Essential updates 2020/2021: Colorectal diseases (benign)—Current topics in the surgical and medical treatment of benign colorectal diseases

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Abstract
The development of new drugs for inflammatory bowel disease (IBD) is remarkable, and treatment strategies using multiple agents and various techniques are required; however, the treatment strategy is likely to be complex. Therefore, appropriate evaluation of traditional surgical treatment strategies and accurate knowledge of the efficacy and limitations of novel treatments are required. Total infectious complications were found to be associated with the use of corticosteroids and anti-tumor necrosis factor-α agents, but not with immunomodulators, anti-integrin agents, and 5-aminosalicylic acid. Regarding surgical procedures for IBD, conceived anastomosis methods, including Kono-S for Crohn's disease stenosis, are associated with better outcomes than conventional techniques. Autologous cell transplantation for Crohn's fistulae has been shown to have a favorable outcome. Diverticulitis is increasing and will be treated more frequently in the future. Risk factors for the incidence of diverticulitis and differences in pathogenesis according to right or left side diverticulitis have been reported. Antibiotic therapy may be omitted for uncomplicated diverticulitis. Moreover, regarding surgical procedures, both bowel resection and anastomosis are associated with favorable short-term outcomes, higher stoma closure rate, and superior medical economy compared to Hartmann’s procedure. Risk factors for recurrence after diverticulitis surgery may provide better postoperative follow-up. In this review, we explore the current topics of colorectal benign diseases, focusing on IBD and diverticulitis, based on clinical trials and meta-analyses from 2020-2021. This review consolidates the available knowledge and improves the quality of surgical procedures and perioperative management for IBD and diverticulitis.

KEYWORDS
Crohn's disease, diverticulitis, inflammatory bowel disease, surgery, ulcerative colitis

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Inflammatory bowel disease (IBD) and diverticular disease are treated with a combination of medical and surgical therapy. The treatment and perioperative management of IBD and diverticulitis are major concerns among surgeons owing to the frequency and complexity of treatment and the severity of these diseases in clinical practice. Currently, there are more than 1 million patients with IBD in the United States and 2.5 million in Europe, with substantial costs for healthcare. Ulcerative colitis (UC) and Crohn's disease (CD) are two of the most common types of IBD. Infliximab was approved for the treatment of UC by the Food and Drug Administration in 2005 in the United States. Although the number of patients hospitalized for ulcerative colitis increased by over 70% in a nearly linear trend, the rate of patients who underwent total proctocolectomy decreased from 111.1 to 77.1 per 1000 UC admissions between 2002 and 2013, according to the Nationwide Inpatient Sample database. However, the majority of total proctocolectomies (69%) were performed within 24 hours of hospital admission. The development of recent medical therapeutic agents for IBD has been remarkable; however, in many cases, surgical treatment is still required.

Diverticulitis and diverticular bleeding require medical treatment for colon diverticulosis. Moreover, diverticular disease-related mortality increased in 58 nations from 1994 to 2016; during this period, the relevant mortality rate increased in 57% of nations, whereas it decreased in only 7% Mortality associated with diverticular disease is increasing worldwide. Surgical treatment for diverticulitis is likely to increase in the future.

Benign colorectal disease from 2018 to 2019 was reviewed in this journal. Several clinical trials and meta-analyses have revealed novel treatment strategies and outcomes of these treatments developed in 2020. In the present review, newly determined characteristics, prognostic markers, non-operative management, and surgical treatment strategies optimal for IBD and diverticulitis are reviewed in accordance with articles published in the last 2 years (2020-2021) (Figure 1).

### 2 | IBD

#### 2.1 | Association between IBD and other diseases

Arthritis, uveitis, pancreatitis, primary sclerosing cholangitis, and erythema nodosum are extraintestinal complications associated with IBD. Other diseases accompanying IBD have been reported in previous meta-analyses (Table 1). Inflammatory resorption of alveolar bones is caused by polymicrobial biofilm-mediated disease. Moreover, inflammatory processes are similar in periodontitis and IBD: the presence of periodontitis was associated with IBD, and periodontitis was strongly associated with both CD and UC. The prevalence of cutaneous symptoms, pyoderma gangrenosum, psoriasis, and herpes zoster infection was frequently revealed to be accompanied by IBD. Patients with IBD had an increased risk of

### FIGURE 1

Summary of key articles on clinical trials and meta-analyses of inflammatory bowel disease and diverticulitis
infection due to immune system dysregulation associated with the use of corticosteroids, immunosuppressant drugs, and anti- tumor necrosis factor (TNF)α. The risk of herpes zoster infection increased in CD (Risk ratio [RR]: 1.74, steroid users RR: 1.78). UC (RR: 1.40, steroid users RR: 1.99, anti-TNFα users RR: 2.29). Patients with IBD with a high risk of HZ infection may benefit from an HZ vaccine.9 Skin lesions are likely to be associated with IBD, and when treating patients with IBD, it is important to carefully examine the skin condition.

Anxiety and depression are commonly experienced by patients with IBD. The prevalence of corresponding symptoms was 32.1% and 25.2%, respectively, and the incidence of such was higher in patients with CD than in those with UC.9 Moreover, these symptoms were associated with CD-related surgery, the Crohn’s disease activity index, and corticosteroid use in patients with CD.10 Patients with IBD often experience anxiety and depression during the perioperative period, and appropriate psychological care may be beneficial in these patients.

### 2.2 Novel agents for IBD

The development of novel therapeutics for IBD is remarkable, so much so that it is difficult for general surgeons to understand all of them. The perioperative impact of these drugs will be discussed later; here, we enumerate novel therapeutic agents that were reported from 2020 to 2021. The results of the clinical trials are summarized in Table 2. Table S1 presents a summary of the approval status of novel agents.

