patients were documented who received an OTSC treatment to close the leak.[9] In this method, the leak at the tip of the "J" was first confirmed via endoscopic guide wire and/or GGE (Figs. 4E and F).[9] The leak was cleaned with hydrogen peroxide, betadine, and/or 50% dextrose in pouchoscopy. An endoscopic cytology brush or argon plasma coagulation can be used to debride the epithelialized orifice of the cavity.[9] Finally, 12-t OTSCs and a 165-cm anchor (Ovesco Endoscopy USA, Cary, NC) were used to close the leak.[9] Of the 12 patients in the literature treated with this method, 8 patients (66.6%) achieved complete closure of the leak as confirmed by the endoscopic guide wire and/or GGE.[9] The remaining 4 patients (33.3%) had a persistent leak and required surgery. There were no immediate postprocedure complications; however, 1 patient developed a presacral spinal abscess and was treated with surgery for drainage followed by elective pouch revision and long-term intravenous antibiotics.[9]

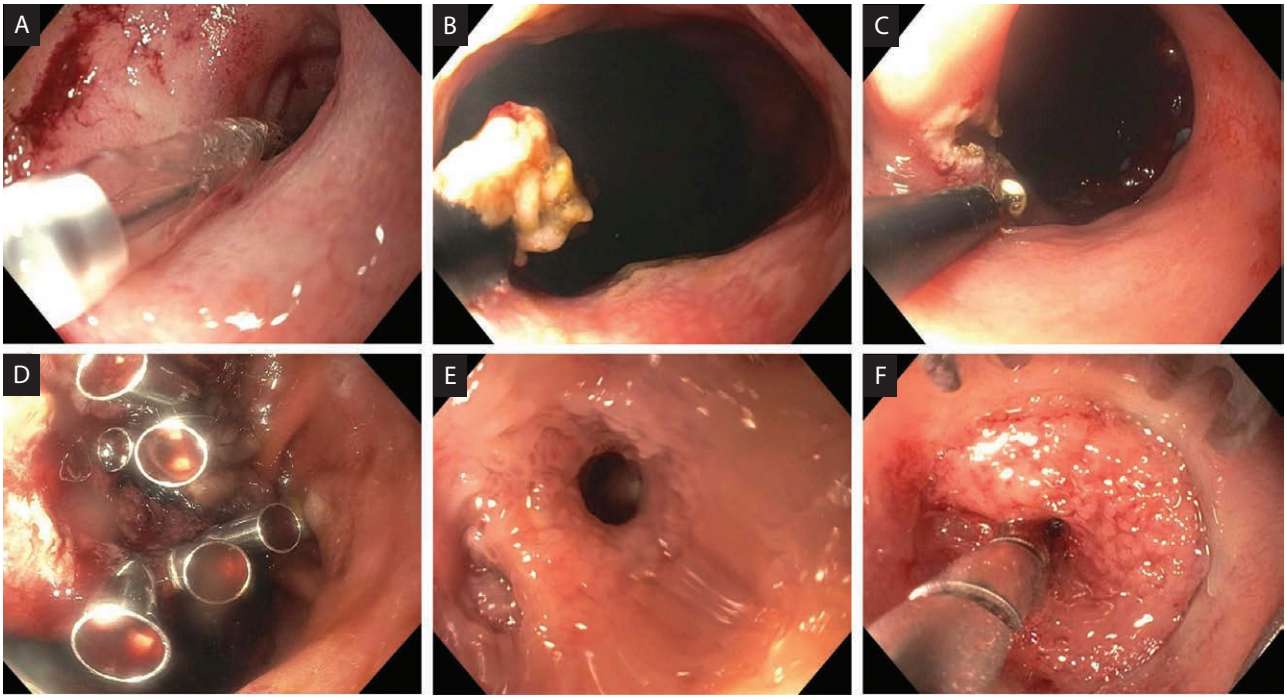

FIGURE 4. Endoscopic management of pouch strictures and leaks. A, Endoscopic balloon dilation of intrinsic pouch inlet stricture. B, Endoscopic stricturotomy of intrinsic stricture at the pouch-anal anastomosis. Shows IT knife with incised tissue from the stricture. C, Endoscopic septectomy of distal pouch twist. D, Placement of endoclips at the wall between pouch body and sinus after sinusotomy was performed. E and F, Ongoing endoscopic closure with an over-the-scope-clip anchored at the leak.

