

Current management of intestinal bowel disease: the role of surgery

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Abstract Inflammatory bowel disease (IBD) is a chronic affection, in which the two main phenotypical components are Crohn's disease and ulcerative colitis. In both diseases, medical treatment has the main role; in some phases of the natural history of IBD, surgery becomes an important therapeutic tool. The IBD represents a model of multidisciplinary management. Timing represents the key issue for proper management of IBD patients. For acute and severe IBD, the surgery can be a salvage procedure. Today, the laparoscopic approach plays an important role in armamentarium of the surgeon. Several articles compared the short- and long-term results between laparoscopic and open approaches in IBD. The aim of this review is to focus the role of surgery in IBD as well as the role of laparoscopic approach, and principally, the “state of the art” for surgical treatment, sometimes very challenging for surgeon, in all clinical features of IBD by a review of literature highlighted by the most recent international guidelines.

Keywords Inflammatory bowel disease · Crohn's disease · Ulcerative colitis · Surgery · Laparoscopic surgery

Introduction

Inflammatory bowel disease (IBD) is a chronic affection, in which the two main phenotypical components are Crohn's disease (CD) and ulcerative colitis (UC). In both diseases, medical therapy has the main role. In some moments of the natural history, however, surgery has an equally important role. For this reason, the IBD is a very significant model of multidisciplinary management that need to “dedicated” professionalism.

The surgical and medical management of IBD has significantly evolved over the course of the last two decades [1]. The aim of this review is to focus the role of surgery in IBD and the role of the laparoscopic approach.

Therefore, we discuss the two morbid conditions separately, since the purpose of this study is to show, clearly and properly, the “state of the art” for surgical treatment in IBD by a review of the literature.

Crohn's disease

CD is an autoimmune disorder characterized by a relapsing transmural bowel inflammation, which can interest completely gastrointestinal tract from the mouth to the anus [2]. Generally, the terminal ileum and the proximal colon are the most frequently affected [3].

Despite the incredible advance in the medical therapy for CD, surgery remains an important component in its management, generally reserved for failure of medical treatment (refractory disease) or complications [4] as stricture, abscess, fistula, haemorrhage, or malignant transformation [2]. For these reasons, about 80 % of all CD patients will require surgical treatment during their lifetime and about 15–20 % of patients will undergo to surgery

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within the first year after diagnosis [2, 3, 5]. Among the patients underwent surgery for primary disease, about 50 % will need additional surgical procedures within 10–15 years [3, 6].

Furthermore, in CD surgical management, there are, also, several debates concerning specific situations as complicated/penetrating disease (abscess–fistula) and recurrent disease, in which the surgery is more difficult and still more demanding. In fact, the pathological alterations of CD and, particularly, the presence of intra-abdominal adhesions and thick and friable inflammatory mesentery make the surgical approach, often, challenging.

The timing represents the key issue for proper management of IBD patients. In our opinion, is paramount the joint evaluation and collaboration between dedicated surgeon and gastroenterologist to achieve the correct indication to surgical treatment. Surgery delay can increase the risk of operative complications and, finally, of worse outcome [7].

Surgical strategy changes depending on the intestinal segment affected by CD and its extent.

Small bowel and ileocolonic Crohn's disease

In consideration of frequency of the localization of CD, the most common procedure is the ileocolic resection (ICR) that represents the first choice for patients with refractory obstructive syndrome after initial medical therapy, as confirmed in 2010, in ECCO guidelines (Statement 7A) [8]. At the present, the laparoscopic approach plays an important role in armamentarium of the surgeon.

There are several articles in the literature, comparing laparoscopic and open approach in CD. The indications for surgery and surgical strategy are identical in laparoscopic and open approaches [9].

In the literature, there are only two prospective randomized controlled trials (PRCTs) [10, 11], two systematic reviews (SRs) [12, 13], and four meta-analyses (M) [14–17].

In 2001, Milsom et al. [10] published the first PRCT about laparoscopic vs open elective ICR for refractory CD. The results showed a significantly faster return of normal pulmonary function, a shorter hospital stay (LOS), and fewer complications in laparoscopic group (LG). The first multicenter PRCT performed by Maartense et al. [11], in 2006, on the same topic concluded that the laparoscopic approach is safe and cost-effective, with morbidity, LOS and costs significantly lower than open approach. Both studies, unfortunately, had the main limit of a small sample size.

