Journal of Translational Gastroenterology **2024** vol. 2(2) | 76–89
DOI: 10.14218/JTG.2023.00096

Review Article

Endoscopic Treatment Approaches for Inflammatory Bowel Diseases: Old Friends and New Weapons

Alberto Barchi[1#], Sarah Bencardino[1#], Ernesto Fasulo[1], Ferdinando D'Amico[1*], Alessandra Zilli[1], Gionata Fiorino[1], Tommaso Lorenzo Parigi[1], Laurent Peyrin-Biroulet[2,3,4,5,6,7], Mariangela Allocca[1], Silvio Danese[1] and Federica Furfaro[1]

[1]Department of Gastroenterology and Endoscopy, IRCCS Ospedale San Raffaele and Vita-Salute San Raffaele University, Milan, Italy; [2]Department of Gastroenterology and Inserm NGERE U1256, University Hospital of Nancy, University of Lorraine, Vandoeuvre-lès-Nancy, France; [3]Department of Gastroenterology, Nancy University Hospital, Vandœuvre-lès-Nancy, France; [4]INFINY Institute, Nancy University Hospital, Vandœuvre-lès-Nancy, France; [5]FHU-CURE, Nancy University Hospital, Vandœuvre-lès-Nancy, France; [6]Groupe Hospitalier privé Ambroise Paré-Hartmann, Paris IBD Center, Neuilly sur Seine, France; [7]Division of Gastroenterology and Hepatology, McGill University Health Centre, Montreal, Canada

Received: December 06, 2023 | **Revised:** February 29, 2024 | **Accepted:** May 15, 2024 | **Published online:** June 28, 2024

Abstract

Inflammatory Bowel Diseases (IBD) still represent a significant medical challenge. The course of IBD is characterized by the development of fibrotic, inflammatory, or dysplastic lesions over time. Recent advancements in operative endoscopy have introduced new strategies to address these issues. Inflammatory and fibrotic strictures pose a challenge for clinicians and represent a surgical risk. Endoscopic treatments include dilation, stent placement, and electroincisional techniques. Moreover, endoscopic approaches can also be considered in the management of IBD-related surgical complications. Addressing colorectal dysplastic lesions is a crucial concern, and several resection endoscopic techniques are available, including endoscopic mucosal resection and endoscopic submucosal dissection. This review aimed to summarize the pros and cons of advanced therapeutic endoscopic approaches in the management of IBD.

Introduction

Inflammatory bowel diseases (IBD), mainly Crohn's disease (CD) and ulcerative colitis (UC), are chronic inflammatory conditions of the gastrointestinal tract. Over time, IBD patients can develop complications that significantly impact their quality of life. Indeed, CD and UC are progressive diseases that can lead to irreversible structural damage to the intestine, characterized by the presence of strictures, fistulas, and abscesses, which may require surgical intervention.[1] Strictures are one of the most prevalent complications of CD, potentially leading to significant morbidities such as bowel obstruction.[2] At least 10% of CD patients have a fibrostenotic phenotype at diagnosis, whereas the majority initially present with a purely inflammatory phenotype.[3,4] In contrast, the inflammatory insult in UC involves exclusively the mucosa and submucosal colon layers, primarily affecting gut integrity and increasing colorectal cancer (CRC) risk.[5] UC has been linked to the development of strictures caused by malignancies,[6] hyperplasia of the muscularis mucosa,[7] and submucosal fibrosis associated with inflammatory cell infiltration.[8] Moreover, both UC and CD are characterized by an increased risk of CRC, which may be preceded by the development of dysplastic lesions.[8] Endoscopy remains an essential tool for assessing and monitoring IBD.[9] It is crucial for diagnosing IBD patients, determining disease activity, and assessing disease progression and treatment response.[10] Complicated IBDs often exhibit a lower response rate to medical therapy; therefore, endoscopy is often included as a component of therapeutic management. In addition to the growing awareness of the endoscopic management of IBD-related strictures, there is rising interest in operative endoscopy as an essential tool for managing dysplastic lesions associated with IBD. Dysplastic lesions can be managed endoscopically, as summarized by the most recent guidelines.[10] The main aim of this review was to outline the advantages and disadvantages of therapeutic endoscopic techniques in the treatment of IBD.

Strictures in IBD: from diagnosis to therapy

The natural history of CD and UC has been improved by modern medical therapies, especially when initiated before bowel dam-

Keywords: Endoscopic treatment; IBD-related strictures; Dysplasia; Endoscopic resection; EMR; ESD; Stricturotomy.

[*]**Correspondence to:** Ferdinando D'Amico, Department of Gastroenterology and Endoscopy, IRCCS Ospedale San Raffaele and Vita-Salute San Raffaele University, Via Olgettina 60, Milan 20132, Italy. ORCID: https://orcid.org/0000-0002-8591-6995. Tel: +39-0226432069, Fax: +39-0282242591, E-mail: damico.ferdinando@hsr.it

[#]These authors contributed equally to this article.

How to cite this article: Barchi A, Bencardino S, Fasulo E, D'Amico F, Zilli A, Fiorino G, *et al*. Endoscopic Treatment Approaches for Inflammatory Bowel Diseases: Old Friends and New Weapons. *J Transl Gastroenterol* 2024;2(2):76–89. doi: 10.14218/JTG.2023.00096.

Table 1. Classification of strictures in inflammatory bowel diseases (IBD)

Criteria	Classification
Etiology	Primary *vs* secondary (anastomotic); benign *vs* malignant
Number	Single *vs* multiple
Degree	High-grade *vs* low-grade
Shape	Web-like *vs* spindle-shaped, circumferential *vs* asymmetric
Length	Short *vs* long
Location	Esophagus, pylorus, small bowel, ileocecal valve anastomosis, colon, rectum, anus
Associated conditions	Fibrosis, edema, proximal dilation, ulceration, fistula with or without abscess, angulated, prior stricturoplasty

age becomes irreversible and fibrosis develops.[1] The mechanisms underlying excessive extracellular matrix deposition and fibrosis development in the gut are similar to those in other organs. Tissue healing involves a regulated response mediated by mesenchymal cells and excessive extracellular matrix, which restores damaged tissue integrity.[11,12] Conversely, persistent upregulation of tissue healing mechanisms, driven by an increase in mesenchymal-derived cells such as fibroblasts, myofibroblasts, and smooth muscle cells, leads to fibrosis.[13] Currently, there are no medications available that can prevent or reduce fibrosis, so patients with IBD continue to experience surgery, disability, and a lower quality of life due to strictures or narrowings.[14] According to population-based research, 20% of patients are likely to experience fibrostenosis within 20 years after a CD diagnosis.[14] Moreover, more than 30% of IBD patients experience this complication within 10 years of diagnosis.[3,4] Fibrosis affects not only CD but also UC.[15] Reports indicate that UC patients develop fibrosis-related colonic strictures in 2% to 11.2% of cases,[15] while the rate for those with colonic CD is around 8%.[15] Nearly 100% of colectomy specimens from UC patients have demonstrated some degree of fibrosis, even in the absence of a stricture, and the degree of fibrosis appears to be inversely correlated with the level of inflammation.[16] Given its predominant colonic localization, strictures in UC should be suspected to conceal colorectal cancer, even though the majority of UC-associated strictures (71% to 100%) are benign.[17] Disease duration and mucosal ulcer size are clinical characteristics associated with stricture formation in UC, but no controlled studies have been conducted in this area.[18] Stricture diagnosis usually arises from clinical suspicion in the presence of IBD-like symptoms or during hospitalization due to occlusions.[19] IBD patients frequently undergo cross-sectional imaging examinations, such as intestinal ultrasound, computerized tomography (CT), or magnetic resonance imaging (MRI), all of which have shown high sensitivity and specificity in detecting stenoses in the small intestine and colon (79% sensitivity and 92% specificity for intestinal ultrasound, 89% sensitivity and 99% specificity for CT, and 89% sensitivity and 94% specificity for MRI).[20] Pure fibrosis or pure inflammation is rare in strictures; instead, fibrosis and inflammation typically coexist to varying degrees.[21] Understanding the composition of strictures, in terms of the relative amounts of inflammation and fibrosis, is essential in determining whether anti-inflammatory or mechanical treatment is preferable.[22] Concerning cross-sectional imaging, MR enterography represents the most cutting-edge imaging method available today.[23] Indicators of inflammation on CT or MRI scans include the "comb sign" (vasa recta engorgement), thickening of the intestinal wall, and hyper-enhancement or lymphadenopathy. Therefore, if inflammation is identified, anti-inflammatory medical therapy could be advisable initially, as it reduces wall edema and intestinal wall thickness, and relieves obstructive symptoms.[24] The CREOLE study first evaluated the efficacy of adalimumab (an anti-tumor necrosis factor alpha monoclonal antibody) therapy in CD patients with symptomatic small bowel strictures, finding that 64% of patients did not require surgical intervention or endoscopic dilation by week 24.[25] On the other hand, mechanical therapies, such as endoscopic or surgical therapy, are primarily required to manage fibrotic strictures.[26] However, there are no validated techniques to discriminate between fibrotic and inflammatory strictures. In a comprehensive review, Paine and colleagues proposed a thorough classification for IBD strictures to better define the appropriate therapeutic option (Table 1).[27] The decision between endoscopic and surgical therapy depends on the severity of the disease, the nature of the stricture, concurrent IBD-related adverse events (such as abscesses), concomitant medical conditions, and local expertise.[27] The appropriate treatment strategy should be patient-tailored and approached by a multidisciplinary team consisting of gastroenterologists, radiologists, and colorectal surgeons.

Endoscopic balloon dilation strategy for CD-related strictures

Surgery has long been a viable option for treating CD-related strictures, particularly involving stricturoplasty or small bowel resection. However, due to its invasiveness and impact on quality of life, preventing surgery should be the primary goal of clinicians.[28] Endoscopic balloon dilation (EBD) is an effective technique for patients with CD strictures localized in the small bowel, ileocolonic, or colonic strictures.[29] EBD is typically best suited for accessible, short, and anastomotic strictures, whereas surgical techniques are better suited for multiple, endoscopically inaccessible strictures that are longer than 5 cm.[29] Two distinct EBD dilation catheters are used: an over-the-wire balloon or a through-the-scope balloon catheter. Due to their safety and ease of use, through-the-scope balloon catheters are typically preferred in most cases.[29] Since the balloons used for inflation are only around 5 cm long, stenoses that are 5 cm or longer are not appropriate for EBD. Additionally, intestinal strictures harboring fistulae or deep ulcers are contraindicated for EBD because of the high risk of perforation and bleeding during the procedure, with a complication rate of 10.3% for actively inflamed strictures.[28] Using an X-ray-guided dilator, the dilation process is carried out while the pressure of the inflated balloon is monitored. The endoscopist chooses the dilation diameter at their discretion.[30] There are two different techniques of EBD, depending on the patency of the stricture: retrograde dilation for passable strictures and anterograde dilation with wire-guided balloons for non-passable strictures. A retrograde procedure involves passing the endoscope through the stricture, inserting the balloon, withdrawing the endoscope, and then inflating the balloon. In anterograde dilation, the stricture is used to insert the guidewire into the