Endoscopic Sinusotomy

Presacral sinus is a common complication of IPAA resulting from chronic posterior anastomotic leaks. Patients with presacral sinus often present with low-grade fever, night sweats, tailbone pain, weight loss, or failure to thrive. Complex presacral sinus may lead to osteomyelitis fistula, perianal fistula, PVF, or pouch-prostate fistula or abscesses inferiorly or anteriorly. Presacral sinus has traditionally been treated with surgical unroofing[42] or surgical redo pouch procedures.[43] Endoscopic sinusotomy has been demonstrated to be a safe and effective treatment modality for presacral sinus.[19,44,45] Endoscopic sinusotomy involves electroincision of the "septum" between pouch body and presacral sinus with a needle knife or insulated-tip knife followed by the placement of endoclips as spacers.[46] A healed presacral sinus is usually covered by epithelia, completing the conversion from sinus to a pseudodiverticulum (Fig. 4D). A historical cohort study compared 141 patients treated with needle knife endoscopic sinusotomy versus 85 patients treated with redo pouch surgery.[19] In this study, of those receiving endoscopic sinusotomy, complete healing of the sinus was achieved in 75 patients (53.2%) and partial healing in 23 patients (16.3%).[47] Of those receiving redo surgery, initial complete healing was obtained in 80 patients (94.1%).[47] However, both modalities resulted in sinus recurrence in 22.7% of patients with endoscopic sinusotomy and 32.9% of patients with surgery ($p = 0.15$), with endoscopic sinusotomy having a numerical advantage.[47] Both cohorts required similar rates of subsequent surgery, at around 21% to 24%.[47] Surgery-free and recurrence-free survivals were comparable in both groups.[47] The rate of adverse events was much higher in the surgery group than in the endoscopic sinusotomy group (43.5% vs 2.5%; $p = 0.0001$).[47] The main complication of endoscopic sinusotomy is delayed bleeding, as ulcers from electroincised and cauterized areas may develop.[46] To prevent this complication, a technique is to use endoclips after incisions and spray 50% dextrose.[46]

Endoscopic Management of Strictures

Classification has helped guide the management of strictures, as it characterizes the nature of strictures for medical versus endoscopic or surgical therapy. For example, medication may have a role in preventing or controlling inflammatory strictures with minimal or no fibrosis.[1] However, endoscopic therapy may have a role in fibrotic or mixed inflammatory and fibrotic strictures due to their mechanical nature. Endoscopic therapy should be combined with medical therapy (for the underlying inflammatory process of IBD) with surgery reserved as a last resort given its invasive nature and risk of operative complications.[1] Endoscopic therapy may also reduce cost; EBD is more cost-effective than surgical resection in CD strictures in a decision model analysis, and the findings may be applicable to pouch stricture.[14] The main surgical modalities for pouch strictures are bowel resection and anastomosis, stricturoplasty, bypass, revision of the pouch, and temporary or permanent diverting ileostomy.

Indications for Endoscopic Stricture Therapy

Various endoscopic therapies for IPAA complications have been developed, including EBD (Fig. 4A), ESt (Fig. 4B), ESTx, endoscopic septectomy (Fig. 4C), endoscopic banding of extrinsic strictures resulting from floppy pouch complex, and endoscopic stenting. EBD, ESt, or ESTx is now considered preferred therapy to address IBD-related strictures, including pouch strictures.[14–16] EBD has shown safety and efficacy for single, short (<4–5 cm), and straight strictures.[48–53] ESt can address refractory long, fibrotic, and anastomotic strictures, with the advantage over EBD in that the endoscopist can control the exact location and depth of the cut.[1,12,54] This explains a reduced risk of perforation yet increased risk of bleeding with endoscopic stricturotomy over EBD. Controlling the location of the intervention is especially important when dealing with strictures located near the vagina, sex nerves, and anal sphincter.[1] The Global Interventional IBD Group recommended ESt as the first-line therapy for distal bowel, anorectal, and pouch-anal anastomotic strictures.[51] Although endoscopic stenting has been documented in CD strictures, there is insufficient documentation in pouch strictures; hence, the role of endoscopic stenting in ileal pouch strictures has yet to be defined.[55–59] If a patient has multiple, long, or angulated strictures, surgery may be most appropriate.[1]

