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# An Update to Surgical Management of Inflammatory Bowel Diseases

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Additional information is available at the end of the chapter

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## 1. Introduction

Surgery still has its place in the treatment of inflammatory bowel diseases (IBD) but it is reserved generally to cases in which medical treatment is unsuccessful in relieving symptoms, preventing disease progression and complications. As the medical treatment has added new drugs (especially newly targeted therapy) and surgical advance in technology has gain in more complex procedures with less morbidity and mortality and minimal invasivity there is a need for periodic update.

## 2. Perioperative care of patients with IBD

Good perioperative care always ensures better surgical results. Patients undergoing surgery for IBD must be prepared psychologically and medically.

Psychological preparation should start by explaining the patient the need for surgery. In this approach the surgeon must be aided by the gastroenterologist that has managed the patient for a long time in most of the cases. After acceptance of surgery, the patient must be explained the objectives, the advantages and disadvantages of each surgical intervention and the decision must be taken in common. People that will be submitted to stomas should also get a consultation from stomatherapist.

Medical preparation of the patients includes correction of hemoglobin, volemia, electrolytes and acid-base levels, coagulopathy, liver function. Total parenteral nutrition may be necessary in patients with nutritional deficits. Coexisting diseases should also be addressed. Any corticosteroid and immunosuppressive therapy should be discontinued before surgery, but corticosteroids need to be tapered immediately after surgery.

### **2.1. Prevention of infection**

Adequate antibiotic prophylaxis or antibiotic therapy should be given, especially in cases with prolonged corticosteroid or infliximab therapy. Anyway, antibiotic prophylaxis pre and intraoperative is mandatory in colon surgery, but we think that may be continued several days after surgery especially in patient treated by corticosteroids and immunosuppressive and immunomodulator therapy because of higher risk of infection on a reduced immune host defense.

The mechanical bowel preparation in elective cases is no longer mandatory in colon surgery and is contraindicated in patients with an acute abdomen or obstruction [1]

### **2.2. Prophylaxis for venous thrombosis**

Patients with IBD are at increased risk for thromboembolic venous and arterial complications [2, 3]. Thus, intermittent pneumatic compression and/or low dose heparin should be used prophylactically.

## **3. Indications for surgery in ulcerative colitis (UC)**

Approximately 30–40% of patients with ulcerative colitis will require surgical treatment.

Indications for surgery are:

- intractable chronic disease,
- lack of response to high-dose corticosteroid therapy
- recurrence of symptoms upon stop of corticosteroid therapy,
- disease progression under maximal medical therapy,
- significant treatment-related complications such as severe steroid or infliximab side effects,
- dysplasia or cancer in patients with long-standing colitis during endoscopic surveillance,
- colonic strictures,
- acute exacerbation of the disease not responsive to rescue therapy such as intravenous steroids, cyclosporine, or infliximab,
- acute complications: hemorrhage, toxic megacolon, perforation, fulminant colitis,
- extracolonic manifestations.

### **3.1. Elective procedures**

The development of restorative procedures such as the ileal pouch anal-canal anastomosis has made surgery a more attractive option in patients in whom medical therapy has been unsuccessful or undesirable.

### **3.2. Refractory colitis**

The treatment of choice for acute severe steroid refractory ulcerative colitis is controversial [4]. Gastroenterologists sustain infliximab [5], while surgeons plead for colectomy [6].

### **3.3. Intractable chronic disease**

The most common indication for elective surgery is disease activity that has been intractable to medical therapy. However, "intractable" is kind of blurry. Some authors have suggested that disease should be considered intractable when it or its treatment is associated with severe and persistent impairment in the quality of life [7]. However, these parameters are difficult to measure and are variable among individual patients.

### **3.4. Refractory Acute Severe Ulcerative Colitis (RASUC)**

Refractory acute severe ulcerative colitis (RASUC), is defined by greater than six bloody stools per day and one of the following: heart rate more than 90 beat/min, erythrocyte sedimentation rate more than 30mm/h, temperature more than 37.8°C, and hemoglobin less than 10.5 g/dl. The appropriate time to initiate surgical intervention during the treatment of RASUC has been a topic of investigation, because patients are usually severely malnourished, immunocompromised, and weakened by side-effects of immunomodulating drugs. [8].

### **3.5. Emergency surgery**

Advances in medical therapy (including use of infliximab) have reduced the need for emergency surgery due to catastrophic complications such as massive hemorrhage, perforation, fulminant colitis, and acute colonic obstruction [9].

A longer duration of in-hospital ineffective medical therapy (8 versus 5 days) that delays surgical therapy in patients with acute severe ulcerative colitis is associated with an increased risk of postoperative complications [10].

Biologic agents were introduced with the intent to help avoid operative intervention in patients with moderately to severely active IBD who have demonstrated an inadequate response to conventional therapies. Ananthakrishnan et al. analyzing a large number of cases hospitalized for IBD found that the use of biologic agents decreases the incidence of emergency surgery in patients with mild disease, but not in those with severe forms. [11]

For Ousslan et al, failure to respond to infliximab determined the decision for colectomy in 19% of the patients. Predicting factors for colectomy were C-reactive protein > 10mg/l before treatment with infliximab, hemoglobin less than 9.4 g/dl, episodic use of infliximab, and previous treatment with cyclosporin. [12]

In the study of Gustavsson et al, with 3-year follow-up, infliximab significantly reduced the need for surgery at 3 month compared to placebo (29% vs 67%), for patients with corticosteroid refractory UC. At 3 years, 50% of patients in the infliximab group and 76% of patients in placebo group needed colectomy. [13]

In a spanish multicenter experience, patients in whom corticosteroids and ciclosporin failed to control the disease, were submitted to infliximab. A 40 years patient, operated because of infliximab failure died after surgery from nosocomial pneumonia. Authors stated that salvage therapy with infliximab after failed corticosteroids and ciclosporin may be associated with risk for morbidity and mortality and therefore should be used in selected patients. [14]

Adalimumab emerged as an indication in the cases in which there is partial or no response to infliximab. In a study from Taxonera et al at 48 weeks of follow-up only 20% of the patients needed surgery. Therefore, application of this new therapy may diminish the indications for surgery in the group of patient non-responders to infliximab therapy.

### 3.6. Suspicion of cancer

The risk of malignancy is directly proportional to the duration of disease. The risk during the first decade of disease is low, but increases substantially after that. After 30 years of disease the risk is about 50 %. [8] Patients with more than 10 years of disease should undergo a colonoscopy each year. Most of the gastroenterologists consider discovery of moderate to severe dysplasia an indication for surgery.

### 3.7. Extraintestinal manifestations

Surgical indication is seldom for extracolonic manifestations of IBD. Benefits from surgery will be in the rare cases of massive hemolytic anemia unresponsive to treatment. In those cases splenectomy should be associated to colectomy [7]. Another extracolonic indication for colectomy is thromboembolic complications. Erythema nodosum and arthralgia of the small and large joints appear to benefit the most from proctocolectomy [15]. In cases of pyoderma gangrenosum, ankylosing spondylitis and arthritis, sclerosing cholangitis surgery may not be so profitable.

Surgical options for ulcerative colitis are:

- Proctocolectomy with permanent ileostomy (Brooke ileostomy)
- Proctocolectomy with continent ileostomy (Kock pouch)
- Abdominal colectomy with ileorectal anastomosis
- Colectomy, mucosal proctectomy, and ileal pouch-anal canal anastomosis (IPAA)
- Colectomy and stapled ileal pouch distal rectal anastomosis (IPDRA)

### 3.8. Elective procedures

- Curative procedure - Proctocolectomy with permanent ileostomy.

- Avoiding of ileostomy - IPAA. Patients under infliximab - three stages IPAA

In the elective surgical population, the standard operation performed is a total proctocolectomy with ileal pouch anal anastomosis. Described by Parks and Nichols in 1978, the procedure involves excision of the abdominal colon, pelvic dissection to remove the rectum, creation of an ileal reservoir, and anastomosis of the pouch to the anus. A variety of pouch designs can be used. The most commonly of them is the J-pouch. Preference for the J-pouch lies in its limited use of bowel, reliable emptying, and ease of construction. [8]

Mortality is low - 0.2–0.4%; however, the risk of pelvic sepsis can be as high as 23% from leaks from the ileoanal anastomosis. To prevent this complication, the operation could be performed in multiple stage (two or three), to allow anastomoses to heal without important consequences [16,17].