balloon, and then the wire exchange procedure is used to remove the wire while propelling the balloon forward.[27] According to a retrospective series, symptomatic improvement after EBD can be maintained, with 80%, 57%, and 52% of patients avoiding surgery at one, three, and five year(s), respectively.[29] EBD generally performs better for patients with small strictures (4 cm or fewer), no inflammation, a straight angle of stricture (in line with the intestinal lumen), and a restriction caused by a single surgical anastomosis without a nearby fistula opening.[31] There are no published guidelines concerning technical details of EBD, such as preferable balloon size, duration of balloon insufflation, anterograde versus retrograde dilation, wire-guided versus non-wire-guided techniques, intralesional injection of long-acting corticosteroids, and the use of fluoroscopy.[31] However, graded dilatation is advised to reduce the risk of bleeding and perforation.[31] In a systematic review by Hassan *et al*., which included 13 trials and 347 CD patients who underwent EBD for strictures, patients were dilated to 18 mm in five studies, 20 mm in six studies, and 25 mm in two studies. Regardless of balloon size, the reported percentage of successful gastroscope or colonoscope passage following dilation ranged from 45% to 100%.[31] Numerous investigations have shown that EBD results in short-term symptomatic improvement between 71% and 100%,[32–34] and overall long-term improvement (defined as surgery-free follow-up) between 50% and 100%.[34–36] Symptomatic recurrence, however, has been observed in 13% to 100% of cases.[37] The timing between dilation sessions varied, with some patients requiring only one dilation and others needing several sessions.[37] Different studies have reported mean intervals between dilations for patients needing repeated dilations, ranging from 5.7 to 32 months.[32,38] A recent meta-analysis reported the symptomatic (defined as obstructive symptom-free status at the end of follow-up) and technical response of EBD in CD.[39] In line with previous literature, the symptomatic response rate was 70.2%, but 75% of patients needed surgery within five years of EBD.[39] Moreover, the rates of adverse events (AEs), including perforation and/or bleeding, were higher than previously reported (6.4%). From the pooled analysis, the most popular and efficient balloon size appears to be 20 mm. The mean procedural time was 2 m, which may be linked to better results (symptomatic response 70.6%, technical response 92.2%).[39] The three-step strategy of increasing the diameter of dilation from one session to the next was the most frequently reported management.[39] EBD has been compared with ileocolic resection in the management of primary ileocolic strictures in CD patients in a retrospective study by Lan *et al*., identifying post-procedure morbidity and surgery-free survival as the main outcomes.[40] Although EBD appeared to be initially effective with few adverse outcomes (4.7%), salvage surgery was frequently required (44.4% of cases).[40] Initial ileocolic resection was linked to a longer surgery-free interval (11.1–0.6 *vs*. 5.4–0.6 y; $p < 0.001$), although it was also associated with higher morbidity (32.2%; $p < 0.0001$).[40] Regarding primary versus anastomotic strictures in CD, the latter appeared to respond to EBD more favorably than de novo primary strictures.[41] Atreja and colleagues comprehensively explored the effectiveness of EBD in primary versus anastomotic CD strictures to prevent surgery, reporting that EBD was equally effective and safe with high technical success and a low rate of complications (0.93% per procedure, 3.1% per patient).[13] CD strictures located in the small intestine distal to the terminal ileum are often effectively accessible only through device-assisted enteroscopy, such as balloon-assisted enteroscopy.[42,43] In a systematic review and meta-analysis of 18 studies with 463 patients and 1,189 EBD procedures, individuals with active disease in the small intestine exhibited reduced short-term clinical efficacy (odds ratio 0.32; 95% confidence interval 0.14–0.73, $p = 0.007$). Additionally, patients with concurrent active disease in the small and/or large intestine faced an elevated risk of progressing toward surgery (hazard ratio 1.85; 95% confidence interval 1.09–3.13, $p = 0.02$ and hazard ratio 1.77; 95% confidence interval 1.34–2.34, $p < 0.001$, respectively). Nevertheless, up to two-thirds of patients may require subsequent re-dilation or surgical intervention.[13] Therefore, the most recent European Society of Gastrointestinal Endoscopy guidelines recommend the use of device-assisted enteroscopy in CD if small-bowel endotherapy is indicated and EBD therapy is feasible.[44] EBD with balloon-assisted enteroscopy can be used with both transoral and transanal approaches when there are numerous strictures dispersed along an extensive segment of the small bowel.[43]

In some settings, surgery could be the preferable option over endoscopy, such as short intervals between endoscopy treatments (<three months), multiple stenoses (>3) in close proximity, long stenosis (>4–5 cm), deep ulcerated strictures, strictures in the deep small bowel, concurrent fistula/abscess, and pre-stenotic luminal dilation (Table 2).[24,27] A flow chart on the indications for surgery or endoscopic treatment is presented in Figure 1. The most recent practical guidelines advised EBD as the primary treatment for endoscopically manageable strictures, given that the benefits outweigh the risks (Fig. 2).[45] Treatment of asymptomatic strictures may delay or avoid the onset of symptomatic strictures. It may also be useful in the assessment of postoperative recurrence after resection and anastomosis or in detecting neoplasia in the bowel proximal to the stricture.[45]

Endoscopic dilation management of UC-related strictures

Regarding UC, available data mainly address post-surgical complications such as strictures in patients with ileal pouch-anal anastomosis (IPAA), which occur in 5% to 38% of cases after proctocolectomy.[46] IPAA is frequently performed,[47] and a continent ileostomy (Kock pouch), which involves creating an internal pouch from the small intestine connected to the abdominal wall by a special valve, can be made for patients with impaired anal sphincter function.[46] Strictures at the pouch-anal anastomosis (pouch outlet), pouch inlet (junction between the pouch body and afferent limb), or at the ileostomy site (especially at the end-to-end ileostomy closure location) are frequently observed in patients with IPAA.[48] Despite being less effective than surgical stricturoplasty, EBD has become a common treatment in this setting because of its minimally invasive nature.[49] There are no technical differences from EBD in CD. The technical success rate, defined as the endoscope passing through without resistance, has been reported to be 97.8% in a prospective study by Shen *et al*. involving 150 patients undergoing 646 dilations for ileal pouch-anal anastomosis strictures. The five-year pouch retention rate was reported to be 97%.[50] Moreover, the efficacy and safety of EBD in IPAA strictures were demonstrated by Fumery *et al*. In this study, they analyzed 20 patients with IPAA complicated by stricture formation (mainly at the anal-pouch anastomosis [87%]). They reported a clinical improvement of 95% after EBD treatment, with only one failure after three years of follow-up.[51] Due to the limited evidence of EBD in UC-related strictures, larger cost-effectiveness studies are warranted to establish its role over other endoscopic techniques.

Endoscopic stenting in IBD

The positioning of endoscopic stenting in IBD strictures is far from standardized. Self-expanding metal stents (SEMS), both fully covered and partially covered, are wrapped with metal mesh cylinders

Table 2. This table provides a summary of the criteria used to determine the selection of endoscopic, including device-assisted enteroscopy (DAE), or surgical treatment for structuring Crohn's disease (CD)

Description		Favor endoscopy	Favor surgery	Consider DAE
Patient factor	Elderly	✓		
	Comorbidities	✓		
Disease factor	Upper GI	✓		
	Small bowel			✓
	Anorectal	✓		
	Stoma/risk for short gut	✓		
	Prior stricturoplasty	✓		
	Short interval between endoscopy treatments (<three months)		✓	
	Short interval between surgeries (<10 years)	✓		
Stricture factors	Multiple (>3) in close proximity		✓	✓
	Long (>4–5 cm)		✓	
	Deep ulcerated strictures		✓	
	Strictures in the deep small bowel		✓	
	Concurrent fistula/abscess		✓	
	Strictures of diverted bowel	✓		
	Prestenotic luminal dilation		✓	
Local Expertise	Endoscopy	✓		
	Surgery		✓	

The tools to rely on are the factors associated with patients, stenosis and disease as well as the location of the stenosis and local expertise.

that exert the force needed to expand strictures and are used in benign or malignant diseases.[51,52] SEMS are indicated for treating strictures longer than 4 cm, those too complex for EBD, and EBD-resistant stenoses.[28] A detailed examination, using both radiology and endoscopy, of disease activity, the extent and location of stenosis, and the existence of regional complications (fistulas and abscesses), is necessary prior to the endoscopic implantation of an enteral stent. While a particular level of activity does not rule out stent implantation, abscesses and fistulas are indeed contraindications.[53] Since all stents exhibit some degree of shortening, ranging from 5% to 40%, the selected stent should be at least 3–4 cm longer than the obstruction to allow a sufficient free margin on either side of the stricture.[53] Fluoroscopy should be used during stent implantation to simultaneously maintain endoscopic and radiologic control. If fluoroscopy is not available, dilation beforehand is advisable to guarantee correct stent placement, although this might later promote early stent migration.[53] The stenosis must be reached with the endoscope before the stent can be inserted, typically done with a long, soft guidewire, such as a hydrophilic biliary guidewire. Accurately identifying where the wire enters an air-filled distal bowel loop is crucial. After that, the wire can be crossed using a catheter or a Fogarty balloon. Before the stent is inserted, radiographic contrast must be given to ensure the correct location and luminal patency. To evaluate total patency, contrast can be introduced into the stent. To stop early migration, clips can be optionally placed at the distal end of the stent. It is essential to refrain from passing through the stent once it has been inserted, as doing so may result in its dislodgement.[53] The first pilot study investigating the use of SEMS in CD-related strictures showed unimpressive results, with only one out of 11 patients treated able to remove the stent at the scheduled time and achieve symptomatic long-term remission.[54] A detachable covered stent is usually utilized in CD patients.[54] Stent migration (6.5% to 13% for PCSEMS) and perforation are the primary safety issues.[55,56] Fully-covered self-expandable metal stents (FCSEMS) are easier to remove since they do not cling to mucous membranes, but this raises the risk of distal migration. On the other hand, PCSEMS can prevent potential distal migration, but their removal is more challenging due to the higher likelihood of mucosal adhesion. Biodegradable stents are a type of polydioxanone, naturally degrading within 10 to 12 weeks. Biodegradable through-the-scope stents are not available, and their use is limited to distal intestinal tubes, such as the recto-sigmoid region.[57] Additionally, the effect of polydioxanone degradation on inflamed tissues is unknown. Although there is not enough data to make a recommendation based on the relatively limited experience with biodegradable stents, their removal is not essential, so their effects might last longer.[58] However, currently available biodegradable stents have poor effectiveness in treating other strictures and may cause a hyperplastic reaction in CD patient's mucosa. The current approach is unappealing due to the technical challenges involved in inserting a biodegradable stent through the endoscope channel, which can make access to proximal stenosis difficult or impossible.[53] Lumen-apposing metal stents (LAMS) consist of metallic bi-flanged wide-lumen stents with a one-step delivery system that has revolutionized endoscopic treatment in several fields.[59] They are especially helpful in treating short, side-to-side ileocolonic anastomosis strictures.[60] Axelrad and colleagues described a case of a CD patient with a 1 cm stenosis near the anal verge, refractory to several EBD sessions, treated with LAMS placement with immediate symptom relief.[60] Other similar case reports have been