Technical Considerations of Endoscopic Stricture Therapy

Several technical considerations must be made when performing these various endoscopic interventions. For EBD, generally, a flexible, single-channel, video upper endoscope is used. If there are multiple strictures at the inlet and afferent limb, a stiffer flexible sigmoidoscope instead of gastroscope may be used to reduce looping. The targeted balloon size, generally between 18 and 20 mm, should correlate with the degree, length, and location of the stricture, which may take several sessions to achieve. Sequential dilations may be performed using the same balloon. If the stricture is traversable, the preferred method is retrograde EBD to antegrade dilation. However, if the stricture is nontraversable due to angulation or severity, antegrade wire-guided through-the-scope EBD may be performed. Technical success is defined by the ability of the endoscope to pass through the stricture location without resistance. EBD may be performed every 3 to 12 months. If patients with strictures require EBD more often than every 3 months, alternative endoscopic approaches (such as ESt) or surgical resection and reanastomosis or strictureplasty are recommended.

Fibrotic strictures or strictures refractory to repeat EBD may be more appropriately treated with ESt or surgery. As for tools, the triple-lumen needle-knife or insulated-tip knife may be used using endoscopic retrograde cholangiopancreatography (ERCP) endocut settings. For ESt or ESTx, settings of electroincision and electrocauterization may be used, knowing that electrocauterization carries a higher risk of late-onset bleeding ulcers. The incisions can be circumferential or radial, where circumferential cutting is preferred to the anastomotic or anorectal ring stricture to reduce the risk of injuring the anal sphincter or causing iatrogenic PVF.[1] In endoscopic stricturoplasty, endoclips may be placed after radial cuts to help keep strictures open as well as prevent perforation and bleeding.

As for endoscopic stenting, the use of a self-expandable covered metal stent has been reported for a long, angulated, EBD-refractory pouch inlet stricture.[1] In this procedure, a guide wire was inserted through the operating channel of an endoscope, and a 10-cm-long, 18-mm stent was placed. However, the stent migrated into the pouch body 2 weeks later; migration is a concerning adverse event that can lead to perforation, bleeding, impaction, and fistulas.[59]

Outcomes of Endoscopic Stricture Therapy

EBD has resulted in technical success in 90% to 100% of procedures in CD patients, and similar rates have been observed in patients with IPAA.[48,60–62] A study following 150 patients with pouch strictures with a median follow-up of 9.6 years by Shen et al[52] found 5-, 10-, and 25-year pouch retention rates of 97%, 90.6%, and 85.6%, respectively. Adverse event rates were <1% for perforation and bleeding requiring transfusion.[52] Similarly, a study by Fumery et al[48] following 88 patients with IPAA post-EBD for a median follow-up of 3.0 years found only 1 patient with stricture-related pouch failure. Complication rates of EBD are generally <1-5%.[48–52]

Although there are multiple studies on ESt in the treatment of CD strictures, limited studies assess ESt in the treatment of pouch strictures. Studies thus far have reported 100% technical success.[47,49,63] One case series that included 53 patients with pouch strictures treated with ESt found immediate technical success in all patients but also found that a repeat procedure was required in 60% of patients with a median follow-up of 0.9 years.[47] Stricture-related surgery was required in 15.3% of patients.[47] The rate of adverse events was 4.7% in patients with ESt at the inlet or afferent limb strictures.[49]

