The Risk Factors for Complications After Crohn’s Disease Surgery

Ilker Ozgur¹, Bora Karip², Cemil Burak Kulle³, Bilger Cavus⁴, Recep Ercin Sonmez¹, Filiz Aykuz⁴, Arzu Poyanli⁵, Emre Balik³, Mehmet Turker Bulut¹, Metin Keskin¹

¹Gastrointestinal Surgery Unit, Department of General Surgery, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Turkey
²Department of General Surgery, Fatih Sultan Mehmet Training and Research Hospital, Istanbul, Turkey
³Department of General Surgery, VKV Koc University Hospital, VKV Koc University Medicine School, Istanbul, Turkey
⁴Gastroenterohepatology, Department of Internal Diseases, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Turkey
⁵Department of Radiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Turkey

Background: Crohn’s disease needs a multidisciplinary approach, and surgery will ultimately be necessary for most patients. Complications usually occur after surgery.

Objective: This study aims to present complication rates in surgically treated Crohn’s disease patients at a single institution and to determine possible risk factors.

Methods: A retrospective analysis of 112 consecutive surgery performed on Crohn’s disease patients between 2003 and 2015. The demographic data, patient and disease characteristics, surgery type, and complications were analyzed.

Results: Of 112 patients, 64 (57.1%) were male and 48 (42.9%) were female. The mean age was 34 (range, 18–78) years. The mean follow-up was 114 ± 32.4 (range, 61–197) months. The most common early complications were intra-abdominal abscess formation (n = 10, 8.9%) and wound infection (n = 7, 6.26%). The incisional hernia was the most common late complication (n = 4, 3.6%). Nonmodifiable disease features associated with complications were colonic involvement of the disease (P = 0.001), penetrating disease character (P = 0.037), stoma formation (P = 0.000), fistula (P = 0.008), and concomitant fistula and intra-
abdominal abscess existence \((P = 0.043)\). Stoma formation was found to be an independent risk factor for complications \((P = 0.001)\).

**Conclusions:** Colonic involvement, penetrating disease, fistula, concomitant abscess and fistula, and stoma formation were identified as nonmodifiable risk factors for complications after surgery for Crohn’s disease.

**Key words:** Crohn’s disease – Postoperative complications – Surgery – Risk factors

Crohn’s disease (CD) is a chronic inflammatory bowel disease that can involve any part of the gastrointestinal system and nondigestive system organs, such as the eyes, joints, and skin. The mean annual incidence of CD in Turkey is 2.2 per 100,000 capita.\(^1\) The disease presents with symptoms that depend on the involved organ. The most common form is a simple ulcerous and inflammatory luminal disease, but stricture or fistula of the bowel is not unusual. The primary treatment option for CD is medical treatment. Advancement in medical therapy options and newly developed drugs in the last 2 decades have decreased the disease relapse rate and prolonged remission.

Although the primary treatment option is medical, depending on the severity of the disease behavior, CD patients will typically undergo surgery at least once during their life.\(^2\) Disease recurrence is reported with a high rate of even >50% in the first year after surgery, and half of these patients become symptomatic.\(^3\) Recent studies have reported a 30% to 50% complication rate after ileocecal resections.\(^4-6\) Disease behavior, aggressive forms, a high risk of disease recurrence, and critical complications mandate a multidisciplinary approach and close follow-up of patients. Insight the mentioned knowledge, we conducted this study to examine the treatment results and complication rates of our multidisciplinary clinic, which has been dealing with the surgical treatment of CD for a long time, and to determine possible risk factors in the health care–provided population.

**Materials and Methods**

Data from a total of 112 patients who had been diagnosed with CD and directed to the Gastrointestinal Surgery Unit at Istanbul Faculty of Medicine, between January 2003 and January 2015, were analyzed retrospectively. Details of patient demographics, smoking status, disease behavior and location, extraluminal disease status, medical therapy, biological agent use and duration, corticosteroid use and duration, immunosuppressive medication type and duration, prior surgery, type of surgery, type of anastomosis, stoma formation rate, and postoperative complications were accessed from patient charts and analyzed. The study was conducted in accordance with the principles of the Declaration of Helsinki, and the study protocol was approved by the Istanbul University Clinical Research Ethics Committee with the 04 numbered decision on date February 22, 2019.