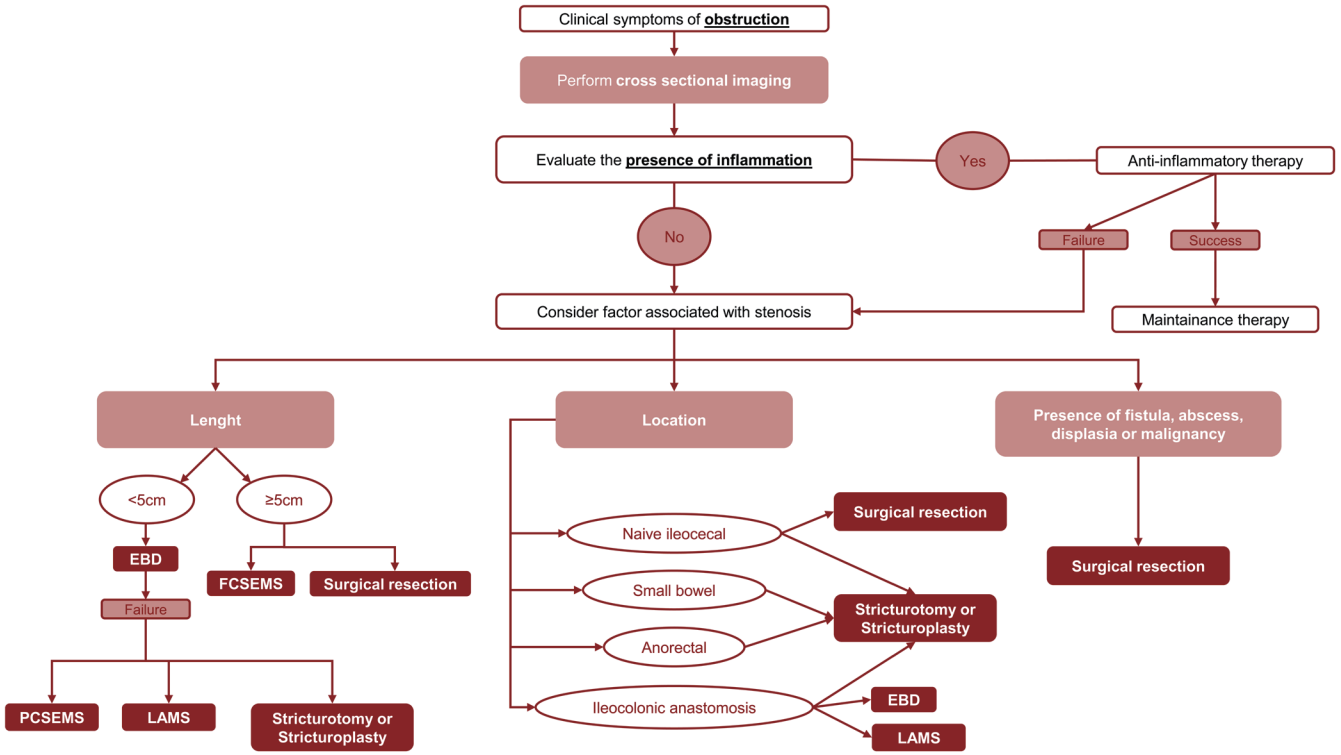

Fig. 1. Flow chart on diagnostic and interventional decision-making of IBD-related stenosis. DAE, device-assisted enteroscopy; EBD, endoscopic balloon dilatation; FCSEM, fully covered self-expanding metal stents; IBD, inflammatory bowel diseases; LAMS, lumen-apposing metal stent; PCSEMS, partially covered self-expanding metal stents.

described more recently,[61] even concerning the use of LAMS in treating post-EBD complications such as perforation events.[62] In conclusion, FCSEMS could be useful for longer stenoses, while PCSEMS might be better for shorter ones.[56] Due to the stent's adhesion to the bowel's mucous membrane, the best timing for stent removal is crucial. According to available data, it appears that the optimal course of treatment is the insertion of a fully covered stent for an average of four weeks (less time for PCSEMS rather than FCSEMS).[53] In a shorter amount of time, a hyperplastic mucosal response to a foreign body is improbable. Perforation has been described as a complication in malignant strictures but has never been documented in IBD patients receiving temporary stent treatment. To reduce this risk, the excessive angulation of the stent should be avoided, and flexible stents should be preferred.[53] Stents should be used when endoscopic treatment with EBD fails to improve the patient's condition and when EBD does not completely remove the necessity for surgery, either now or in the future (as a bridge to surgery).[53] The PRO-DILAT, an open-label, randomized trial, in-

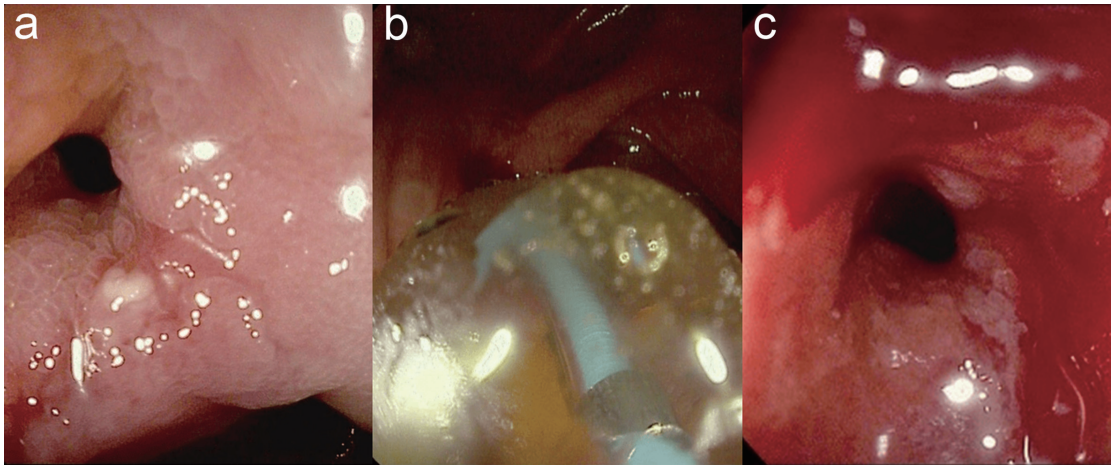

Fig. 2. Non endoscopically transitable ileo-ciecal stenosis in CD treated with wire guided endoscopic balloon dilatation. (a) Ileo-ciecal stenosis. (b) Balloon on guide. (c) Post dilatation mucosal trauma. (https://www.wjgnet.com/1948-5190/full/v2/i1/29.htm)

cluded patients with CD with obstructive symptoms and predominantly fibrotic strictures less than 10 cm in length, comparing EBD and FCSEMS.[63] The primary endpoint was survival free time due to symptomatic recurrence, showing that at one year, 51% of the 39 patients in the FCSEMS group and 80% of the 41 patients in the EBD group were free from needing any additional treatment (odds ratio [OR] 39 [95% CI 14–106]; p = 00061). This poor result was recently confirmed by a meta-analysis by Chandan *et al*., reporting a pooled clinical efficacy rate of 60.9% (95% CI, 51.6–69.5%) for stenting in CD, with a high rate of migrations (43.9%) and general AEs (15.7%).[58] However, the position of endoscopic stenting in CD strictures is still unclear, and more comparative well-designed studies are needed.

Endoscopic stricturotomy and stricturoplasty techniques

Endoscopic electroincision represents a precise method with complete control over the depth and topographic location of the targeted tissue cut.[37] Endoscopic stricturotomy (ESt) is an endoscopic technique, involving electrocautery incision of the tissue to open the stricture wall.[37] The ability to choose the orientation of the incision, circumferential, horizontal, or radial at the wall of the stricture reduces the risk of iatrogenic trauma, making ESt both useful and safe.[64] In contrast to ESt, which requires tissue incision and debridement to increase luminal patency, endoscopic stricturoplasty (Esx) involves tissue incision and the placement of endoclips.[64] The feasibility of ESt and ESx in CD-related strictures has been evaluated in recent years.[65] They are indicated for short stenoses (0.5–1.5 cm) and must be performed by expert endoscopists.[56] According to previous studies,[65,66] 23% to 50% of patients with CD and primary or anastomotic strictures who had endoscopic stricturoplasties or stricturotomies had previously received EBD treatment. In CD patients, endoscopic ESt and ESx seemed to be more effective for ileocolonic anastomotic strictures than EBD, especially for fibrotic anastomotic, anal, or distal bowel strictures.[45] The clinical effectiveness of ESt compared to EBD was explored by Lan and colleagues, detecting a higher technical success (100% versus 89.5%, p = 0.25) and better outcomes in terms of the need for surgical intervention after endoscopy (9.5% versus 33.5%, p = 0.03) for ESt compared to EBD.[66] ESt and ESx seem reasonable for short-length (<3 cm) strictures refractory to other treatments.[65] Although there may be a higher possibility of bleeding with ESt and ESx compared to EBD (8.8% *vs*. 0%), there is a lesser risk of procedure-related perforation (0% *vs*. 1.1 %).[41,65,66] Additionally, for primary ileocolonic strictures and ileocolonic anastomosis strictures in CD, ESt and ESx have shown efficacy comparable to surgical bowel resection.[66] ESt also appears feasible with device-assisted enteroscopy for small bowel strictures associated with CD.[67] Current guidelines suggest standardizing ESt and ESx, either in nomenclature or technical aspects, for EBD-refractory non-passable strictures, especially in the anorectal area.[45]

Anti-inflammatory agents' sub-mucosal injection as an aiding tool in IBD-related strictures

The injection of anti-inflammatory agents as an adjunct to endoscopic management of IBD-related strictures is controversial. East JE *et al*. injected intralesional long-acting steroids into CD strictures and initially reported even worse outcomes when triamcinolone 40 mg was injected into the stricture tissue.[68] A randomized controlled trial in a pediatric cohort, however, demonstrated the superiority of long-acting steroid injection versus placebo in CD-related EBD-treated strictures, both in terms of time free of redilation (p = 0.04) and time free of surgery after EBD (p = 0.02).[69] Conversely, a prospective study including thirteen adult CD patients was stopped early when it was discovered that the injection of triamcinolone 40 mg resulted in a need for redilation sooner than with a placebo.[68] This study only evaluated anastomotic strictures that may have been present for a long time (eight to 30 years after surgery). The multicenter design may have also impacted the variability of endoscopic techniques used at different centers.[68] Nevertheless, the majority of the data for steroid injection in CD-related strictures remain retrospective and uncontrolled. A systematic review demonstrated no significant difference in terms of EBD timing and clinical efficacy with the addition of steroid injection at the level of the stricture.[68] Antitumor necrosis factor intralesional injection, particularly Infliximab, has recently expanded the field of stricture therapy and generated discussion about its purpose.[70] However, its efficacy is still unclear, so its use is not currently recommended, and further studies are necessary.[45] There is no data about other biologics such as Vedolizumab and Ustekinumab.

Endoscopic approach of dysplastic lesions in IBD

Visible and invisible dysplasia in IBD: Management and indications

Chronic inflammatory insult in IBD has the potential to cause dysplasia and lead to CRC.[9] The risk of CRC is increased in IBD compared to the general population, broadly by twofold.[71] Endoscopic surveillance remains the main tool to prevent CRC occurrence in IBD.[71] Surveillance colonoscopy is generally recommended eight years after disease onset by international guidelines.[71] The main risk factors for CRC development include disease extent, longer disease duration, family history of CRC, backwash ileitis, strictures, and pseudopolyps.[72] The presence of one or a combination of these risk factors serves as a signal to reduce the follow-up interval for colonoscopy to two-three years.[72] The presence of Primary Sclerosing Cholangitis (PSC) further shortens this time to yearly colonoscopy.[72] Dysplastic lesions in IBD are rare but represent a real challenge for the specialist, requiring high expertise and a multidisciplinary approach to guide decision-making.[73] Dysplasia can be broadly divided into flat non-visible dysplasia and visible elevated dysplastic lesions, previously termed dysplasia-associated lesions or masses (DALMs) by a pilot study of Blackstone *et al*.[74] Agreement has not been reached concerning the pathological outline of DALMs in respect to sporadic colonic polyps or flat lesions, with the definitive agreement on defining DALM when a lesion grew on inflamed mucosa.[75] Otherwise, the two entities seemed indistinguishable. The main divergence on the topic was whether to perform a surveillance colonoscopy after DALM resection or to indicate prophylactic colectomy due to the high risk of colon cancer.[76] The International Consensus Recommendations on Surveillance for Colorectal Endoscopic Neoplasia Detection and Management in Inflammatory Bowel Disease Patients (hereinafter referred to as SCENIC recommendations) developed a consensus, gathering gastroenterologists and endoscopists with expertise in IBD, finally agreeing on the definitive withdrawal of DALM terminology.[76] The current guidelines recommend an adapted version of the Kyoto-Paris classification for colonic lesion description: polyps are defined as lesions raising 2.5 mm above the mucosal surface, while below that limit, a lesion is classified as non-polypoid (flat elevated, flat, or flat depressed).[77,78] Dysplasia occurring at random biopsy sampling must be addressed as "non-visible dysplasia".[78] The American Gastroenterological Association provided a clear management flow chart of dysplastic lesions in IBD