The SR conducted by Dasari [12], in 2011, reprocesses the data of two previous PRCTs, and it concludes that laparoscopy for small bowel CD may be as safe as the open operation. There was no significant difference in the

perioperative outcomes and in the long-term reoperation rates for disease-related or non-disease-related complications of CD. The laparoscopic ICR compared with open approach was associated with shorter LOS, equal morbidity rate, and acceptable conversion rate (0–16.7 %), as demonstrated, in 2006, in Polle's SR [13] included 14 publications and 729 patients.

In 2005 Rosman et al. [14] conducted the first meta-analysis of 16 studies and 840 patients (396 in LG). This study confirms the previous data (with mean conversion rate 7 %, range 0–29 %) and affirms that laparoscopy was associated with fewer surgical recurrences and a reduced need for reoperations. They concluded that laparoscopy appeared feasible and safe even in the challenging field of CD. In addition, Tilney and Tan's meta-analyses [15, 16] in 2006 and 2007, respectively, suggested that laparoscopic surgery was equivalent with open surgery. The morbidity rate was 12.8 % in LG and 20.2 % in open group (OG), with a difference statistically significant [16]. Tilney [15] concluded that laparoscopic ileocecal resection (LIR) was associated with no more adverse events than open surgery. However, Tan [16] affirmed that LS for CD was a safe, feasible, and viable option, but technically demanding, considered less postoperative morbidity and similar incidence of recurrent disease. All meta-analyses [14–16] reported a significantly longer operation time in LG, as only disadvantage of laparoscopic surgery.

These data are confirmed by Lee et al. [18], in 2011, in open population analysis employing the National Surgical Quality Improvement Program (NSQIP) database (2005–2009) that evaluates the results for 1917 ICRs, of which 644 (33.6 %) performed by laparoscopic approach. Similarly, Lesperance et al. [19] analyze previous data from 2000–2004 NIS database of 396,911 patients admitted with diagnosis of CD, of whom 49,609 (12 %) required surgery, 2826 (6 %) and 46,783 (94 %) patients underwent laparoscopic and open resections, respectively. They find an overall complication rate of 15 %, an overall mortality rate of 0.9 %, and lower charge as well as lower morbidity and mortality 8 % vs 16 % and 0.2 % vs 0.9 %, respectively.

In the largest series from single Institution [20] about 335 laparoscopic resection for primary ICR (49 %) and recurrent and penetrating CD, the postoperative complication rate was 13 %, the reoperation rate for postoperative complications was 4 %, and the conversion rate was 2 %. The authors concluded that the safety and feasibility of laparoscopic resection for the management of complex Crohn's disease are possible in trained and experienced hands.

A few studies demonstrated the long-term comparison, in terms of recurrence of the disease and disease-related as well as treatment-related complications, with acceptable long follow-up. Only two PRCTs are available [21,

22] and concluded that, in long-term outcomes, laparoscopic resection was, at least, comparable with open surgery in the treatment of ileocolic CD.

Overall, operation rates for recurrent disease, incisional hernia, and adhesive small bowel obstruction (SBO) were not significantly different [22].

Already in 2003, Bergamaschi et al. [23] concluded that laparoscopic ICR led to significantly lower 5-year SBO rates in selected patients with ileocecal CD as compared with open ICR. Five-year recurrence rates, however, did not differ.

The ECCO guidelines [8] on laparoscopic resections (Statement 7f) stated that “A laparoscopic approach is to be preferred for ileocolonic resections in Crohn’s disease [EL 2A, RG B] where appropriate expertise is available...”.

Patel et al. [17], in 2013, conducted the last and largest meta-analysis. The work included 34 studies and 2519 patients that ranged in studies from 13 to 456 subjects. The majority of studies looked at patients undergone ileocecal resection only. They showed shorter LOS, earlier return to solid diet, time to flatus, and to bowel movement in LG. The perioperative complication risk was 12 % in LG compared with 18 % in OG, with strong evidence. They evaluated, in long-term outcomes, surgical recurrence, SBO, and incisional hernia. The follow-up ranged from 12 to 132 months. There was no evidence of significant difference in terms of surgical recurrence and SBO in LG and OG. They concluded that laparoscopic surgery appeared to reduce the risk of perioperative complications and, in long-term period, of incisional hernia in patients with CD, but recommended further RCT with adequate follow-up duration. Laparoscopic approach provides better psychological impact.

