Retrospective Study of Surgical Outcomes in 60 Patients with Crohn Disease from a Single Center in Poland

Background: In Crohn disease (CD), pharmacotherapy with nutritional support is the treatment of choice. However, complications and a lack of response to drugs are indications for surgery. The aim of this study was to present indications for surgery and methods of surgical treatment of CD and to analyze the postoperative morbidity and mortality risk factors.

Material/Methods: This was a retrospective analysis of adult patients who underwent surgery for CD between January 2015 and January 2019. Sixty of 457 patients (13%) hospitalized for CD required surgical treatment. The parameters age, sex, body mass index, duration, behavior and location of the disease, pharmacotherapy, indications for surgery, type and duration of surgery, perioperative complications, and laboratory tests results were analyzed.

Results: Most procedures (90%) were elective. The most common indications for surgery were fistulae and strictures. The most frequently performed procedure was right hemicolectomy (60%). Thirty-two percent of patients had postoperative complications. Perianal disease ($P=0.002$) and penetrating behavior ($P=0.01$) were associated with more surgeries. Stricturing and penetrating behavior was more frequent in patients with ileal/ileocecal involvement than in those with CD affecting the colon ($P=0.039$). Patients with smoking history had a significantly lower age at first surgery ($P=0.02$). The use of anti-TNF medications appeared to extend time between diagnosis and first surgery ($P=0.014$).

Conclusions: Although the analysis did not reveal any risk factors for perioperative complications, perianal manifestations, penetrating disease type, ileal/ileocecal involvement, and smoking may be associated with risk of earlier surgery or multiple surgeries.

Keywords: Crohn Disease • General Surgery • Postoperative Complications

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Background

Crohn disease (CD) is a chronic inflammatory disease that can affect any part of the gastrointestinal tract. Pharmacotherapy, including corticosteroids, immunomodulators (6-mercaptopurine, azathioprine, methotrexate), tumor necrosis factor (TNF) inhibitors (infliximab, adalimumab), and other biologicals (vedolizumab, ustekinumab) along with nutritional support (oral nutrition supplements, enteral nutrition, exclusive enteral nutrition, parenteral nutrition) is the treatment of choice for CD [1-3]. Current strategies aim for deep, long-lasting remission with mucosal healing. Main goals include preventing complications and disease progression and restoring quality of life because curative, causal therapy is not yet available [1-5].

Despite optimal pharmacotherapy, many patients have complications, such as obstruction, fistulae, or abscesses, which are indications for surgical intervention [6]. The 10-year risk of major abdominal surgery for CD decreased from 46.5% to 26.2% during recent decades [7]. There have been consistent improvements in surgical treatment of CD over the years. Since the surgery for CD has become more specialized and less invasive, it can be considered not only as a last resort but also as an alternative to pharmacotherapy [8,9].

The chronic nature of CD is the reason a vast number of patients have many risk factors for perioperative complications. According to several studies [10-14], age, preoperative weight loss, malnutrition, low albumin level, elevated C-reactive protein (CRP) level, disease duration, penetrating behavior, duration of surgery, open surgery, previous resection, and use of steroids or anti-TNF medications are associated with an increased risk of complications. However, rates of complications vary widely (17.6% to 40.9%) in different studies [10-13], and the safety of preoperative anti-TNF therapy is still debated. In 2020, the European Crohn’s and Colitis Organisation (ECCO) guidelines on surgical treatment of CD stated that cessation of anti-TNF therapy prior to surgery is not mandatory [6]; however, this recommendation remains controversial [15]. Some recent meta-analyses reported an association between biological treatment and perioperative complications, while another found no difference in risk [16-18].

The aim of this study was to present the most common indications for surgery and the methods and results of surgical treatment of CD in our referral hospital. We also analyzed the prevalence of postoperative morbidity and mortality risk factors as well as correlations between obtained data and the rate of perioperative complications.

Material and Methods

Ethics Statement

This was a retrospective study of medical records, and all patients gave their written informed consent for data management. According to the opinion of the Ethics Committee and local legislation, no additional approval was required due to the anonymous and non-interventional design of the project.