### 3.9. In emergency situations

Toxic megacolon – the procedure of choice is open colectomy with ileostomy and closure of the rectum or distal colostomy. The rectum may be resected afterwards with ileal pouch-anal anastomosis. IPAA from the beginning should not be performed because of risk of complications.

Hemorrhage – Proctocolectomy, suture of a bleeding ulcer or Hartmann-type colectomy leaving a small stump of distal rectum.

### 3.10. Other options for restorative proctocolectomy

Ileal pouch distal rectum anastomosis (IPDRA) – anastomosis between ileal pouch and distal rectum – easier to perform, better anal sensation and continence especially at night.

Main disadvantage – leaving rectal mucosa behind, that should be avoided in patients with cancer or severe dysplasia in colorectal mucosa, severe extraintestinal manifestations.

Advantage – older patients, lack of adequate mobilisation for tension-free anastomosis – ileorectal anastomosis (IRA)

#### Indications

- Patients not suitable for IPAA
- Refusal of ileostomy
- Medical conditions in which a stoma is relatively contraindicated (eg, portal hypertension or ascites),
- Women of childbearing age because of the risk of infertility,
- Patients in whom Crohn's disease cannot be excluded,
- Patients with colitis complicated by advanced colonic malignancy,

Functional results after IRA



A retrospective analysis of the functional results after IRA for ulcerative colitis or indeterminate colitis in 86 patients found that the rectum was eventually resected in 17% of cases, rectal dysplasia occurred in 17%, rectal cancer 8% and refractory proctitis 28%. The cumulative probability of developing rectal dysplasia at 5, 10, 15, and 20 years was 7, 9, 20, and 25 percent, respectively. The cumulative probability of developing rectal cancer at 5, 10, 15, and 20 years was 0, 2, 5, and 14 percent, respectively. The cumulative probability of having a functioning IRA at 10 and 20 years was 74 and 46 percent, respectively. [18]

Satisfactory rectal function varies greatly depending upon the selections of patients and length of follow-up. The risk of cancer in the residual rectum has been reported to be 6 % at 20 years and 15 % at 30 years. The risk is significant considering that most patients are young and have many years to live.

Farouk et al noted that in 1386 patients with restorative proctocolectomy and over 8-year follow-up, 80% reported complete diurnal continence, with 50% requiring medications to slow intestinal transit. [19]

#### 4. Surgical options for Crohn's disease

Crohn's disease is not curable by surgery. Therefore, this is actually reserved for complications or to symptoms refractory to medical therapy [20].

Surgical decision making in Crohn's disease is driven by anatomic distribution and inflammatory subtype of disease. Forty percent of patients have ileal disease with segments of colonic involvement, with 20–25% of patients exhibiting isolated colonic disease and 5–10% with isolated anorectal disease [21]. Surgical intervention is primarily performed for the complications of Crohn's disease: stricture and obstruction, fistula, or medically refractory disease. Approximately 70% of Crohn's disease patients ultimately require surgery, often multiple, making minimally invasive options appealing

Indications for surgery are:

- obstruction,
- perforation in small intestinal Crohn's disease,
- failure to respond to medical therapy in patients with colonic involvement,
- strictures,
- fistula

Surgery should address only to segments causing obstruction, bleeding, or perforation. Resection is performed when there is an abscess or fistula to an adjacent organ. The disease-free margins are established by gross inspection, microscopic disease at the margins will not be associated with recurrence. Therefore we should avoid large margins, in the idea of preserving as much as possible of small bowel capital because the patients may need another resection in the future and thus preventing the short bowel syndrome.

Ileocolic resections should be followed by a side-to-side anastomosis. A meta-analysis of eight comparative studies found that a side-to-side anastomosis was associated with fewer anastomotic leaks and postoperative complications, a shorter hospital stay and a lower perianastomotic recurrence rates compared to end-to-end anastomosis [22]. However, the authors suggested that further randomized controlled trials are needed to confirm these associations.

#### **4.1. Duodenal disease**

Duodenal Crohn's disease very rarely requires surgery. The major indications for surgery are obstruction and less often perforation or fistula formation. Gastrojejunostomy rather than resection is typically performed. Strictureplasty, duodenojejunostomy, and endoscopic balloon dilation have also been described [23].

#### **4.2. Intra-abdominal abscess, peritonitis**

- Intraperitoneal abscesses were classically drain by open surgery and were followed by surgical resection of the diseased segment of the bowel.
- Progress of interventional radiology, new biologic agents and progress of laparoscopy changed this classic approach [24,25].
- Percutaneous drainage guided by CT or abdominal ultrasound has a low rate of complications and a high rate of success - approximately 70% of attempted cases. Complete drainage of the abscess may necessitate repeated punctures. This attitude allows the patient to be prepared for an elective resection of the bowel after the sepsis resolves, after improving nutritional status and decreasing corticosteroids. Controversy exists regarding the need for subsequent operation after adequate abscess drainage as intractable disease or recurrent abscess occurs in at least 30% of these patients within a year.
- If percutaneous drainage is unsuccessful, surgical drainage should be performed. The timing of surgery following percutaneous abscess drainage, when clinically indicated, occurs after clinical resolution of sepsis.
- Peritonitis is rare in Crohn's disease. Exploratory laparotomy with peritoneal lavage, with construction of a stoma is most commonly required. The decision whether to resect or not the bowel depends upon the operative findings and the patient's condition [26].
- Abdominal wall abscesses (psoas and rectus sheath) are less common and more difficult to control locally than intra-abdominal abscesses. In a retrospective review of 13 patients with an abdominal wall abscess treated by percutaneous and/or open operative drainage, all 13 required resection of the diseased segment even after successful drainage of the abscess [25].

#### **4.3. Fistulas**

Fistulas to adjacent organs (stomach, duodenum, bladder, vagina, and sigmoid colon) are treated by resection and anastomosis of the diseased segment of the bowel and closure of



the fistula. Resection of the adjacent segment is necessary only when it is primarily involved with Crohn's disease. Bypasses should be avoided because persistent disease in the bypassed segment can lead to abscess formation, bleeding, perforation, bacterial overgrowth, and malignancy.

#### 4.4. Strictures

Intestinal strictures can be relieved by resection; synchronous small bowel resection in patients with multiple strictures is common [27]. Strictureplasty or balloon dilation may be a suitable alternative for selected patients.

##### 4.4.1. Strictureplasty

Strictureplasty is performed by longitudinal incision across the stricture and a transversal closure that enlarges the lumen. Indication is represented by the patients that have isolated areas of short stricture and are at risk for short bowel syndrome due to previous surgery or extension of enterectomy. Strictureplasty can relieve obstruction, and is often performed in association with a small bowel resection [27, 28]. It can also be performed without excision of bowel [29, 30]. It should not be performed in acutely inflamed bowel.

To avoid large enterectomy for extensive and/or multiple strictures occurring over long intestinal segments, a side-to-side isoperistaltic or other type of nonconventional strictureplasty is safe and effective [31, 32].

Strictureplasty has been associated with excellent results, including relief of obstruction, the ability to withdraw steroids, and improvement in symptoms [31, 33] the risk of fistula or recurrent stricture formation is low and comparable to resection. Whether preservation of diseased bowel increases the long-term risk of malignancy is unknown, although case reports have documented adenocarcinoma arising from sites of previous strictureplasty [34].

The following examples illustrate the range of findings in two of the largest series

In a series of 1124 procedures of strictureplasty on 314 patients there was a synchronous bowel resection in 66% of cases, overall morbidity was 18%, septic complications in 5%, morbidity was higher in patients with preoperative weight loss and older age, recurrence after surgery was met in 34% during a median follow-up of 7.5 years, recurrence was higher in younger patients [30]:

Another study included 479 procedures of strictureplasty performed in 100 patients with a follow-up of 7 years in average [35]. Overall morbidity was 22% and included sepsis – 11%, obstruction 4%, hemorrhage - 4% percent, and mortality – 3%. After a first strictureplasty the reoperation rate were 52% at 40 months, 56% at 26 months after a second, 86% at 27 months after a third, 63% at 26 months after a fourth. The major risk factor for reoperation was young age. The early relaparotomy rate was 8 percent. One patient developed cancer after many years of disease. The authors biopsied suspicious lesions, rather than going for routine biopsy of all lesions.