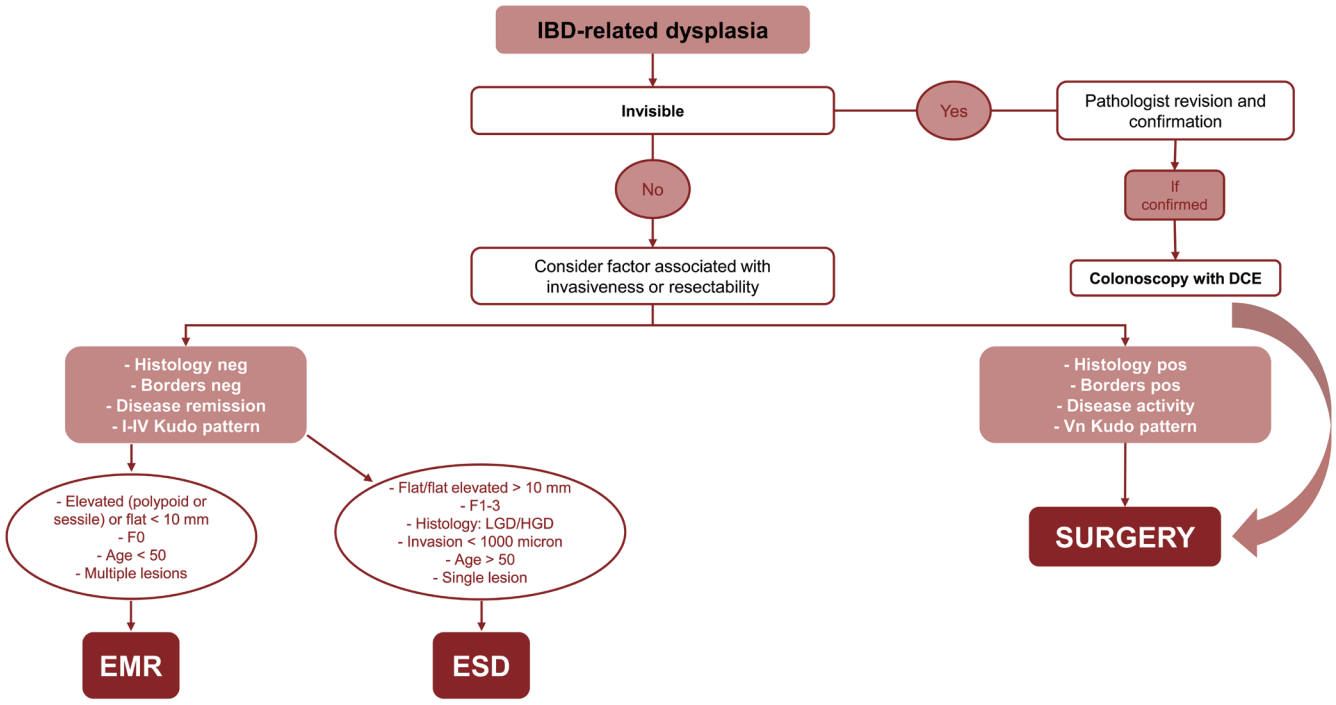

Fig. 3. Practical flow chart for the management of visible Inflammatory Bowel Diseases (IBD)-related dysplastic lesions. Management of IBD-related dysplasia: in cases of invisible dysplasia report on random biopsies, second-look pathologist confirmation and colonoscopy with Dye-spread Chromoendoscopy (DCE) to localize the dysplasia. In cases of visible polypoid/sessile or flat <10 mm lesions, without fibrotic signs (F0), age <50 years, without endoscopic or histologic features of invasiveness may undergo endoscopic mucosal resection (EMR), while in cases of larger (>10 mm) flat lesions, with low or high grade dysplasia (LGD/HGD) and age >50 years, endoscopic submucosa dissection (ESD) is the technique of preference. In all cases of invasiveness features, surgery is the only option.

(Fig. 3).[78] For visible dysplastic lesions that are endoscopically approachable, with clear margins, favorable histology, and <2 cm in size, endoscopic resection with post-operative surveillance follow-up based on histology is advisable.[78] For larger lesions (>2 cm) or with unfavorable characteristics, endoscopic treatment with close (three/six months) follow-up versus surgery has to be considered by a multidisciplinary team.[78] Concerning invisible dysplasia found during random biopsies, the main recommendation remains to ask for a second opinion confirmation by another pathologist, and once confirmed, colonoscopy with dye-spread chromoendoscopy should be repeated.[79]

Endoscopic approaches to elevated and flat dysplastic lesions in IBD

Visible elevated or flat dysplastic lesions can be approached endoscopically.[78] A systematic review and meta-analysis by Wanders and colleagues, based on 10 studies with more than 1,704 combined years of follow-up, showed a pooled overall risk of CRC development of 0.5% for polypoid dysplasia in long-standing UC.[80] In this context, general endoscopic guidelines recommend the standard endoscopic mucosal resection (EMR) technique for small polypoid lesions (specifically <20 mm) or flat lesions <10 mm that show no clear signs of dysplasia extension at the borders (Fig. 4).[80] The target of complete resection rate (R0) through "en bloc" resection is recommended for every lesion treated endoscopically.[81] Piecemeal resection is associated with a higher rate of recurrence and a lower R0 rate.[81] In IBD lesions, as in non-IBD contexts, the choice between EMR and endoscopic submucosal dissection (ESD) techniques is determined by the desired outcome. In a pilot prospective study by Hurlstone and colleagues, analyzing two cohorts of 46 and 89 type 0-I and type 0-II lesions (including seven type 0-II lesions over 10 mm in size, namely Laterally Spreading Tumors) in long-standing UC patients treated with EMR and standard polypectomy, no dysplastic lesions or CRC were detected during follow-up colonoscopies.[82] Recently, a retrospective evaluation by Nishio and colleagues, comprising 102 total lesions in 74 long-standing UC patients, with 46% of them being polypoid lesions, found that the overall R0 resection rate did not differ between EMR and ESD (75% *vs*. 86%, $p = 0.49$).[82] Challenges emerge when observing flat lesions larger than 20 mm in the colonic mucosa of long-standing IBD patients undergoing active surveillance, especially when these lesions lack a clear superficial pattern or distinct borders.[82] ESD, an endoscopic resection technique introduced in the early 2000s, enables the complete removal of dysplastic tissue from the deep submucosal layer through submucosal exposure by saline injection and subsequent dissection of the fibers with electrocautery knives.[82] Endoscopic guidelines advise performing ESD only when resection by snare-based techniques is infeasible or for colorectal lesions showing superficial submucosal invasiveness.[82] In IBD-related dysplastic lesions, ESD is gaining further recognition, moving from initial reports on its use as a complement to EMR to recent acceptance due to its higher *en bloc* and R0 resection rates.[83,84] ESD has always been considered the preferential technique for non-polypoid visible dysplastic lesions since the SCENIC recommendations were developed.[85] The first large series on ESD in IBD-related non-polypoid dysplasia reported a low rate of metachronous lesions after ESD performance (only seven out of 55

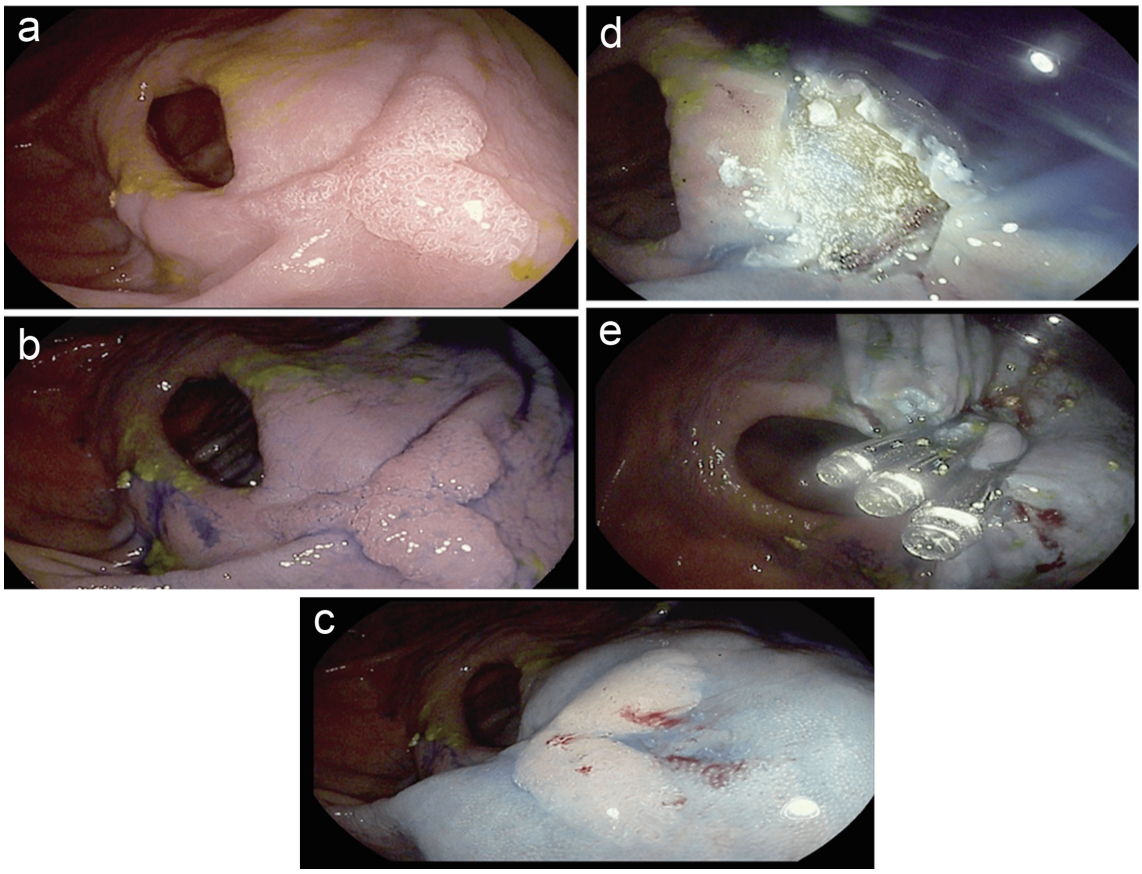

Fig. 4. Lateral spreading tumor (LST) with low grade dysplasia resected with "en bloc" EMR in a patient with longstanding CD with ileocecal resection and left hemicolectomy for adenocarcinoma. (a) Non granular LST of ileo-colonic anastomosis. (b) Dye-Based Chromoendoscopy with Methylene blue (c) Lifting of the LST with a solution of adrenaline glycerol and carmine indigo (d) resection margin after EMR. (e) Placement of 3 clips for prophylactic purposes.

