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# **OPEN** Prognostic significance of the Controlling Nutritional Status (CONUT) score in predicting postoperative complications in patients with Crohn's disease

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Preoperative immune-nutritional status is correlated with postoperative outcomes. The Controlling Nutritional Status (CONUT) score is a useful tool for predicting the postoperative outcomes of cancer surgery. This study aimed to evaluate whether the CONUT score could predict postoperative complications in Crohn's disease (CD) patients. In total, 202 CD patients were eligible. Univariate and multivariate analyses were performed to identify risk factors for postoperative complications. Receiver operating characteristic (ROC) curves were generated to examine the cutoff value for predictors of postoperative complications. Among all the patients, 66 developed postoperative complications. The cut-off value of the CONUT score was 3.5 for complications. Eighty-one patients had a low CONUT score (<3.5), and 121 patients had a high CONUT score (>3.5). There was a significant difference in postoperative complications between the groups with low and high CONUT score (17.3% vs. 43.0%, p < 0.001). Patients with high CONUT score had low body mass index (BMI), more mild postoperative complications (p = 0.001) and a longer postoperative stay (p = 0.002). Postoperative complications were correlated with BMI, preoperative albumin, the preoperative CONUT score, and preoperative infliximab use. Then, the preoperative CONUT score was an independent risk factor for complications (OR 3.507, 95% CI 1.522-8.079, p = 0.003). ROC analysis showed that the CONUT score was a better predictor of postoperative complications in CD patients than albumin and the prognostic nutritional index. Thus, a preoperative CONUT score cut-off value of more than 3.5 could help to identify patients with a high possibility of malnutrition and postoperative complications.

Crohn's disease (CD) is a transmural inflammatory disease of the intestinal mucosa, and it occurs discontinuously in any segment of the digestive tract<sup>1</sup>. The interplay between genetic factors, environmental factors, and gut microbiota is reported to be involved in the pathogenesis of Crohn's disease; this interplay leads to an abnormal mucosal immune response and an imbalanced intestinal epithelial barrier<sup>2,3</sup>. Almost 80% of CD patients are reported to receive surgical treatment due to the failure of medical therapy during their lifetime<sup>4</sup>. Postoperative complications, especially infectious complications, are common in CD patients who receive digestive surgery and occur at a rate of 10% to 37%<sup>5</sup>. Therefore, reliable clinical predictors of postoperative complications are needed in CD.

The nutritional status and immunological status of CD patients are important factors for postoperative complications due to the pathophysiological characteristics of CD. Thus, the roles of albumin (ALB), body mass index (BMI), C-reactive protein (CRP), prognostic nutritional index (PNI), faecal calprotectin, subcutaneous fat area (SFA), interleukin-6 and other indicators are studied in predicting postoperative complications in CD<sup>6-10</sup>. For example, Dreznik et al.<sup>11</sup> suggested that the nutritional status of CD patients needs to be optimized to avoid

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hazardous surgical complications, and postoperative complications in patients with low albumin can be minimized by nutritional support. Grass et al.<sup>12</sup> reported that malnutrition was a major risk factor for postoperative complications, and postoperative morbidity can be decreased efficiently by enteral and parenteral routes. Additionally, a high preoperative CDAI score with severe inflammatory response could predict negative postoperative outcomes<sup>13</sup>. Therefore, it is necessary to find a scoring system to assess both nutritional status and immune status.

The Controlling Nutritional Status (CONUT) score is calculated based on the serum albumin level, total blood cholesterol concentration, and total peripheral lymphocyte count, and this objective tool was first reported for the early detection of hospital malnutrition in 2005<sup>14</sup>. The CONUT system is considered to be associated with the host's nutritional and immune status based on these three laboratory parameters<sup>15</sup>. The CONUT is widely used as a prognostic indicator in cancer patients. Kuroda et al.<sup>16</sup> reported that the CONUT score tended to estimate nutritional status and predict long-term overall survival in gastric cancer patients after surgery. The early post-operative CONUT score was found to be an independent risk factor for postoperative complications in patients with hepatocellular carcinoma after liver resection<sup>17</sup>. Recently, a meta-analysis showed that the CONUT score was helpful for predicting which patients with gastrointestinal and hepatopancreatobiliary cancers are at an increased risk of mortality and postoperative complications<sup>18</sup>. However, the clinical significance of the CONUT system for predicting postoperative outcomes in CD remains unknown.

This study analysed a large cohort of CD patients in the Inflammatory Bowel Disease Center of our hospital to demonstrate the role of the CONUT score in CD patients. The aim of the current study was to evaluate the relationship between the CONUT score and postoperative complications and to find a reliable and simple indicator to reflect immune-nutritional status in CD.