In our opinion, the surgeon should be a skilled laparoscopist with a good knowledge of colorectal/IBD surgery.

Complicated and recurrent Crohn’s disease

In case of complicated CD by abscess, resection should be preceded by antibiotics and, for not small abscesses, percutaneous drainage under CT or US guidance [9]. If percutaneous drainage fails, surgical procedure is necessary immediately. In small abscess, the surgical intervention consists in its removal, resection of diseased segment, and primary anastomosis; in extensive case, the surgery involves the clearance of sepsis and temporary diversion. Emergency resections should be avoided to not jeopardize the bowel length in the case of more extensive resection than necessary [9].

The technical difficulties related to penetrating and recurrent CD limited the application of laparoscopy for this

topic, and at this moment, the ECCO consensus guidelines did not allow recommendation of the laparoscopic approach for complicated CD [5, 8].

In this setting, however, laparoscopic ICR is feasible and safe with good postoperative outcomes, but in a very experienced group. In 2009, Goyer et al. [24] analyzed in a prospective study the outcomes of 124 consecutive laparoscopic IRCs for CD, during 10 years, comparing the postoperative results of seventy patients with non-complicated primary CD and 54 patients with penetrating or recurring (complex) CD. Results suggested that complex CD was significantly associated with an increased operative time, a higher risk of conversion (37 % vs 14 %), and a higher rate of diverting stoma (39 % vs 9 %). Mean hospital stay and overall postoperative morbidity were similar between both groups (17 % vs 17 %), including major surgical postoperative complications (7 % vs 6 %).

Only in the recurrent CD, the same group compares the laparoscopic and open approaches [25]: among the 62 iterative ICRs, 29 (for 29 patients) were performed using laparoscopy and 33 (for 28 patients) by open approach. The occurrence of intraoperative intestinal injuries was more frequent in the LG than in the OG (5 vs. 0). The conversion rate was 31 %. Overall morbidity rate and overall postoperative rate were similar in both groups, even for converted patients. The authors considered that laparoscopy is not a contraindication for patients requiring surgery for recurrent CD, even if a previous resection was performed by the open approach, but they considered that a history of multiple laparotomies (more than three) and diffuse peritonitis were contraindications for a laparoscopic approach. They concluded that the laparoscopic approach to iterative ICR was challenging and complex with an increased risk of small bowel injury, and it can be recommended for much selected patients with recurrent and non-fistulizing CD.

Hasegawa et al. [26], in 2003, suggested that adhesions to the abdominal wall were expected to be minimal when the primary procedure was performed laparoscopically.

The ECCO guidelines [8] (Statement 7f) stated that “... In more complex cases or recurrent resection, there is insufficient evidence to recommend laparoscopic surgery as the technique of first choice [EL3, RG C]”.

The consensus concluded, on this topic, that laparoscopic surgery in complex cases should currently only be done at highly specialized centers and preferentially within clinical studies [8].

In recurrent patients, the conversion rate is higher. Chaudhary et al. [27], in 2011, identify the risk factors for conversion: complex fistula, fibrosis, and the need to carry out multiple stricturoplasties. The morbidity rate increased to 40 % for converted patients. In Pinto’s experience [28], the conversion rate is 18.7 % in primary surgery and 32 % in reoperative group.

Laparoscopy and conversion

In laparoscopic Crohn resection, the conversion to open surgery is defined as an incision of more than 5 cm [29] or any unplanned incision or a planned incision longer than 6 cm. [30].

The factors influencing conversion largely reflect technical challenge and severity of disease. In a prospective study [30], the conversion rate was 30 %. On univariate analysis, more than three episodes of acute flare of CD, male gender, preoperative immunosuppressive drugs, intra-abdominal abscess or fistula at the time of laparoscopy, and resection of other intestinal segment were factors that predicted conversion. On multivariate analysis, recurrent medical episodes of CD and intra-abdominal abscess or fistula at the time of laparoscopy were the two independent risk factors for conversion. It is important to considerate these risk factors in preoperative preparation. Postoperative morbidity rate is comparable: 15 % in the LG and 29 % in the converted group (p: n.s.) [30].