**Surgical decision**

All performed interventions were decided on in weekly multidisciplinary department meetings (surgery, gastroenterology, radiology), and the surgeries were performed by colorectal surgeons. All patients had an intestinal resection and/or stricturoplasty. The anastomosis was created with a stapler or hand sewn, according to the surgeon’s preference.

**Patient medication use**

Preoperative medical treatment was defined as steroid use until the day of surgery; azathioprine, 6-mercaptopurine, or methotrexate within 4 weeks before surgery; and anti–tumor necrosis factor-α (anti-TNFα) treatment within 8 weeks of surgery.

**Follow-up**

Patients were followed up in outpatient clinics. The first control visit was in the first month, followed by a visit at the sixth month after surgery with both the general surgery and gastroenterology departments. After the first year, routine, yearly controls, and colonoscopy if needed were performed at the gastroenterology outpatient clinic.

**Evaluation of potential variables**

Several variables were evaluated as potential risk factors for complications. Preoperative nonmodifiable risk factors were sex, age \((\geq 40\text{ }\text{versus }< 40\text{ years})\),
years), age group at operation (A1, ≤16 years; A2, 17–40 years; A3, >40 years), disease location (ileal [L1], colonic [L2], ileocolonic [L3], isolated upper disease [L4]), disease behavior (nonpenetrating/nonstricturing [B1], stricturing [B2], penetrating [B3]), presence of perianal disease, extraluminal disease, disease duration, age at disease onset, medical treatment existence before surgery, and medical treatment duration before surgery. The modifiable preoperative risk factors were smoking habit, medical treatment before surgery, hematocrit level, albumin level, total parenteral nutrition, intraperitoneal abscess, fistula other than a perianal disease, and coexisting fistula and abscess. The modifiable operative risk factors were defined as the surgical approach (laparoscopic versus open), surgery type (elective versus emergent), stoma formation, and anastomosis type (hand sewn versus stapled).

Complications

Early complications were defined as those occurring within 30 days of surgery. Late complications were defined as those occurring during follow-up after hospital discharge.

Statistical analysis

A Microsoft Excel database (Microsoft Corp, Redmond, Washington) was used to extract data for statistical analysis. Categorical values were calculated with χ² or Fisher’s exact test. Univariate and multivariate regression was performed for risk factors. P < 0.05 was considered statistically significant. IBM SPSS Statistics for Windows, Version 22.0 software (IBM Corp, Armonk, New York) was used to perform the statistical analyses.

Compliance with ethical standards

This article was written in accordance with the ethical standards of the institutional review board and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Results

A total of 112 patients were included in the study. Male sex was more common than female (n = 64, 57.1% versus n = 48, 42.9%). The mean age at surgery was 38 ± 12.3 years (range: 19–80 years), and the mean age at diagnosis of CD was 30.8 ± 11.4 years (range: 7–63 years). Ileocolic disease was the most common form, followed by ileal disease. Penetrating disease (n = 51, 45.5%) and stricturing disease (n = 44, 39.3%) were the most common forms of disease behavior. Concomitant extraluminal disease was observed in 22 (19.6%) patients (Table 1). The mean disease duration was 95.9 ± 64.7 months (range: 6–324 months). Sixty-one patients (54.4%) were active smokers until the surgery. Before surgery, 90 (80.4%) patients were using medical treatment for a mean of 65.5 ± 56.4 months (range: 12–324 months), and 79 (70.5%) were using more than 1 medication. In all, 33% (n = 37) used a biological agent and 42.8% (n = 48) used steroids.