Study Population

The data were obtained from the medical records of patients with CD who underwent surgery between January 2015 and January 2019 in the Department of Digestive Tract Surgery, University Clinical Center, Medical University of Silesia in Katowice. Sixty adult patients with CD confirmed by ileocolonoscopy with multiple biopsy specimens or by histopathological examination of the specimen removed during previous surgery were included in the study. The small intestine involvement was assessed with magnetic resonance imaging (MRI) or computed tomography (CT). We excluded 9 patients with CD who had surgery only to restore bowel continuity.

Analyzed Parameters

The patients were classified according to the Montreal Classification for CD [19]. For each patient, we determined current age at diagnosis (A), location (L), and behavior (B) status. The analyzed parameters were the following: age, sex, clinical features (locations and behavior of the disease, body mass index (BMI), age at diagnosis, disease duration, presence of abscesses or fistulae, smoking habit, CD pharmacotherapy, comorbidities (diabetes, hypertension, asthma, ischemic heart disease), surgical characteristics (age at first surgery, time between diagnosis and first surgery, number of surgeries, indications, American Society of Anesthesiologists (ASA) class, duration, type of surgery, technique and position of the anastomosis, need of ostomy creation, size of removed specimen, blood loss, presence and type of early (0-30 days after the surgery) and late (>30 days) perioperative complications, need of reoperation, mortality, and time of hospitalization before and after surgery. We also analyzed results of laboratory tests at admission day: white blood cells (WBC), platelets, hemoglobin, protein, albumin, and CRP levels.

Statistical Analysis

The statistical analyses were performed using the program Statistica 13.3. Continuous variables were reported as mean and standard deviation. Qualitative variables were expressed as absolute values and percentages. The Mann Whitney U test or Kruskal-Wallis test and chi-squared test or Fisher’s exact test.
were used to compare between-group differences for quantitative and qualitative variables, respectively. Analyzed dependent variables were age at first surgery, time from diagnosis to first surgery, number of surgeries due to CD, and length of hospitalization. The distribution of quantitative variables was verified with the Shapiro-Wilk test. Odds ratios (OR) with their 95% confidence intervals (CI) were calculated, if applicable. Pearson’s correlation or Spearman’s rank correlation was used to find associations between continuous variables. A P value of <0.05 was considered statistically significant.

We performed univariate analysis for morbidity and mortality risk factors using the chi-squared test and Mann-Whitney U test. Analyzed dependent variables were death within 30 days after surgery, occurrence of complications, and occurrence of severe complications (classified as Clavien-Dindo grade ≥III). Multivariate analysis with logistic regression model was considered for independent variables with a P value <0.05 in bivariate comparisons.

The results were divided into 4 sections: study population characteristics, laboratory tests results, surgical characteristics, and associative analysis.

### Study Population Characteristics

Forty-eight percent (n=29) of 60 patients were women. The mean age was 38±10.41 (21-75) years. According to the Montreal classification, the most common location was ileocolic. The most frequent behavior was stricturing and penetrating (B2+B3), with only 11.9% (n=7) of patients having non-stricturing, non-penetrating CD, but 42.9% of them (n=3) had concomitant perianal disease. Patients’ general clinical characteristics are detailed in Table 1.

### Laboratory Tests

Thirty percent (n=21) of patients had increased WBC levels, and 43% (n=26) had increased platelet levels. Nineteen patients (31.7%) were underweight. Approximately 50% (n=31) of patients had anemia. Mild anemia was most common (n=21), but moderate and severe anemia occurred more often in women than in men (Figure 1); however, the difference was not significant (P=0.363). Albumin levels were decreased in 42.4% of patients (14/33), and CRP levels were elevated in 73.6% of patients (39/53). Detailed results of laboratory tests are described in Table 2.