ESDs performed).[84,86–88] A group of IBD experts recommended the safe application of ESD in UC patients aged over 50, exhibiting endoscopic remission. This is particularly suggested for single flat lesions larger than 10 mm without signs of deep invasion and displaying clear distinct borders.[86] A recent systematic review and meta-analysis by Chen *et al*., pooling data from seven large series on 202 IBD patients, detected an overall R0 rate and "en bloc" rate of 75% and 93% respectively.[86] Both the en bloc and R0 rates dropped to 86% and 70% when combining the results of the hybrid technique (a combination of EMR and ESD).[89] The hybrid technique consists of an initial dissection of the lesion combined with mucosectomy to complete the lesion removal. This kind of technique is burdened by higher rates of failure and recurrence, relegating it to salvage therapy in complex cases where ESD is not practicable.[90] A retrospective series of 25 patients (nine CD patients) reported an 88% R0 rate on a median lesion size of 30 mm, with three cases of adenocarcinoma occurrence at histology requiring surgery.[90] No AEs associated with ESD were reported. In a 19-month median post-ESD follow-up, only two cases of dysplasia (one low grade and one high grade) occurred.[91] These results were confirmed by a more recent series by Manta *et al*., with an even higher R0 rate (96.2%), no reported recurrence, and only two metachronous lesions.[91] The largest comparison between EMR and ESD for the treatment of colorectal dysplastic lesions in IBD was performed by Hirai and colleagues.[91] The authors described 142 lesions treated with EMR and 96 treated with ESD. ESD was performed for larger and flatter lesions compared to EMR. ESD showed a 6.3% perforation rate versus 0% for EMR. R0 rates were comparable (96% *vs*. 89%, $p = 0.08$) with no difference in recurrence rate at follow-up either.[92] The most significant burden of ESD was the presence of features threatening technical feasibility.[92] Endoscopic features indicative of reduced operability, such as location and size, along with submucosal fibrosis, were identified as primary predictors of incomplete resection and perforation, respectively, in a retrospective analysis by Hayashi *et al*.[92] Recently, a study by Nishio and colleagues found longer disease duration (≥10 years; odds ratio [OR] 6.11; $p < 0.03$) and the presence of scars in the mucosa surrounding the lesion (OR 39.61; $p < 0.01$) as independent risk factors for submucosal fibrosis in multivariate analysis.[93] Consequently, a higher rate of perforation was seen in F0/1 (mild fibrosis) and F2 (more severe fibrosis) ($p < 0.01$). Despite no difference in the R0 rate, en bloc rates were reported between the two fibrosis degrees.[93] Recurrence rate and overall CRC risk after endoscopic resection is another relevant controversy. A recent meta-analysis by Mohan *et al*. highlighted an overall pooled risk of CRC and high-grade dysplasia (HGD) after endoscopic resection of 2% for both outcomes, with a pooled risk of any lesion of 43%.[94] Therefore, it seems crucial to depict the actual risks and outcomes of managing HGD in IBD patients. Nishio and colleagues recently reported a non-statistical differential incidence ($p = 0.17$) of HGD/CRC recurrence on endoscopically resected HGD lesions in UC compared with LGD

ones (24.6% versus 13.7%). Therefore, the authors concluded that endoscopic management of HGD lesions in UC, with subsequent proper surveillance, is feasible.[94]

Advanced and upcoming endoscopic resection techniques

Recent advances in endoscopic resection techniques have significantly impacted the management of IBD-related lesions.[95] To address the technical challenges and elevated risk of perforation associated with ESD, which ranges from approximately 4% to 6% compared to 1–2% for EMR, and considering the lower R0 rates, often exceeding 90% in pooled analyses,[96] several recent large randomized controlled trials have validated the safety and feasibility of "underwater" EMR (U-EMR). This is particularly notable for removing lesions in the left/sigmoid colon.[97,98] U-EMR is basically an advanced endoscopic resection technique based on the principles of standard mucosectomy (submucosal injection to elevate the lesion and subsequent excision of the lesion using a loop) performed with prior instillation of water in the colon lumen to elevate the lesion away from the colon walls and increase loop stability, thereby facilitating the procedure.[99] The most recent meta-analysis by Chandan and colleagues reported a pooled relative risk of 1.25 ($p = 0.07$) in favor of U-EMR compared to c-EMR in managing colonic polyps, especially those below the 20 mm threshold.[99] In IBD-related lesions, Hosotani and colleagues recently highlighted in a case report how U-EMR achieved optimal R0 "en-bloc" resection of a flat dysplastic lesion in UC, which was previously biopsied and presented with submucosal fibrosis.[99] The floating effect created by water immersion, exposing the lesion and creating easier access to it, has demonstrated optimal results even in cases of severe fibrosis, such as lesions occurring on UC scars.[100] Another innovative tool in endoscopic resection is the use of traction devices. These devices expose the submucosal layer to complete ESD for complex lesions more completely and quickly.[101] In IBD, the use of nylon loops for traction of large flat lesions has been described in a pilot report.[102] A recent French report detailed the use of the A-TRACT-2 device, which creates traction on the margins of a large flat sigmoid lesion to the opposite colonic wall, fully exposing the submucosa to achieve R0 resection.[103] The feasibility of traction devices in removing lesions in a fibrotic environment must be assessed in larger observational and randomized trials.

Leaks and fistulas: Endoscopic management of worrisome complications in CD and UC

Anastomotic leakages and pouch sinus after IPAA in UC

Worrisome post-surgery complications in UC that can be treated endoscopically include leaks. Acute anastomotic leaks, defined as "full-thickness gastrointestinal defects" at the level of a surgical anastomosis,[104] can develop after IPAA in up to 15% of UC patients.[104] In other gastrointestinal tract locations, anastomotic leaks have been managed endoscopically for ages, using either endoclips or metallic stents with varying degrees of clinical success.[105] Since its introduction, endoscopic vacuum therapy (EVT) has proved to be a safe and effective minimally invasive treatment for these complications.[52] While the use of EVT in the rectum is still emerging, encouraging data have been released.[52] Early reports on EVT in treating leaks after IPAA have shown good efficacy of negative pressure application in the initial stabilization of the defect.[52] Typically, an acute anastomotic leak after IPAA requires surgical suturing at the anopouch.[52] Gardenbroek and colleagues, in a retrospective cohort study of IPAA patients, evaluated the application of short-interval EVT sessions leading to early surgical treatment compared to a direct standard surgical approach. They reported improved outcomes in terms of anastomotic healing ($p = 0.003$) and long-term functionality preservation of the pouch (93% vs. 86%).[52] Recently, the same study group proposed a flowchart for the management of IPAA-related anastomotic leaks, identifying a C-reactive protein level above 135 mg/L on the 4th post-operative day as a red flag, together with clinical suspicion of a leak. After CT evaluation, EVT-assisted early surgical suturing significantly increased pouch preservation ($p = 0.009$) compared to conventional management, likely due to early control of pelvic sepsis.[106] A persistent anastomotic leak can result in a presacral sinus, a harmful complication of IPAA. A new endoscopic technique called endoscopic sinusotomy (ESi) has been devised.[106] ESi is associated with a much lower incidence of procedure-related complications and seems to be more effective at addressing pouch sinus than surgical redo.[107] In the absence of standardized guidelines, ESi could therefore be advised as a first-line treatment for presacral sinus instead of surgical re-intervention.[107]

Fistulas and abscesses an endoscopic and surgical challenge

Fistulas are alarming complications in IBD, often leading to surgery in both CD and UC.[108] Fistulas can be enterocutaneous, enteroenteric, or perianal, with their management primarily being surgical.[108] Endoscopic fistulotomy is typically knife-directed, involving the complete opening of the fistula tract with an electrocautery knife and endoscopic clipping of the edges.[109] Kochhar and colleagues described 29 cases of fistulas in IBD patients treated with endoscopic fistulotomy, with the majority (48.2%) being pouch body or suture line fistulas after IPAA in UC, 24.1% being J-tip anastomosis fistulas, and 20% being perianal in CD. They reported an overall success rate of 89.6% in fistula closure.[109] Endoscopic clipping with over-the-scope clips (OTSCs) has demonstrated high clinical efficacy.[109] OTSCs are metallic clips mounted above a plastic cap attached to the tip of the scope. Suction applied by the scope grasps the target tissue into the cap, and the clip is released via a plastic releasing wheel, closing the defect through all wall layers.[110] A large series of 100 fistulas, including 11 from IBD patients, reported an overall clinical success rate of 79%, which dropped to 45% for IBD fistulas.[111] However, the OTSC closure of chronic tip-of-post-surgical 'J' leaks and transverse staple leaks appears to be safe and effective.[112] Recently, ESD has been evaluated as a potential technique for managing fistulas, sometimes combined with OTSCs.[113] A recent report by Wallenhorst and colleagues explored the feasibility of endoscopic dissection of a 25-mm fistulous tract in perianal CD with a presacral abscess collection. ESD was completed with the closure of the submucosal defect using an OTSC.[114] The management of abscesses is also crucial in IBD, particularly in CD. Abscess collections are usually drained surgically due to faster and more manageable outcomes.[115] On the other hand, some abscesses are not surgically manageable due to their location (abdominal or pelvic) or the patient's general condition.[116] In these cases, if the fistula orifice is endoscopically approachable, placing plastic double pigtail stents or setons is indicated.[117] Nevertheless, the endoscopic treatment of infectious fluid collections in IBD typically serves as a temporary measure, with radiologic or surgical interventions being the more routine and definitive approaches.[115] The applicability of advanced endoscopic treatments, like ESD and OTSC placement or endoscopic drainage, must be addressed in large trials to highlight cost-effectiveness.

Discussion

Endoscopic treatment in IBD is crucial, especially when fibrosis and CRC occur. Strictures are severe complications of IBD, increasing the risk of occlusion and worsening the outcomes of medical therapies. Several endoscopic approaches are available for stricture management. EBD is the most viable option, and numerous studies have demonstrated its efficacy in improving clinical outcomes and reducing the need for surgical resection. The latest practical guidelines recommend EBD as the preferred method for addressing short, non-passable, symptomatic strictures, when accessible and without pre-stenotic dilation. Its efficacy has been demonstrated in ileal strictures as well, whether assessed through enteroscopy, ileocolonic anastomosis, or even in the ileo-pouch or pouch-anal site following IPAA in ulcerative colitis. In addition to EBD, endoscopic stenting is another minimally invasive approach, specifically tailored for strictures that cannot be effectively treated with EBD. For longer strictures (>4 cm) or those that are difficult to approach with dilation or refractory to several dilation attempts, endoscopic stenting with FCSEMS and PCSEMS is advisable. The endoscopic approach to IBD-related strictures should be considered in all cases of complex settings, elderly patients with relevant comorbidities, low levels of active inflammation, and single or low numbers of endoscopically reachable strictures.[45] It is important to highlight the need for stricture biopsy sampling to clearly determine its origin.[45] Regarding endoscopic electroincision techniques, such as ESt and ESx, no clear consensus exists. Incising the stricture tissue allows a safe opening of the stenosis without the risk of perforation. Therefore, in centers with adequate endoscopic operational expertise, these advanced techniques could be helpful following the failure or partial success of EBD attempts.[45] Anorectal strictures, being easily accessible, are the best candidates for ESx and ESt.[45] Little data is available to clearly determine the role of intralesional injection of anti-inflammatory agents as an adjunct tool for EBD.[45] Future controlled studies are needed to improve our understanding of the feasibility and cost-effectiveness of non-invasive or minimally invasive approaches to IBD fibrotic evolution. Advanced endoscopic resection techniques have radically changed the landscape of dysplasia detection and treatment. Novel tools such as EMR and ESD enable IBD endoscopists to carefully resect even large dysplastic lesions without invasive characteristics, preventing unnecessary surgeries. Especially when performed by skilled endoscopists, ESD could be the preferred technique for managing single elevated dysplastic lesions in IBD patients.[83,84] This preference is attributed to its lower rates of recurrence and relatively contained adverse events compared to standard polypectomy or EMR.[86] Technological advances in scopes and devices are leading to the development of even more precise, rapid, and effective resection techniques, exemplified by U-EMR. Endoscopy has also recently developed in the treatment of fistulas and abscesses, which are worrisome inflammatory and infectious complications in both CD and UC.

Conclusion

Interventional endoscopy is transforming the management of complicated IBD cases. Nowadays, an operative endoscopy team specialized in managing IBD complications is necessary to ensure a consistent standard of care for IBD patients in dedicated IBD units. This is particularly crucial for addressing fibrotic stenoses, which may benefit from direct endoscopic intervention, and, more importantly, for managing dysplastic lesions associated with longstanding IBD. This level of expertise contributes to avoiding unnecessary surgical interventions, ultimately improving the quality of life and reducing morbidity in these susceptible patients.

Acknowledgments

None.

Funding

None.