### Table 2 Meta-analyses of characteristics and markers inflammatory bowel disease

| Focus                                      | Main results                                                                 | Reference                                      |
|--------------------------------------------|------------------------------------------------------------------------------|-----------------------------------------------|
| Periodontitis                               | The association between periodontitis and UC: present (OR 5.37)               | BMC Oral Health. 2020 Mar 12;20(1):67          |
| Periodontitis                               | The relation between periodontitis and IBD: OR: 2.10 (CD: 1.72, UC: 2.39)     | Biomed Res Int. 2021 Mar 12;2021:6692420       |
| Periodontal disease (PD)                   | The presence of PD was associated with IBD: OR: 2.78 (CD: 3.41, UC: 3.98)     | Acta Odontol Scand. 2021 Jul;79(5):344-35       |
| Pyoderma gangrenosum (PG)                  | The incidence of PG in IBD: OR: 0.4 to 2.6%. PG was associated with female gender (RR: 1.33), CD (RR: 1.19), erythema nodosum (RR: 9.28), and ocular extra-intestinal manifestation (RR: 4.55) | Dig Dis Sci. 2020 Sep;65(9):2675-2685          |
| Psoriasis                                  | The prevalence of psoriasis: CD 3.6% and UC 2.8%.                            | J Crohns Colitis. 2020 Mar 13;14(3):351-360   |
| Herpes zoster (HZ) infection               | Risk of HZ infection: CD: RR: 1.74 (steroid users RR: 1.78), UC: RR: 1.40 (steroid users RR: 1.99, anti-TNFα users RR: 2.29) IBD patients with high risk of HZ infection may benefit from an HZ vaccine | Eur J Clin Microbiol Infect Dis. 2020 Feb;39(2):219-227 |
| Rheumatoid arthritis                       | The association between IBD and the risk of RA: higher risk of RA among patients with IBD: RR 2.59 (CD, RR: 3.14, UC, RR: 2.29) | BMC Gastroenterol. 2020 Jun 17;20(1):192       |
| Elderly onset (EO) and adult onset (AO) IBD| EO = AO: 5-year risk of surgery, overall exposure to corticosteroids EO < AO: exposure to immunomodulators, biologic agents | Clin Gastroenterol Hepatol. 2020 Oct;18(11):2437-2447 |
| Anxiety and depression                     | Anxiety symptoms: 32.1%, depression symptoms: 25.2% CD > UC: anxiety symptoms (OR 1.2), depression symptoms (OR 1.2) | Lancet Gastroenterol Hepatol. 2021 May;6(5):359-370 |
| Opioid use                                 | Prevalence of opioid use: outpatients setting 21%, hospitalized 62% female (RR 1.20), depression (RR 1.99), substance abuse (RR 4.67), prior surgery (RR 2.33), biologic use (RR 1.36), steroid use (RR 1.41) | Clin Gastroenterol Hepatol. 2021 May;19(5):895-907.e4. |

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**TABLE 2** Meta-analyses of characteristics and markers inflammatory bowel disease

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| Periodontitis                               | The relation between periodontitis and IBD: OR: 2.10 (CD: 1.72, UC: 2.39)     | Biomed Res Int. 2021 Mar 12;2021:6692420       |
| Periodontal disease (PD)                   | The presence of PD was associated with IBD: OR: 2.78 (CD: 3.41, UC: 3.98)     | Acta Odontol Scand. 2021 Jul;79(5):344-35       |
| Pyoderma gangrenosum (PG)                  | The incidence of PG in IBD: OR: 0.4 to 2.6%. PG was associated with female gender (RR: 1.33), CD (RR: 1.19), erythema nodosum (RR: 9.28), and ocular extra-intestinal manifestation (RR: 4.55) | Dig Dis Sci. 2020 Sep;65(9):2675-2685          |
| Psoriasis                                  | The prevalence of psoriasis: CD 3.6% and UC 2.8%.                            | J Crohns Colitis. 2020 Mar 13;14(3):351-360   |
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| Rheumatoid arthritis                       | The association between IBD and the risk of RA: higher risk of RA among patients with IBD: RR 2.59 (CD, RR: 3.14, UC, RR: 2.29) | BMC Gastroenterol. 2020 Jun 17;20(1):192       |
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| Opioid use                                 | Prevalence of opioid use: outpatients setting 21%, hospitalized 62% female (RR 1.20), depression (RR 1.99), substance abuse (RR 4.67), prior surgery (RR 2.33), biologic use (RR 1.36), steroid use (RR 1.41) | Clin Gastroenterol Hepatol. 2021 May;19(5):895-907.e4. |

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The effects and tolerability of upadacitinib (a selective Janus kinase 1 inhibitor),11 ozanimod (targeting sphingosine-1-phosphate receptor subtypes 1 and 5),12 and mongersen (antisense oligodeoxynucleotide to Smad7)13 have been reported in clinical trials for CD.

Novel agents for UC, including etrasimod (selective sphingosine 1-phosphate receptor modulator),14 ozanimod,15 vedolizumab (inhibits the gut-selective α4β7 integrin),16 cobitolimod (activates Toll-like receptor 9),17 and budesonide (systemic corticosteroids)18 were reported from 2020 to 2021.
A meta-analysis showed that anti-TNF-α agents prevented endoscopic recurrence (RR: 0.34) but not clinical recurrence (RR: 0.60, not significant [n.s.]). Patients receiving anti-TNF-α therapy experienced more adverse effects than those who were not (RR: 1.75). Curcumin, as an adjuvant treatment for mesalamine, was proven to be effective in inducing clinical remission (odds ratio [OR]: 5.2), endoscopic remission (OR: 5.7), and endoscopic improvement (OR: 17.1), and was shown to be safe in UC.

2.3 | Non-drug treatment for IBD

Hyperbaric oxygen (HBO) and endoscopic balloon dilation are typically used for bowel obstruction caused by adhesions and stenosis, respectively. The favorable effects of these treatments on the symptoms associated with IBD are described below (Table 3 and 4).

A previous study reported patients with UC who were hospitalized for acute flares and were treated with HBO. The patients responded to HBO treatment on day 3 (required less rehospitalization or colectomy (0% vs 66%)). Moreover, patients with CD (n = 20) with high perianal fistula(s) who failed to respond to conventional treatment were treated with HBO, and the rates of clinical response and remission were 60% and 20%, respectively. In a meta-analysis, the response rate of HBO was 83.2% in UC and 81.9% in CD, while complete healing of the fistula was noted in 47.6% of fistulizing CD cases.

Endoscopic balloon dilation for small intestinal strictures in CD was evaluated in a previous meta-analysis. The technical success rate of endoscopic balloon dilation was 94.9%, major complication rate was 5.3%, symptom recurrence rate was 48.3%, and rate of re-dilation or surgery was 38.8% and 27.4%, respectively.

The safety and efficacy of fecal microbiota transplantation (FMT) for the treatment of Clostridioides difficile infections have been reported. The intestinal flora plays an important role in the progression of UC. FMT has been shown to change the production of mucosal-associated invariant T cell cytokines.