Data on the safety and efficacy of endoscopic stenting in ileal pouches are currently insufficient. Stents in CD strictures have shown high risks of migration, impaction, and perforation.[59,64] As mentioned, very few cases have been reported using stents in pouch strictures and have reaffirmed the risk of stent migration.[1] Future effort could consider drug-eluting balloons, or biodegradable or drug-eluting stents.[37] As endoscopic stenting has not been well studied in patients with ileal pouches, it is not routinely recommended for such patients.[37]

CONCLUSIONS

Restorative proctocolectomy with IPAA is the procedure of choice following colectomy for patients with medically refractory UC, colitis-associated neoplasia, or familial

adenomatous polyposis. Post-IPAA complications are common, especially strictures and anastomotic leaks, which can lead to pouch failure. Endoscopic therapies have emerged as a valid treatment option that is more definitive than medical treatment, less invasive, and less costly than surgical intervention. It may delay or prevent the need for surgery. Endoscopic clipping can be attempted in acute leaks or chronic leaks at the tip of the "J." Chronic leak with presacral sinus often benefits from endoscopic sinusotomy. Endoscopic treatment modalities for pouch strictures include EBD and endoscopic electroincision with ESt or ESTx. EBD is more appropriate for single, short, and straight strictures, whereas ESt or ESTx is for fibrotic strictures or strictures at the anastomosis, anorectal, or anopouch ring. EBD carries a higher risk for perforation than ESt, while ESt is more often associated with bleeding than EBD. Some key tenets to endoscopic therapy in post-IPAA complications include thorough characterization of leaks and strictures through imaging, shared decision-making with patients regarding treatment strategy balancing risks and benefits, an experienced endoscopist in the proper setting, and a backup plan using surgery. Moving forward, further studies should ascertain the optimal parameters for endoscopic management, including duration, size, or pressure of balloon insufflation number of dilations per EBD session, elective versus scheduled dilation, comparison of various endoscopic knives, and cut/cauterization setting. Prospective studies should further investigate the safety and efficacy of endoscopic therapies.