Sixty-four (57.1%) patients had prior abdominal surgery, and acute appendicitis was the most common indication. Thirty-five (31.5%) patients required total parenteral nutrition (TPN) before surgery. An intraabdominal abscess was present in 44 (39.3%) patients, and 23 (20.5%) that were suitable were drained percutaneously before surgery. Preoperative antibiotics were used in 84 (75%) patients. Elective (n = 98, 87.5%) and open surgery (n = 93, 83%) were the most common surgical approaches. Fourteen patients underwent emergency (n = 14, 12.5%) surgery. Laparoscopic surgery was performed in 19 (17%) patients, with a 15.8% (n = 3) conversion rate to open surgery. A stapled anastomosis (n = 74, 66.1%) was more common than a hand-sewn technique (n = 11, 12.9%), and 27 (24.1%) patients had no anastomosis. Ileocolonic resection was the predominant surgery type (n = 95, 84.4%), followed by colonic resection (n = 7, 6.34%). Only six patients (5.4%) underwent stricturoplasty. The mean follow-up after surgery was 114 ± 32.4 months, with a median of 113 months (range: 61–197 months).

In total, 27 (24.1%) patients developed complications after surgery. Intraabdominal abscess formation (n = 10) was the most common early complication after surgery, followed by wound infection (n = 7). Incisional hernia (n = 4) was the most common late complication (Table 2). The complication rate was higher among patients with shorter medical treatment (n = 27, mean: 54.8 ± 48.9 months versus n = 85, mean: 68.8 ± 58.5 months; P = 0.324) but was not statistically significant. Sex, medical treatment before surgery, steroid use, biological agent use, multiple drug use, hematocrit level, albumin level, age at diagnosis, disease duration, and smoking habit did not affect the complication rate (Table 1). The stoma formation was not affected by disease location or behavior. Disease duration was different
Table 1  Disease characteristics and factors affecting complications