In a meta-analysis, the safety and effectiveness of FMT for treating UC was reported. Reportedly, FMT did not have a sustained effect on the treatment of UC patients unless the administration was repeated and prolonged. The efficacy of FMT depends on microbial interactions between the donor and recipient strains. The interactions between bacterial and metabolic pathways are also associated with the induction of remission. Future studies are needed so that a sustained therapeutic effect can be obtained after FMT treatment in UC patients.

2.4 | Surgical management for IBD

In patients with CD, stenosis and fistula are the main indications for surgery. The optimal time for surgery and surgical procedures are the main concerns of surgeons (Table 3 and 5). For patients with IBD, ileocecal resection and infliximab were similar to laparoscopic ileocecal resection and infliximab.

TABLE 2  Novel agents for inflammatory bowel disease

| Agents | Target | Endpoints | Main results | Reference |
|--------|--------|----------|--------------|-----------|
| Crohn's disease | | | | |
| Upadacitinib | Janus kinase 1 inhibitor | Clinical remission (16 wk) and endoscopic remission (12 wk) | Endoscopic (not clinical) remission increased | Gastroenterology. 2020 Jun;158(8):2123-2138.e8 |
| Ozanimod | Sphingosine-1-phosphate receptor subtypes 1 and 5 | Endoscopic Score for Crohn's Disease (SES-CD) from baseline to 12 wk | The mean change SES-CD: 2.2, endoscopic, histological, clinical improvements | Lancet Gastroenterol Hepatol. 2020 Sep;5(9):819-828 |
| Mongersen | Antisense oligodeoxynucleotide to Smad7 | Clinical remission CD Activity Index score <150 (12 wk) | NS | Am J Gastroenterol. 2020 May;115(5):738-745 |
| Ulcerative colitis | | | | |
| Etrasimod | Sphingosine 1-phosphate receptor modulator | Improvement in modified MCS (etrasimod vs placebo) | Etrasimod favorable (P = 0.009) endoscopic improvement: 41.8% vs 17.8% | Gastroenterology. 2020 Feb;158(3):550-561 |
| Ozanimod | Sphingosine-1-phosphate receptor subtypes 1 and 5 | Induction and maintenance therapy (ozanimod vs placebo) | Clinical remission (18.4% vs 6.0%, P < .001), maintenance (37.0% vs 18.5%, P < .001) | N Engl J Med. 2021 Sep 30;385(14):1280-1291 |
| Vedolizumab | Inhibits the gut-selective α4β7 integrin | Maintenance treatment, intravenous vedolizumab vs placebo groups | Clinical remission: 46.2%, 42.6%, and 14.3%, respectively | Gastroenterology. 2020 Feb;158(3):562-572 |
| Cobritsimod | Activates Toll-like receptor 9 | The proportion of clinical remission | Cobritsimod: 21% vs placebo: 7% (OR 3.8) | Lancet Gastroenterol Hepatol. 2020 Dec;5(12):1063-1075 |
TABLE 3 Clinical trials of inflammatory bowel disease

| Factor                                      | Endpoints                                                                 | Main results                                                                                                                                 | Reference                                                                 |
|---------------------------------------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Markers of inflammatory bowel disease       |                                                                           |                                                                                                                                             |                                                                          |
| Disease activity miR-320a levels            | Appropriate clinical disease indices and endoscopic scoring systems       | MiR-320a expression (peripheral blood) are associated with the clinical and endoscopic disease activities of IBD                              | Clin Transl Gastroenterol. 2020 Mar;11(3):e00134                          |
| Response to infliximab in CD               | Predicting mucosal healing                                               | Oncostatin M can predict the outcome of infliximab treatment. (AUC = 0.91)                                                                    | Aliment Pharmacol Ther. 2020 Jul;52(2):284-291                           |
| Vedolizumab                                 | Variables response to vedolizumab (against the α4β7 integrin heterodimer) | Markers associated with vedolizumab-induced clinical remission: CD: IL17A, TNF, CXCL1, CCL19, UC: G-CSF and IL7                           | Clin Gastroenterol Hepatol. 2021 Mar;19(3):503-510.e1                     |
| Anxiety/depression                          | The risk factors of anxiety/depression in IBD                             | CD: CD-related surgery and CDAI/depression in IBD                                                                                              | Sci Rep. 2021 Jan 14;11(1):1440                                          |
| Microbial factors                           | Maintenance of remission                                                 | Favorable: Lac unfavorable: Enterobacteriaceae (OR 6.35) Lachnospiraceae family (OR 0.47)                                               | Gut Microbes. 2020 Nov 1:11(6):1713-1728                                 |
| Faecal calprotectin (Fcal)                  | Prediction of postoperative recurrence after ileocolonic resection (CD)   | Fcal variation: predictor of early endoscopic postoperative recurrence AUC = 0.73, sensitivity = 64.7%, specificity = 87.5%          | Dig Liver Dis. 2020 Jul;52(7):740-744                                    |
| Nonoperative treatment for IBD              |                                                                           |                                                                                                                                             |                                                                          |
| HBO for chronic antibiotic-refractory pouchitis (CARP) | The efficacy and safety of HBO for CARP                                | mPDAI symptom score: 3.19 to 1.91 mPDAI endoscopy scores: 2.34 to 1.29 improving CARP                                                      | Inflamm Bowel Dis. 2021 Jun 15;27(7):965-970                            |
| Nonoperative treatment for Crohn’s disease  |                                                                           |                                                                                                                                             |                                                                          |
| Oral Sucrosomial® Iron                      | Intravenous ferric carboxy-maltose (FMC) vs Sucrosomial® Iron (SI)        | FCM = SI: Hemoglobin, Iron (4, 8, 12 wk)                                                                                                     | Nutrients. 2021 Feb 12;13(2):608                                          |
| Vitamin D                                  | Endoscopic recurrence (26 wk)                                            | Vitamin D vs placebo (58% vs 66%, NS)                                                                                                       | Clin Gastroenterol Hepatol. 2021 Aug;19(8):1573-1582.e5                   |
| Hyperbaric oxygen therapy (HBO)            | Efficacy, safety, and feasibility of HBO in CD                           | Clinical response: 60% Clinical remission: 20%                                                                                               | Aliment Pharmacol Ther. 2021 Mar;53(5):587-597                           |
| Nonoperative treatment for ulcerative colitis |                                                                           |                                                                                                                                             |                                                                          |
| Deep remission (a tight control strategy)   | Major adverse outcomes that indicate CD progression                      | Favorable: deep remission CD endoscopic index of severity scores below 4, with no deep ulcerations or steroid use                         | Gastroenterology. 2020 Jul;159(1):139-147                                 |
| HBO 2.4 atmospheres (90 min)               | Day 3 responders: 5 days vs 3 days of HBO                                | HBO favorable: low rates of re-hospitalization, colectomy at 3 mo (0% vs 66%)                                                              | Aliment Pharmacol Ther. 2020 Sep;52(6):955-963                           |
| Fecal microbiota transplantation (FMT)      | T regulatory and mucosal associated invariant T (MAIT) cell populations   | Changes in MAIT cell cytokine production were observed in cFMT                                                                              | BMC Gastroenterol. 2021 Jul 8;21(1):281                                   |
| Apheresis selective removal of leukocytes   | Clinical remission (Mayo score ≤2) at 12 mo                             | Apheresis: 46.6%, control: 36.4% (NS)                                                                                                       | J Gastroenterol. 2020 Apr;55(4):390-400                                   |
| Cannabis 80 mg tetra-hydrocannabinol        | Lichtiger disease activity index, CRP, calprotectin, Mayo endoscopic score and QOL | Cannabis favorable: Lichtiger index, QOL Cannabis = placebo: Mayo endoscopic score                                                          | PLoS One. 2021 Feb 11;16(2):e0246871                                     |