Moorthy et al. [31], in a retrospective analysis, identified factors predicting conversion in laparoscopic surgery for CD analyzing also patients with recurrent disease (RD). On univariate analysis, age >40 years, surgery for recurrence, time from diagnosis, and the presence of a clinical mass were factors that predicted conversion. These factors on multivariate analysis remained significant, except time from diagnosis.

Bowel-sparing surgery

Lee and Papaioannou [32], in 1982, described the use of stricturoplasty (S) techniques in CD to preserve bowel function. At present, there are several techniques to fashion a stricturoplasty. The most common are Heineke–Mikulicz S performed for short strictures, Finney S for longer strictures, and Michelassi side-to-side isoperistaltic S for multiple sequential strictures. Several authors reported new types of S. For example, Fazio and Tjandra [33] introduced a technique that joins Heineke–Mikulicz and Finney S; Poggioli [34] proposed a side-to-side diseased-to diseased-free anastomosis.

In the literature, there are several studies, including SRs [35, 36] compared the stricturoplasty and resection, which confirmed the safety and bowel-sparing potential of former procedure in small bowel CD [8]. In 2007, Reese et al. [35] conducted a review of literature and included seven studies with a total of 688 CD patients, divided into two groups, stricturoplasty (45 %) and bowel resection with or without S (55 %), and they compared postoperative adverse events and recurrence. In S alone group, there was a lower risk of developing postoperative complications, but it was not

statistically significant. Surgical recurrence after S was more likely than after resection. In resection group, there was a significantly longer recurrence-free survival. In the same year, Yamamoto et al. [36] conducted an SR and meta-analysis on safety and efficacy of stricturoplasty. They analyzed 23 studies with 1112 patients and 3259 stricturoplasties (Heineke–Mikulicz 81 %, Finney 10 %, side-to-side isoperistaltic 5 %) localized in jejunum and/or ileum (94 %), and in previous ileocolonic anastomosis (4 %). The overall septic complications (leak/fistula/abscess) rate was 4 %. The risk factors for the complications were poor nutritional status, anaemia, peritoneal contamination, older age, and emergency operation. A 5-year recurrence rate after S was 28 %; in 90 % of the patients, recurrence occurred at new sites and only 3 % of cases developed a site-specific recurrence. Younger age was a risk factor for recurrence, and this was not clear. The authors concluded that stricturoplasty is a safe and effective procedure for patients with jejunoileal CD, including ileocolonic recurrence.

Carcinoma, active bleeding, and phlegmon are contraindications to stricturoplasty. There should be a certain caution concerning the long-term consequences of this procedure, since several case reports showed the occurrence of adenocarcinoma at stricturoplasty sites [8].

The ECCO guidelines [8] stated that “Stricturoplasty is a safe alternative to resection in jejunoileal Crohn’s disease, including ileocolonic recurrence, with similar short-term and long-term results..... (EL2a, RG C)” (Statement 7C).

In our opinion, a strict patient selection is most important for correct indication to stricturoplasty, and when we do it, we perform biopsies of the stenosis and we mark by clips the S to facilitate the radiological follow-up.

Colorectal Crohn’s disease

The colon is involved in CD in up to 30 % of cases [9]. It is important to distinguish the different aspects of clinical presentation (emergent or elective surgery) and the extension of disease (localised or multi-segment colonic CD) to establish the right surgical plan. The stricturoplasty in colonic stenosis is not recommended [8].

In 2006, Tekkis et al. [37] published a meta-analysis about the comparison of segmental vs subtotal/total colectomy for colonic CD. They included six articles and 488 patients, of whom 223 (45.7 %) underwent colectomy with ileorectal anastomosis (C + IRA) and 265 (54.3 %) segmental colectomy (SC). In short-term and long-term results, there was no significant difference in terms of surgical recurrence rates, overall recurrence rates, and postoperative adverse events between both groups. There

was a difference, not statistically significant, in the incidence of permanent stoma after both procedures favoring the SC group. The only statistically significant difference was the time of recurrence earlier in the SC group. They concluded that both procedures were equally effective as treatment for colonic CD, but SC exposed patients to recurrences earlier than C + IRA.