#### 4.4.2. Balloon dilation

Another method to dilate intestinal strictures is with a hydrostatic balloon. Experience is relatively limited compared with strictureplasty or resection, and the long-term efficacy and safety is therefore less well-established. A meta-analysis of 13 studies (with a total of 347 patients) reported overall technical success in 86 % of cases and long-term efficacy in 58 percent, with up to 33 months of follow-up [36]. On multivariate analysis, a stricture length of  $\leq 4$  cm was associated with better surgery-free outcomes. The outcome of balloon dilatation to relieve obstruction from intestinal strictures in Crohn's disease is not influenced by the type of concomitant medical therapy [37].

Couckuyte et al performed 78 dilatation procedures for 59 ileocolonic strictures in 55 patients, all procedures were carried out endoscopically under general anesthesia. Success was registered in 90% with 11% perforations from which 30% needed surgery and 60% were solved only with medical treatment. Mean period of time to recurrence of obstruction was up to 11 months for 62% of patients. [38]

In pediatric patients injections of corticosteroids into strictures after balloon dilatations were followed by fewer redilatations than in placebo group. [39]. For adults it didn't work the same [40]

#### 4.4.3. Stenting

Placement of an expandable metal stent within colonic strictures has been described, but experience is limited, and the safety of this approach is uncertain [41].

### 4.5. Colorectal disease

Options for surgery range from temporary diverting ileostomy to resection of segments of diseased colon or even the entire colon and rectum. Same conservative principles applied to disease involving the small intestine should also be applied to the surgical management of Crohn's colitis

The optimal procedure depends in part upon the extent of the disease and the clinical setting:

- Segmental colectomy may be adequate for isolated areas of colonic involvement. An ileorectal anastomosis can be carried out if the rectum is spared. A proctectomy will be required in half of the patients [42]. While no prospective randomized study has been undertaken to compare segmental colectomy and total colectomy with ileorectal anastomosis, both procedures appear to be equally effective as treatment options for colonic Crohn's disease. However, patients undergoing segmental resection may have earlier recurrence [43]. The choice of operation depends upon the extent of colonic disease; there may be better outcomes with ileorectal anastomosis in those who have two or more involved colonic segments.
- Total proctocolectomy is indicated for patients with extensive, diffuse colorectal disease.
- Subtotal colectomy with ileostomy is usually performed in emergency situations.

- An abdominoperineal resection with a permanent end-colostomy is indicated in patients with severe Crohn's disease limited to the anorectum. An intersphincteric proctectomy will minimize the risk of a nonhealing wound and sexual or urinary dysfunction, by avoiding dissection near the hipogastric plexuses. In the presence of anorectal disease and sepsis a Hartmann procedure can be carried out in the first place leaving a small stump of distal rectum, followed by a perineal proctectomy. [44].

#### 4.6. Anorectal disease

The management of anorectal disease, present in 14–38% of patients, remains difficult despite advances in medical therapy. Perianal fistula or abscess is the initial presentation of Crohn's disease in approximately 30% of cases and has been associated with increased extra-intestinal symptoms and steroid resistance, resulting in significant disability [8].

The number of Crohn's patients who require surgery has, however, decreased with the advances in medical management.

Most of the abscesses are small, difficult to drain and can disappear with antibiotics alone. The antibiotic therapy should associate ciprofloxacin to metronidazole. Greater abscesses can be drained by placement of a seton or by ultrasound or CT guided large bore needle aspiration or drain placement.

Treatment of the perianal fistula depends on the type of fistula (simple vs. complex) and underlying rectal inflammation.

Simple fistulas are intersphincteric or transsphincteric below the dentate line in origin with a single opening and no associated stricture or abscess. Such fistulas have an excellent response to antibiotic and surgical therapy and heal 80–100% of the time with simple fistulotomy [8]

Complex fistulas on the contrary, involve the superficial, transsphincteric, or intersphincteric region below the dentate line, have multiple openings, and can be associated with rectal stricture or rectovaginal fistula.

Pelvic MRI provides the most accurate information (90% accuracy) about fistulous burden and underlying rectal inflammation and is instrumental in surgical planning and monitoring response to therapy. Accuracy approaches 100% when MRI is combined with examination under anesthesia. [45, 46]

Complex fistulas represent a challenge and require aggressive immunomodulating therapy in combination with surgical therapy. Many patients feel improvement in symptoms with antibiotic therapy (ciprofloxacin and metronidazole); however, symptom relief is transient with recurrence on withdrawal of antibiotics. Infliximab has proven to be the immunosuppressive drug of choice in treatment of complex perianal fistulas with two randomized trials showing decreased number of fistulas, increased disease-free period, and fewer required hospitalizations and surgeries.[47]

Surgical therapy has evolved for complex fistulas as well with the development of less invasive techniques for closure of high fistulas to prevent incontinence associated with damage

to the anal sphincters. Some of the newest approaches use fibrin glue and collagen plugs to occlude fistulous tracts without requiring incision.

A study from Chung et al comparing collagen fistula plug to fibrin glue, rectal advancement flap, and seton placement for treatment of 51 patients with complex perianal fistulas showed a 75% resolution rate with use of the plug compared with less than 30% for each of the other modalities. [48]

The systematic review by Soltani and Kaiserof evaluating the efficacy of endorectal flap advancement for complex perianal Crohn's disease found a 46% resolution [49].

The review by Lewis and Maron on anorectal Crohn's disease provides an algorithm for management of complex perianal fistulas, stressing that surgical therapy in excess of seton placement should not be attempted during active proctitis due to inflammation [50].

Postoperative medical treatment for prevention of Crohn's disease recurrence is controversial in light of data supporting increased incidence of complications with preoperative immunosuppressive therapy. However, a randomized, placebo-controlled clinical trial showed no difference in incidence of adverse events (anastomotic leak, wound complications, infection, obstruction, bleeding, death) between postoperative patients treated with infliximab within 4 weeks of surgery and those untreated. [51]

Bordeianou et al studied the effect of immediate vs. tailored medical prophylaxis on endoscopic and/or symptomatic recurrence in 199 patients who underwent ileocecectomy for Crohn's disease. The group found that there was no difference in recurrence rates between patients treated with medication immediately after surgery and those treated based on endoscopic finding, adding to the debate on whether perioperative and postoperative medical suppression is advantageous. [52]

## **5. Minimally invasive surgery for inflammatory bowel disease**

The laparoscopic approach was already proven feasible both for UC and CD.

### **5.1. Minimally invasive surgery for chronic ulcerative colitis**

A way to use laparoscopy is only for the mobilization of the colon (cecum, ascendent, descendent, sigmoid) and to perform the rest of the operation in open but with a smaller incision [53]

Laparoscopic subtotal colectomy performed in emergency conditions was followed by acceptable outcomes and shorter hospital stay, although in such cases is not usually recommended [54].

Another possibility is to perform colon and rectal mobilisation, section of the mesocolon and even the rectum with linear ENDO-GIA. Some authors do that by hand assisted technique.

### 5.1.1. To divert or not after laparoscopic surgery

This is a question still under debate. Ky et al had a series of 32 laparoscopic IPAA (29 for UC) in which they didn't divert and had a morbidity of 34% and 3% leak rate [55]. Hasegawa et al performed 18 cases all with diversions and had 33% morbidity and 0% leak rate [56]. Others like Marcello et al from 20 cases (13 for UC) divert only in 60% of cases and had 5% leak rate.[57]

Is laparoscopy superior to open approach? In short term yes – as already proven by comparison between them, with faster recovery (including faster ambulation, less postoperative pain, faster return of bowel movement and time to first passage of flatus and feces).

Brown et al compared laparoscopic-assisted restorative proctocolectomy to open approach and found shorter operative time in open group, and similar functional outcome and recovery, only better cosmesis by shorter abdominal scar. The hand-assisted method seems to reduce the operative time with more than 30 minutes [58].

Postoperative morbidity is still relatively high due to extensive procedure (25-34%) [55, 56, 57]

## 5.2. Minimally invasive surgery for Crohn's disease

Laparoscopic approach have the potential of decreasing morbidity, speeding recovery, and reducing costs, while decreasing the incidence of small bowel obstruction and ventral (abdominal wall) hernias [59,60].

A randomized comparative trial between open and laparoscopic ileo-colic resection found a conversion rate of 6% and no significant difference in immediate postoperative recovery (passage of flatus and length of hospital stay). The only benefit was a faster recovery of forced expiratory volume and forced expiratory vital capacity. [61]

Maartense et al performed a comparative randomized controlled trial between laparoscopic-assisted ileocolonic resection performed by experienced surgeons in laparoscopy with open resections in Crohn's disease [62]. Morbidity, hospital stay, and costs were lower in the laparoscopic group, although there were no significant differences in quality-of-life at three months follow-up.