(Continues)
those reported in a retrospective study (n = 134). However, the incidence of relapse in patients with ileocolonic CD (n = 1863) after early bowel resection was compared to that after initial therapy, and the overall (OR: 0.53) and surgical relapse (OR: 0.47) were lower in patients who underwent early bowel resection than in those who received initial medical therapy. Moreover, the requirement for maintenance biologic therapy (OR: 0.24) was lower in patients who received early bowel resection than in those who received initial medical therapy. The incidence of relapse after strictureplasty was also compared to that of bowel resection for patients with CD. The results demonstrated that strictureplasty alone increased disease recurrence compared to bowel resection (hazard ratio [HR]: 1.61), and the morbidity rate was not significantly different between the two groups. Antimesenteric cutback end-to-end isoperistaltic anastomosis, known as Sasaki-W anastomosis, has been reported as a novel hand-sewn anastomotic technique for CD. In a previous randomized control trial (RCT), Kono-S anastomosis, antimesenteric functional end-to-end handsewn anastomosis, were performed for the stenosis of the patients with CD, and the endoscopic recurrence was 22.2% in the Kono group and 62.8% in the conventional group (n = 79). In a previous meta-analysis, the surgical outcomes of Kono-S were found to be 0% for surgical recurrence and 5% for endoscopic recurrence. Kono-S anastomosis yields a favorable outcome with increasing evidence, hence may be considered an optimal procedure for CD stenosis.

Fistula formation in CD is an intractable disease that is difficult to treat. The injection of allogeneic or autologous tissue is a promising new treatment for perianal fistulas in CD. Panes et al. reported the efficacy and safety of allogeneic adipose-derived mesenchymal stem cells in the treatment of complex perianal fistulas in CD. Additionally, the effects of the injection of autologous adipose tissue as a treatment modality for fistulas were reported in a cohort of CD patients in 2019. Further trials on autologous tissue implantation have been attempted for fistulas in patients with CD in phase 1 trials and RCTs. Autologous subcutaneous, adipose-derived, and allogeneic mesenchymal stem cells, as well as bone marrow-derived mesenchymal stromal cells, were harvested in these trials, and the results suggested that such treatments for fistulas may be effective and feasible (Table 3). In a meta-analysis (n = 1252), the stem cell treatment group had a higher rate of fistula healing than the placebo group (61.8% vs 40.5%, OR: 2.21).

The number of patients admitted for UC is increasing; however, the number of surgeries per admission is decreasing. Colonic perforation, life-threatening bleeding, and toxic megacolon remain key indicators for emergency surgery, regardless of therapeutic advancements. Biologic agents have been used in patients with severe ulcerative colitis who are refractory to steroid therapy. Patients who are refractory to steroid therapy and infliximab are recommended for surgery. Even when control is achieved with drugs, the problem of carcinogenesis remains. This poses a significant issue, particularly since the prognosis of UC patients with colorectal cancer is worse than that of colorectal cancer patients without UC.

Table 3 (Continued)

| Factor | Endpoints | Main results | Reference |
|--------|-----------|--------------|-----------|
| Surgery vs Infliximab | Need for surgery or repeat surgery or anti-TNF therapy | Treatment effect was similar to placebo. Laparoscopic ileocolic resection: not successful | Lancet Gastroenterol Hepatol. 2020 Oct;5(10):900-907 |
| Kono-S anastomotic methods | Kono-S vs stapled ileocolic side-to-side anastomosis | 22.2% in the Kono-S group and 62.8% in the Conventional group presented an ER | Ann Surg. 2020 Aug;272(2):210-217 |
| Autologous subcutaneous adipose tissue | Clinical and radiographic healing at 6 mo | All patients: reduction in the size of fistula tracts 3 of 5; cessation of drainage. None: complete healing | Inflamm Bowel Dis. 2020 Apr 11;26(5):670-677 |
| Autologous adipose-derived stem cells | The closure of fistulas at months 3, 6, and 12 | Healing rate (3, 6, 12m): the observation vs control, 90.9% vs 45.5%, 72.7% vs 54.5%, and 63.6% vs 54.5%, respectively (NS) | Stem Cell Res Ther. 2020 Mar 17;11(1):124 |
| Allogeneic mesenchymal stem cells | Follow-up 1 y after the procedure | Perianal abscess (15%), complete closure (69%) | Dis Colon Rectum. 2021 Mar 1;64(3):328-334 |
| Allogeneic mesenchymal stromal cells | Fistula closure using bone marrow-derived mesenchymal stromal cells | Fistulas with closure at 24 wk were still closed after 4 y | J Crohns Colitis. 2020 Jan 1;14(1):64-70 |
| Fibrin glue | The rate of complete clinical remission at 1 y | Complete clinical remission (1 y): 45.4% | Gastroenterology. 2021 Feb;160(3):710-719.e2 |

Abbreviations: ACU, area under the curve; OR, odds ratio; TNF: tumor necrosis factor.
Impaired in the EOUC patients. It is therefore important to select an appropriate procedure.

Rates after surgery for elderly patients were 47.3% and 1.3%, respectively. Neither short-term nor long-term functional outcomes were significantly different between patients aged 50-65 years and elderly patients (age ≥ 65 years). However, the general condition, organ function, anorectal function, and activities of daily living (ADL) were impaired in the EOUC patients. It is therefore important to select an appropriate procedure.