In da Luz Moreira case-matched study [38], on comparison laparoscopic and open colonic resections in patients with colonic refractory CD, the conversion rate was 26 %; there was no mortality, and postoperative complications were similar (26 % in LG vs 33 % in OG). Overall LOS, including 30-day readmission, was shorter in LG, with statistically significant. The overall recurrence rates and recurrence requiring surgery rates were 41 and 4 % in LG as well as 33 and 22 % in OG, respectively, but the median follow-up time was significantly longer in OG. They concluded that laparoscopic colectomy was a safe and acceptable option in Crohn's colitis, but longer follow-up was needed to accurately establish recurrence rates. Umanskiy et al. [39] confirm these data in 2010. They concluded that laparoscopic colectomy in Crohn's colitis is a safe and effective technique in the hands of experienced surgeons for appropriately selected cases. In the same year, Holubar et al. [40] performed a single institution study from Mayo Clinic, describing outcomes associated with laparoscopic surgery for Crohn's colitis, including predictors of conversion to laparotomy and postoperative complications. They included, over 11 years, 92 patients underwent several surgical procedures: total colectomy in 43 cases (47 %), 17 (18 %) subtotal colectomies, and in 32 cases (35 %) segmental resection. The most common indication was refractory colitis (90 %) followed by neoplasia (10 %). Laparoscopy was performed in 57 % of cases and in 43 % was hand-assisted. The conversion rate was 16 %, and the only predictor of conversion was a small bowel disease. There was no 30-day mortality. A short-term morbidity rate was 34 %, and five cases needed reoperation (three obstructions and two anastomotic leaks). Only perianal disease predicted postoperative complications. They concluded that minimally invasive colectomy in Crohn's colitis can be safely accomplished with reasonable operative times, conversion rates, and excellent postoperative outcomes.

ECCO guidelines [8] stated that "If surgery is necessary for localized colonic disease (less than a third of the colon involved) then resection only of the affected part is preferable [EL3, RG C]" (Statement 7G). It also stated that "Two segmental resections can be considered for a patient with an established indication for surgery when macroscopic disease affects both ends of the colon [EL3, RG C]" (Statement 7H). In this case, the consensus was less clear, several experts were in favour of segmental resections of

macroscopic disease and two anastomoses, while others preferred a subtotal colectomy with an ileorectal anastomosis. There are no comments on laparoscopic surgery in CD colitis.

We will discuss about emergent colorectal surgery in the section on UC.

Perianal Crohn's disease

Perianal CD (PCD) develops in about 23–38 % of CD [41, 42]. The incidence increases related the duration of CD [41] and is related to site of disease [42].

There are two possible mechanisms in the aetiopathogenesis of fistulas and abscesses: (1) initial inflammation in the rectum causes either ulcers (that extend into deep) or penetrating fistulas; and (2) infected anal glands penetrate the intersphincteric space and then progress to abscesses or fistula.

Clinically, perianal disease can manifest as tags, deep ulcers, fistulas, abscesses, and rectal stenosis. The symptomatology is characterized by perianal pain and/or burning sting and/or rectorragy in less critical cases, deterioration in quality of life with faecal incontinence, recurrent infections, sepsis, and impairment of sexual activity in severe cases.

Parks' classification was created to describe anal fistulas not associated with CD. He described five types of fistula in relation to its course and the anal sphincters: superficial, intersphincteric, trans-sphincteric, suprasphincteric, and extrasphincteric [43].

Today is used Bell's classification based on Park's classification and describes simple and complex fistula. The former is superficial or intersphincteric or low trans-sphincteric fistula with a single short tract and the internal and external openings near the anal verge. The latter involves all anorectal sphincters with single or multiple fistulas with or without abscess [44, 45].

The combination of diagnostic modalities, such as endoscopy, Magnetic Resonance (MRI) and/or Endo-US as well as Explotation Under Anesthesia increases accuracy to 100 %, and it is recommended to determine an optimal management strategy [46, 47].

The role of surgery, in addition to improve quality of life, is to avoid, or possibly to differ, proctectomy or ostomy. The first aim is the control and treatment of sepsis that must be performed in acute setting [48]. In the last decades, for the complex fistula, the introduction of α -TNF inhibitors changed the treatment algorithm: the most correct treatment requires a multidisciplinary approach.