## Results

**Study population and baseline characteristics.** A total of 202 CD patients were enrolled in the study; 135 (66.8%) were male, and the mean age of the patients was  $36.5 \pm 0.9$  years. In total, 202 patients received an anastomosis after bowel resection, and 60 patients received a protective ostomy. The mean disease duration before surgery was  $48.7 \pm 3.4$  months. Ileocolonic involvement was the most common disease pattern. Preoperatively, 39 (19.3%) patients had a medical history of azathioprine, 24 (11.9%) of infliximab, 55 (27.2%) of 5-ASA, 10 (5.0%) of corticosteroids, and 70 (36.1%) of enteral nutrition. The Montreal classification and the history of medical treatment are shown in Table 1. The mean CONUT score was  $4.3 \pm 0.2$ , and the mean PNI score was  $41.7 \pm 0.5$ . The ROC curve analysis showed that the CONUT cut-off value was 3.5. Thus, 81 (40.1%) patients were in the low CONUT group, with a score less than 3.5, and 121 (59.9%) were in the high CONUT group, with a score less than 3.5.

**Operative data and postoperative complications.** For 131 (64.9%) patients, this was their first surgery. A total of 120 (59.4%) patients underwent laparoscopic surgery successfully; however, 40 (19.8%) experienced conversion to laparotomy. The mean operative time was  $191.1 \pm 4.2$  min. The low CONUT group had a higher rate of laparoscopic surgery than the high CONUT group (74.1% vs. 49.6%, p=0.001), which might be associated with nutrition status, disease activity, and surgical history. After surgery, a total of 136 (67.3%) CD patients recovered uneventfully, and 66 (32.7%) patients had postoperative complications: 41 (20.3%) had mild complications, and 34 (16.8%) had major complications. The common complications in our hospital were wound infection (10.4%), early postoperative bowel obstruction (6.4%), and gastrointestinal bleeding (5.9%). The incidence of intra-abdominal abscess and anastomotic leakage was only 2.0% and 3.0% in our centre, and there was no significant difference between the low and high CONUT groups. The mean postoperative stay was  $10.1 \pm 0.4$  days. In the low CONUT group, 14 (17.3%) patients had postoperative complications, which was significantly lower than the number in the high CONUT group (17.3% vs. 43.0%, p<0.001). Therefore, the mean postoperative stay was also longer in the high CONUT group (8.6  $\pm$  0.6 vs.  $11.1 \pm 0.5$ , p=0.002). More details are shown in Table 2.

**Factors associated with postoperative complications.** Univariate and multivariate analyses were performed to identify risk factors for complications in CD patients. The univariate analysis showed that BMI, preoperative albumin, the CONUT score, and preoperative use of infliximab were associated with postoperative complications. Moreover, there was no significant difference in PNI between the group with and without complications ( $42.3 \pm 0.5$  vs.  $40.4 \pm 0.9$ , p = 0.079). Then, the multivariate logistic regression analysis identified the preoperative CONUT score and infliximab as independent risk factors associated with postoperative complications (OR = 3.507, 95% CI 1.522–8.079, P = 0.003; OR = 2.619, 95% CI 1.050–6.531, P = 0.039) (Tables 3 and 4).

**Predictive accuracy of the CONUT score vs. other scoring systems for postoperative complications.** It has been reported that ALB and PNI constitute a practical predictive index for postoperative complications in patients with CD or other digestive diseases<sup>8,10</sup>. ROC curve analysis was performed to examine the predictive accuracy of the CONUT score, ALB, and PNI. The areas under the curve (AUC) for the CONUT score, ALB, and PNI were 0.611, 0.399, and 0.418, respectively, which indicated that the CONUT score might be a better predictor of postoperative complications (Fig. 1). Additionally, the sensitivity of the CONUT score was 78.8%, and the specificity was 50.7%. The Youden index of the CONUT score was 0.281.