Alves et al found that the need for conversion to an open procedure was predicted by the severity of disease; independent predictors of conversion including a history of recurrent medical episodes of Crohn's disease and the presence of intra-abdominal abscess or fistula at the time of laparoscopy [63].

Recurrences after laparoscopic surgery were similar after conventional surgery. Laparoscopic colectomy was found to be safe and effective in the hands of experienced surgeons for selected patients with Crohn's colitis [64].

In the review by Fichera et al on Crohn's disease, the author highlights three meta-analyses that compared laparoscopic with open ileocolic surgery that demonstrated earlier return of bowel function leading to shorter hospital stay, fewer late small bowel obstructions, and de-



creased early complications such as wound infections and bleeding with laparoscopic surgery. [20]

Two large studies on laparoscopic surgery for isolated colonic disease found similarly good outcomes with fewer complications. Holubar et al reported their outcomes for 92 patients who underwent laparoscopic colectomy, showing a total complication rate of 34%, reintervention rate of 7.6%, and anastomotic leak rate of 3.8%, all consistent with reported outcomes for open colectomy. Fifteen percent of laparoscopic cases were converted to open and presence of small bowel disease was the only predictive factor identified, independent of presence of phlegmonous or fistulous disease. [65]

Umanskiy et al compared outcomes of 125 patients who underwent laparoscopic vs. open colectomy and/or proctectomy for Crohn's disease. The most common procedure in both groups was total proctocolectomy with end ileostomy and the only statistically significant difference in procedures performed applied to completion proctectomies, which were more likely to be open. Patients in the laparoscopic group had earlier return of bowel function, reduced length of hospital stay, and decreased intraoperative blood loss. Interestingly, the reduced blood loss did not result in fewer transfusions, which were similar in both groups [66].

#### *5.2.1. Recurrence after laparoscopic surgery*

There was also no clinical recurrence at 20 months [60]. In a study by Tabet et al with 39 months follow up, there were similar rates of recurrence 48% vs 45%. [67]

Watanabe et al and Bemelman et al performed laparoscopic-assisted resection for Crohn's disease, including patients with enteric fistulas. Postoperative outcome was better in laparoscopic group [68, 69]. Same results were noted by Duepre et al., Tabet et al, and Young Fadok et al. (all comparative studies) who found short term outcome benefits associated with the minimally invasive approach [60, 67, 70].

#### *5.2.2. Costs*

For Duepre et al costs per case were higher for laparoscopic group.[70]. Young-Fadok et al reported an overall cost for laparoscopic cases significantly less than for the open ones [60].

There is a broad range of conversion rates (1.4-24 %), morbidity (10-29 %), length of stay (3.3-8.8 days), and leak rates (0-5%). Most of the series involve relatively small numbers of patients. [59, 69, 70]

#### *5.2.3. Long term benefits of laparoscopic approach*

Laparoscopic surgery is considered to generate less postoperative adhesions and less incisional hernias.

Bergamaschi et al reported the results of a comparative study with long term follow up between laparoscopic and open ileocecal resections. At 5 years, they found a rate of 11.1 % small bowel obstructions for laparoscopic group and 35.4 percent for the open group, and the result was statistically significant.[59]



Generally, laparoscopic colectomy is followed by lower incidence of incisional hernia and small bowel obstruction, with significant differences, as reported by Duepre et al [70].

Functional outcome [71], quality of life [71] are similar but cosmetic results [71] especially for women [72] are higher after laparoscopy.

## 6. Complications

### 6.1. Early complications

Are usual after restorative proctocolectomy.

The most frequent are bowel obstruction, pouch bleeding, pelvic and wound sepsis, transient urinary dysfunction, and dehydration from temporary loop ileostomy with high output. Surgery is not mandatory in many of those cases. Incidence of pelvic abscess after IPAA is estimated to 5% [73]. Pelvic abscesses lead to transabdominal or local surgery in most of the cases, failure of pouch in quarter of cases, incontinence, need for constipating or bulking medications was in the patients in whom the reservoir was preserved. There was also a decrease in the quality of life of those patients.

Portal vein thrombosis can occur after IPAA. Clinical manifestations may include pain, fever, vomiting, leukocytosis, and unexplained postoperative ileus. Diagnose is made with CT-scanner. Treatment with anticoagulation will lead to full resolution.

### 6.2. Late complications

- stricture of the anastomosis,
- poor postoperative anorectal function,
- anal fistula and abscess,
- reduced fertility [74],
- pouchitis - this is the most frequent. In one series, the cumulative probability of suffering at least one episode of clinical pouchitis was 18 and 48 % at 1 and 10 years, respectively [75],
- irritable pouch syndrome and anismus (anorectal dysfunction)[76].

Majority of the pouch related complication can be solved by medical treatment consisting mainly in local measures, surgery being required in a minority. In one series of almost 1000 patients who had undergone IPAA, reoperation for complications was necessary in only 12 % [77].

As an example, ileal pouch fistulas and strictures refractory to dilatation are difficult to treat and may require revision of the pouch if Crohn's disease can be excluded. A transvaginal repair is favored for a pouch-vaginal fistula [78]. A combined abdominal perineal repair may offer better results compared with a local procedure [79]. A controlled septic condition does not preclude salvage surgery. Although pouch failure occurs more often than with pri-

mary IPAA, high patient satisfaction and quality of life can be achieved [80]. Furthermore, excision of the pouch is associated with a high risk of complications, especially delayed perineal wound healing [81, 82].

A number of unusual late complications have been described including [83, 84, 85]:

- Solitary ileal ulcer
- Traumatic ileal ulcer perforation
- Superior mesenteric artery syndrome
- Mucosal prolapse with outlet obstruction
- Volvulus
- Sacral osteomyelitis
- Puborectal spasm
- Fibroid polyps
- Pharmacobezoar

### 6.3. Long-term results of surgery

The long-term success of surgery depends upon the type of operation, the clinical setting, and surgical expertise. Several studies have suggested that functional results are poor during the long-term follow-up in patients who had adverse personality factors before surgery (such as problems with sexual satisfaction, difficulty expressing emotions, perfectionist body ideals, and poor frustration tolerance) [79]. The following results were described in some of the largest series.

One series included 1885 patients who underwent an ileal pouch-anal anastomosis for ulcerative colitis and were followed for an average of 11 years. The mean number of stools was 5.7 per day at one year and 6.4 at 20 years, and also increased at night from 1.5 to 2.0. The incidence of frequent fecal incontinence increased from 5 to 11 percent during the day and from 12 to 21 percent at night. The overall rate of pouch success at 5, 10, 15, and 20 years was 96, 93, 92, and 92 percent, respectively. Quality of life remained unchanged and 92 percent remained in the same employment. [86]

In another report that included 486 patients who had undergone proctocolectomy and ileoanal anastomosis for ulcerative colitis or familial adenomatous polyposis, the cumulative probabilities of pouch failure were 1, 5, and 7 percent at 1, 5, and 10 years, respectively [87]. The most common cause of pouch failure was fistula formation.

Tulchinsky et al reported 634 patients who underwent restorative proctocolectomy for IBD. Patients were followed for a mean of 85 months. Failure (defined as removal of the pouch or the need for an ileostomy) was divided into early (occurring within one-year) or late (occurring more than one-year postoperatively). Three patients died postoperatively while an additional 23 died (of a variety of causes) during follow-up. Of the remaining patients, there

were a total of 61 failures (10 %) of which 24.6% were early and 75.4% late. Failures were due to pelvic sepsis (52 %), poor function (30 %), pouchitis (11 %), and miscellaneous causes (four patients, all early failures). Predictors of failure included a final diagnosis of Crohn's disease, a type J or S reservoir, female gender, postoperative pelvic sepsis, and a one-stage procedure. Failure rates increased with time from 9% at five years to 13% at 10 years. [88]

Another series showed that results in older patients (>65) are not as good; however, appropriate case selection was followed by acceptable function and quality of life to patients of all ages [89].

Anal canal strictures were described in up to 11 percent of 213 patients [82]. Strictures that were not fibrotic responded well after anal dilation while fibrotic strictures were more commonly associated with intra- or postoperative complications and frequently required surgical therapy.

A systematic review of 43 observational studies (with a total of 9317 patients) found a pouch failure rate of 6.8%, increasing to 8.5% in those with more than five-year follow-up [90]. Pelvic sepsis occurred in 9.5%. Severe, mild, and urge fecal incontinence was reported in 3.7, 17, and 7.3 percent, respectively. These results suggest that current techniques are associated with non-negligible complication rates and leave room for improvement and continued development of alternative procedures.