### Table 1. The general patient clinical characteristics.

| Category                        | Value               |
|---------------------------------|---------------------|
| Mean age                        | 38 (±10.4)          |
| Mean age at diagnosis (years)   | 31 (±10)            |
| Disease duration (years)        | 6.3 (±5.9)          |
| Montreal classification:        |                     |
| A1 (≤16)                        | n=1 (1.7%)          |
| A2 (17-40)                      | n=46 (76.7%)        |
| A3 (>40)                        | n=10 (16.7%)        |
| Location of the disease n=58    |                     |
| L1 (ileal)                      | n=3 (5%)            |
| L2 (colonic)                    | n=9 (15%)           |
| L3 (ileocolonic)                | n=46 (76.7%)        |
| L4 (upper GI – jejunum, duodenum, gaster) | n=4 (7%) |
| Behaviour n=59                  |                     |
| B16                             | n=7 (11.7%)         |
| B2                              | n=15 (25%)          |
| B3                              | n=15 (25%)          |
| B2+B3                           | n=22 (36.7%)        |
| Perianal disease (p)            | n=11 (18.3%)        |
| Presence of fistulae and abscesses* | n=37 (61.7%) |
| Fistulae                        |                     |
| Abscesses                       | n=25 (41.7%)        |
| Use of biological therapy n=59  | n=19 (31.7%)        |
| Use of glucocorticoids          | n=23 (38.3%)        |
| Use of azathioprine             | n=26 (43.3%)        |
| Use of mercaptopurine           | n=11 (18.3%)        |
| Current smoker n=60             | n=13 (21.7%)        |
| BMI n=60                        | 20.9 (±3.95)        |
| Underweight (<18.5)             | n=19 (31.7%)        |
| Normal weight (18.5-24.9)       | n=32 (53.3%)        |
| Overweight (25-29.9)            | n=8 (13.3%)         |
| Obese (³30)                     | n=1 (1.7%)          |

* Current or in medical history. BMI – body mass index.
Surgical Characteristics

Sixty-eight percent of patients had the first surgery due to CD before the age of 40 years (Figure 2A). Most patients (70%, n=30) required surgery during first 5 years from diagnosis (Figure 2B). Mean time between diagnosis and first surgery was 4.5 years (±4.5). Sixty percent (n=36) of patients already had surgery for CD before 2015. Thirty percent (n=18) of patients had more than 1 previous surgery. The most common indications for surgery were fistula, stricture, strictures with intermittent ileus, and abscess (Table 3). Ten percent (n=6) of surgeries were urgent, with indications of perforation (n=2), abscess (n=2), and obstruction (n=2).

The right hemicolectomy was the most frequent procedure in our patients. The main procedures are listed in Table 3. The additional procedures were abscess drainage (n=9), surgical treatment of fistulae (n=6), marsupialization of an ovarian cyst (n=3), hernia repair (n=2), splenectomy (n=1), partial gastrectomy (n=1), and cholecystectomy (n=1).

The total number of patients who had partial resection of the ileum or jejunum was 43 (72%). There were 3 resections of the jejunum, with an average length of removed specimen of 73.3 cm (range, 10-100 cm). The ileal resections were performed as main procedures or during hemicolectomy, with an average length of removed intestine of 41.6 cm (range, 5-150 cm).

Intestinal anastomoses were created in 60% of patients (n=36), while 33% (n=20) of patients required ostomy creation. All created stomas were end enterostomies. The types of enterostomies and anastomoses are listed in Table 3.

The complications rate was 31.7% (n=19). The complication details are presented in Table 4. Reoperation was essential in 15% (n=9) of patients. Ten percent (n=6) of patients had another surgery to restore bowel continuity.

Associative Analysis

The analysis of disease behavior according to the Montreal classification showed that perianal disease was associated with more surgeries (OR 8.85, 95% CI 1.05-74.5, P=0.002). Also, the mean age at first surgery was lower (31±6.5) in patients with anal lesions than in patients without perianal disease (35±10.3), but the difference was not significant (P=0.33). Time from diagnosis to first surgery was associated with disease behavior (P=0.02, Kruskal-Wallis test), and the difference was significant between groups with B1 and B3 (P=0.02, Mann-Whitney U test) and between groups with B2 and B3 (P=0.048), but not between groups with B1 and B2 (Figure 2C).
Penetrating-type disease was associated with the shortest average time between diagnosis and first surgery (3.4±4.7). Moreover, patients with penetrating disease had significantly more surgeries (OR 3.8, 95% CI 1.19-12.14, \( P = 0.01 \)) than other patients. Non-stricturing, non-penetrating behavior (B1) was more frequent in patients with colitis type (L2) than in those with ileitis or ileocolitis (L1, L3) type (33.3% and 8.2% respectively, OR 5.63, 95% CI 1.01-31.5, \( P = 0.03 \)). CD diagnosis at an older age was associated with shorter time between diagnosis and first surgery (Spearman’s correlation: \( r = -0.4 \), \( P = 0.008 \); linear regression: \( R^2 = 0.11 \), \( b = -0.32 \), \( P = 0.03 \)).