REFERENCES

1. Bharadwaj S, Shen B. Medical, endoscopic, and surgical management of ileal pouch strictures (with video). *Gastrointest Endosc.* 2017;86:59–73.
2. Kirat HT, Remzi FH. Technical aspects of ileoanal pouch surgery in patients with ulcerative colitis. *Clin Colon Rectal Surg.* 2010;23:239–247.
3. Köhler LW, Pemberton JH, Zinsmeister AR, Kelly KA. Quality of life after proctocolectomy. A comparison of Brooke ileostomy, Kock pouch, and ileal pouch-anal anastomosis. *Gastroenterology.* 1991;101:679–684.
4. Fazio VW, Kiran RP, Remzi FH, et al. Ileal pouch anal anastomosis: analysis of outcome and quality of life in 3707 patients. *Ann Surg.* 2013;257:679–685.
5. Sagar PM, Lewis W, Holdsworth PJ, Johnston D, Mitchell C, MacFie J. Quality of life after restorative proctocolectomy with a pelvic ileal reservoir compares favorably with that of patients with medically treated colitis. *Dis Colon Rectum.* 1993;36:584–592.
6. Sagar PM, Pemberton JH. Intraoperative, postoperative and reoperative problems with ileoanal pouches. *Br J Surg.* 2012;99:454–468.
7. Silvestri MT, Hurst RD, Rubin MA, Michelassi F, Fichera A. Chronic inflammatory changes in the anal transition zone after stapled ileal pouch-anal anastomosis: is mucosectomy a superior alternative? *Surgery.* 2008;144:533–537.
8. Umanskiy K, Fichera A. Health related quality of life in inflammatory bowel disease: the impact of surgical therapy. *World J Gastroenterol.* 2010;16:5024–5034.
9. Kochhar GS, Shen B. Endoscopic treatment of leak at the tip of the "J" ileal pouch. *Endosc Int Open.* 2017;5:E64–E66.
10. Fazio VW, Ziv Y, Church JM, et al. Ileal pouch-anal anastomoses complications and function in 1005 patients. *Ann Surg.* 1995;222:120–127.
11. Hahnloser D, Pemberton JH, Wolff BG, Larson DR, Crownhart BS, Dozois RR. Results at up to 20 years after ileal pouch-anal anastomosis for chronic ulcerative colitis. *Br J Surg.* 2007;94:333–340.
12. Shen B. Diagnosis and management of postoperative ileal pouch disorders. *Clin Colon Rectal Surg.* 2010;23:259–268.
13. Paye F, Penna C, Chiche L, Tiret E, Frileux P, Parc R. Pouch-related fistula following restorative proctocolectomy. *Br J Surg.* 1996;83:1574–1577.
14. Lee KE, Lim F, Faye AS, Shen B, Hur C. Endoscopic balloon dilation is cost-effective for Crohn's disease strictures. *Dig Dis Sci.* Published online Mar 15, 2022. doi: 10.1007/s10620-022-07420-z.
15. Shen B, Kochhar GS, Kariv R, et al. Diagnosis and classification of ileal pouch disorders: consensus guidelines from the International Ileal Pouch Consortium. *Lancet Gastroenterol Hepatol.* 2021;6:826–849.
16. Shen B, Kochhar GS, Navaneethan U, et al. Endoscopic evaluation of surgically altered bowel in inflammatory bowel disease: a consensus guideline from the Global Interventional Inflammatory Bowel Disease Group. *Lancet Gastroenterol Hepatol.* 2021;6:482–497.
17. Kirat HT, Kiran RP, Oncel M, Shen B, Fazio VW, Remzi FH. Management of leak from the tip of the "J" in ileal pouch-anal anastomosis. *Dis Colon Rectum.* 2011;54:454–459.
18. Holubar SD. Prevention, diagnosis, and treatment of complications of the IPAA for ulcerative colitis. *Dis Colon Rectum.* 2018;61:532–536.
19. Lan N, Hull TL, Shen B. Endoscopic sinusotomy versus redo surgery for the treatment of chronic pouch anastomotic sinus in ulcerative colitis patients. *Gastrointest Endosc.* 2019;89:144–156.
20. Sagap I, Remzi FH, Hammel JP, Fazio VW. Factors associated with failure in managing pelvic sepsis after ileal pouch-anal anastomosis (IPAA)–a multivariate analysis. *Surgery.* 2006;140:691–703.
21. Chapman JR, Larson DW, Wolff BG, et al. Ileal pouch-anal anastomosis: does age at the time of surgery affect outcome? *Arch Surg.* 2005;140:534–539.
22. Senapati A, Tibbs CJ, Ritchie JK, Nicholls RJ, Hawley PR. Stenosis of the pouch anal anastomosis following restorative proctocolectomy. *Int J Colorectal Dis.* 1996;11:57–59.
23. Wu XR, Mukewar S, Kiran RP, Remzi FH, Shen B. Surgical stricturoplasty in the treatment of ileal pouch strictures. *J Gastrointest Surg.* 2013;17:1452–1461.
24. Belliveau P, Trudel J, Vasilevsky CA, Stein B, Gordon PH. Ileoanal anastomosis with reservoirs: complications and long-term results. *Can J Surg.* 1999;42:345–352.
25. Foley EF, Schoetz DJ Jr, Roberts PL, et al. Rediversion after ileal pouch-anal anastomosis. Causes of failures and predictors of subsequent pouch salvage. *Dis Colon Rectum.* 1995;38:793–798.