In the small perianal abscess, the first treatment is antibiotics, and in case of failure, the surgical drainage is recommended. In large abscess and/or perineal sepsis, the

surgical drainage must be performed as soon as possible (Statement 9F) [49].

The treatment of perianal fistula must be performed for simple and complex fistulas [48].

Fistulotomy is generally used for simple fistula. For complex fistula, the combined therapy that consists in the initially approach by surgical strategy followed by the use of biological drugs must be considered. This type of strategy predicts the first phase with solution of sepsis, the second phase with simplification of the fistula, and the third phase with initial medical therapy and removal of seton.

For complex fistula, “cone-like technique” is performed. It consists in a wide excision of cutis and the ischiorectal tissue involved with the top at level of external sphincter. The aim is to facilitate a “step-by-step” surgical wound closure by secondary intention from the apex to the basis. Thus, there is a significantly low risk of early closure of external part of fistulectomy and, therefore, to avoid a recurrent abscess. This method removes the perianal septic tissues, the ramifications of fistula, and solves the acute condition. Seton is placed in trans-sphincteric tract. [47, 48].

Certainly, an approach for a complex fistula increases the risk of sphincter injury and incontinence: cutting seton carries a high risk of anal incontinence (54 %) [46], then the loose seton should be employed [48]. It preserves the integrity of the anal sphincter and represents an efficient and safe method in the treatment of Crohn’s perianal fistulas [46].

The ECCO guidelines [49] stated: “Infliximab (EL 1b, RG A) or Adalimumab (EL 1b, RG B) should be used as the second line medical treatment (EL 1b, RG B)” (statement 9 K); however, the IG-IBD guidelines affirm that “Anti-TNF agents should be used as the first choice of medical therapy for complex perianal CD [infliximab EL1b, RG A; adalimumab EL1b, RG B]” (Statement 5D) [47].

The closure of the fistula is indicated after endoscopic resolution of proctitis. This is an ulceration and/or stricture in the rectum, or inflammation and/or stricture of the anal canal and represents an important component for fistula assessment, and it is a prognostic negative index [46].

Moreover, the results were not completely satisfactory, because the healed is described in 29–76 % of patients [50–52].

For this reason, others surgical options are tried in addition, such as mucosal advanced flap (MAF), bioprosthetic plugs, or ligation of intersphincteric tract (LIFT).

MAF can be a surgical alternative closing internal fistula opening utilizing a rectal mucosal flap to cover the primary fistula opening, thereby closing the high pressure into the fistula tract [46, 53, 54]. It is not indicated that in the presence of proctitis, it causes an ectropion of anal canal, and it is technically difficult in anterior wall. MAF offers

satisfactory results in 64 % of cases but causes incontinence in 9.4 % (0–28.6 %) [55]. It also allows the possibility to reperform the flap.

LIFT closes the internal opening in intersphincteric space, removing infected remnant tissue. The best moment to perform LIFT is during the removal of seton, because the fistula must be mature. By this technique, the healing rate is 74.6 %, and there is not risk of incontinence [56].

In patients with severe, complicated and/or refractory PCD, a diverting temporary stoma is an option [46]. Diversion of the faecal stream and an optimal medical management provide, usually, a decrease in distal bowel inflammation, and these avoid the need for major surgery, including proctectomy [57–59]. Singh et al. [57] show that this type of treatment can improve symptoms in two thirds of patients with refractory perianal disease, but bowel restoration is successful in only 17 % of these. The long-term results of temporary stoma, such as attempted and successful restoration of bowel continuity, are poorly understood [57, 60], and in this condition, the proctectomy is a very frequent option.

In our opinion, the improvement in quality of life represents the main aim in the treatment of perianal fistulas.

Ulcerative colitis

About 20 % of patients with UC will require a surgical intervention during his lifetime [7].

There are surgical indications either in elective situations (chronic refractory UC and dysplasia/cancer) or in emergency (acute severe UC).