|                          | Complicated |     | Uncomplicated |     | P   | OR  |
|--------------------------|-------------|-----|---------------|-----|-----|-----|
|                          | n           | %   | n             | %   |     |     |
| Sex                      |             |     |               |     |     |     |
| Female                   | 12          | 44.4| 36            | 42.4| 0.848| 0.037|
| Male                     | 15          | 55.6| 49            | 57.6|     |     |
| Age, years               |             |     |               |     |     |     |
| A1 (<16)                 |             |     |               |     |     | 0.859|
| A2 (17–40)               | 16          | 59.3| 52            | 61.2|     |     |
| A3 (>40)                 | 11          | 40.7| 33            | 38.8|     |     |
| Mean age, years          | 39.6±13.7   |     | 38.5±11.8     |     | 0.694|     |
| Age at diagnosis, years  |             |     |               |     | 0.589|     |
| A1 (<16)                 | 2           | 7.4 | 5             | 5.8 |     |     |
| A2 (17–40)               | 18          | 66.6| 65            | 76.5|     |     |
| A3 (>40)                 | 7           | 26  | 15            | 17.7|     |     |
| Mean age at diagnosis, years | 31.4±12.7     |     | 30.7±11       |     | 0.753|     |
| Disease location<sup>a</sup> |     |     |               |     | 0.001| 1.409|
| L1 (ileal)               | 0           |     | 10            |     | 11.8|     |
| L2 (colonic)             | 4           | 14.8| 4             |     | 4.7 |     |
| L3 (ileo-colonic)        | 23          | 85.2| 62            |     | 72.9|     |
| L4 (isolated upper disease) | 0       |     | 9             |     | 10.6|     |
| Disease behavior<sup>b</sup> |     |     |               |     | 0.037| 2.550|
| B1 (nonpenetrating/stricturing) | 1 |        | 16            | 18.8|     |     |
| B2 (structuring)         | 9           | 33.3| 35            |     | 41.2|     |
| B3 (penetrating)         | 17          | 63  | 34            |     | 40  |     |
| P (perianal disease)     | 7           | 25.9| 27            | 31.8| 0.565| 0.752|
| Smoking                  |             |     |               |     | 0.449| 0.716|
| Current smokers          | 13          | 48.4| 48            |     | 56.5|     |
| Nonsmoker or ex-smoker   | 14          | 51.6| 37            |     | 43.5|     |
| Disease age, months      | 97.3±52.4   |     | 95.4±67.5     | 6324| 0.894|     |
| Medical treatment duration until surgery, months | 54.8±48.9 (12–324) | 68.8±58.4 (12–240) | 0.324|     |
| Anti-TNF consumption time, months (37 patients) | 6.8±3.9 | 6.6±6.7 | 0.912|     |
| Steroid consumption time, months (42 patients) | 18.7±31.3 | 9.6±13.3 | 0.185|     |
| Serum albumin level, gr/dL | 3.46±0.7 | 3.41±0.7 | 0.768|     |
| Hematocrit level, %      | 34.2±6.2    |     | 34.7±4.5     |     | 0.644|     |
| Prior medical treatment  | 21          | 77.7| 69            | 81.2| 0.699| 0.812|
| Med. Treat. Change       | 18          | 66.7| 51            | 67.1| 0.937| 0.963|
| Multiple drug consumption | 18         | 66.7| 61            | 71.8| 0.613| 0.787|
| Steroid consumption      | 13          | 52  | 35            | 43.2| 0.440| 1.424|
| Anti-TNF consumption     | 11          | 44  | 26            | 32.5| 0.293| 1.632|
| TPN                      | 7           | 6.3 | 28            | 25.2| 0.563| 0.780|
| Prior abdominal surgery  | 17          | 15.2| 47            | 42  | 0.483| 1.374|
| Extra-intestinal involve  | 8           | 7.1 | 14            | 12.5| 0.134| 2.135|
| Intra-abdominal abscess existence | 13     | 11.6| 31            | 27.7| 0.279| 1.618|
| Fistula existence        | 17          | 63  | 29            | 34.1| 0.008| 3.283|
| Abscess and fistula coexistence | 11          | 40.7| 18            | 21.2| 0.043| 2.559|
| Percutaneous drainage    | 7           | 25.9| 16            | 18.8| 0.426| 1.509|
| Preoperative antibiotics  | 23          | 85.2| 61            | 71.8| 0.161| 2.262|
| Surgical approach        |             |     |               |     | 0.352| 0.539|
| Laparoscopic              | 3           | 11.1| 16            | 18.8|     |     |
| Open                     | 24          | 88.9| 69            | 81.2|     |     |
| Surgery type             |             |     |               |     | 0.676| 0.767|
| Emergent                 | 4           | 14.8| 10            | 11.8|     |     |
| Elective                 | 23          | 85.2| 75            | 88.2|     |     |
| Anastomosis type         |             |     |               |     | 0.248| 2.500|
| Hand sewn                | 4           | 18.2| 7             | 11.1|     |     |
| Stapler                  | 18          | 81.8| 56            | 88.2|     |     |
| Anastomosis              | 22          | 81.5| 63            | 74.1| 0.395| 1.537|
| Stoma formation          | 12          | 44.4| 10            | 11.8| 0.000| 6.0  |

OR, odds ratio; TNF, tumor necrosis factor; TPN, total parenteral nutrition.

<sup>a</sup>Groups are compared as L1 (ileal) versus L2 (colonic) + L3 (ileo-colonic).

<sup>b</sup>B1 (nonpenetrating/ nonstricturing) versus B2 (structuring) + B3 (penetrating).
Late complications

Involvement, penetrating disease, presence of a single institution. Our study suggested that colonic and risk factors for complications of CD patients in a this study, we showed the clinical characteristics associated with complications have been investigated. Various risk factors have been investigated, but these factors differ across communities. In this study, we showed the clinical characteristics and risk factors for complications of CD patients in a single institution. Our study suggested that colonic involvement, penetrating disease, presence of a fistula, concomitant abscess and fistula, and stoma formation were associated with complication occurrence. Stoma formation was an independent risk factor for complications.