The patients with smoking history (36.7%, \( n = 22 \)) had a higher rate of postoperative complications (40.9%, \( n = 9 \)) than did nonsmokers (26.3%, \( n = 10 \)), but the difference was not significant (OR 1.94, 95% CI 0.64-5.91, \( P = 0.26 \)). However, mean age at first surgery was significantly (\( P = 0.02 \)) lower in smokers (30.4±7.4) than in nonsmokers (36.5±10.4).

The use of anti-TNF medications (adalimumab, infliximab) appeared to extend the time between diagnosis and first surgery (\( P = 0.014 \)). The average time from diagnosis to first surgery was 6.4 years (±3.8) in the group with biological therapy (\( n = 14 \)), compared with 3.5 years (±4.7) in the group without such treatment (\( n = 28 \)).

Several variables were associated with duration of hospitalization by Spearman’s correlation. Patients with lower hemoglobin (\( r = -0.393 \), \( P = 0.002 \)), lower protein (\( r = -0.394 \), \( P = 0.014 \)), and higher CRP levels at admission (\( r = 0.428 \), \( P = 0.001 \)) required longer hospitalization. There were also correlations between protein level (\( r = -0.517 \), \( P = 0.001 \)), duration of surgery (\( r = 0.288 \), \( P = 0.026 \)), and time of postoperative hospitalization. Longer surgery was associated with the higher blood loss (\( r = 0.443 \), \( P = 0.005 \)). However, none of these factors showed a significant association in linear regression analysis.

The patients who needed ostomy creation (\( n = 15 \)) had significantly higher CRP levels at admission (\( P = 0.008 \), CRP median 120.5 mg/L, Figure 3A) and more previous surgeries (\( P = 0.015 \)) than did patients without ostomy (\( n = 36 \), CRP median 14.44 mg/L). The necessity of ostomy creation was associated with longer hospitalization (\( P = 0.007 \)). The average time of hospitalization among patients with ostomy was 22±27 days, while it was 11±6 days in patients without ostomy.

Figure 2. First surgery for Crohn disease: patients’ characteristics. (A) Patient stratification depending on age at first surgery. (B) Patient stratification depending on time between diagnosis and first surgery. (C) Correlation between time from diagnosis to first surgery and disease behavior according to the Montreal classification. Figure were created using the program Statistica (version 13.3, 1984-2017 TIBCO Software Inc).
According to the results of Spearman’s correlation, higher CRP levels were associated with lower albumin ($r=-0.051$, $P=0.002$), lower hemoglobin ($r=-0.491$, $P=0.0001$), and lower BMI ($r=-0.313$, $P=0.02$). In linear regression analysis, only correlations between CRP and albumin ($R^2=0.33$, $b=-0.57$, $P=0.0005$) and between CRP and Hb ($R^2=0.14$, $b=-0.38$, $P=0.005$) were significant. (Figure 3B).

No variables were significantly associated with the occurrence of perioperative complications in the bivariate analysis. The analysis of mortality risk factors was not performed as there were no deaths within 30 days after surgery.

**Discussion**

The analysis of the 60 patients with CD included in this study showed that despite the latest improvements in CD medical management, surgery still remains crucial for a significant age at first surgery due to CD (years) 34.4 (±9.8)
Duration of the surgery (min.) 200 (±92)
Time of hospitalization (days), postoperative 14 (±17), 8 (±5)
Indications for surgery
Fistula 27 (36%)
Stricture 14 (18.7%)
Abscess 12 (16%)
Ileus, strictures with intermittent ileus 12 (16%), 7 (9.3%)
Other (perforation, rectal bleeding) 3 (4%)
Type of surgery/main procedure
Right hemicolectomy 36 (60%)
Partial resection of small intestine 7 (11.7%)
Total or subtotal colectomy 5 (8.3%)
Abscess drainage 3 (5%)
Left hemicolectomy 2 (3.3%)
Surgical treatment of fistulae 2 (3.3%)
Appendectomy 2 (3.3%)

Table 3. Surgical characteristics of the patients.