26. Tulchinsky H, Hawley PR, Nicholls J. Long-term failure after restorative proctocolectomy for ulcerative colitis. *Ann Surg.* 2003;238:229–234.
27. Gemlo BT, Wong WD, Rothenberger DA, Goldberg SM. Ileal pouch-anal anastomosis. Patterns of failure. *Arch Surg.* 1992;127:784–787.
28. Körsgen S, Keighley MR. Causes of failure and life expectancy of the ileoanal pouch. *Int J Colorectal Dis.* 1997;12:4–8.
29. MacRae HM, McLeod RS, Cohen Z, O'Connor BI, Ton EN. Risk factors for pelvic pouch failure. *Dis Colon Rectum.* 1997;40:257–262.
30. Meagher AP, Farouk R, Dozois RR, Kelly KA, Pemberton JH. J ileal pouch-anal anastomosis for chronic ulcerative colitis: complications and long-term outcome in 1310 patients. *Br J Surg.* 1998;85:800–803.
31. Setti-Carraro P, Ritchie JK, Wilkinson KH, Nicholls RJ, Hawley PR. The first 10 years' experience of restorative proctocolectomy for ulcerative colitis. *Gut.* 1994;35:1070–1075.
32. Raval MJ, Schnitzler M, O'Connor BI, Cohen Z, McLeod RS. Improved outcome due to increased experience and individualized management of leaks after ileal pouch-anal anastomosis. *Ann Surg.* 2007;246:763–770.
33. El-Gazzaz GS, Kiran RP, Remzi FH, Hull TL, Geisler DP. Outcomes for case-matched laparoscopically assisted versus open restorative proctocolectomy. *Br J Surg.* 2009;96:522–526.
34. Tang L, Cai H, Moore L, Shen B. Evaluation of endoscopic and imaging modalities in the diagnosis of structural disorders of the ileal pouch. *Inflamm Bowel Dis.* 2010;16:1526–1531.
35. Dolinsky D, Levine MS, Rubesin SE, Laufer I, Rombeau JL. Utility of contrast enema for detecting anastomotic strictures after total proctocolectomy and ileal pouch-anal anastomosis. *AJR Am J Roentgenol.* 2007;189:25–29.
36. Shen B, Fazio VW, Remzi FH, Lashner BA. Clinical approach to diseases of ileal pouch-anal anastomosis. *Am J Gastroenterol.* 2005;100:2796–2807.
37. Blesl A, Eibisberger M, Schörghuber M, Klivinyi C, Stadlbauer V. High rate of gastrointestinal bleeding in patients with secondary sclerosing cholangitis in critically ill patients (SC-CIP). *J Clin Med.* 2021;10:1925.
38. Saunders BP, Brown GJ, Lemann M, Rutgeerts P. Balloon dilation of ileocolonic strictures in Crohn's disease. *Endoscopy.* 2004;36:1001–1007.
39. Block M, Börjesson L, Lindholm E, Oresland T. Pouch design and long-term functional outcome after ileal pouch-anal anastomosis. *Br J Surg.* 2009;96:527–532.
40. Gustavsson A, Halfvarson J, Magnuson A, Sandberg-Gertzén H, Tysk C, Järnerot G. Long-term colectomy rate after intensive intravenous corticosteroid therapy for ulcerative colitis prior to the immunosuppressive treatment era. *Am J Gastroenterol.* 2007;102:2513–2519.
41. Remzi FH, Fazio VW, Delaney CP, et al. Dysplasia of the anal transitional zone after ileal pouch-anal anastomosis: results of prospective evaluation after a minimum of ten years. *Dis Colon Rectum.* 2003;46:6–13.
42. Ahmed Ali U, Shen B, Remzi FH, Kiran RP. The management of anastomotic pouch sinus after IPAA. *Dis Colon Rectum.* 2012;55:541–548.
43. Remzi FH, Aytac E, Ashburn J, et al. Transabdominal redo ileal pouch surgery for failed restorative proctocolectomy: lessons learned over 500 patients. *Ann Surg.* 2015;262:675–682.
44. Khoudari G, Singh A, Shen B. Endoscopic sinusotomy using needle knife technique for treatment of H-pouch with leak and sinus. *ACG Case Rep J.* 2019;6:e00071.
45. El Ouali S, Veniero JC, Shen B. Computed tomography-guided endoscopic sinusotomy for an ileal pouch presacral sinus. *Endoscopy.* 2018;50:730–731.