## Discussion

In patients with CD, malnutrition and systemic inflammation are the main risk factors for postoperative complications. In the current study, our results linked high CONUT scores in CD patients undergoing bowel resection to poor postoperative outcomes. Furthermore, the CONUT score was found to be an independent risk factor

Age', year36.5 ± 0.935.6 ± 1.337.0 ± 1.20.429Men135 (56.8)58 (71.6)77 (63.6)0.238BM', kg/m²18.7 ± 0.219.3 ± 0.318.3 ± 0.20.009BM'r, kg/m²105.004 (4.9)6 (5.0)0.995Hypertension11.0 (5.0)4 (4.9)7 (5.8)0.794Preoperative hemoglobin*11.8 ± 0.112.6 ± 0.211.4 ± 0.2<0.001Preoperative c-ractive protein*13.2 ± 2.08.4 ± 1.116.4 ± 3.20.048Preoperative c-ractive protein*15.2 ± 2.05.9 ± 0.25.9 ± 0.30.923Preoperative c-ractive protein*4.7 ± 0.055.4 ± 0.40.010Mean disease d-mation before surgery*, moth4.7 ± 0.055.4 ± 0.40.021Mean disease d-mation before surgery*, moth4.7 ± 0.055.4 ± 0.40.642A (2.17-40)13.6 (2.7)5 (67.9)81.66.9)0.887A (3-40)13.6 (6.7)5 (67.9)81.66.9)0.887A (3-40)13.6 (2.7)2 (32.1)50.(1.3)0.181L2 (colonic)19.9(4)8 (9.9)11.9(1.1)0.851L2 (colonic)19.9(3)9 (1.1)11.61.0)0.812L2 (colonic)10.5(2)9 (1.1)10.40.10.41B (inflammatory/failure of medical therapy10 (5.0)2 (2.5)8 (6.0)0.14L4 (upper gastrointestinal)10 (5.0)2 (2.5)8 (6.2)0.614D (2 colonic)10 (3.1)10 (4.0)0.6140.614 <td< th=""><th>Characteristics</th><th>All (202)</th><th>Low CONUTS (81)</th><th>High CONUTS (121)</th><th>P value</th></td<>	Characteristics	All (202)	Low CONUTS (81)	High CONUTS (121)	P value
BHP, kg/m <sup>2</sup> 18.7 ± 0.2     19.3 ± 0.3     18.3 ± 0.2     0.009       Comorbidities       Diabetes mellitus     10 (5.0)     4 (4.9)     6 (5.0)     0.995       Hypertension     11 (5.4)     4 (4.9)     7 (5.8)     0.794       Preoperative hemoglobin <sup>4</sup> 11.8 ± 0.1     12.6 ± 0.2     11.4 ± 0.2     <0.001       Preoperative abumin <sup>4</sup> 56.1 ± 0.4     40.0 ± 0.4     33.5 ± 0.5     <0.001       Preoperative abumin <sup>4</sup> 56.1 ± 0.4     40.0 ± 0.4     33.5 ± 0.5     <0.001       Preoperative explinecty te sedimentation rate <sup>4</sup> 16.7 ± 1.1     14.0 ± 1.4     18.5 ± 1.5     0.033       Preoperative red blood cell <sup>4</sup> 4.32 ± 0.04     4.47 ± 0.05     4.08 ± 0.06     <0.001       Man disasse duration before surgery <sup>4</sup> , month     48.7 ± 3.4     0.4 ± 5.0     54.2 ± 4.4     0.043       Matrial Lassification     2 (1.0)     1 (1.2)     1 (0.8)     0.642       A2 (17=40)     2 (1.0)     1 (1.2)     1 (0.8)     0.642       A3 (>40)     2 (6 (3.7)     2 (6 (3.1)     5 0 (41.3)     0.185	Age <sup>a</sup> , year	36.5±0.9	35.6±1.3	37.0±1.2	0.429
Comorbidities     Image: Comorbidities       Diabetes mellitus     10 (5.0)     4 (4.9)     6 (5.0)     0.995       Hypertension     11 (5.4)     4 (4.9)     7 (5.8)     0.794       Preoperative hemoglobin*     11.8 ± 0.1     12.6 ± 0.2     11.4 ± 0.2     <0.001	Men	135 (66.8)	58 (71.6)	77 (63.6)	0.238
Diabetes mellitus10 (5.0)4 (4.9)6 (5.0)0.995Hypertension11 (5.4)4 (4.9)7 (5.8)0.794Preoperative hemoglobin*11.8 ± 0.112.6 ± 0.211.4 ± 0.2<0.001	BMI <sup>a</sup> , kg/m <sup>2</sup>	18.7±0.2	19.3±0.3	18.3±0.2	0.009
Hypertension11 (5.4)4 (4.9)7 (5.8)0.794Preoperative hemoglobin*11.8 $\pm$ 0.112.6 $\pm$ 0.211.4 $\pm$ 0.2<0.001	Comorbidities	-			
Here11.8.10.112.6.10.211.4. $\pm$ 0.2<0.001Preoperative hemoglobin*11.8.40.112.6.10.211.4. $\pm$ 0.2<0.001	Diabetes mellitus	10 (5.0)	4 (4.9)	6 (5.0)	0.995