IPAA may have long-term effects:

- on female reproductive health [91],
- some women experience increased dyspareunia [92], although the ability to experience orgasm and coital frequency remain unchanged,
- female fertility is significantly decreased [93], possibly due to pelvic adhesions, although successful pregnancies occur regularly [94], patients may experience a transient increase in stool frequency (including incontinence) during pregnancy, which resolves after delivery, pregnancy and delivery are safe in patients with IPAA. Patients should not be discouraged from childbearing because of the pouch. Whether vaginal or cesarean delivery is better for women with a pelvic pouch remains controversial.

Satisfactory long-term functional outcome and excellent quality of life have also been described after stapled restorative proctocolectomy. In a series of 977 patients, quality of life increased for two years after surgery, with no deterioration thereafter [95]. The prevalence of perfect continence increased from 76 percent before surgery to 82 percent after surgery and, although continence deteriorated somewhat more than two years after surgery, it was no worse than preoperative values. Ninety-eight percent of patients would have recommended the surgery to others. In another prospective, observational study, patients who had a stapled anastomosis had higher rates of daytime, nighttime, and complete continence compared with patients who underwent a hand-sewn anastomosis [32].

#### 6.4. Morbidity of operation due to use of biologic agents

*Preoperative use of infliximab.* The efficacy of the biologic agents must be balanced against the morbidity associated with their usage, and surgeons have been worried about the safety associated with the preoperative use of these medications in patients requiring elective or non-elective operations for their IBD.

Beddy et al believed the evidence showed that recent biologic agent administration in a patient with Crohn's disease should not cause the surgeon to delay surgery or employ fecal diversion proximal to an anastomosis. However, they felt that patients with ulcerative colitis preoperatively managed with infliximab and immunosuppressant medications should undergo a three-stage rather than two-stage restorative proctocolectomy and ileal pouch-anal anastomosis (IPAA); the first operation would be a total or subtotal colectomy and creation of ileostomy that allows patients to be withdrawn from medications prior to performing the IPAA procedure. They proposed this approach in hopes of improving long-term ileal pouch function by decreasing the risk of short-term infectious complications attributed to combination therapy.[83]

Gainsbury et al, remarked that there is an increased risk of septic complications associated with preoperative infliximab and elective surgery for ulcerative colitis, growing evidence appears to refute that notion. [99]

Whether immunosuppressive therapy increases the risk of postoperative complications is still controversy. For some authors [98, 99, 100, 101] it may not be responsible but for others [102, 103, 104] it is, increasing risk for sepsis, intraabdominal abscesses [102,104], and especially when associated with other immunomodulators (ciclosporin) [103]. In this conceptual area there is need for more controlled trials.

Ellis et al found that unlike surgical mortality for most disorders, the operative mortality associated with colectomy for ulcerative colitis has increased in recent years despite centralization of care. This finding raises considerable concern that patients potentially are not receiving prompt or appropriate surgical care because of alterations in medical therapy. [105]

#### 6.5. Pouchitis

Outside of the perioperative period, the most common late complication of ileal pouch anal anastomosis is pouchitis, occurring in up to 60% of patients.[106] Pouchitis is thought to be the result of immunologic reaction to altered bowel flora. Symptoms range from mild diarrhea to severe abdominal pain and fistulization with neighboring organs. In a recent review from the Cleveland Clinic, multivariate analysis identified pulmonary co-morbidities, S-pouch reconstruction, disease proximal to the splenic flexure, and extraintestinal disease are the factors predictive of subsequent pouchitis. Patients who developed pouchitis had higher incidence of obstruction, fistula, and stricture and reported lower quality of life than controls [94]. Once identified, the treatment of pouchitis is primarily medical, with most patients showing excellent response to antibiotics and/or probiotics and immunomodulators. A Cochrane database review of trials through 2010 found that ciprofloxacin was more effec-

tive than metronidazole and budesonide enemas were equally effective to metronidazole in the treatment of acute pouchitis. The probiotic VSL#3 was more effective than placebo for prevention and treatment of chronic pouchitis[108]. Haveranet al reported complete resolution of symptoms in stricturing and antibiotic resistant pouchitis with azathioprine and 6-mercaptopurine. However, fistulizing disease required the addition of infliximab, with 46% of such patients ultimately requiring diverting ileostomy for relief. Alternatives to ileostomy for pouch failure include pouch salvage techniques such as transanal mobilization or abdominoperineal revision of the pouch, with success rates ranging from 48 to 93%.[18] A small percentage of patients will ultimately be identified as having Crohn's disease as the cause of their fistulae and pouch complications.[109]

In a review of almost 1800 IPAA attempts from the Mayo Clinic, abandonment was required in 4.1 % [97].

## 7. Postoperative monitoring

### Risk of dysplasia and cancer

All patients who undergo surgical procedures for ulcerative colitis should be monitored regularly for the development of long-term complications.

In addition to functional problems, complications can occur at any stage, including the development of dysplasia and possibly cancer.

However, in a study of potentially high-risk patients (eg, Kock pouch for  $\geq 14$  years, a pelvic pouch for  $\geq 12$  years, a history of dysplasia or cancer in the proctocolectomy specimen or troublesome pouchitis), the development of dysplasia was rare [98].

### 7.1. Dysplasia

The presence of inflammatory changes in a retained rectal stump, anal transitional zone, and ileal reservoir after stapled pouch-anal anastomosis is a cause of concern because of the long-term risk of dysplasia.

A systematic review of 23 observational and case control studies estimated that the prevalence of confirmed dysplasia in the pouch, anal transitional zone, or rectal cuff was 1.13 % (0-19%) The prevalence of high-grade, low-grade, or indefinite dysplasia was 0.15, 0.98, and 1.23 %, respectively. Dysplasia was equally frequent in the pouch and rectal cuff or anal transitional zone [112].

If dysplasia and cancer are identified before or at operation the risk for postoperative dysplasia is higher. The risk of neoplasia is not completely eliminated by colectomy and mucosectomy. A retrospective review of 3203 patients with a preoperative diagnosis of IBD who underwent restorative proctocolectomy found that the cumulative incidence for pouch neoplasia at 5, 10, 15, 20 and 25 years were 0.9, 1.3, 1.9, 4.2, and 5.1 %, respectively 11 patients developed adenocarcinoma of the pouch or at the anal transitional zone, one developed



lymphoma in the pouch, three developed squamous cell carcinoma at the anal transitional zone, and 23 developed pouch dysplasia. The prognosis of pouch adenocarcinoma appeared to be poor [100].

If the rectal cuff becomes symptomatic or develops dysplasia, the retained rectal mucosa from the restorative proctocolectomy can be removed by a transanal completion mucosectomy and reconstructing the ileal pouch-anal anastomosis as an alternative to a complete anal rectal resection and permanent ileostomy. The mucosectomy removes all rectal mucosa, confers a highest likelihood of a surgical cure, and reduces the risk of future dysplasia. Short term results in a series of 27 patients included reduced pouchitis symptoms and 90 % of patients were moderately to very satisfy with the procedure. Incontinence was reduced by 70 percent at 12 months of observation [101].

The optimal frequency of pouch endoscopy and biopsy is not well established. It is recommended to perform an initial screening five years after creation of an ileal pouch in children or when the total disease duration exceeds seven years [102].

In patients that had severe villous atrophy or dysplasia in the resected colon or rectum the aforementioned interval may be reduced. In patients with pouch or anal high-grade dysplasia detected during surveillance, resection of the ileal pouch and anal canal should be considered.

In a retrospective review of 222 patients who required operative intervention for Crohn's colitis, there were 2.3% dysplasia and 2.7% adenocarcinoma. In this small cohort, the risk factors for the development of dysplasia or adenocarcinoma included longer disease duration (over 17 years), extensive disease, and older age at diagnosis (38 years of age or older). These findings support colonoscopic screening and surveillance of patients with Crohn's colitis. [116]

## **7.2. Recurrence**

The postoperative recurrence rate for patients undergoing a resection and anastomosis is high in Crohn's disease. In most series up to 20 percent of patients will not have a clinical recurrence even at 15 years after surgery Those with severe endoscopic or radiologic findings are at increased risk to have or develop symptoms (72 versus 42%). An increased risk for reoperation has been associated with perforating disease and smoking [117].