Proximal stoma diversion is commonly constructed when IPAA is performed. Anastomotic strictures and pouch failures have been shown to be more common in diverted patients than in non-diverted patients, but re-operation was more frequently required in non-diverted patients. However, this meta-analysis contained only one RCT; more evidence-based research is therefore desirable to exclude selection bias.

TABLE 4 Meta-analyses of nonoperative treatment for inflammatory bowel disease

| Focus                                | Endpoints                                                                 | Main results                                                                                                                                  | Reference |
|--------------------------------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Nonoperative treatment for inflammatory bowel disease | Sleep quality | The relation between sleep quality and disease activity Subjective sleep quality and disease activity (OR 3.52), sleep efficiency and disease activity (OR 4.55) | Sleep Med. 2020 Nov;75:301-308 |
|                                      | Iron supplementation | Ferric carboxymaltose (FCM), iron isomaltoside (IIM), iron sucrose (IS), oral iron (OI) Response rates with FCM, IIM, IS, OI: 81%, 74%, 75%, 69% FCM: the most cost-effective | Adv Ther. 2021 Jan;38(1):660-677 |
|                                      | Hyperbaric oxygen therapy (HBO) | Response rate and complete healing of fistula Response rate of HBO, UC: 83.2%, CD: 81.9%, the complete healing of fistula: 47.6% | Eur J Gastroenterol Hepatol. 2021 Apr 19 |
|                                      | Antibiotic refractory pouchitis | The safety and efficacy of various biological agents for antibiotic refractory pouchitis Clinical improvement: IFX 71.4%, ADA 58.2%, VDZ 47.9%, remission: IFX 65.7%, ADA 31%, VDZ 47.4% | J Clin Gastroenterol. 2021 Jul 1;55(6):481-491 |
| Nonoperative treatment for ulcerative colitis | Adjuvant curcumin therapy | Clinical and endoscopic remission Clinical remission (OR 5.18) Endoscopic remission (OR 17.05) Clinical improvement (OR 4.79 NS) | J Gastroenterol Hepatol. 2020 May;35(5):722-729 |
|                                      | Infliximab (IFX) vs cyclosporine and tacrolimus (TAC) | Short-term remission, short-term, colectomy rate IFX favorable: lower short-term (OR 0.59), 1 y colectomy rate (OR 0.53), 3 y colectomy rate (OR 0.41) | Medicine. 2020 Oct 30;99(44):e22894 |
|                                      | Faecal microbiota transplantation (FMT) | Safety and effectiveness of treating UC Efficacy: FMT favorable (OR 2.29) Multiple donors delivered (OR 2.76) Side effects: NS | Int J Colorectal Dis. 2020 Jun;35(6):1025-1034 |
| Nonoperative treatment for Crohn’s disease | Adalimumab | Failure to maintain clinical remission in people with quiescent CD Adalimumab: 59% vs placebo: 86% Adalimumab is an effective therapy for maintenance of clinical remission | Cochrane Database Syst Rev. 2020 May 16;5(5):CD012877 |
|                                      | Anti-tumor necrosis factor (TNF) α | Preventing endoscopic and clinical recurrence Endoscopic recurrence (RR 0.34) clinical recurrence (RR 0.60, NS) AEAs with anti-TNF therapy (RR 1.75) | J Gastroenterol Hepatol. 2021 Apr;36(4):864-872 |
|                                      | Stem cell therapy | CD activity index Reduce: CD activity index, CD endoscopic index of severity, simplified endoscopy score for CD | Stem Cell Res Ther. 2021 Aug 18;12(1):463 |
|                                      | Placebo | The rate of response to placebo endoscopic assessment of CD activity Response: 16.2%, remission 5.2% lower rates of response to placebo increased concentration of CRP | Clin Gastroenterol Hepatol. 2020 May;18(5):1121-1132.e2 |
|                                      | Endoscopic balloon dilation | Small intestinal strictures in CD evaluate endoscopic balloon dilation Technical success: 94.9%, efficacy: 82.3%, complications: 5.3%, rec.: 48.3% (re-dilated: 38.8%, surg.: 27.4%) | Aliment Pharmacol Ther. 2020 Oct;52(7):1104-1116 |

use, and were more likely to require surgical treatment for UC than NEOUC patients.47

Ileal pouch-anal anastomosis (IPAA) was selected for patients who required total proctocolectomy. In recent years, the number of elderly patients undergoing the said procedures for UC has increased (age > 50 years). The overall 30-day morbidity and mortality rates after surgery for elderly patients were 47.3% and 1.3%, respectively. Neither short- nor long-term functional outcomes were significantly different between patients aged 50-65 years and elderly patients (age > 65 years). However, the general condition, organ function, anorectal function, and activities of daily living (ADL) were impaired in the EOUC patients. It is therefore important to select an appropriate procedure.
| Focus | Endpoints | Main Results | Reference |
|-------|-----------|--------------|-----------|
| Surgical treatment for inflammatory bowel disease | Overall postoperative complications (30d) | Urgent surgery: – 40% increase in overall complication (RR: 1.43) Mortality and readmission rates: NS | Int J Colorectal Dis. 2021 Feb;36(2):253-263 |
| Surgical treatment for ulcerative colitis | Predict colectomy | Prognostic factors (predict colectomy) | Gastroenterology. 2021 Jan; 160(1):378-402.e22 |
TABLE 5 (Continued)