Preoperative albumin* $36.1\pm0.4$ $40.0\pm0.4$ $33.5\pm0.5$ $<0.001$ Preoperative C-reactive protein* $13.2\pm2.0$ $8.4\pm1.1$ $16.4\pm3.2$ $0.048$ Preoperative erythrocyte sedimentation rate* $16.7\pm1.1$ $14.0\pm1.4$ $18.6\pm1.5$ $0.033$ Preoperative white blood cell* $5.9\pm0.2$ $5.9\pm0.3$ $0.923$ Preoperative red blood cell* $4.23\pm0.04$ $4.47\pm0.05$ $4.08\pm0.06$ $<0.001$ Mean disease duration before surgery*, month $48.7\pm3.4$ $40.4\pm5.0$ $54.2\pm4.4$ $0.043$ Montreal classificationAge, yearsA1 ( $\leq 16$ ) $2(1.0)$ $1(1.2)$ $1(0.8)$ $0.642$ A2 ( $17-40$ ) $136$ ( $67.3$ ) $55$ ( $67.9$ ) $81$ ( $66.9$ ) $0.887$ A3 (>40) $64$ ( $31.7$ ) $25$ ( $30.9$ ) $39$ ( $32.2$ ) $0.838$ LocationL1 (ileal) $76$ ( $37.6$ ) $26$ ( $32.1$ ) $50$ ( $41.3$ ) $0.185$ L2 (colonic) $19$ ( $9.4$ ) $8$ ( $9.9$ ) $11$ ( $9.1$ ) $0.851$ L3 (ileocolonic) $95$ ( $47.0$ ) $44$ ( $54.3$ ) $51$ ( $42.1$ ) $0.089$ L4 (upper gastrointestinal) $26$ ( $12.9$ ) $9(11.1)$ $17$ ( $14.0$ ) $0.511$ BehaviorB1 (inflammatory/failure of medical therapy) $10$ ( $5.0$ ) $2$ ( $2.5$ ) $8$ ( $6.6$ ) $0.643$ B2 (stricturing) $143$ ( $70.8$ ) $55$ ( $67.9$ ) $81$ ( $72.0$ ) $0.651$ B2 (stricturing) $143$ ( $70.8$ ) $55$ ( $7.9$ ) $80$ ( $72.0$ ) $0.640$ B3 (penetrating) $P6$ ( $63$	Hypertension	11 (5.4)	4 (4.9)	7 (5.8)	0.794
Preoperative C-reactive protein*13.2±2.08.4±1.116.4±3.20.048Preoperative crythrocyte sedimentation rate*16.7±1.114.0±1.418.6±1.50.033Preoperative white blood cell*5.9±0.25.9±0.25.9±0.30.923Preoperative red blood cell*4.23±0.044.47±0.054.08±0.06<0.001	Preoperative hemoglobin <sup>a</sup>	11.8±0.1	12.6±0.2	11.4±0.2	< 0.001
Preoperative erythrocyte sedimentation rate <sup>a</sup> 16.7 ± 1.1     14.0 ± 1.4     18.6 ± 1.5     0.033       Preoperative white blood cell <sup>a</sup> 5.9 ± 0.2     5.9 ± 0.3     0.923       Preoperative red blood cell <sup>a</sup> 4.23 ± 0.04     4.47 ± 0.05     4.08 ± 0.06     <0.001	Preoperative albumin <sup>a</sup>	$36.1 \pm 0.4$	$40.0 \pm 0.4$	33.5±0.5	< 0.001
Preoperative white blood cell <sup>a</sup> 59±0.2     59±0.2     59±0.3     0.923       Preoperative red blood cell <sup>a</sup> 4.23±0.04     4.47±0.05     4.08±0.06     <0.001	Preoperative C-reactive protein <sup>a</sup>	13.2±2.0	8.4±1.1	16.4±3.2	0.048
Pre- per per ative red blood cell <sup>a</sup> 4.23±0.04     4.47±0.05     4.08±0.06     <0.001       Mean disease duration before surgery <sup>a</sup> , month     48.7±3.4     40.4±5.0     54.2±4.4     0.043       Montreal classification     A     2 (1.0)     1 (1.2)     1 (0.8)     0.642       A2 (17-40)     136 (67.3)     55 (67.9)     81 (66.9)     0.887       A3 (>40)     64 (31.7)     25 (30.9)     39 (32.2)     0.838       Location     11 (1.2)     1 (0.8)     0.642       L2 (colonic)     19 (9.4)     8 (9.9)     11 (9.1)     0.851       L3 (leocolonic)     19 (9.4)     8 (9.9)     11 (9.1)     0.851       L3 (leocolonic)     19 (9.4)     8 (9.9)     11 (9.1)     0.851       L3 (leocolonic)     19 (9.4)     8 (9.9)     11 (9.1)     0.851       B4 (stricturing)     10 (5.0)     2 (2.5)     8 (6.6)     0.642       B4 (stricturing)     10 (5.0)     2 (2.5)     8 (72.7)     0.460       B3 (pen etrating)     66 (32.7)     2 9 (35.8)     3 7 (30.6)     0.438	Preoperative erythrocyte sedimentation rate <sup>a</sup>	16.7±1.1	$14.0 \pm 1.4$	18.6±1.5	0.033