Unfortunately, nearly 80% to 90% of CD patients are likely to undergo surgery during the disease. The surgical strategy may vary depending on the bowel site affected, the existence of complications, the patient’s general condition, and disease severity, which will determine a single operation approach, such as ileocecal resection or stricturoplasty, or more extended surgery, such as a total colectomy or proctocolectomy. Several population-based studies have reported postoperative complication rates of 10% to 50%. Abscess formation, wound site infection, anastomosis leakage, and extra-abdominal infections were all related to infectious processes. Postoperative complication risks have been evaluated in several other retrospective studies. The reported intra-abdominal septic complication (IASC) rate is 9% to 13%, which is similar to the results of our research.

Our study group has similarities of disease characteristics to the Western population in disease location, disease behavior, and smoking habit. When demographic data were compared, the male predominance (57.1%) in our cohort was dissimilar to most Western reports, and a smaller proportion of patients (39.3%) was diagnosed after age 40. These demographic variations between study groups, such as later onset age, may arise because of underlying genetic differences, dietary patterns, and gut microbiota. Exposure to the Western lifestyle and dietary habits in daily social life is more common among Turkish men than women. This condition may contribute to the predominance of male sex in our study group.

Preoperative preparation is critical for CD patients because nutritional status is a major determinant of surgical outcomes. The complication rate can be minimized with optimal preparation before surgery. Malnutrition, weight loss, low blood hemoglobin, hematocrit values, and albumin levels have frequently been observed as parameters that are a risk factor for postoperative complications. Our results revealed no association between the complication rate and preoperative TPN or smoking. Nonetheless, smoking is a well-described risk factor for disease recurrence. Heavy smokers have been shown to have a higher risk of relapse compared with other groups who smoked less. The rate of smoking in our study was high because patients who smoked even 1 cigarette per day were

### Table 2 Complications after CD surgery

| Complications                     | n  | %  | Dindo-Clavien Class |
|-----------------------------------|----|----|---------------------|
| Early complications (within 30 days) |    |    |                     |
| Intra-abdominal abscess           | 10 | 8.9| II                  |
| Wound infection                   | 7  | 6.3| II                  |
| Anastomotic leakage               | 3  | 2.7| IIIb                |
| Intra-abdominal bleeding          | 3  | 2.7| n = 2/ II, n = 1/IIIb|
| De-novo fistula                   | 1  | 0.9| IIIb                |
| Pneumonia                         | 1  | 0.9| II                  |
| Stoma torsion                     | 1  | 0.9| IIIb                |
| More than one                     | 6  |    |                     |
| Total patients                    | 20 | 17.8|                   |
| Late complications                |    |    |                     |
| Incisional hernia                 | 4  | 3.6| IIIb                |
| Ileus                             | 1  | 0.9| II                  |
| Stoma stricture                   | 1  | 0.9| IIIb                |
| Fecal incontinence                | 1  | 0.9| IIIb                |
| Total patients                    | 7  | 6.3|                     |
considered smokers. The degree of tobacco use may determine the absolute effect of smoking on disease course. Several other recent studies did not find smoking to be a risk factor. One author even followed an initial report indicating that smoking was a risk factor for complications, with a subsequent report several years later that did not regard it as a risk factor.

The choice of drug therapy largely depends on individualized medical treatment. Disease response, remission, tolerance, and side effects all play a role in drug preference. Most of the patients in our study