| Other (protocolectomy, resection of transverse colon, resection of rectum) | 3 (5%) |
| Intestinal anastomoses | 36 (60%) |
| Small – large, side to side | 14 (39%) |
| Small – large, end to side | 8 (22%) |
| Small – large, end to end | 5 (14%) |
| Small – large, side to end | 2 (6%) |
| Small – small side to end, end to side, end to end | 6 (18%) |
| Large – large, end to end | 1 (3%) |
| Osteomies: ileostomies, colostomies | 17 (85%), 3 (15%) |
| Mean blood loss (ml) | 145.8 (±310.9) |

American Society of Anaesthesiologists’ (ASA) classification (n=58)

| 1 | 1 (1.7%) |
| 2 | 41 (70.7%) |
| 3 | 14 (24.1%) |
| 4 | 1 (1.7%) |
| 5 | 1 (1.7%) |

Table 4. Surgical complications.

| Early complications (0-30 days) | Late complications (>30 days) |
| Suppuration in a wound (n=3) | Fluid collection (n=4) |
| Obstructive strangulation of jejunum (n=1) | Peritonitis (n=1) |
| Prolongated paralytic ileus (n=1) | Recurrence of an abscess (n=1) |
| Haemorrhage (n=1) | Collapse of transversostomy (n=1) |
| Duodenal perforation with peritonitis and paralytic ileus (n=1) | Purulent fistula (n=1) |
| Respiratory distress (n=1) | Septic fever (n=1) |
| Gastrointestinal bleeding (n=1) | |
number of patients with certain complications. The results of the study confirm the results of many other studies in the literature.

Men and women are affected equally by CD, which was observed in adult epidemiological studies [20,21], retrospective analyses [22,23], and in the present study (men/women=31/29). The mean age at diagnosis (31 years) in the present study was similar to that mentioned in the literature [10,24,25], with the most common Montreal class of A2 (17-40 years).

It is a common knowledge that terminal ileum and ileocecal involvement (Montreal class L3) is the most frequent location of CD. However, the percentage of ileocolic location varied from 23.5% to 75.7% in several studies [10,23,25,26] and 78.9% in the present study. This may be due to the differences in disease duration among patients. A Danish population-based inception cohort study [26] showed changes in disease location (increasing percentage of L3) and behavior progression from B1 Montreal class to either B2 or B3 in the course of the disease. The progression of disease behavior in that study was associated with the risk of surgery, and this may be the reason that, despite a relatively high proportion of non-stricturing, non-penetrating behavior (B1) at diagnosis, most patients requiring surgical treatment are assessed as B2 or B3. Out of the 60 patients undergoing surgery in our hospital, only 11.9% had non-stricturing, non-penetrating behavior, and it was more frequent in patients with the colitis type than in those with the ileitis or ileocolitis type (33.3% and 8.3%, respectively). Similar results were found in a population-based cohort study from Minnesota [27].

The mean time between diagnosis and first surgery among our patients was 4.5 years, with 70% of patients requiring surgery during the first 5 years from diagnosis. These results are comparable to those reported in the literature [22,24]; however, overall risk of surgery within 5 years from diagnosis varies (24% to 77%) in different studies [7,27-30]. This may be due to a disparity in the number of patients with each disease type and improvements in CD management. The highest resection rate (77%) was observed in a population-based cohort of 907 patients diagnosed with primary ileocecal CD between 1955 and 1989 [28], while in other studies (more recent and including all CD locations) it was up to 38%, and the risk of major abdominal surgery decreased between decades. In our present study, the average time from diagnosis to first surgery was 7 years for colitis and 4.1 years for ileocolitis and ileitis.

Intestinal stenosis and fistulae tend to be the main indications for surgery [22,23,29]. In the present study, stricture (19%), intermittent ileus (16%), ileus (9%), and fistulae (36%) were 80% of all indications for surgery, which correspond to those mentioned in the literature. Consequently, intestinal resections (especially ileal resection or right hemicolectomy, which accounted for 60% in the present study) and surgery for perianal fistulae remain the most common procedures [23,27,31].

According to the ECCO evidence-based consensus on the diagnosis and management of CD, smoking, penetrating and stricture disease behavior, ileal disease, jejunal disease, and young age at diagnosis are risk factors for surgery [32].

In our study, patients with a smoking history had a higher rate of postoperative complications and significantly lower age at
first surgery. Some studies do not reveal an association between smoking and complication rate [31], but the impact of tobacco use on disease activity, higher risk of structuring and fistulizing behavior, and early postoperative recurrence is well described [33-36]. Moreover, it has been proven that smoking cessation reduces progression to B2/B3 disease and the risk of surgery [36]. Despite the fact that smoking is strongly forbidden in CD, as many as 21.7% of patients undergoing surgery in our hospital and 12% to 36.9% of patients in several studies were smokers [23,25,27,37].