| Focus                                  | Endpoints                                                                 | Main Results                                                                                     | Reference                                      |
|----------------------------------------|---------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|------------------------------------------------|
| Two-stage restorative colectomy        | Complication rates (modified 2-stage, classic 2-stage, 3-stage approaches) | Pediatric pts: modified 2-stage approaches leak rates higher, adult cohorts: modified 2-stage approaches lower leak rates | Int J Colorectal Dis. 2020 Oct; 35(10):1817-1830. |
| Surgical treatment for Crohn’s disease | Kono-S anastomosis                                                        | Recurrence (rec.), complications                                                                  | Surg Today. 2021 Apr;51(4):493-501              |
| IPAA                                   | Long-term functional outcomes The pouch failure rate                        | Mean 24-h stool frequency: 6.3 bowel movement, overall pouch failure rate:15%, no risk factors for pouch failure were identified | Dis Colon Rectum. 2021 Mar 1;64(3):355-364      |
| Surgery vs initial medical therapy     | Early bowel resection (EBR) relapse rate, Newcastle- Ottawa and Jadad scales | EBR favorable: overall/surgical relapse (OR 0.53/0.47), requirement biologic therapy (OR 0.24), RFS, (OR 0.62); morbidity (NS) | Int J Colorectal Dis. 2020 Mar;35(3):501-512    |
| Strictureplasty (SPX)                  | Recurrence-free survival SPX vs bowel resection (BR)                       | SPX alone increased disease recurrence than BR (HR 1.61)                                         | Int J Colorectal Dis. 2020 Apr;35(4):705-717    |
| Stem cells therapy                     | The efficacy and safety for CD fistula Stem cell therapy vs placebo        | Stem cell group favorable: fistula healing (61.8% vs 40.5%, OR 2.21) the treatment-related adverse events (RR 0.58) | Stem Cell Res Ther. 2021 Jan 7:12(1):32         |
| Risk of recurrence (rec.)              | Risk of clinical, surgical and endoscopic (ES) rec. in positive resection margins, granulomas or plexitis | Positive resection margins: clinical/ surgical /ES rec. (RR 1.26/1.87/ND), Granulomas: clinical/surgical /ES rec. (RR 1.31/1.37/NS), Plexitis: ES/ clinical rec (RR: 1.31/NS) | Clin Gastroenterol Hepatol. 2021 Mar;19(3):451-462 |
| Rate of recurrence                     | Postoperative recurrence (POR)                                             | TNF-α agents (1 y) endoscopic, clinical, surgical POR: 21.7, 13.1, 3.8%, 5-y rec. rate: endoscopic, surgical rec.:84.2%, 17.5% | J Dig Dis. 2021 Jul;22(7):399-407               |

Illeal pouch-anal anastomosis is a safe procedure for EOUC patients; however, anorectal function and ADL should be considered when determining whether to perform the procedure. Further studies are needed to determine how to construct the diverting stoma.

2.5 | Perioperative managements for patients with IBD

Patients with IBD are often immunosuppressed before surgery, therefore requiring careful perioperative management. A meta-analysis examined the combined data from 68 published studies and identified the association between IBD medication and infectious complications within 30 days after surgery for IBD. Most patients were 18 years or older, and both men and women participated. The patients were divided into five groups based on their IBD medications (corticosteroids, anti-TNFα agents, immunomodulators, anti-integrin agents, and 5-ASA); the patients in these groups were compared with those who were not taking medications. Total infectious complications were associated with the use of corticosteroid (OR: 1.70) and anti-TNFα agent (OR: 1.60); however, they were not associated with the use of immunomodulators (OR: 1.29), anti-integrin agents (OR: 1.04), or 5-ASA (OR: 0.76). The patients treated with vedolizumab (VDZ) showed a decrease in the incidence of infectious complications (OR: 0.49), but the risks of surgical site infection (SSI) (OR: 2.97), superficial SSI (OR: 2.24), and ileus (OR: 2.16) increased. The reason for the decreased risk of infectious complications may be that VZD suppresses intestinal inflammation by inhibiting the interaction between MAdCAM-1 and α4β7 and preventing T cells from entering the intestinal mucosal system. The suppression of intestinal inflammation by VDZ reduces postoperative infectious complications, whereas excessive immunosuppression may be the cause of postoperative SSI.

Vitamin D is commonly deficient in patients with CD and the risk of CD-related surgery increases in patients with lower serum vitamin D levels. However, the incidence of postoperative endoscopic or clinical recurrence of CD in patients who underwent ileocolonic resection was not found to be significantly different between patients who received postoperative treatment with high-dose vitamin D and those who received placebo.
In Crohn’s disease, the treatment strategy emphasizes the preservation of intestinal function. Although Crohn’s disease rarely leads to short bowel syndrome, some cases of this condition are unavoidable.\textsuperscript{56} Teduglutide, a glucagon-like peptide-2 (GLP-2) analog, has been approved in Japan for the treatment of short bowel syndrome. Teduglutide promotes improved intestinal absorption function and reduces the need for long-term intravenous support, which is difficult to manage.\textsuperscript{57}

Pouchitis is a common complication after total proctocolectomy with IPAA, and if it persists (≥3 episodes/y) despite antibiotic treatment, is considered chronic antibiotic refractory pouchitis (CARP). The efficacy and safety of treatment with infliximab (IFX; n = 22), adalimumab (ADA; n = 42), and vedolizumab (VDZ; n = 144) were evaluated in a meta-analysis. Clinical improvement rates after treatment with IFX, ADA, and VDZ were 71.4%, 58.2%, and 47.9%, respectively, and the clinical remission rates were 65.7%, 31%, and 47.4%, respectively.\textsuperscript{58} Biologic therapy is effective in the treatment of CARP. Moreover, HBO has been reported as an effective therapy for CARP in a meta-analysis (Tables 3 and 4).\textsuperscript{59}

### 3 | DIVERTICULITIS

#### 3.1 | Characteristic diverticulitis in a recent study

In the United States, the first incidence rate of diverticulitis was 2.9% between February 2015 and February 2020. The risk factors for the incidence of diverticulitis were being male, elderly (age >65 years), and Caucasian.\textsuperscript{60} Low physical activity, overweight and obesity,\textsuperscript{61} smoking, appendectomy, proton-pump inhibitors, and non-steroidal anti-inflammatory drug use\textsuperscript{62} are other established risk factors for diverticular disease. The risk of developing such was reduced by high fiber intake. Individuals consuming fiber (30 g/d) have a 41% risk reduction compared to those with low fiber intake.\textsuperscript{63}