hen disease duration before surgery*, month $48.7 \pm 3.4$ $40.4 \pm 5.0$ $54.2 \pm 4.4$ $0.043$ Montreal classificationAge, yearsA1 ( $\leq 16$ )2 (1.0)1 (1.2)1 (0.8) $0.642$ A2 (17-40)136 (67.3)55 (67.9)81 (66.9) $0.887$ A3 (>40)64 (31.7)25 (30.9)39 (32.2) $0.838$ Location11 (jieal)76 (37.6)26 (32.1)50 (41.3) $0.185$ L2 (colonic)19 (9.4)8 (9.9)11 (9.1) $0.851$ L3 (ileocolonic)95 (47.0)44 (54.3)51 (42.1) $0.089$ L4 (upper gastrointestinal)26 (12.9)9 (11.1)17 (14.0) $0.541$ BehaviorB1 (inflammatory/failure of medical therapy)10 (5.0)2 (2.5) $8 (6.6)$ $0.164$ B2 (stricturing)143 (70.8)55 (67.9)88 (72.7) $0.460$ B3 (penetrating)66 (32.7)29 (35.8)37 (30.6) $0.438$ Perianal disease59 (29.2)24 (29.6)35 (28.9) $0.914$ Operative time*, min191.1 ± 182.06.9197.3 ± 5.1 $0.071$ First time operated131 (64.9)54 (66.7)77 (63.6) $0.658$ Laparoscopic surgery120 (59.4)60 (74.1)60 (49.6) $0.001$ Conversion40 (18.8)11 (13.6)29 (24.0) $0.692$ Hiftiximab24 (11.9)8 (9.9)16 (13.2) $0.471$ 5-ASA55 (27.2)21 (25.9)34 (28.1) $0.734$ Corticosteroids10 (5.0)	Preoperative white blood cell <sup>a</sup>	$5.9 \pm 0.2$	$5.9 \pm 0.2$	5.9±0.3	0.923
Montreal classificationAge, yearsA1 ( $\leq$ 16)2 (1.0)1 (1.2)1 (0.8)0.642A2 (17-40)136 (67.3)55 (67.9)81 (66.9)0.887A3 (>40)64 (31.7)25 (30.9)39 (32.2)0.838Location11 (ielal)76 (37.6)26 (32.1)50 (41.3)0.185L2 (colonic)19 (9.4)8 (9.9)11 (9.1)0.851L3 (ileocolonic)95 (47.0)44 (54.3)51 (42.1)0.089L4 (upper gastrointestinal)26 (12.9)9 (11.1)17 (14.0)0.541BehaviorB1 (inflammatory/failure of medical therapy)10 (5.0)2 (2.5)8 (6.6)0.164B2 (stricturing)143 (70.8)55 (67.9)88 (72.7)0.460B3 (penetrating)66 (32.7)29 (35.8)37 (30.6)0.438Perianal disease59 (29.2)24 (29.6)35 (28.9)0.914Operative time <sup>a</sup> , min191.1 ±4.2182.0 ±6.9197.3 ±5.10.071First time operated131 (64.9)54 (66.7)77 (63.6)0.658Laparoscopic surgery120 (59.4)60 (74.1)60 (49.6)0.001Conversion40 (19.8)11 (13.6)29 (24.0)0.699 <b>Properative treatment</b> Azathioprine39 (19.3)17 (21.0)22 (18.2)0.4715-ASA55 (27.2)21 (25.9)34 (28.1)0.734Corticosteroids10 (5.0)3 (3.7)7 (5.8)0.497	Preoperative red blood cell <sup>a</sup>	$4.23 \pm 0.04$	$4.47 \pm 0.05$	$4.08 \pm 0.06$	< 0.001
Age, yearsA1 (≤16)2 (1.0)1 (1.2)1 (0.8)0.642A2 (17-40)136 (67.3)55 (67.9)81 (66.9)0.887A3 (>40)64 (31.7)25 (30.9)39 (32.2)0.838Location11 (ilal)76 (37.6)26 (32.1)50 (41.3)0.185L2 (colonic)19 (9.4)8 (9.9)11 (9.1)0.851L3 (ileocolonic)95 (47.0)44 (54.3)51 (42.1)0.089L4 (upper gastrointestinal)26 (12.9)9 (11.1)17 (14.0)0.541BehaviorB1 (inflammatory/failure of medical therapy)10 (5.0)2 (2.5)8 (6.6)0.164B2 (stricturing)143 (70.8)55 (67.9)88 (72.7)0.460B3 (penetrating)66 (32.7)29 (35.8)37 (30.6)0.438Perianal disease59 (29.2)24 (29.6)35 (28.9)0.914Operative time*, min191.1 ±4.2182.0 ± 6.9197.3 ± 5.10.071First time operated131 (64.9)54 (66.7)77 (63.6)0.658Laparoscopic surgery120 (59.4)60 (74.1)60 (49.6)0.001Conversion40 (19.8)11 (13.6)29 (24.0)0.692Hatipprine131 (64.9)54 (66.7)77 (63.6)0.658Laparoscopic surgery120 (59.4)60 (74.1)60 (49.6)0.001Conversion40 (19.8)11 (13.6)29 (24.0)0.692Heraperate22 (18.2)52 (12.9)34 (28.1)0.734Azathioprine39 (19.3	Mean disease duration before surgery <sup>a</sup> , month	$48.7 \pm 3.4$	$40.4 \pm 5.0$	$54.2 \pm 4.4$	0.043
A 1 (≤16)     2 (1.0)     1 (1.2)     1 (0.8)     0.642       A2 (17-40)     136 (67.3)     55 (67.9)     81 (66.9)     0.887       A3 (>40)     64 (31.7)     25 (30.9)     39 (32.2)     0.838       Location     11 (ielal)     76 (37.6)     26 (32.1)     50 (41.3)     0.185       L2 (colonic)     19 (9.4)     8 (9.9)     11 (9.1)     0.851       L3 (ileocolonic)     95 (47.0)     44 (54.3)     51 (42.1)     0.089       L4 (upper gastrointestinal)     26 (12.9)     9 (11.1)     17 (14.0)     0.541       Behavior     11 (inflammatory/failure of medical therapy)     10 (5.0)     2 (2.5)     8 (6.6)     0.164       B2 (stricturing)     143 (70.8)     55 (67.9)     88 (72.7)     0.460       B3 (penetrating)     66 (32.7)     29 (35.8)     37 (30.6)     0.438       Perianal disease     59 (29.2)     24 (29.6)     35 (28.9)     0.914       Operative time*, min     191.1 ± 4.2     182.0 ± 6.9     197.3 ± 5.1     0.071       First time operated     131 (64.9)     54 (66.7)	Montreal classification				