A laparoscopic approach does not appear to decrease the risk of recurrence. A retrospective review of 89 patients undergoing laparoscopically resected primary ileocolonic Crohn's colitis found recurrent disease in 61 percent [118]. The median time to recurrence was 13 months (range 1.3 months to 8.7 years). Only the presence of granulomas in the resected specimen was identified as a risk factor for time to recurrence, and these patients were almost three times more likely to develop a recurrence.

The recurrence rate is lower in patients with Crohn's colitis who undergo a total colectomy and ileostomy compared to those with disease involving other segments of the digestive tract. We already know, from a study in 1985 by Goligher et al Such patients have only a 10



percent recurrence rate in the small intestine at 10 years [106]. A number of medical options are available that may reduce the risk of recurrence. A relatively aggressive approach should be considered in patients with diffuse and distal Crohn's colitis. Total proctocolectomy in properly selected patients is associated with low morbidity, a decreased risk of recurrence, and a longer time to recurrence [20]

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## References

- [1] Zmora O., Mahajna A., Bar-Zakai B., Hershko D., Shabtai M., Krausz M., Ayalon A. – Is mechanical bowel preparation mandatory for left-sided colonic anastomosis? Results of a prospective randomised trial. *Tech coloproctol*, 01 July 2006; 10(2): 131-5
- [2] Schapira M, Henrion J, Ravoet C, et al. Thromboembolism in inflammatory bowel disease. *Acta Gastroenterol Belg* 1999; 62:182.
- [3] Irving PM, Pasi KJ, Rampton DS. Thrombosis and inflammatory bowel disease. *Clin Gastroenterol Hepatol* 2005; 3:617.
- [4] Cohen RD. How should we treat severe acute steroid-refractory ulcerative colitis? *Inflamm Bowel Dis* 2009; 15:150.
- [5] Becker JM, Stucchi AF. Treatment of choice for acute severe steroid-refractory ulcerative colitis is colectomy. *Inflamm Bowel Dis* 2009; 15:146.
- [6] Randall J, Singh B, Warren BF, et al. Delayed surgery for acute severe colitis is associated with increased risk of postoperative complications. *Br J Surg* 2010; 97:404.
- [7] Heyries L, Bernard JP, Perrier H, et al. [Hemorrhagic rectocolitis and autoimmune hemolytic anemia]. *Gastroenterol Clin Biol* 1998; 22:741.

- [8] Nandivada P, Poylin V, Nagle D, Advances in the Surgical Management of Inflammatory Bowel Disease, *Curr Opin Gastroenterol*. 2012;28(1):47-51.
- [9] Goudet P, Dozois RR, Kelly KA, et al. Changing referral patterns for surgical treatment of ulcerative colitis. *Mayo Clin Proc* 1996; 71:743.
- [10] Michelassi, F. Indications for surgical treatment in ulcerative colitis and Crohn's disease. In: *Operative Strategies in Inflammatory Bowel Disease*, Michelassi, F, Milson, JW (Eds), Springer, 1997. p.151.
- [11] Ananthakrishnan AN, McGinley EL, Binion DG, Saeian K. A nationwide analysis of changes in severity and outcomes of inflammatory bowel disease hospitalizations. *J Gastrointest Surg* 2011; 15:267–276.
- [12] Oussalah A, Evesque L, Laharie D, et al. A multicenter experience with infliximab for ulcerative colitis: outcomes and predictors of response, optimization, colectomy, and hospitalization. *Am J Gastroenterol* 2010; 105:2617–2625.
- [13] Gustavsson A, Järnerot G, Hertervig E, et al. Clinical trial: colectomy after rescue therapy in ulcerative colitis - 3-year follow-up of the Swedish-Danish controlled infliximab study. *Aliment Pharmacol Ther* 2010; 32:984–989. Chaparro M, Burgueño P, Iglesias E, et al. Infliximab salvage therapy after failure of ciclosporin in corticosteroid-refractory ulcerative colitis: a multicentre study. *Aliment Pharmacol Ther* 2012; 35:275–283. Goudet P, Dozois RR, Kelly KA, et al. Characteristics and evolution of extraintestinal manifestations associated with ulcerative colitis after proctocolectomy. *Dig Surg* 2001; 18:51.
- [14] Cima R, Pemberton JH. Medical and surgical management of chronic ulcerative colitis. *Arch Surg* 2005; 140:300–310.
- [15] Heuschen UA, Hinz U, Allemeyer EH, et al. Risk factors for ileoanal J pouch-related septic complications in ulcerative colitis and familial adenomatous polyposis. *Ann Surg* 2002; 235:207–216.
- [16] da Luz Moreira A, Kiran RP, Lavery I. Clinical outcomes of ileorectal anastomosis for ulcerative colitis. *Br J Surg* 2010; 97:65.
- [17] Farouk R, Pemberton JH, Wolff BG, et al. Functional outcomes after ileal pouchanal anastomosis for chronic ulcerative colitis. *Ann Surg* 2000;
- [18] Fichera A, Michelassi F. Surgical treatment of Crohn's disease. *J Gastrointest Surg* 2007; 11:791.
- [19] Grucela A, Steinhagen RM. Current surgical management of ulcerative colitis. *Mt Sinai J Med* 2009; 76:606–612.
- [20] Simillis C, Purkayastha S, Yamamoto T, et al. A meta-analysis comparing conventional end-to-end anastomosis vs. other anastomotic configurations after resection in Crohn's disease. *Dis Colon Rectum* 2007; 50:1674.

- [21] Worseley MJ, Hull T, Ryland L, Fazio V. Strictureplasty is an effective option in the operative management of duodenal Crohn's disease. *Dis Colon Rectum* 1999; 42:596.
- [22] Cellini C, Safar B, Fleshman J. Surgical management of pyogenic complications of Crohn's disease. *Inflamm Bowel Dis* 2010; 16:512.
- [23] Neufeld D, Keidar A, Gutman M, Zissin R. Abdominal wall abscesses in patients with Crohn's disease: clinical outcome. *J Gastrointest Surg* 2006; 10:445.
- [24] Fleshman JW. Pyogenic complications of Crohn's disease, evaluation, and management. *J Gastrointest Surg* 2008; 12:2160.
- [25] Spencer MP, Nelson H, Wolff BG, Dozois RR. Strictureplasty for obstructive Crohn's disease: the Mayo experience. *Mayo Clin Proc* 1994; 69:33.
- [26] Tjandra JJ, Fazio VW, Lavery IC. Results of multiple strictureplasties in diffuse Crohn's disease of the small bowel. *Aust N Z J Surg* 1993; 63:95.
- [27] Yamamoto T, Keighley MR. Long-term results of strictureplasty without synchronous resection for jejunoileal Crohn's disease. *Scand J Gastroenterol* 1999; 34:180.
- [28] Dietz DW, Fazio VW, Laureti S, et al. Strictureplasty in diffuse Crohn's jejunoileitis: safe and durable. *Dis Colon Rectum* 2002; 45:764.
- [29] Tonelli F, Fedi M, Paroli GM, Fazi M. Indications and results of side-to-side isoperistaltic strictureplasty in Crohn's disease. *Dis Colon Rectum* 2004; 47:494.
- [30] Michelassi, F. Indications for surgical treatment in ulcerative colitis and Crohn's disease. In: *Operative Strategies in Inflammatory Bowel Disease*, Michelassi, F, Milson, JW (Eds), Springer, 1997. p.151.
- [31] Michelassi F, Taschieri A, Tonelli F, et al. An international, multicenter, prospective, observational study of the side-to-side isoperistaltic strictureplasty in Crohn's disease. *Dis Colon Rectum* 2007; 50:277.
- [32] Menon AM, Mirza AH, Moolla S, Morton DG. Adenocarcinoma of the small bowel arising from a previous strictureplasty for Crohn's disease: report of a case. *Dis Colon Rectum* 2007; 50:257.
- [33] Fearnhead NS, Chowdhury R, Box B, et al. Long-term follow-up of strictureplasty for Crohn's disease. *Br J Surg* 2006; 93:475.
- [34] Hassan C, Zullo A, De Francesco V, et al. Systematic review: Endoscopic dilatation in Crohn's disease. *Aliment Pharmacol Ther* 2007; 26:1457.
- [35] Thienpont C, D'Hoore A, Vermeire S, et al. Long-term outcome of endoscopic dilatation in patients with Crohn's disease is not affected by disease activity or medical therapy. *Gut* 2010; 59:320.
- [36] Couckuyt H, Gevers AM, Coremans G, et al. Efficacy and safety of hydrostatic balloon dilatation of ileocolonic Crohn's strictures: a prospective longterm analysis. *Gut* 1995; 36:577.