The right- and left-sided acute colonic diverticulitis has different characteristics. Right-sided diverticulitis affects younger, male (OR: 1.33), and taller patients with a lower body mass index. Smoking (OR: 2.23), alcohol consumption (OR: 1.85), and comorbidity (OR: 0.21) were also associated with right-sided diverticulitis. Further, it has a more favorable outcome with lower risk of complications, less frequent emergency surgery, recurrence, and length of hospital stay (Table 6 and 7).\textsuperscript{64,65}

| TABLE 6 | Clinical trials of diverticulitis and diverticular disease |
| --- | --- | --- | --- |
| Factor | Endpoints | Main results | Reference |
| Characteristics |  |  |  |
| Right side vs left side diverticulitis | Clinical features | Right side: younger, male, tall, lower BMI, less advanced Hinchey stages, shorter hospital stays, less recurrent | Sci Rep. 2020 Feb 28:10(1):3754 |
| Nonoperative treatment |  |  |  |
| Vitamin D vs placebo | Time to diverticular disease hospitalization from randomization | Vitamin D: 1.4% and placebo: 1.5% (NS) | Clin Nutr. 2021 Mar;40(3):839-843 |
| Antibiotic treatment vs placebo | Treatment effect | Antibiotic treatment = placebo: length of hospital stay, adverse events, readmission, intervention, inflammation markers, pain | Clin Gastroenterol Hepatol. 2021 Mar;19(3):503-510.e1 |
| Surgical treatment | Costs and cost - effectiveness | PA favorable: overall costs: PAR vs HP (£20 544 vs £28 670), incremental cost-effectiveness: £-39 094 cost-utility: £-101 435 | Br J Surg. 2020 Nov;107(12):1686-1694 |
| PRA vs HP | Long-term outcomes and quality of life (QoL) | PA favorable: general QoL (EQ-VAS), EQ-5D index scores, PA = HP: GIQLI (intestine-specific QOL) | Int J Colorectal Dis. 2021 Oct;36(10):2159-2164 |
| Surgery or not | QoL at 5-year follow-up | Surgery favorable: potential to improve quality of life | Ann Surg. 2020 Aug;272(2):284-287 |
| Damage control surgery (DCS) | Rate of stoma at discharge and at 6 mo | DCS 8.3% vs conventional treatment 57% (at discharge), DCS 0% vs conventional treatment 42% (at 6 mo) | World J Surg. 2020 Dec;44(12):4098-4105 |
| Hartmann’s reversal | Factors of morbidity and mortality of Hartmann’s reversal | Low albuminemia, renal failure, coronary artery disease, corticosteroids | Sci Rep. 2020 Feb 27:10(1):3643 |
| Focus | Endpoints | Main results | Reference |
|------|----------|--------------|-----------|
| **Characteristics** | | | |
| Right-sided diverticulitis | Characteristic, comorbidity, recurrence (rec.) | Younger, male, smoking, alcohol consumption, less comorbidity, lower rec., less emergency surgery, shorter length of hospital stays | Colorectal Dis. 2020 Dec;22(12):1908-1923 |
| Left-sided acute diverticulitis | Disease severity, risk of recurrence according to age | Young = elder: need emergency surgery or drainage, recurrence | Eur J Gastroenterol Hepatol. 2020 May;32(5):547-554 |
| Preventive medicine Fiber intake | The risk of diverticular according to dietary fiber intake, fiber subtypes | Risk reduction: 23/41/58% (Fiber intake 20/30/40 g/d). Cereal/fruit/vegetable fiber per 10 g/d (RR 0.74/0.56/0.80) | Eur J Nutr. 2020 Mar;59(2):421-432 |
| **Nonoperative treatment** | | | |
| Conservative treatment for uncomplicated right-side diverticulitis | Treatment failure, ES at rec for uncomplicated right-sided diverticulitis | Treatment failure: 2.5%, rec. rate: 10.9%, complicated diverticulitis at rec: 4.4%, emergency surgery at rec: 9.0% | Int J Colorectal Dis. 2021 Aug;36(8):1791-1799 |
| Observation vs Antibiotic treatment for uncomplicated diverticulitis | Rates of ongoing diverticulitis, rec., complicated diverticulitis, sigmoid resection | NS Observational management of uncomplicated AD is safe | Br J Surg. 2020 Jul;107(8):1062-1069 |
| Intravenous antibiotics for Right-sided diverticulitis (Hinchey I/II) | Rec. rate, morbidity associated with rec. | Rec. rate: 12% (nonoperative management is safe and feasible) required urgent surgery at the time of first rec.: 9.9% | Dis Colon Rectum. 2020 Oct;63(10):1466-1473 |
| Nonoperative management for sigmoid complicated diverticulitis with abscess | Relapse rate at 30 d, rec. of AD | Relapse rate: 18.9%, rec. of AD: 25.5% (distant abscess: 51% vs pericolic abscess: 18%) | Langenbecks Arch Surg. 2020 May;405(3):277-281 |
| Nonoperative management for complicated diverticulitis with abscess | Treatment failure (time intervals: 1986-2000, 2000-2010, 2010-) | Treatment failure rate at 90 days: 16.4%, (1986-2000:19.2%, 2000-2010:18.6%, 2010-: 15.3%, NS) | Int J Colorectal Dis. 2021 Jul;36(7):1367-1383 |
| **Surgical treatment** | | | |
| Primary anastomosis (PRA) vs Hartmann's procedure (HP) | Mortality, morbidity, stoma reversal after surgery for Hinchey III or IV diverticulitis | PRA favorable: stoma reversal, reversal-related morbidity, PRA = HP: mortality, morbidity, reintervention rates | Int J Colorectal Dis. 2020 Aug;35(8):1371-1386 |
| PRA vs HP | Mortality, morbidity after surgery for Hinchey III or IV diverticulitis | NS | Arq Bras Cir Dig. 2021 Jan 15;33(3):e1546 |
| PRA vs HP for perforated diverticulitis with generalized peritonitis | Stoma rate, 30-day mortality, overall mortality, major complications | PRA favorable: stoma rate, overall mortality, major complications, PRA = HP: 30-day mortality | Tech Coloproctol. 2020 Jun;24(6):527-543 |
| Open vs laparoscopic surg. (LS) for diverticulitis with colovesical fistula | Operative time, stoma rates, complications, mortality | Open = LS: operative time, stoma rates, leakage, SSI, mortality, LS favorable: postoperative complications, length of stay | ANZ J Surg. 2021 Sep;91(9):E570-E577. |
| Open vs LS emergency surgery for complicated diverticulitis | Mortality, morbidity, severe complications, and reoperation rates | Open = LS: postoperative mortality, morbidity, severe complications, and reoperation rates | Medicine. 2020 Oct 2;99(40):e22421 |
| Damage control surgery for complicated diverticulitis | Leakage, mortality | Major leakage: 4.7%, overall mortality: 9.2% | Int J Colorectal Dis. 2021 May;36(5):867-879 |
| Surgery for immune-suppressed patients | Mortality | Elective surgery: immunosuppressed = immunocompetent patients, emergent surgery: immunocompetent patients favorable | Am J Surg. 2021 Jan;221(1):72-85 |
3.2 | Treatment approach for diverticulitis

Patients with uncomplicated acute diverticulitis are commonly treated with antibiotics; however, in recent RCTs, this has been omitted for acute uncomplicated diverticulitis, which is characterized by elevated body temperature, inflammatory parameters, except for sepsis, and any sign of complications, such as abscess, free air, or fistula on computed tomography. Moreover, an earlier study demonstrated that the median hospital stay duration, adverse events, and hospital readmission were not significantly different during antibiotic treatment and observation. In a 1-year follow-up of patients with uncomplicated diverticulitis, the rates of ongoing, recurrent, and complicated diverticulitis and undergoing sigmoid resection were not significantly different during antibiotic treatment and observation. These results provide evidence for the omission of antibiotics in patients with uncomplicated acute diverticulitis.