The general conditions and the use of immunosuppressive therapy are very important for the decision on surgical strategy and timing, as stated in ECCO guidelines (statement 2) [61]. The goal of dedicated physician (gastroenterologist and colorectal surgeon) is to optimize clinical conditions and to improve nutritional status of patients to reduce surgical risks [61]. Normally, surgery should be delayed in patients who recently received anti-TNF therapy.

The surgical strategy in UC is not wide, and usually, proctocolectomy and ileal pouch-anal anastomosis (IPAA) is the gold standard in elective surgery [62, 63]. In patients not amenable to restorative surgery, a total proctocolectomy with permanent ileostomy is the procedure of choice. An intersphincteric perineal dissection may improve perineal wound healing [61]. Intersphincteric proctectomy is recommended as an alternative procedure to spare the pelvic floor and external anal sphincter to provide optimal pelvic floor closure and reduce the risk of perineal wound healing problems. Partial colectomy is rarely performed [7, 62].

IPAA can be performed in one, two, and three steps: colectomy with ileostomy is the first step in surgical treatment of acute severe colitis or in patients saturated with steroids. In this setting, the following IPAA is considering the second step. The third step is the closure of the residual ileostomy.

In elective situation, if the conditions are permissive, the standard treatment is directly the IPAA with ileostomy (two steps treatment). In selected patients and in reference centers, IPAA can be performed without ileostomy (one-step treatment). The pouch configuration is J-shaped [64]. The ECCO guidelines [61] stated that “The J-pouch is the standard of care due to its simplicity to construct and good long-term function outcome (EL 2)” (Statement 5E).

In IPAA, the retained rectal stump in a stapled anastomosis should be minimal (<2 cm) to minimize the risk of subsequent cuffitis and dysplasia in the site of the rectal remnant. In fact, the statement 5F mentions, “In performing pouch surgery, a stapled anastomosis is preferred as it results in decreased nocturnal incontinence. However, a long rectal cuff/retained rectum (>2 cm) with a subsequent risk for inflammation and/or dysplasia should be avoided (EL 3)” [61].

The mortality of IPAA is rare (0–1 %) [65]. The early postoperative complications are pouchitis (26,8 %), mild fecal incontinence (14,3 %), small bowel obstruction (11,4 %), anastomotic stricture (10,7 %), pelvic sepsis (7,5 %), severe fecal incontinence (6,1 %), perianal fistula (4,5 %), pouch failure (4,3 %), and sexual disfuncions (3,0 %) [66]. Defunctioning ileostomy reduces the septic consequences of leakage but also the rate of leakage itself [61].

IPAA represents a complex surgical technique with long and adequate learning curve, and it should be performed in high volumes centers (>8.4 IPAA annually) [67] to maintain low rate of postoperative complications. In the literature, some studies highlight that surgical volumes have a beneficial effect on patient outcome [61, 68, 69]. The learning curve was calculated in 23 patients underwent stapled IPAA and in 31 patients with hand sewn IPAA [70].

The colectomy with ileorectal anastomosis (IRA) is a reasonable and alternative procedure, in very highly selected patients with mild proctitis controllable by local therapy, distensible rectum and no dysplasia, compared with IPAA, as demonstrated in the literature [61, 71–73], because IRA is a less complex procedure with lower morbidity rates and with reasonable clinical results [61]. In young patients, furthermore, with concerns regarding fecundability and sexual function, IRA might be offered as an interim procedure [73] with the condition that an IPAA should be performed within 10 years of diagnosis to maintain a low cancer risk. For this reason, meticulous endoscopic surveillance with a plan for at least yearly visits for rectal biopsies is needed [71, 73]. The urgency and

acute and uncontrollable proctitis are the most common causes of failure after IRA. [61].

Nevertheless, the IPAA remains, internationally, the current gold standard. [61–63, 71–73].

In the last years, laparoscopy has also established increasingly in the treatment of UC and, in expert hands and in reference centers, became the gold standard. In several recent studies [62, 74–77], earlier return of bowel movements, short hospital stays, reduced pain, decreased morbidity, decreased short- and long-term complications have been observed after laparoscopy. Long operative times and learning curve are still delaying the universal approach of laparoscopy in the surgical management of UC [62, 78].