A2 (17-40)     136 (67.3)     55 (67.9)     81 (66.9)     0.887       A3 (>40)     64 (31.7)     25 (30.9)     39 (32.2)     0.838       Location      11 (ala)     76 (37.6)     26 (32.1)     50 (41.3)     0.185       L2 (colonic)     19 (9.4)     8 (9.9)     11 (9.1)     0.851       L3 (ileocolonic)     95 (47.0)     44 (54.3)     51 (42.1)     0.089       L4 (upper gastrointestinal)     26 (12.9)     9 (1.1)     17 (14.0)     0.541       Behavior       88 (72.7)     0.460       B2 (stricturing)     143 (70.8)     55 (67.9)     88 (72.7)     0.460       B3 (penetrating)     66 (32.7)     29 (35.8)     37 (30.6)     0.438       Perianal disease     59 (29.2)     24 (29.6)     35 (28.9)     0.914       Operative time*, min     191.1 ± 4.2     182.0 ± 6.9     197.3 ± 5.1     0.071       First time operated     131 (64.9)     54 (66.7)     77 (63.6)     0.658       Laparoscopic surgery     120 (59.4)     60 (74.1)     60 (49.6)     0.001<	Age, years				
A3 (>40)     64 (31.7)     25 (30.9)     39 (32.2)     0.838       Location     11 (ileal)     76 (37.6)     26 (32.1)     50 (41.3)     0.185       L2 (colonic)     19 (9.4)     8 (9.9)     11 (9.1)     0.851       L3 (ileocolonic)     95 (47.0)     44 (54.3)     51 (42.1)     0.089       L4 (upper gastrointestinal)     26 (12.9)     9 (11.1)     17 (14.0)     0.541       Behavior     11 (inflammatory/failure of medical therapy)     10 (5.0)     2 (2.5)     8 (6.6)     0.164       B2 (stricturing)     143 (70.8)     55 (67.9)     88 (72.7)     0.460       B3 (penetrating)     66 (32.7)     29 (35.8)     37 (30.6)     0.438       Perianal disease     59 (29.2)     24 (29.6)     35 (28.9)     0.914       Operative time <sup>a</sup> , min     191.1 ± 4.2     182.0 ± 6.9     197.3 ± 5.1     0.071       First time operated     131 (64.9)     54 (66.7)     77 (63.6)     0.658       Laparoscopic surgery     120 (59.4)     60 (74.1)     60 (49.6)     0.001       Conversion     40 (19.8) <td< td=""><td>A1 (≤16)</td><td>2 (1.0)</td><td>1 (1.2)</td><td>1 (0.8)</td><td>0.642</td></td<>	A1 (≤16)	2 (1.0)	1 (1.2)	1 (0.8)	0.642
Location     Point	A2 (17–40)	136 (67.3)	55 (67.9)	81 (66.9)	0.887
I.1 (ileal)     76 (37.6)     26 (32.1)     50 (41.3)     0.185       I.2 (colonic)     19 (9.4)     8 (9.9)     11 (9.1)     0.851       I.3 (ileocolonic)     95 (47.0)     44 (54.3)     51 (42.1)     0.089       I.4 (upper gastrointestinal)     26 (12.9)     9 (11.1)     17 (14.0)     0.541       Behavior      70 (5.0)     2 (2.5)     8 (6.6)     0.164       B2 (stricturing)     10 (5.0)     2 (2.5)     8 (6.6)     0.460       B3 (penetrating)     66 (32.7)     29 (35.8)     37 (30.6)     0.438       Perianal disease     59 (29.2)     24 (29.6)     35 (28.9)     0.914       Operative time <sup>a</sup> , min     191.1 ± 4.2     182.0 ± 6.9     197.3 ± 5.1     0.071       First time operated     131 (64.9)     54 (66.7)     77 (63.6)     0.658       Laparoscopic surgery     120 (59.4)     60 (74.1)     60 (49.6)     0.001       Conversion     40 (19.8)     11 (13.6)     29 (24.0)     0.620       Infliximab     24 (11.9)     8 (9.9)     16 (13.2)     0.471 </td <td>A3 (&gt;40)</td> <td>64 (31.7)</td> <td>25 (30.9)</td> <td>39 (32.2)</td> <td>0.838</td>	A3 (>40)	64 (31.7)	25 (30.9)	39 (32.2)	0.838
L2 (colonic)     19 (9.4)     8 (9.9)     11 (9.1)     0.851       L3 (ileocolonic)     95 (47.0)     44 (54.3)     51 (42.1)     0.089       L4 (upper gastrointestinal)     26 (12.9)     9 (11.1)     17 (14.0)     0.541       Behavior	Location				