Conflict of interest

SB, AB, EF, AZ, and TLP declare no conflict of interest. FDA has served as a speaker for Sandoz, Janssen, Galapagos, and Omega Pharma; he also served as an advisory board member for Ferring, Galapagos, AbbVie and Nestlé, and FF received consulting fees from Amgen, AbbVie, Janssen, and Pfizer. LPB has served as a speaker, consultant, and advisory board member for Merck, AbbVie, Janssen, Genentech, Mitsubishi, Ferring, Norgine, Tillots, Vifor, Hospira/Pfizer, Celltrion, Takeda, Biogaran, Boehringer-Ingelheim, Lilly, HAC-Pharma, Index Pharmaceuticals, Amgen, Sandoz, Forward Pharma GmbH, Celgene, Biogen, Lycera, Samsung Bioepis and Theravance, and GF served as a consultant for AbbVie, Amgen, Celltrion, Ferring, Galapagos, Janssen, Pfizer, Sandoz and Takeda, and SD has served as a speaker, consultant, and advisory board member for Schering-Plough, AbbVie, Actelion, Alfa Wassermann, AstraZeneca, Cellerix, Cosmo Pharmaceuticals, Ferring, Genentech, Grunenthal, Johnson and Johnson, Millennium Takeda, MSD, Nikkiso Europe GmbH, Novo Nordisk, Nycomed, Pfizer, Pharmacosmos, UCB Pharma and Vifor, and MA received consulting fees from Nikkiso Europe, Mundipharma, Janssen, AbbVie, and Pfizer.

Author contributions

Conceiving the article (FF), writing the article and creating tables and figures (AB, SB), critically reviewing the content of the paper and supervising the project (EF, FD, AZ, GF, LPB, TLP, MA, SD). The manuscript was approved by all authors.

Data sharing statement

No new data were generated or analyzed in support of this research.

References

[1] Furfaro F, Ragaini E, Peyrin-Biroulet L, Danese S. Novel Therapies and Approaches to Inflammatory Bowel Disease (IBD). J Clin Med 2022;11(15):4374. doi:10.3390/jcm11154374, PMID:35955992.
[2] Allocca M, Fiorino G, Bonifacio C, Peyrin-Biroulet L, Danese S. Non-invasive Multimodal Methods to Differentiate Inflamed vs Fibrotic Strictures in Patients With Crohn's Disease. Clin Gastroenterol Hepatol 2019;17(12):2397–2415. doi:10.1016/j.cgh.2019.04.025, PMID:30995529.
[3] Cosnes J, Cattan S, Blain A, Beaugerie L, Carbonnel F, Parc R, *et al*. Long-term evolution of disease behavior of Crohn's disease. Inflamm Bowel Dis 2002;8(4):244–50. doi:10.1097/00054725-200207000-00002, PMID:12131607.
[4] Louis E, Collard A, Oger AF, Degroote E, Aboul Nasr El Yafi FA, Belaiche J. Behaviour of Crohn's disease according to the Vienna classification: changing pattern over the course of the disease. Gut 2001;49(6):777–782. doi:10.1136/gut.49.6.777, PMID:11709511.
[5] Rao SS, Read NW. Gastrointestinal motility in patients with ul-

cerative colitis. Scand J Gastroenterol Suppl 1990;172:22–28. doi:10.3109/00365529009091905, PMID:2353168.
[6] Leighton JA, Shen B, Baron TH, Adler DG, Davila R, Egan JV, *et al*. ASGE guideline: endoscopy in the diagnosis and treatment of inflammatory bowel disease. Gastrointest Endosc 2006;63(4):558–565. doi:10.1016/j.gie.2006.02.005, PMID:16564852.
[7] Goulston SJ, McGovern VJ. The nature of benign strictures in ulcerative colitis. N Engl J Med 1969;281(6):290–295. doi:10.1056/NEJM196908072810603, PMID:5793199.
[8] Yamagata M, Mikami T, Tsuruta T, Yokoyama K, Sada M, Kobayashi K, *et al*. Submucosal fibrosis and basic-fibroblast growth factor-positive neutrophils correlate with colonic stenosis in cases of ulcerative colitis. Digestion 2011;84(1):12–21. doi:10.1159/000320773, PMID:21304240.
[9] Itzkowitz SH, Yio X. Inflammation and cancer IV. Colorectal cancer in inflammatory bowel disease: the role of inflammation. Am J Physiol Gastrointest Liver Physiol 2004;287(1):G7–17. doi:10.1152/ajpgi.00079.2004, PMID:15194558.
[10] Peyrin-Biroulet L, Sandborn W, Sands BE, Reinisch W, Bemelman W, Bryant RV, *et al*. Selecting Therapeutic Targets in Inflammatory Bowel Disease (STRIDE): Determining Therapeutic Goals for Treat-to-Target. Am J Gastroenterol 2015;110(9):1324–1338. doi:10.1038/ajg.2015.233, PMID:26303131.
[11] Latella G, Di Gregorio J, Flati V, Rieder F, Lawrance IC. Mechanisms of initiation and progression of intestinal fibrosis in IBD. Scand J Gastroenterol 2015;50(1):53–65. doi:10.3109/00365521.2014.968863, PMID:25523556.
[12] Latella G, Rogler G, Bamias G, Breynaert C, Florholmen J, Pellino G, *et al*. Results of the 4th scientific workshop of the ECCO (I): pathophysiology of intestinal fibrosis in IBD. J Crohns Colitis 2014;8(10):1147–1165. PMID:24731838.
[13] Bettenworth D, Bokemeyer A, Kou L, Lopez R, Bena JF, El Ouali S, *et al*. Systematic review with meta-analysis: efficacy of balloon-assisted enteroscopy for dilation of small bowel Crohn's disease strictures. Aliment Pharmacol Ther 2020;52(7):1104–1116. PMID:32813282.
[14] Spiceland CM, Lodhia N. Endoscopy in inflammatory bowel disease: Role in diagnosis, management, and treatment. World J Gastroenterol 2018;24(35):4014–4020. doi:10.3748/wjg.v24.i35.4014, PMID:30254405.
[15] de Dombal FT, Watts JM, Watkinson G, Goligher JC. Local complications of ulcerative colitis. Stricture, pseudopolyps and cancer of the colon and rectum. Am J Proctol 1967;18(3):198–201. PMID:6046369.
[16] Gordon IO, Agrawal N, Goldblum JR, Fiocchi C, Rieder F. Fibrosis in ulcerative colitis: mechanisms, features, and consequences of a neglected problem. Inflamm Bowel Dis 2014;20(11):2198–2206. doi:10.1097/MIB.0000000000000080, PMID:24892966.
[17] De Dombal FT, Watts JM, Watkinson G, Goligher JC. Local complications of ulcerative colitis: stricture, pseudopolyposis, and carcinoma of colon and rectum. Br Med J 1966;1(5501):1442–1447. doi:10.1136/bmj.1.5501.1442, PMID:5933046.
[18] Gumaste V, Sachar DB, Greenstein AJ. Benign and malignant colorectal strictures in ulcerative colitis. Gut 1992;33(7):938–941. doi:10.1136/gut.33.7.938, PMID:1644333.
[19] Hunt RH, Teague RH, Swarbrick ET, Williams CB. Colonoscopy in management of colonic strictures. Br Med J 1975;3(5979):360–361. doi:10.1136/bmj.3.5979.360, PMID:1156760.
[20] Panés J, Bouzas R, Chaparro M, García-Sánchez V, Gisbert JP, Martínez de Guereñu B, *et al*. Systematic review: the use of ultrasonography, computed tomography and magnetic resonance imaging for the diagnosis, assessment of activity and abdominal complications of Crohn's disease. Aliment Pharmacol Ther 2011;34(2):125–145. PMID:21615440.
[21] Adler J, Punglia DR, Dillman JR, Polydorides AD, Dave M, Al-Hawary MM, *et al*. Computed tomography enterography findings correlate with tissue inflammation, not fibrosis in resected small bowel Crohn's disease. Inflamm Bowel Dis 2012;18(5):849–856. PMID:21710535.
[22] Zappa M, Stefanescu C, Cazals-Hatem D, Bretagnol F, Deschamps L, Attar A, *et al*. Which magnetic resonance imaging findings accurately evaluate inflammation in small bowel Crohn's disease? A retrospective comparison with surgical pathologic analysis. Inflamm Bowel Dis 2011;17(4):984–993. PMID:20722053.
[23] Rimola J, Planell N, Rodríguez S, Delgado S, Ordás I, Ramírez-Morros A, *et al*. Characterization of inflammation and fibrosis in Crohn's disease lesions by magnetic resonance imaging. Am J Gastroenterol 2015;110(3):432–440. PMID:25623654.
[24] Rieder F, Zimmermann EM, Remzi FH, Sandborn WJ. Crohn's disease complicated by strictures: a systematic review. Gut 2013;62(7):1072–1084. doi:10.1136/gutjnl-2012-304353, PMID:23626373.
[25] Bouhnik Y, Carbonnel F, Laharie D, Stefanescu C, Hébuterne X, Abitbol V, *et al*. Efficacy of adalimumab in patients with Crohn's disease and symptomatic small bowel stricture: a multicentre, prospective, observational cohort (CREOLE) study. Gut 2018;67(1):53–60. PMID:28119352.
[26] Yaffe BH, Korelitz BI. Prognosis for nonoperative management of small-bowel obstruction in Crohn's disease. J Clin Gastroenterol 1983;5(3):211–215. doi:10.1097/00004836-198306000-00003, PMID:6306093.
[27] Paine E, Shen B. Endoscopic therapy in inflammatory bowel diseases (with videos). Gastrointest Endosc 2013;78(6):819–835. doi:10.1016/j.gie.2013.08.023, PMID:24139079.
[28] Chen M, Shen B. Endoscopic Therapy in Crohn's Disease: Principle, Preparation, and Technique. Inflamm Bowel Dis 2015;21(9):2222–2240. doi:10.1097/MIB.0000000000000433, PMID:26284298.
[29] Gustavsson A, Magnuson A, Blomberg B, Andersson M, Halfvarson J, Tysk C. Endoscopic dilation is an efficacious and safe treatment of intestinal strictures in Crohn's disease. Aliment Pharmacol Ther 2012;36(2):151–158. doi:10.1111/j.1365-2036.2012.05146.x, PMID:22612326.
[30] Hirai F. Current status of endoscopic balloon dilation for Crohn's disease. Intest Res 2017;15(2):166–173. doi:10.5217/ir.2017.15.2.166, PMID:28522945.
[31] Rieder F, Latella G, Magro F, Yuksel ES, Higgins PDR, Di Sabatino A, *et al*. European crohn's and colitis organisation topical review on prediction, diagnosis and management of fibrostenosing crohn's disease. J Crohns Colitis 2016;10(8):873–885. PMID:26928961.
[32] Stienecker K, Gleichmann D, Neumayer U, Glaser HJ, Tonus C. Long-term results of endoscopic balloon dilatation of lower gastrointestinal tract strictures in Crohn's disease: a prospective study. World J Gastroenterol 2009;15(21):2623–2627. doi:10.3748/wjg.15.2623, PMID:19496192.
[33] Ramboer C, Verhamme M, Dhondt E, Huys S, Van Eygen K, Vermeire L. Endoscopic treatment of stenosis in recurrent Crohn's disease with balloon dilation combined with local corticosteroid injection. Gastrointest Endosc 1995;42(3):252–255. doi:10.1016/s0016-5107(95)70101-x, PMID:7498692.
[34] Brooker JC, Beckett CG, Saunders BP, Benson MJ. Long-acting steroid injection after endoscopic dilation of anastomotic Crohn's strictures may improve the outcome: a retrospective case series. Endoscopy 2003;35(4):333–337. doi:10.1055/s-2003-38145, PMID:12664391.
[35] Breysem Y, Janssens JF, Coremans G, Vantrappen G, Hendrickx G, Rutgeerts P. Endoscopic balloon dilation of colonic and ileocolonic Crohn's strictures: long-term results. Gastrointest Endosc 1992;38(2):142–147. doi:10.1016/s0016-5107(92)70379-4, PMID:1568610.
[36] Couckuyt H, Gevers AM, Coremans G, Hiele M, Rutgeerts P. Efficacy and safety of hydrostatic balloon dilatation of ileocolonic Crohn's strictures: a prospective longterm analysis. Gut 1995;36(4):577–580. doi:10.1136/gut.36.4.577, PMID:7737567.
[37] Van Assche G, Vermeire S, Rutgeerts P. Endoscopic therapy of strictures in Crohn's disease. Inflamm Bowel Dis 2007;13(3):356–8, discussion 362-3. doi:10.1002/ibd.20091, PMID:17230480.
[38] Foster EN, Quiros JA, Prindiville TP. Long-term follow-up of the endoscopic treatment of strictures in pediatric and adult patients with inflammatory bowel disease. J Clin Gastroenterol 2008;42(8):880–885. doi:10.1097/MCG.0b013e3181354440, PMID:18645528.
[39] Morar PS, Faiz O, Warusavitarne J, Brown S, Cohen R, Hind D, *et al*. Systematic review with meta-analysis: endoscopic balloon dilatation for Crohn's disease strictures. Aliment Pharmacol Ther 2015;42(10):1137–1148. PMID:26358739.
[40] Lan N, Stocchi L, Ashburn JH, Hull TL, Steele SR, Delaney CP, *et al*. Outcomes of endoscopic balloon dilation vs surgical resection for primary ileocolic strictures in patients with crohn's disease. Clin Gas-