46. Shen B. Corrective endoscopy for the treatment of structural complications after pouch surgery. *Gastroenterol Hepatol (N Y).* 2018;14:717–719.
47. Lan N, Shen B. Endoscopic stricturotomy with needle knife in the treatment of strictures from inflammatory bowel disease. *Inflamm Bowel Dis.* 2017;23:502–513.
48. Fumery M, Patel NS, Boland BS, Dulai PS, Singh S, Sandborn WJ. Efficacy and safety of endoscopic balloon dilatation of ileoanal pouch strictures. *Inflamm Bowel Dis.* 2018;24:1316–1320.
49. Lan N, Wu JJ, Wu XR, L T, Hull, Shen B. Endoscopic treatment of pouch inlet and afferent limb strictures: stricturotomy vs. balloon dilation. *Surg Endosc.* 2021;35:1722–1733.
50. Shen B, Fazio VW, Remzi FH, et al. Endoscopic balloon dilation of ileal pouch strictures. *Am J Gastroenterol.* 2004;99:2340–2347.
51. Shen B, Kochhar G, Navaneethan U, et al. Practical guidelines on endoscopic treatment for Crohn's disease strictures: a consensus statement from the Global Interventional Inflammatory Bowel Disease Group. *Lancet Gastroenterol Hepatol.* 2020;5:393–405.
52. Shen B, Lian L, Kiran RP, et al. Efficacy and safety of endoscopic treatment of ileal pouch strictures. *Inflamm Bowel Dis.* 2011;17:2527–2535.
53. Shen B. Endoscopic band ligation with hypertonic glucose cushion in the treatment of ileal pouch prolapse. *Gastroenterol Rep (Oxf).* 2021;9:480–482.
54. Sinh P, Shen B. Endoscopic evaluation of surgically altered bowel in patients with inflammatory bowel diseases. *Inflamm Bowel Dis.* 2015;21:1459–1471.
55. Attar A, Branche J, Coron E, et al. An anti-migration self-expandable and removable metal stent for Crohn's disease strictures: a nationwide study from GETAID and SFED. *J Crohns Colitis.* 2021;15:521–528.
56. Das R, Singh R, Din S, et al. Therapeutic resolution of focal, predominantly anastomotic Crohn's disease strictures using removable stents: outcomes from a single-center case series in the United Kingdom. *Gastrointest Endosc.* 2020;92:344–352.
57. El Ouali S, Kessler H, Shen B. Self-expandable metal stent in the treatment of refractory long pouch inlet stricture. *Inflamm Bowel Dis.* 2019;25:e13–e14.
58. Loras Alastruey C, Andújar Murcia X, Esteve Comas M. The role of stents in the treatment of Crohn's disease strictures. *Endosc Int Open.* 2016;4:E301–E308.
59. Loras C, Pérez-Roldan F, Gornals JB, et al. Endoscopic treatment with self-expanding metal stents for Crohn's disease strictures. *Aliment Pharmacol Ther.* 2012;36:833–839.
60. Bettenworth D, Gustavsson A, Atreja A, et al. A pooled analysis of efficacy, safety, and long-term outcome of endoscopic balloon dilation therapy for patients with stricturing Crohn's disease. *Inflamm Bowel Dis.* 2017;23:133–142.
61. Morar PS, Faiz O, Warusavitarne J, et al.; Crohn's Stricture Study (CroSS) Group. Systematic review with meta-analysis: endoscopic balloon dilatation for Crohn's disease strictures. *Aliment Pharmacol Ther.* 2015;42:1137–1148.

62. Navaneethan U, Lourdusamy V, Njei B, Shen B. Endoscopic balloon dilation in the management of strictures in Crohn's disease: a systematic review and meta-analysis of non-randomized trials. *Surg Endosc*. 2016;30:5434–5443.
63. Zhang LJ, Lan N, Wu XR, Shen B. Endoscopic stricturotomy in the treatment of anastomotic strictures in inflammatory bowel disease (IBD) and non-IBD patients. *Gastroenterol Rep (Oxf)*. 2020;8:143–150.
64. Bharadwaj S, Fleshner P, Shen B. Therapeutic armamentarium for stricturing Crohn's disease: medical versus endoscopic versus surgical approaches. *Inflamm Bowel Dis*. 2015;21:2194–2213.