L3 (ileocolonic)     95 (47.0)     44 (54.3)     51 (42.1)     0.089       L4 (upper gastrointestinal)     26 (12.9)     9 (11.1)     17 (14.0)     0.541       Behavior       B1 (inflammatory/failure of medical therapy)     10 (5.0)     2 (2.5)     8 (6.6)     0.164       B2 (stricturing)     143 (70.8)     55 (67.9)     88 (72.7)     0.460       B3 (penetrating)     66 (32.7)     29 (35.8)     37 (30.6)     0.438       Perianal disease     59 (29.2)     24 (29.6)     35 (28.9)     0.914       Operative time <sup>a</sup> , min     191.1 ± 4.2     182.0 ± 6.9     197.3 ± 5.1     0.071       First time operated     131 (64.9)     54 (66.7)     77 (63.6)     0.658       Laparoscopic surgery     120 (59.4)     60 (74.1)     60 (49.6)     0.001       Conversion     40 (19.8)     11 (13.6)     29 (24.0)     0.669       Preoperative treatment     39 (19.3)     17 (21.0)     22 (18.2)     0.620       Infliximab     24 (11.9)     8 (9.9)     16 (13.2)     0.471       5-ASA     55 (27.2)     <	L1 (ileal)	76 (37.6)	26 (32.1)	50 (41.3)	0.185
L4 (upper gastrointestinal)     26 (12.9)     9 (11.1)     17 (14.0)     0.541       Behavior     B1 (inflammatory/failure of medical therapy)     10 (5.0)     2 (2.5)     8 (6.6)     0.164       B2 (stricturing)     143 (70.8)     55 (67.9)     88 (72.7)     0.460       B3 (penetrating)     66 (32.7)     29 (35.8)     37 (30.6)     0.438       Perianal disease     59 (29.2)     24 (29.6)     35 (28.9)     0.914       Operative time <sup>a</sup> , min     191.1 ± 4.2     182.0 ± 6.9     197.3 ± 5.1     0.071       First time operated     131 (64.9)     54 (66.7)     77 (63.6)     0.658       Laparoscopic surgery     120 (59.4)     60 (74.1)     60 (49.6)     0.001       Conversion     40 (19.8)     11 (13.6)     29 (24.0)     0.699       Preoperative treatment     J	L2 (colonic)	19 (9.4)	8 (9.9)	11 (9.1)	0.851
Behavior     Bit (inflammatory/failure of medical therapy)     10 (5.0)     2 (2.5)     8 (6.6)     0.164       B2 (stricturing)     143 (70.8)     55 (67.9)     88 (72.7)     0.460       B3 (penetrating)     66 (32.7)     29 (35.8)     37 (30.6)     0.438       Perianal disease     59 (29.2)     24 (29.6)     35 (28.9)     0.914       Operative time <sup>a</sup> , min     191.1 ±4.2     182.0 ±6.9     197.3 ±5.1     0.071       First time operated     131 (64.9)     54 (66.7)     77 (63.6)     0.658       Laparoscopic surgery     120 (59.4)     60 (74.1)     60 (49.6)     0.001       Conversion     40 (19.8)     11 (13.6)     29 (24.0)     0.669       Preoperative treatment     39 (19.3)     17 (21.0)     22 (18.2)     0.620       Infliximab     24 (11.9)     8 (9.9)     16 (13.2)     0.471       5-ASA     55 (27.2)     21 (25.9)     34 (28.1)     0.734       Corticosteroids     10 (5.0)     3 (3.7)     7 (5.8)     0.497	L3 (ileocolonic)	95 (47.0)	44 (54.3)	51 (42.1)	0.089
B1 (inflammatory/failure of medical therapy)     10 (5.0)     2 (2.5)     8 (6.6)     0.164       B2 (stricturing)     143 (70.8)     55 (67.9)     88 (72.7)     0.460       B3 (penetrating)     66 (32.7)     29 (35.8)     37 (30.6)     0.438       Perianal disease     59 (29.2)     24 (29.6)     35 (28.9)     0.914       Operative time <sup>a</sup> , min     191.1 ± 4.2     182.0 ± 6.9     197.3 ± 5.1     0.071       First time operated     131 (64.9)     54 (66.7)     77 (63.6)     0.658       Laparoscopic surgery     120 (59.4)     60 (74.1)     60 (49.6)     0.001       Conversion     40 (19.8)     11 (13.6)     29 (24.0)     0.669       Preoperative treatment     39 (19.3)     17 (21.0)     22 (18.2)     0.620       Infliximab     24 (11.9)     8 (9.9)     16 (13.2)     0.471       5-ASA     55 (27.2)     21 (25.9)     34 (28.1)     0.734       Corticosteroids     10 (5.0)     3 (3.7)     7 (5.8)     0.497	L4 (upper gastrointestinal)	26 (12.9)	9 (11.1)	17 (14.0)	0.541