- [37] Di Nardo G, Oliva S, Passariello M, 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; 72:1201.
- [38] 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; 5:1065.
- [39] Matsushashi N, Nakajima A, Suzuki A, et al. Long-term outcome of non-surgical strictureplasty using metallic stents for intestinal strictures in Crohn's disease. *Gastrointest Endosc* 2000; 51:343.
- [40] Horgan, AF, Dozois, RR. Management of colonic Crohn's disease. *Problems in General Surgery* 1999; 16:68.
- [41] Tekkis PP, Purkayastha S, Lanitis S, et al. A comparison of segmental vs subtotal/total colectomy for colonic Crohn's disease: a meta-analysis. *Colorectal Dis* 2006; 8:82.
- [42] Sher ME, Bauer JJ, Gorphine S, Gelernt I. Low Hartmann's procedure for severe anorectal Crohn's disease. *Dis Colon Rectum* 1992; 35:975.
- [43] Buchanan GN, Halligan S, Bartram CI, et al. Clinical examination, endosonography, and MR imaging in preoperative assessment of fistula in ano: comparison with outcome-based reference standard. *Radiology* 2004; 233:674–681.
- [44] Schwartz DA, Wiersema MJ, Dudiak KM, et al. A comparison of endoscopic ultrasound, magnetic resonance imaging, and exam under anesthesia for evaluation of Crohn's perianal fistulas. *Gastroenterology* 2001; 121:1064–1072.
- [45] Present DH, Rutgeerts P, Targan S, et al. Infliximab for the treatment of fistulas in patients with Crohn's disease. *N Engl J Med* 1999; 340:1398–1405.
- [46] Chung W, Ko D, Sun C, et al. Outcomes of anal fistula surgery in patients with inflammatory bowel disease. *Am J Surg* 2010; 199:609–613.
- [47] Soltani A, Kaiser AM. Endorectal advancement flap for cryptoglandular or Crohn's fistula-in-ano. *Dis Colon Rectum* 2010; 53:486–495.
- [48] Lewis RT, Maron DJ. Anorectal Crohn's disease. *Surg Clin N Am* 2010; 90:83–97.
- [49] Regueiro M, El-Hachem S, Kip KE, et al. Postoperative infliximab is not associated with an increase in adverse events in Crohn's disease. *Dig Dis Sci* 2011; 56:3610–3615.
- [50] Bordeianou L, Stein SL, Ho VP, et al. Immediate vs tailored prophylaxis to prevent symptomatic recurrences after surgery for ileocecal Crohn's disease. *Surgery* 2011; 149:72–78.
- [51] Kienle P, Weitz J, Benner A, et al. Laparoscopically assisted colectomy and ileoanal pouch procedure with and without protective ileostomy. *Surg Endosc*. 2003May; 17(5):716-20.

- [52] Fowkes L, Krishna K, Menon A, et al. Laparoscopic emergency and elective surgery for ulcerative colitis. *Colorectal Dis* 2008; 10:373–378.-
- [53] Ky AJ, Sonoda T, Milsom JW. One-stage laparoscopic restorative proctocolectomy: an alternative to the conventional approach? *Dis Colon Rectum*. 2002 Feb;45(2): 207-10;discussion 210-1.
- [54] Hasegawa H, Watanabe M, Baba H, Nishibori H, Kitajima M. Laparoscopic restorative proctocolectomy for patients with ulcerative colitis. *J Laparoendosc Adv Surg Tech A*. 2002 Dec;12(6):403-6.
- [55] Marcello PW, Milsom JW, Wong SK, et al. Laparoscopic restorative proctocolectomy: case-matched comparative study with open restorative proctocolectomy. *Dis Colon Rectum*. 2000 May;43(5):604-8.
- [56] Brown SR, Eu KW, Seow-Choen F. Consecutive series of laparoscopic-assisted vs. minilaparotomy restorative proctocolectomies. *Dis Colon Rectum*. 2001 Mar;44(3): 397-400.
- [57] Bergamaschi R, Pessaux P, Arnaud JP. Comparison of conventional and laparoscopic ileocolic resection for Crohn's disease. *Dis Colon Rectum*. 2003 Aug;46(8):1129-33.
- [58] Young-Fadok TM, Hall Long K, McConnell EJ et al. Advantages of laparoscopic resection for ileocolic Crohn's disease. Improved outcomes and reduced costs. *Surg Endosc*. 2001 May;15(5):450-4.
- [59] Milsom JW, Hammerhofer KA, Bohm B, et al. Prospective, randomized trial comparing laparoscopic vs. conventional surgery for refractory ileocolic Crohn's disease. *Dis Colon Rectum*. 2001 Jan;44(1):1-8.
- [60] Maartense S, Dunker MS, Slors JF, et al. Laparoscopic-assisted versus open ileocolic resection for Crohn's disease: a randomized trial. *Ann Surg* 2006; 243:143.
- [61] Alves A, Panis Y, Bouhnik Y, et al. Factors that predict conversion in 69 consecutive patients undergoing laparoscopic ileocecal resection for Crohn's disease: a prospective study. *Dis Colon Rectum* 2005; 48:2302.
- [62] Lowney JK, Dietz DW, Birnbaum EH, et al. Is there any difference in recurrence rates in laparoscopic ileocolic resection for Crohn's disease compared with conventional surgery? A long-term, follow-up study. *Dis Colon Rectum* 2006; 49:58.
- [63] Holubar SD, Dozois EJ, Privitera A, et al. Minimally invasive colectomy for Crohn's colitis: a single institution experience. *Inflamm Bowel Dis* 2010; 16:1940–1946.
- [64] Umanskiy K, Malhotra G, Chase A, et al. Laparoscopic colectomy for Crohn's colitis. A large prospective comparative study. *J Gastrointest Surg* 2010; 14:658–663.
- [65] Tabet J, Hong D, Kim CW et al. Laparoscopic versus open bowel resection for Crohn's disease. *Can J Gastroenterol*. 2001 Apr;15(4):237-42.



- [66] Watanabe M, Hasegawa H, Yamamoto S, et al. Successful application of laparoscopic surgery to the treatment of Crohn's disease with fistulas. *Dis Colon Rectum*. 2002 Aug;45(8):1057-61.
- [67] Bemelman WA, Slors JF, Dunker MS et al. Laparoscopic-assisted vs. open ileocolic resection for Crohn's disease. A comparative study. *Surg Endosc*. 2000 ug;14(8):721-5.
- [68] Duepre HJ, Senagore AJ, Delaney CP, et al. Advantages of laparoscopic resection for ileocecal Crohn's disease. *Dis Colon Rectum*. 2002 May;45(5):605-10.
- [69] Dunker MS, Bemelman WA, Slors JFM, et al. Functional outcome, quality of life, body image, and cosmesis in patients after laparoscopic-assisted and conventional restorative proctocolectomy: a comparative study. *Dis Colon Rectum* 2001; 44:1800–1807.
- [70] Polle SW, Dunker MS, Slors JF, et al. Body image, cosmesis, quality of life, and functional outcome of hand-assisted laparoscopic versus open restorative proctocolectomy: long-term results of a randomized trial. *Surg Endosc* 2007; 21:1301.
- [71] Farouk R, Pemberton JH, Wolff BG, et al. Functional outcomes after ileal pouch-anal anastomosis for chronic ulcerative colitis. *Ann Surg* 2000;
- [72] Olsen KO, Joelsson M, Laurberg S, Oresland T. Fertility after ileal pouch-anal anastomosis in women with ulcerative colitis. *Br J Surg* 1999; 86:493.
- [73] Hahnloser D, Pemberton JH, Wolff BG, et al. Pregnancy and delivery before and after ileal pouch-anal anastomosis for inflammatory bowel disease: immediate and long-term consequences and outcomes. *Dis Colon Rectum* 2004; 47:1127.
- [74] Shen B, Remzi FH, Lavery IC, et al. A proposed classification of ileal pouch disorders and associated complications after restorative proctocolectomy. *Clin Gastroenterol Hepatol* 2008; 6:145.
- [75] Galandiuk S, Scott NA, Dozois RR, et al. Ileal pouch-anal anastomosis. Reoperation for pouch-related complications. *Ann Surg* 1990; 212:446.
- [76] Burke D, van Laarhoven CJ, Herbst F, Nicholls RJ. Transvaginal repair of pouch-vaginal fistula. *Br J Surg* 2001; 88:241.
- [77] Johnson P, Richard C, Ravid A, et al. Female infertility after ileal pouch-anal anastomosis for ulcerative colitis. *Dis Colon Rectum* 2004; 47:1119.
- [78] Baixauli J, Delaney CP, Wu JS, et al. Functional outcome and quality of life after repeat ileal pouch-anal anastomosis for complications of ileoanal surgery. *Dis Colon Rectum* 2004; 47:2.
- [79] Karoui M, Cohen R, Nicholls J. Results of surgical removal of the pouch after failed restorative proctocolectomy. *Dis Colon Rectum* 2004; 47:869.
- [80] Prudhomme M, Dozois RR, Godlewski G, et al. Anal canal strictures after ileal pouch-anal anastomosis. *Dis Colon Rectum* 2003; 46:20.