| Variable                                      | n  | %   | P   | OR  |
|-----------------------------------------------|----|-----|-----|-----|
| Sex                                           |    |     |     |     |
| Female                                        | 11 | 9.8 | 0.450 | 1.432 |
| Male                                          | 11 | 9.8 | 0.754 | 0.857 |
| Age, yrs.                                      |    |     |     |     |
| A1 (≤16)                                      | 0  | 0   | 0.735 | 0.674 |
| A2 (17–40)                                    | 14 | 12.5|       |     |
| A3 (>40)                                      | 8  | 7.1 |       |     |
| Age at diagnosis, years                       |    |     |     |     |
| A1 (≤16)                                      | 2  | 1.8 | 0.685 | 1.263 |
| A2 (17–40)                                    | 15 | 13.4|       |     |
| A3 (>40)                                      | 5  | 4.5 |       |     |
| Disease location: L2 (colonic) + L3 (ileocolonic) | 22 | 19.4| 0.102 | 4.570 |
| Disease behavior                              |    |     |     |     |
| B1 (nonpenetrating/nonstricturing)            | 2  | 1.8 | 0.375 | 0.873 |
| B2 (structuring) + B3 (penetrating)           | 20 | 17.9|       |     |
| Smoking                                       |    |     |     |     |
| Current smokers                               | 12 | 10.7| 0.353 | 0.637 |
| Nonsmoker or ex-smoker                        | 10 | 8.9 |       |     |
| Prior medical treatment                       | 21 | 18.8| 0.047 | 6.391 |
| Medical treatment change                      | 19 | 16.4| 0.023 | 4.136 |
| Multiple drug consumption                     | 20 | 17.9| 0.019 | 5.254 |
| Steroid consumption                           | 15 | 14.2| 0.015 | 3.312 |
| Anti-TNF consumption                          | 12 | 11.4| 0.033 | 2.784 |
| Extra intestinal involvement                  | 4  | 3.6 | 0.847 | 0.889 |
| Abscess                                       | 17 | 15.2| 0.076 | 0.385 |
| Fistula                                       | 12 | 10.7| 0.152 | 1.976 |
| Fistula and abscess                           | 4  | 3.6 | 0.357 | 0.578 |
| TPN                                           | 9  | 8.1 | 0.290 | 1.678 |
| Percutaneous drainage                         | 3  | 2.7 | 0.372 | 0.553 |
| Antibiotics                                   | 17 | 15.2| 0.784 | 1.167 |
| Surgery type                                  |    |     |     |     |
| Emergency                                     | 2  | 1.8 | 0.590 | 1.538 |
| Elective                                      | 20 | 17.9|       |     |
| Surgical approach                             |    |     | 0.643 | 0.730 |
| Laparoscopic                                  | 3  | 2.7 |       |     |
| Open                                          | 19 | 17  |       |     |
| Disease age (months ± SD)                     |    |     | 0.044 |     |
| Stoma formed                                  | 68.9|     |     |     |
| No stoma                                      | 53.5|     |     |     |
| Medical treatment duration until surgery (months ± SD) | 65.4 ± 56.4 | 0.212 |     |
| Stoma formed                                  | 43.6|     |     |     |
| No stoma                                      | 51.7|     |     |     |
| Albumin level, g/dL ± SD                      |    |     | 0.264 |     |
| Stoma                                         | 3.4 ± 0.7|     |     |     |
| No stoma                                      | 3.38 |     |     |     |
| Hematocrit level, % ± SD                      |    |     | 0.032 |     |
| Stoma                                         | 34.6 ± 4.9|     |     |     |
| No stoma                                      | 34.1 |     |     |     |
| No stoma                                      | 36.7 |     |     |     |
used thiopurine, 5-aminosalicylic acid, and a corticosteroid before surgery. Thirty percent of the patients included in our research were using anti-TNFα therapy. This rate is slightly higher than that reported in the Western population. It may be a result of our status as a referral hospital and an accumulation of nonresponders to medical therapy in the study group. The study group also consisted of patients who had been referred to surgery with no further medical options for treatment.

Several studies and meta-analyses have investigated whether immunosuppressive or biological therapy increases the risk of postoperative complications. Some studies have demonstrated that anti-TNFα therapy increased the complication rate, but not all. The current recommendation does not suggest the cessation of anti-TNFα medication before surgery. It has been reported that preoperative treatment with anti-TNFα did not increase the risk of postoperative complications. We also found that the complication rate was not affected by anti-TNFα therapy or duration. Withdrawal of steroids from treatment has been linked to decreased complication rates. We demonstrated no association between the incidence of complications and the use of corticosteroids, or medication use before the surgery, long duration of medical treatment duration before surgery, or multidrug treatment. All these patients were evaluated as being at high risk for complications and had a higher stoma rate.