In cases of recurrent diverticulitis or persistent symptoms, the choice between surgery and conservative treatment is an important concern. The failure rates of nonoperative management for acute diverticulitis with complicated abscesses is 16.4%, and the failure rates have not significantly decreased in the last 30 years. The failure rate of percutaneous drainage as a nonoperative management for patients with pelvic abscess was three times higher than that for pericolic abscesses. Hence, surgical treatment should be considered for abscesses in areas distant from colonic diverticulitis.

The aim of diverticulitis surgery is to treat acute inflammation and symptoms, and improve quality of life (QOL). A previous study compared elective sigmoid resection and conservative management in patients who had ongoing abdominal complaints for >3 months and/or frequently recurring left-sided diverticulitis of >2 episodes in 2 years. The Gastrointestinal Quality of Life Index of the patients after sigmoid resection was higher than that after conservative treatment. Colonic resection for recurrent diverticulitis improved QOL, and these data are helpful in determining the indications for bowel resection.

3.3 | Surgical procedure for diverticulitis

The major concerns of acute diverticulitis surgery are associated with bowel resection. These factors were analyzed in meta-analyses and RCTs (Table 6 and 7).

Primary anastomosis (PRA) and nonrestorative resection (NRR), which are defined as end colostomy or diverting transverse colostomy without resection, respectively, were selected as emergency surgeries. The morbidity rates after PRA did not differ from those after NRR; however, postoperative morbidity rates of stoma closure surgery were significantly lower in PRA (12%) than in NRR (27.2%) (OR: 0.31). The non-reversal rate of stoma in PRA (16%) was lower than that in NRR (35.5%) (OR: 0.37). Moreover, PRA was associated with better short- and long-term outcomes than NRR.

Further, it is important to establish whether PRA or Hartmann's procedure (HP) should be selected when performing colonic resection for acute diverticulitis. PRA has favorable rates of stoma reversal (PRA, 80.3%; HP, 62.1%; OR, 2.62) and reversal-related morbidity (PRA, 11.9%; HP, 27%; OR, 0.33). The mortality (PRA 5%, HP 6.4%, OR: 0.83, n.s.), morbidity (PRA 50.6%, HP 49.5%, OR: 0.99, n.s.), and reintervention rates (PRA 7.4%, HP 7.5%, OR: 0.90, n.s.) did not differ between PRA and HP. Moreover, the overall mean costs per patient were also lower for PRA (€20 544) than for HP (€28 670), with a mean difference of €8126. Based on these data, PRA should be considered, if possible.

In a meta-analysis, emergency laparoscopic surgery for colonic diverticulitis had a lower morbidity rate than open surgery, though the rates of postoperative mortality, severe complications, and reoperation did not differ. However, this meta-analysis was based on both RCTs and retrospective studies. A greater number of high-quality RCTs are necessary to compare laparoscopic surgery and open surgery. Laparoscopic surgery is classified into two types: laparoscopic primary resection and laparoscopic lavage without primary resection. Laparoscopic peritoneal lavage is associated with higher morbidity than laparoscopic primary resection.

Immunosuppressed patients with diverticular disease have an increased risk of developing complicated diverticulitis. The mortality and morbidity rates of immunosuppressed patients were higher than those of immunocompetent patients for emergent surgery (RR: 1.91 and RR: 2.18, respectively), but not for elective surgery (RR: 1.70 and RR: 1.40, respectively). Elective surgery may be planned for immunosuppressed patients with diverticulitis according to a meta-analysis.

3.4 | Recurrence after diverticulitis surgery

A time-to-event analysis for recurrence- and colostomy-free survival was performed using a large retrospective cohort. Of the patients with uncomplicated diverticulitis treated with non-operative methods, 19% underwent elective surgery and 81% were treated medically for recurrent uncomplicated diverticulitis after initial therapy. Patients who underwent elective surgery were associated with lower rates of recurrence than those treated with medical therapy (15% vs 61% at 5 years, OR: 0.17). The rate of colostomy after elective surgery (1.8%) was lower than that after medical therapy (2.3%) at 5 years (OR: 2.3). The recurrence rate of diverticulitis was reported to be 5.8% in a meta-analysis. Six factors related to recurrence after bowel resection with diverticulitis were identified: younger age and irritable bowel syndrome (preoperative); anastomotic level and uncomplicated recurrent diverticulitis (operative); absence of active diverticulitis on pathology and persistence of postoperative pain (postoperative). According to the results of this study, elective surgery prevents diverticulitis recurrence or colostomy risk.

4 | Future perspective and summary

In this review, we present key articles on clinical trials and meta-analyses of IBD and diverticulitis from 2020 to 2021.
development of new drugs for IBD is remarkable, and treatment strategies using multiple agents and various techniques are required. It is necessary for surgeons to have a deep understanding of the surgical procedure and perioperative management, as well as the impact of new drugs. In terms of the surgical procedure for CD, it is important to select an optimal procedure that preserves bowel function, minimizes recurrence, and reduces complications. The usefulness of autologous cell transplantation for fistulae on CD has been verified, and it may be clinically applied in the future. It is also important to enhance knowledge on perioperative management associated with IPAA in total proctocolectomy for IBD.

The incidence of diverticulitis is increasing, and more patients are expected to require surgical treatment in the future. According to recent reports, antimicrobial therapy is unnecessary for uncomplicated diverticulitis. Regarding surgical procedures for diverticulitis, both bowel resection and anastomosis are associated with favorable short-term outcomes, higher stoma closure rate, and more reasonable medical costs than HP. The risk factors for the recurrence of diverticulitis are summarized, and these data support the optimal management for postoperative diverticulitis patients. This review consolidates the available knowledge and improves the quality of surgical procedures and perioperative management in treating IBD and diverticulitis.

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