- [81] Taylor WE, Wolff BG, Pemberton JH, Yaszemski MJ. Sacral osteomyelitis after ileal pouch-anal anastomosis: report of four cases. *Dis Colon Rectum* 2006; 49:913.
- [82] Jain A, Abbas MA, Sekhon HK, Rayhanabad JA. Volvulus of an ileal J-pouch. *Inflamm Bowel Dis* 2010; 16:3.
- [83] Mmeje C, Bouchard A, Heppell J. Image of the month. Pharmacobezoar: a rare complication after ileal pouch-anal anastomosis for ulcerative colitis. *Clin Gastroenterol Hepatol* 2010; 8:A28.
- [84] Hahnloser D, Pemberton JH, Wolff BG, et al. Results at up to 20 years after ileal pouch-anal anastomosis for chronic ulcerative colitis. *Br J Surg* 2007; 94:333.
- [85] Lepistö A, Luukkonen P, Järvinen HJ. Cumulative failure rate of ileal pouch-anal anastomosis and quality of life after failure. *Dis Colon Rectum* 2002; 45:1289. -
- [86] Tulchinsky H, Hawley PR, Nicholls J. Long-term failure after restorative proctocolectomy for ulcerative colitis. *Ann Surg* 2003; 238:229.
- [87] Delaney CP, Fazio VW, Remzi FH, et al. Prospective, age-related analysis of surgical results, functional outcome, and quality of life after ileal pouch-anal anastomosis. *Ann Surg* 2003; 238:221.
- [88] Hueting WE, Buskens E, van der Tweel I, et al. Results and complications after ileal pouch anal anastomosis: a meta-analysis of 43 observational studies comprising 9,317 patients. *Dig Surg* 2005; 22:69.
- [89] Wax JR, Pinette MG, Cartin A, Blackstone J. Female reproductive health after ileal pouch anal anastomosis for ulcerative colitis. *Obstet Gynecol Surv* 2003; 58:270.
- [90] Cornish JA, Tan E, Teare J, et al. The effect of restorative proctocolectomy on sexual function, urinary function, fertility, pregnancy and delivery: a systematic review. *Dis Colon Rectum* 2007; 50:1128.
- [91] Johnson P, Richard C, Ravid A, et al. Female infertility after ileal pouch-anal anastomosis for ulcerative colitis. *Dis Colon Rectum* 2004; 47:1119. Hahnloser D, Pemberton JH, Wolff BG, et al. Pregnancy and delivery before and after ileal pouch-anal anastomosis for inflammatory bowel disease: immediate and long-term consequences and outcomes. *Dis Colon Rectum* 2004; 47:1127. FAZIO
- [92] Beddy D, Dozois EJ, Pemberton JH. Perioperative complications in inflammatory bowel disease. *Inflamm Bowel Dis* 2011; 17:1610–1619.
- [93] Gainsbury ML, Chu DI, Howard LA, et al. Preoperative infliximab is not associated with an increased risk of short-term postoperative complications after restorative proctocolectomy and ileal pouch-anal anastomosis. *J Gastrointest Surg* 2011; 15:397–403.
- [94] Subramanian V, Pollok RC, Kang JY, Kumar D. Systematic review of postoperative complications in patients with inflammatory bowel disease treated with immunomodulators. *Br J Surg* 2006; 93:793.

- [95] Colombel JF, Loftus EV Jr, Tremaine WJ, et al. Early postoperative complications are not increased in patients with Crohn's disease treated perioperatively with infliximab or immunosuppressive therapy. *Am J Gastroenterol* 2004; 99:878.
- [96] Marchal L, D'Haens G, Van Assche G, et al. The risk of post-operative complications associated with infliximab therapy for Crohn's disease: a controlled cohort study. *Aliment Pharmacol Ther* 2004; 19:749.
- [97] Gaertner WB, Decanini A, Mellgren A, et al. Does infliximab infusion impact results of operative treatment for Crohn's perianal fistulas? *Dis Colon Rectum* 2007; 50:1754.
- [98] Appau KA, Fazio VW, Shen B, et al. Use of infliximab within 3 months of ileocolonic resection is associated with adverse postoperative outcomes in Crohn's patients. *J Gastrointest Surg* 2008; 12:1738.
- [99] Schluender SJ, Ippoliti A, Dubinsky M, et al. Does infliximab influence surgical morbidity of ileal pouch-anal anastomosis in patients with ulcerative colitis? *Dis Colon Rectum* 2007; 50:1747.
- [100] Selvasekar CR, Cima RR, Larson DW, et al. Effect of infliximab on short-term complications in patients undergoing operation for chronic ulcerative colitis. *J Am Coll Surg* 2007; 204:956.
- [101] Ellis MC, Diggs BS, Vetto JT, Herzig DO. Trends in the surgical treatment of ulcerative colitis over time: increased mortality and centralization of care. *World J Surg* 2011; 35:671–676.
- [102] Lipman JM, Kiran RP, Shen B, et al. Perioperative factors during ileal pouchanal anastomosis predict pouchitis. *Dis Colon Rectum* 2011; 54:311–317.
- [103] Holubar SD, Cima RR, Sandborn WJ, Pardi DS. Treatment and prevention of pouchitis after ileal pouch anal anastomosis for chronic ulcerative colitis. *Cochrane Database Syst Rev* 2010:CD001176. doi: 10.1002/14651858. CD001176.pub2. Simchuk EJ, Thirlby RC. Risk factors and true incidence of pouchitis in patients after ileal pouch-anal anastomoses. *World J Surg* 2000; 24:851–856.
- [104] Haveran LA, Sehgal R, Poritz LS, et al. Infliximab and/or azathioprine in the treatment of Crohn's disease-like complications after IPAA. *Dis Colon Rectum* 2011; 54:15–20. Browning SM, Nivatvongs S. Intraoperative abandonment of ileal pouch to anal anastomosis--the Mayo Clinic experience. *J Am Coll Surg* 1998; 186:441.
- [105] Thompson-Fawcett MW, Marcus V, Redston M, et al. Risk of dysplasia in long-term ileal pouches and pouches with chronic pouchitis. *Gastroenterology* 2001; 121:275.
- [106] Scarpa M, van Koperen PJ, Ubbink DT, et al. Systematic review of dysplasia after restorative proctocolectomy for ulcerative colitis. *Br J Surg* 2007; 94:534.
- [107] Kariv R, Remzi FH, Lian L, et al. Preoperative colorectal neoplasia increases risk for pouch neoplasia in patients with restorative proctocolectomy. *Gastroenterology* 2010; 139:806.

- [108] Sarigol S, Wyllie R, Gramlich T, et al. Incidence of dysplasia in pelvic pouches in pediatric patients after ileal pouch-anal anastomosis for ulcerative colitis. *J Pediatr Gastroenterol Nutr* 1999; 28:429.
- [109] Maykel JA, Hagerman G, Mellgren AF, et al. Crohn's colitis: the incidence of dysplasia and adenocarcinoma in surgical patients. *Dis Colon Rectum* 2006; 49:950.
- [110] Avidan B, Sakhnini E, Lahat A, et al. Risk factors regarding the need for a second operation in patients with Crohn's disease. *Digestion* 2005; 72:248.
- [111] Malireddy K, Larson DW, Sandborn WJ, et al. Recurrence and impact of postoperative prophylaxis in laparoscopically treated primary ileocolic Crohn disease. *Arch Surg* 2010; 145:42.
- [112] Goligher JC. The long-term results of excisional surgery for primary and recurrent Crohn's disease of the large intestine. *Dis Colon Rectum* 1985; 28:51.
- [113] Litzendorf ME, Stucchi AF, Wishnia S, et al. Completion mucosectomy for retained rectal mucosa following restorative proctocolectomy with double-stapled ileal pouch-anal anastomosis. *J Gastrointest Surg* 2010; 14:562.