Laparoscopic IPAA is an alternative technique to open surgery, and it is feasible and safety. Short- and long-term results after laparoscopy are comparable with open surgery. In fact, in 2004, Maartense et al. [79] have demonstrated the short-term benefits and the differences as regard quality of life for laparoscopic versus open surgery. Antolovic et al. [80], in 2006, compared the need of blood transfusion during laparoscopic technique versus open surgery. Holubar et al. [81] have analyzed safety and feasibility of laparoscopy examining short-terms outcomes. Berdah et al. [82] report mid-term outcomes. Fichera et al. [83] analyze long-term outcomes after laparoscopic IPAA: there are not obvious differences between groups, open, and laparoscopy, in terms of treatment, indication, and duration of surgery.

Laparoscopic IPAA ensures a significant better preservation of female fecundity, because mini-invasive technique reduces visceral and pelvic adhesions [84, 85].

Concerning the laparoscopic approach, the ECCO guidelines stated “Laparoscopic surgery is safe and feasible for the elective surgical treatment of UC and confers better short-term outcomes at the expense of longer operative times increased procedural costs (EL 2). Long-term advantages of a minimally invasive approach are a reduction in adhesion formation and a better-preserved fecundity in addition to a reduced incidence of hernias” (EL 3) (statement 5A) [61].

Acute Severe Ulcerative Colitis (ASC) is defined, concerning to Truelove and Witts classification [86], as an acute condition, in which the patient has a bloody stool frequency (≥ 6 /day) and tachycardia (>90 bpm), or temperature $>37,8$ °C, or anaemia (Hb 10,5 g/dl), or an elevated ESR (>30 mm/h). Only one further criterion in addition to the bloody frequency ≥ 6 /day is needed to define a severe attack. Surgery is indicated when medical therapy fails.

The surgical treatment is an emergent subtotal-colectomy with ileostomy and without anastomosis as stated in the ECCO guidelines [61, 63]. The rectal preservation is important for many reasons: not always is possible preoperatively to identify the phenotypical disease in ASC,

because differential diagnosis between CD and UC is very hard, and there is a high risk of postoperative morbidity in IPAA procedure [2]. In fact, ECCO guidelines in CD [8] stated (statement K) that “All the available evidence suggests that in patients with an unsuspected diagnosis of Crohn’s disease after IPAA, there are higher complication and failure rates. At present, an IPAA is not recommended in a patient with Crohn’s colitis. [EL2a, RG B]”.

ECCO guidelines [61] has established that “The optimal management of the remaining rectum following colectomy for acute severe colitis is unclear. The data to support mucus fistula, Hartmann’s pouch or subcutaneous position of the distal bowel remain conflicting” (Statement 5B).

It is possible to perform colectomy by laparoscopic approach. Bartels et al. [87], in 2013, compared short-term outcomes after laparoscopic and open subtotal colectomy for acute colitis, in an SR and meta-analysis. The results cannot be generalized to critically ill patients in need of an emergency subtotal colectomy. The pooled conversion rate was 5.5 %. Pooled risk ratio for complications showed no significant difference, except for wound infections and intra-abdominal abscess, which were in favor of laparoscopy. The length of hospital stay (LOS) was significantly shorter after laparoscopic subtotal colectomy. The ECCO guidelines [61] (Statement 5C) concluded that “A laparoscopic approach in emergency colectomy results in a shorter hospital stay and in reduction of postoperative infectious complications (wound infections, deep abscess) and where appropriate expertise exists should, therefore, be the approach of choice (EL2)”.

Conclusion

Surgical management of IBD can condition the following therapy and patient’s quality of life. It is tricky and complex, because the surgical scenarios are different and challenging. It requires skill as regard intraoperative decision of surgical tactic and technique to be adopted. It is necessary a multidisciplinary collaboration especially in surgical timing.

Even in IBD, laparoscopic surgery has affirmed its space, especially in the less complex cases, but it is necessary that experienced and dedicated IBD surgeon performs it. Data of the literature affirm its use principally in ileocecal resection with intracorporeal anastomosis, but the future perspectives consider the conventional stricturoplasties and other resections as well as IPAA too.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical standard All procedures in our paper were in accordance with the ethical standards of the institutional as well as national research committee.

Research involving human participants and/or animals This articles does not contain any studies with human participants or animal performed by any of the authors.

Informed consent For this type of study formal consent is not required.

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