The perforating disease has been reported as a risk factor for postoperative complications. It has been found to increase anastomosis-related complications and postoperative IASC. Aggressive disease characteristics also contribute to the outcome. In our study, disease behavior and localization both significantly influenced the complication rate.

Preoperative antibiotics and percutaneous drainage have been proposed as a means to improve the postoperative outcome. Previous reports have demonstrated that the presence of an abscess or fistula increased the occurrence of postoperative IASC. Our study population had similar complication rates concerning preoperative antibiotic administration and percutaneous drainage. A fistula or fistula with abscess formation also significantly increased the complication rate in our study group.

Emergency conditions and the surgical approach did not affect the complication rate. Stoma formation is sometimes unavoidable and was seen in 19.6% of the patients in this study. Colonic disease and penetrating disease behavior were not found to affect stoma formation. Prior medical treatment, the need for a change in medical treatment, corticosteroid use, and multidrug treatment all affected stoma formation with significant statistical value. The stoma-formed patients also had a longer disease duration. These patients had no further medical treatment options and were referred for surgery because of unresponsiveness to medical therapy. The statistical significance between the stoma formation rate and medical treatment parameters verifies the disease condition and patient status thus the stoma-formed patients who depleted both medical treatment options and general condition had higher complication rates despite stoma formation.

The current study has a comparable complication rate to the reported in the literature. Only 2 of the nonmodifiable risk factors, disease location and behavior, had a statistical significance on the complication rate, and none of the modifiable risk factors had statistical significance. This low complication rate may be accepted as an achievement indicator of the health care team, which has good

Table 4 Univariate and multivariate analysis of risk factors for complications

| Risk Factor                        | Univariate | Multivariate |
|------------------------------------|------------|--------------|
|                                    | P  | OR | LR | HR | 95% CI | P  |
| Disease location                   |    |    |    |    |        |    |
| L1 (ileal)                         | 0.001 | 13.3 | 2.577 | Reference | 0.000–656892 | 0.787 |
| L2 (colonic) + L3 (ileocolonic)    | 0.037 | 2.550 | 11.664 | Reference | 0.265–46.373 | 0.342 |
| Disease behavior                   |    |    |    |    |        |    |
| B1 (nonpenetrating/stricturing)    | 0.008 | 3.283 | 6.972 | Reference | 0.904–0.176 | 0.903 |
| B2 (structuring) + B3 (penetrating)| 0.043 | 2.559 | 3.846 | Reference | 0.581–11.582 | 0.212 |
| Fistula existence                  |    |    |    |    |        |    |
| Abscess and fistula existence      | 0.000 | 6.0 | 12.300 | 7.242 | 2.207–23.767 | 0.001 |

CI, confidence interval; HR, hazard ratio; LR, likelihood ratio.
control of risk factors because of convenient and multidisciplinary enthusiasm.

This study has some limitations. Limited data acquisition was possible with a retrospective design, and working as a referral center aggravated this condition. The study group consisted of severely deteriorated CD patients. Although the patients’ general condition, medical treatment, and nutritional status before surgery were considered, there may be some bias in the study group because of an accumulation of patients with varying disease severity. Research with larger study groups and a prospective design may decrease these biases. Further prospective studies may be designed to investigate risk factors and the underlying genetic pool in a nationwide database.

Conclusion

We determined several nonmodifiable risk factors of complications after surgery for CD: colonic involvement, penetrating disease, presence of a fistula, concomitant abscess and fistula, and stoma formation. The study also demonstrated that corticosteroid treatment, medical treatment before the surgery, longer duration of medical treatment before surgery, and multidrug treatment were not risk factors for intra-abdominal septic complications. Thus, stoma formation can be advocated for this subgroup of patients.

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