troenterol Hepatol 2018;16(8):1260–1267. PMID:29505909.
[41] Lan N, Stocchi L, Delaney CP, Hull TL, Shen B. Endoscopic stricturotomy versus ileocolonic resection in the treatment of ileocolonic anastomotic strictures in Crohn's disease. Gastrointest Endosc 2019;90(2):259–268. doi:10.1016/j.gie.2019.01.021, PMID: 30710508.
[42] Hirai F, Andoh A, Ueno F, Watanabe K, Ohmiya N, Nakase H, *et al*. Efficacy of Endoscopic Balloon Dilation for Small Bowel Strictures in Patients With Crohn's Disease: A Nationwide, Multi-centre, Open-label, Prospective Cohort Study. J Crohns Colitis 2018;12(4):394–401. PMID:29194463.
[43] Yamamoto H, Yano T, Araki A, Esaki M, Ohtsuka K, Ohmiya N, *et al*. Guidelines for endoscopic balloon dilation in treating Crohn's disease-associated small intestinal strictures (supplement to the Clinical Practice Guidelines for Enteroscopy). Dig Endosc 2022;34(7):1278–1296. PMID:36073310.
[44] Pennazio M, Rondonotti E, Despott EJ, Dray X, Keuchel M, Moreels T, *et al*. Small-bowel capsule endoscopy and device-assisted enteroscopy for diagnosis and treatment of small-bowel disorders: European Society of Gastrointestinal Endoscopy (ESGE) Guideline - Update 2022. Endoscopy 2023;55(1):58–95. PMID:36423618.
[45] Shen B, Kochhar G, Navaneethan U, Farraye FA, Schwartz DA, Iacucci M, *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(4):393–405. PMID:31954438.
[46] Kayal M, Ungaro RC, Riggs A, Kamal K, Agrawal M, Cohen-Mekelburg S, *et al*. Ileal pouch anal anastomosis for the management of ulcerative colitis is associated with significant disability. Clin Gastroenterol Hepatol 2022;20(4):e761–769. PMID:34033922.
[47] Lamb CA, Kennedy NA, Raine T, Hendy PA, Smith PJ, Limdi JK, *et al*. British Society of Gastroenterology consensus guidelines on the management of inflammatory bowel disease in adults. Gut 2019;68(Suppl 3):s1–106. PMID:31562236.
[48] Psillos AI, Catanzaro J. Ileal pouch anal anastomosis: an overview of surgery, recovery, and achieving postsurgical continence. Ostomy Wound Manage 2011;57(12):22–28. PMID:22156175.
[49] Wu XR, Mukewar S, Kiran RP, Remzi FH, Shen B. Surgical strictureplasty in the treatment of ileal pouch strictures. J Gastrointest Surg 2013;17(8):1452–1461. doi:10.1007/s11605-013-2216-3, PMID:23690206.
[50] Shen B, Lian L, Kiran RP, Queener E, Lavery IC, Fazio VW, *et al*. Efficacy and safety of endoscopic treatment of ileal pouch strictures. Inflamm Bowel Dis 2011;17(12):2527–2535. PMID:21351202.
[51] 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(6):1316–1320. doi:10.1093/ibd/izy006, PMID:29697797.
[52] Mandarino FV, Barchi A, D'Amico F, Fanti L, Azzolini F, Viale E, *et al*. Endoscopic Vacuum Therapy (EVT) versus Self-Expandable Metal Stent (SEMS) for Anastomotic Leaks after Upper Gastrointestinal Surgery: Systematic Review and Meta-Analysis. Life (Basel) 2023;13(2):287. doi:10.3390/life13020287, PMID:36836644.
[53] 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(3):E301–E308. doi:10.1055/s-0042-101786, PMID:27014743.
[54] Attar A, Maunoury V, Vahedi K, Vernier-Massouille G, Vida S, Bulois P, *et al*. Safety and efficacy of extractible self-expandable metal stents in the treatment of Crohn's disease intestinal strictures: a prospective pilot study. Inflamm Bowel Dis 2012;18(10):1849–1854. PMID:22161935.
[55] Axelrad JE, Lichtiger S, Sethi A. Treatment of Crohn's Disease Anastomotic Stricture With a Lumen-apposing Metal Stent. Clin Gastroenterol Hepatol 2018;16(3):A25–A26. doi:10.1016/j.cgh.2017.05.016, PMID:28529163.
[56] Loras C. Endoscopic Stenting for Inflammatory Bowel Disease Strictures. Gastrointest Endosc Clin N Am 2022;32(4):699–717. doi:10.1016/j.giec.2022.04.004, PMID:36202511.
[57] Lorenzo-Zúñiga V, Moreno-de-Vega V, Marín I, Boix J. Biodegradable stents in gastrointestinal endoscopy. World J Gastroenterol 2014;20(9):2212–2217. doi:10.3748/wjg.v20.i9.2212, PMID:24605020.
[58] Chandan S, Dhindsa BS, Khan SR, Deliwala S, Kassab LL, Mohan BP, *et al*. Endoscopic Stenting in Crohn's Disease-related Strictures: A Systematic Review and Meta-analysis of Outcomes. Inflamm Bowel Dis 2023;29(7):1145–1152. PMID:35880681.
[59] Bang JY, Varadarajulu S. Lumen-apposing metal stents for endoscopic ultrasonography-guided interventions. Dig Endosc 2019;31(6):619–626. doi:10.1111/den.13428, PMID:31050068.
[60] Shen B. Endoscopic management of inflammatory bowel disease-associated complications. Curr Opin Gastroenterol 2020;36(1):33–40. doi:10.1097/MOG.0000000000000600, PMID:31688337.
[61] Marcellier G, Lorenzo D, Hedjoudje A, Jais B, Bouhnik Y, Prat F. First treatment of Crohn's disease refractory anastomotic stricture with a lumen-apposing metallic stent suitable for colonoscopy. Endoscopy 2022;54(8):E409–E410. doi:10.1055/a-1559-1279, PMID:34496437.
[62] Olivier R, Scheer S, Albouys J, Schaefer M, Taibi A, Geyl S, *et al*. Rescue lumen-apposing metal stent to treat a perforation secondary to balloon dilation of a Crohn's disease stenosis. Endoscopy 2022;54(5):E197–198. PMID:33979862.
[63] Loras C, Andújar X, Gornals JB, Sanchiz V, Brullet E, Sicilia B, *et al*. Self-expandable metal stents versus endoscopic balloon dilation for the treatment of strictures in Crohn's disease (ProtDilat study): an open-label, multicentre, randomised trial. Lancet Gastroenterol Hepatol 2022;7(4):332–341. PMID:31078252.
[64] Reinglas J, Bessissow T. Strictures in Crohn's Disease and Ulcerative Colitis: Is There a Role for the Gastroenterologist or Do We Always Need a Surgeon? Gastrointest Endosc Clin N Am 2019;29(3):549–562. doi:10.1016/j.giec.2019.02.009, PMID:31078252.
[65] Lan N, Shen B. Endoscopic Stricturotomy with Needle Knife in the Treatment of Strictures from Inflammatory Bowel Disease. Inflamm Bowel Dis 2017;23(4):502–513. doi:10.1097/MIB.0000000000001044, PMID:28296818.
[66] Lan N, Shen B. Endoscopic Stricturotomy Versus Balloon Dilation in the Treatment of Anastomotic Strictures in Crohn's Disease. Inflamm Bowel Dis 2018;24(4):897–907. doi:10.1093/ibd/izx085, PMID:29546384.
[67] Yang H, Kurban M, Li M, Huang Z, Lin H, Hu P, *et al*. Device-assisted enteroscopy-based stricturotomy for small bowel strictures associated with Crohn's disease (with video). Gastroenterol Rep (Oxf) 2022;10:goac073. PMID:36523791.
[68] East JE, Brooker JC, Rutter MD, Saunders BP. A pilot study of intrastricture steroid versus placebo injection after balloon dilatation of Crohn's strictures. Clin Gastroenterol Hepatol 2007;5(9):1065–1069. doi:10.1016/j.cgh.2007.04.013, PMID:17627903.
[69] Di Nardo G, Oliva S, Passariello M, Pallotta N, Civitelli F, Frediani S, *et al*. Intralesional steroid injection after endoscopic balloon dilation in pediatric Crohn's disease with stricture: a prospective, randomized, double-blind, controlled trial. Gastrointest Endosc 2010;72(6):1201–1208. PMID:20951986.
[70] Hendel J, Karstensen JG, Vilmann P. Serial intralesional injections of infliximab in small bowel Crohn's strictures are feasible and might lower inflammation. United European Gastroenterol J 2014;2(5):406–412. doi:10.1177/2050640614547805, PMID:25360319.
[71] Beaugerie L, Itzkowitz SH. Cancers Complicating Inflammatory Bowel Disease. N Engl J Med 2015;373(2):195. doi:10.1056/NEJMc1505689, PMID:26154801.
[72] Maaser C, Sturm A, Vavricka SR, Kucharzik T, Fiorino G, Annese V, *et al*. ECCO-ESGAR Guideline for Diagnostic Assessment in IBD Part 1: Initial diagnosis, monitoring of known IBD, detection of complications. J Crohns Colitis 2019;13(2):144–164. PMID:30137275.
[73] Engelsgjerd M, Farraye FA, Odze RD. Polypectomy may be adequate treatment for adenoma-like dysplastic lesions in chronic ulcerative colitis. Gastroenterology 1999;117(6):1288–94, discussion 1488-91. doi:10.1016/s0016-5085(99)70278-7, PMID:10579969.
[74] Blackstone MO, Riddell RH, Rogers BH, Levin B. Dysplasia-associated lesion or mass (DALM) detected by colonoscopy in long-standing ulcerative colitis: an indication for colectomy. Gastroenterology 1981;80(2):366–374. PMID:7450425.
[75] Odze RD. Adenomas and adenoma-like DALMs in chronic ulcerative colitis: a clinical, pathological, and molecular review. Am J Gastroenterol 1999;94(7):1746–1750. doi:10.1111/j.1572-0241.1999.01201.x, PMID:10406230.