The analysis showed that patients with penetrating disease had the shortest time from diagnosis to first surgery. Perianal lesions and penetrating disease were the risk factors for a higher number of surgeries, which was consistent with the literature [25]. Some studies have also reported a positive association between penetrating disease type and the complication rate [24,31].

Patients with perianal disease had also lower age at first surgery, with an average of 30.4 years in comparison to 35.7 years among patients without perianal lesions. The difference was similar in a retrospective analysis carried out between 2005 and 2014 in which patients with perianal disease were an average of 34 years of age and those without were 39 [22]. Also, the postoperative recurrence rate in patients with anal lesions and in patients with juvenile-onset disease was significantly higher in a Japanese study analyzing the postoperative course of 168 patients [25]. In our study, an older age at diagnosis was associated with shorter time between diagnosis and first surgery.

There is a considerable debate in the literature as to whether the risk of surgery has decreased in the era of biological therapy. Some studies have reported a decrease in surgical risk [30,38], while others have reported no difference [39]. Anti-TNF treatment was described as a factor which leads to significant reduction of surgical requirements [40]. A Japanese study [25] identified biological therapy as a postoperative recurrence suppressor. The association between preoperative anti-TNF therapy and morbidity after surgery remains unclear in older [41-44] and more recent studies [16-18,45]. According to the recent ECCO guidelines, cessation of anti-TNF therapy prior to surgery is not mandatory [6], but this is still questioned [15]. In our department, 31.7% of patients received biological treatment before surgery. Use of anti-TNF medications (adalimumab, infliximab) appeared to extend the time between diagnosis and first surgery (from 3.5 to 6.4 years, \( P=0.014 \)), and did not affect the overall complication rate.

The occurrence of symptoms, such as abdominal pain, decreased food intake, and diarrhea, is the reason patients with CD are particularly prone to weight loss and malnutrition, which is an important risk factor for postoperative complications [46]. In our study, more than a third of patients were underweight. The disturbed iron metabolism due to chronic inflammation and rectal bleeding lead to anemia [47], which affected up to 51.7% of patients in the present study.

Patients undergoing surgery for CD have fairly high rates of postoperative complications, ranging from 23% to 51.3% in the literature [10,12,48-51]. Analysis of risk factors for septic complications after surgery for CD shows various complication rates, from 10.6 to 30.7% [51], depending on the number of identified risk factors among patients, namely low albumin level, low hemoglobin level, and elevated CRP. We did not find an association between these factors and complications, which may have been due to the limited number of observations.

According to a recent study by Gklavas et al [11], patients are more likely to have postoperative complications if they had a previous surgery for CD. Our results were the same as those of a Korean retrospective analysis [31] in that there was no association between previous laparotomy and an increased risk of postoperative complications. We did not observe postoperative mortality, but the literature reports mortality rates from 0.6% in elective to 3.6% in emergent surgeries for CD [52].

Limitations of the study are the small number of patients and retrospective design, which resulted in the study containing variables that could not be controlled. However, the study is important for assessing the current role of surgery in CD and to evaluate the results of surgical treatment in our referral hospital.

Conclusions

Despite recent improvements in CD pharmacotherapy, 13% of patients hospitalized for CD required surgical intervention, with the most commonly performed procedure being right hemicolectomy. The mean time between CD diagnosis and first surgery was shorter than 5 years, and most patients had more than 1 surgery for CD. Perianal manifestations, penetrating disease type, ileal/ileocolic involvement, and cigarette smoking may be associated with the risk of earlier surgery or multiple surgeries. The necessity of ostomy creation was most common in patients with higher CRP levels and many previous surgeries. Additional efforts are needed to prevent the occurrence of intestinal stenosis, fistulae, and abscesses, which were the main reasons for surgery. Perioperative complications occurred in 32% of patients. Owing to the high prevalence of anemia, hypoalbuminemia, and underweight among patients with CD, nutritional therapies should be an important point of preoperative management as they may improve postoperative outcomes.
Declaration of Figures’ Authenticity

All figures submitted have been created by the authors, who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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