[76] Rubin PH. Adenomas in ulcerative colitis: endoscopic polypectomy or colectomy? Inflamm Bowel Dis 1999;5(4):304–305. doi:10.1097/00054725-199911000-00011, PMID:10579125.
[77] The Paris endoscopic classification of superficial neoplastic lesions: esophagus, stomach, and colon: November 30 to December 1, 2002. Gastrointest Endosc 2003;58(6 Suppl):S3–43. doi:10.1016/S0016-5107(03)02159-X, PMID:14652541.
[78] Murthy SK, Feuerstein JD, Nguyen GC, Velayos FS. AGA Clinical Practice Update on Endoscopic Surveillance and Management of Colorectal Dysplasia in Inflammatory Bowel Diseases: Expert Review. Gastroenterology 2021;161(3):1043–1051.e4. doi:10.1053/j.gastro.2021.05.063, PMID:34416977.
[79] Iannone A, Ruospo M, Wong G, Principi M, Barone M, Strippoli GFM, *et al*. Chromoendoscopy for Surveillance in Ulcerative Colitis and Crohn's Disease: A Systematic Review of Randomized Trials. Clin Gastroenterol Hepatol 2017;15(11):1684–1697.e11. doi:10.1016/j.cgh.2016.11.021, PMID:27890853.
[80] Wanders LK, Dekker E, Pullens B, Bassett P, Travis SP, East JE. Cancer risk after resection of polypoid dysplasia in patients with longstanding ulcerative colitis: a meta-analysis. Clin Gastroenterol Hepatol 2014;12(5):756–764. doi:10.1016/j.cgh.2013.07.024, PMID:23920032.
[81] Libânio D, Pimentel-Nunes P, Bastiaansen B, Bisschops R, Bourke MJ, Deprez PH, *et al*. Endoscopic submucosal dissection techniques and technology: European Society of Gastrointestinal Endoscopy (ESGE) Technical Review. Endoscopy 2023;55(4):361–389. PMID:36882090.
[82] Nishio M, Hirasawa K, Ozeki Y, Sawada A, Ikeda R, Fukuchi T, *et al*. An endoscopic treatment strategy for superficial tumors in patients with ulcerative colitis. J Gastroenterol Hepatol 2021;36(2):498–506. PMID:32754980.
[83] Smith LA, Baraza W, Tiffin N, Cross SS, Hurlstone DP. Endoscopic resection of adenoma-like mass in chronic ulcerative colitis using a combined endoscopic mucosal resection and cap assisted submucosal dissection technique. Inflamm Bowel Dis 2008;14(10):1380–1386. doi:10.1002/ibd.20497, PMID:18465807.
[84] Iacopini F, Saito Y, Yamada M, Grossi C, Rigato P, Costamagna G, *et al*. Curative endoscopic submucosal dissection of large nonpolypoid superficial neoplasms in ulcerative colitis (with videos). Gastrointest Endosc 2015;82(4):734–738. PMID:25982856.
[85] Laine L, Kaltenbach T, Barkun A, McQuaid KR, Subramanian V, Soetikno R, *et al*. SCENIC international consensus statement on surveillance and management of dysplasia in inflammatory bowel disease. Gastrointest Endosc 2015;81(3):489–501.e26. PMID:25708752.
[86] Soetikno R, East J, Suzuki N, Uedo N, Matsumoto T, Watanabe K, *et al*. Endoscopic submucosal dissection for nonpolypoid colorectal dysplasia in patients with inflammatory bowel disease: in medias res. Gastrointest Endosc 2018;87(4):1085–1094. PMID:29571773.
[87] Kinoshita S, Uraoka T, Nishizawa T, Naganuma M, Iwao Y, Ochiai Y, *et al*. The role of colorectal endoscopic submucosal dissection in patients with ulcerative colitis. Gastrointest Endosc 2018;87(4):1079–1084. PMID:29122603.
[88] Suzuki N, Toyonaga T, East JE. Endoscopic submucosal dissection of colitis-related dysplasia. Endoscopy 2017;49(12):1237–1242. doi:10.1055/s-0043-114410, PMID:28806821.
[89] Chen W, Zhang Y-L, Zhao Y, Yang A-M, Qian J-M, Wu D. Endoscopic resection for non-polypoid dysplasia in inflammatory bowel disease: a systematic review and meta-analysis. Surg Endosc 2021;35(4):1534–1543. PMID:33523273.
[90] Yamaguchi H, Fukuzawa M, Kawai T, Muramatsu T, Matsumoto T, Uchida K, *et al*. Significance of rescue hybrid endoscopic submucosal dissection in difficult colorectal cases. Clin Endosc 2023;56(6):778–789. doi:10.5946/ce.2022.268, PMID:37491992.
[91] Lightner AL, Vaidya P, Allende D, Gorgun E. Endoscopic submucosal dissection is safe and feasible, allowing for ongoing surveillance and organ preservation in patients with inflammatory bowel disease. Colorectal Dis 2021;23(8):2100–2107. doi:10.1111/codi.15746, PMID:34021968.
[92] Hirai M, Yanai S, Kunisaki R, Nishio M, Watanabe K, Sato T, *et al*. Effectiveness of endoscopic resection for colorectal neoplasms in ulcerative colitis: a multicenter registration study. Gastrointest Endosc 2023;98(5):806–812. doi:10.1016/j.gie.2023.05.058, PMID:37263363.
[93] Nishio M, Hirasawa K, Saigusa Y, Atsusaka R, Azuma D, Ozeki Y, *et al*. Predictors of severe submucosal fibrosis during endoscopic submucosal dissection in patients with ulcerative colitis: Retrospective cohort study. Dig Endosc 2024;36(2):172–181. PMID:37070407.
[94] Mohan BP, Khan SR, Chandan S, Kassab LL, Ponnada S, Asokkumar R, *et al*. Endoscopic resection of colon dysplasia in patients with inflammatory bowel disease: A systematic review and meta-analysis. Gastrointest Endosc 2021;93(1):59–67.e10. PMID:32592777.
[95] Iacucci M, Furfaro F, Matsumoto T, Uraoka T, Smith S, Ghosh S, *et al*. Advanced endoscopic techniques in the assessment of inflammatory bowel disease: new technology, new era. Gut 2019;68(3):562–572. PMID:30580249.
[96] Nishizawa T, Yahagi N. Endoscopic mucosal resection and endoscopic submucosal dissection: technique and new directions. Curr Opin Gastroenterol 2017;33(5):315–319. doi:10.1097/MOG.0000000000000388, PMID:28704212.
[97] Lenz L, Martins B, Andrade de Paulo G, Kawaguti FS, Baba ER, Uemura RS, *et al*. Underwater versus conventional EMR for nonpedunculated colorectal lesions: A randomized clinical trial. Gastrointest Endosc 2023;97(3):549–558. PMID:36309072.
[98] Rodríguez Sánchez J, Alvarez-Gonzalez MA, Pellisé M, Coto-Ugarte D, Uchima H, Aranda-Hernández J, *et al*. Underwater versus conventional EMR of large nonpedunculated colorectal lesions: A multicenter randomized controlled trial. Gastrointest Endosc 2023;97(5):941–951.e2. PMID:36572129.
[99] Choi AY, Moosvi Z, Shah S, Roccato MK, Wang AY, Hamerski CM, *et al*. Underwater versus conventional EMR for colorectal polyps: systematic review and meta-analysis. Gastrointest Endosc 2021;93(2):378–389. PMID:33068608.
[100] Takabayashi K, Kato M, Sasaki M, Iwao Y, Ogata H, Kanai T, *et al*. Underwater endoscopic mucosal resection for a sporadic adenoma located at severe longitudinal ulcer scars in ulcerative colitis. Endoscopy 2022;54(1):E30–31. PMID:33618370.
[101] Azzolini F, Mandarino FV, Barchi A, Biamonte P, Napolitano M, Esposito D, *et al*. Novel approach to endoscopic submucosal dissection using an additional working channel: A case report. Endoscopy 2022;54(11):E652–653. PMID:35120384.
[102] Yzet C, Masgnaux L-J, Rivory J, Wallenhorst T, Lupu A, Jacques J, *et al*. Endoscopic submucosal dissection of colonic residual laterally spreading tumor with adaptive traction: use of the additional loops to improve traction focally in difficult area. Endoscopy 2023;55(S01):E260–261. PMID:36427508.
[103] Masgnaux L-J, Pioche M, Rivory J, Rostain F, Jacques J, Fumery M, *et al*. Endoscopic submucosal resection with adaptative traction device: a new strategy to facilitate resection in patient with inflammatory bowel disease. Endoscopy 2023;55(S01):E466–467. PMID:36828022.
[104] Busweiler LAD, Wijnhoven BPL, van Berge Henegouwen MI, Henneman D, van Grieken NCT, Wouters MWJM, *et al*. Early outcomes from the Dutch Upper Gastrointestinal Cancer Audit. Br J Surg 2016;103(13):1855–1863. PMID:27704530.
[105] Dasari BVM, Neely D, Kennedy A, Spence G, Rice P, Mackle E, *et al*. The role of esophageal stents in the management of esophageal anastomotic leaks and benign esophageal perforations. Ann Surg 2014;259(5):852–860. PMID:24509201.
[106] Wasmann KA, Reijntjes MA, Stellingwerf ME, Ponsioen CY, Buskens CJ, Hompes R, *et al*. Endo-sponge Assisted Early Surgical Closure of Ileal Pouch-anal Anastomotic Leakage Preserves Long-term Function: A Cohort Study. J Crohns Colitis 2019;13(12):1537–1545. PMID:31054256.
[107] Lan N, Shen B. Endoscopic Treatment of Ileal Pouch Sinus. Inflamm Bowel Dis 2018;24(7):1510–1519. doi:10.1093/ibd/izy029, PMID:29668894.
[108] Bemelman WA, Baron TH. Endoscopic Management of Transmural Defects, Including Leaks, Perforations, and Fistulae. Gastroenterology 2018;154(7):1938–1946.e1. doi:10.1053/j.gastro.2018.01.067, PMID:29454791.
[109] Kochhar G, Shen B. Endoscopic fistulotomy in inflammatory bowel disease (with video). Gastrointest Endosc 2018;88(1):87–94. doi:10.1016/j.gie.2018.02.034, PMID:29501418.
[110] Piyachaturawat P, Mekaroonkamol P, Rerknimitr R. Use of the Over the Scope Clip to Close Perforations and Fistulas. Gastrointest En-

dosc Clin N Am 2020;30(1):25–39. doi:10.1016/j.giec.2019.08.002, PMID:31739966.
[111] Prosst RL, Joos AK. Short-term outcomes of a novel endoscopic clipping device for closure of the internal opening in 100 anorectal fistulas. Tech Coloproctol 2016;20(11):753–758. doi:10.1007/s10151-016-1537-0, PMID:27669711.
[112] Kochhar GS, Shen B. Endoscopic treatment of leak at the tip of the "J" ileal pouch. Endosc Int Open 2017;5(1):E64–E66. doi:10.1055/s-0042-121664, PMID:28180150.
[113] Barsic N, Rivory J, Monneuse O, Saurin JC, Ponchon T, Pioche M. Successful closure of a refractory rectal anastomotic fistula using endoscopic submucosal dissection combined with an over-the-scope clip. Endoscopy 2018;50(4):E99–E101. doi:10.1055/s-0044-100612, PMID:29396972.
[114] Wallenhorst T, Jacques J, Bouguen G, Pagenault M, D'Halluin P-N, Siproudhis L, *et al*. Successful Closure of a Rectal Fistula of Crohn's Disease Using Endoscopic Submucosal Dissection Combined With an Over-the-Scope Clip. Am J Gastroenterol 2019;114(9):1416. PMID:31397677.
[115] Shen B. Exploring endoscopic therapy for the treatment of Crohn's disease-related fistula and abscess. Gastrointest Endosc 2017;85(6):1133–1143. doi:10.1016/j.gie.2017.01.025, PMID:28153572.
[116] Kotze PG, Shen B, Lightner A, Yamamoto T, Spinelli A, Ghosh S, *et al*. Modern management of perianal fistulas in Crohn's disease: future directions. Gut 2018;67(6):1181–94. PMID:29331943.
[117] Sinh P, Shen B. Endoscopically placed guidewire-assisted seton for an ileal pouch-pouch fistula. Gastrointest Endosc 2015;82(3):575–576. doi:10.1016/j.gie.2015.04.020, PMID:26005014.