B2 (stricturing)143 (70.8)55 (67.9)88 (72.7)0.460B3 (penetrating)66 (32.7)29 (35.8)37 (30.6)0.438Perianal disease59 (29.2)24 (29.6)35 (28.9)0.914Operative time <sup>a</sup> , min191.1 $\pm$ 4.2182.0 $\pm$ 6.9197.3 $\pm$ 5.10.071First time operated131 (64.9)54 (66.7)77 (63.6)0.658Laparoscopic surgery120 (59.4)60 (74.1)60 (49.6)0.001Conversion40 (19.8)11 (13.6)29 (24.0)0.069Properative treatmentAzathioprine39 (19.3)17 (21.0)22 (18.2)0.620Infliximab24 (11.9)8 (9.9)16 (13.2)0.4715-ASA55 (27.2)21 (25.9)34 (28.1)0.734Corticosteroids10 (5.0)3 (3.7)7 (5.8)0.497Enteral nutrition70 (36.1)29 (35.8)41 (33.9)0.779	Behavior				
B3 (penetrating)     66 (32.7)     29 (35.8)     37 (30.6)     0.438       Perianal disease     59 (29.2)     24 (29.6)     35 (28.9)     0.914       Operative time <sup>4</sup> , min     191.1 ± 4.2     182.0 ± 6.9     197.3 ± 5.1     0.071       First time operated     131 (64.9)     54 (66.7)     77 (63.6)     0.658       Laparoscopic surgery     120 (59.4)     60 (74.1)     60 (49.6)     0.001       Conversion     40 (19.8)     11 (13.6)     29 (24.0)     0.069       Preoperative treatment     Xathioprine     39 (19.3)     17 (21.0)     22 (18.2)     0.620       Infliximab     24 (11.9)     8 (9.9)     16 (13.2)     0.471       5-ASA     55 (27.2)     21 (25.9)     34 (28.1)     0.734       Corticosteroids     10 (5.0)     3 (3.7)     7 (5.8)     0.497       Enteral nutrition     70 (36.1)     29 (35.8)     41 (33.9)     0.779	B1 (inflammatory/failure of medical therapy)	10 (5.0)	2 (2.5)	8 (6.6)	0.164
Perianal disease     59 (29.2)     24 (29.6)     35 (28.9)     0.914       Operative time <sup>a</sup> , min     191.1 ± 4.2     182.0 ± 6.9     197.3 ± 5.1     0.071       First time operated     131 (64.9)     54 (66.7)     77 (63.6)     0.658       Laparoscopic surgery     120 (59.4)     60 (74.1)     60 (49.6)     0.001       Conversion     40 (19.8)     11 (13.6)     29 (24.0)     0.069       Preoperative treatment     Xathioprine     39 (19.3)     17 (21.0)     22 (18.2)     0.620       Infliximab     24 (11.9)     8 (9.9)     16 (13.2)     0.471       5-ASA     55 (27.2)     21 (25.9)     34 (28.1)     0.734       Corticosteroids     10 (5.0)     3 (3.7)     7 (5.8)     0.497       Enteral nutrition     70 (36.1)     29 (35.8)     41 (33.9)     0.779	B2 (stricturing)	143 (70.8)	55 (67.9)	88 (72.7)	0.460
Operative time <sup>a</sup> , min     191.1 ± 4.2     182.0 ± 6.9     197.3 ± 5.1     0.071       First time operated     131 (64.9)     54 (66.7)     77 (63.6)     0.658       Laparoscopic surgery     120 (59.4)     60 (74.1)     60 (49.6)     0.001       Conversion     40 (19.8)     11 (13.6)     29 (24.0)     0.069       Preoperative treatment     Xathioprine     39 (19.3)     17 (21.0)     22 (18.2)     0.620       Infliximab     24 (11.9)     8 (9.9)     16 (13.2)     0.471       5-ASA     55 (27.2)     21 (25.9)     34 (28.1)     0.734       Corticosteroids     10 (5.0)     3 (3.7)     7 (5.8)     0.497       Enteral nutrition     70 (36.1)     29 (35.8)     41 (33.9)     0.779	B3 (penetrating)	66 (32.7)	29 (35.8)	37 (30.6)	0.438
First time operated     131 (64.9)     54 (66.7)     77 (63.6)     0.658       Laparoscopic surgery     120 (59.4)     60 (74.1)     60 (49.6)     0.001       Conversion     40 (19.8)     11 (13.6)     29 (24.0)     0.069       Preoperative treatment     39 (19.3)     17 (21.0)     22 (18.2)     0.620       Infliximab     24 (11.9)     8 (9.9)     16 (13.2)     0.471       5-ASA     55 (27.2)     21 (25.9)     34 (28.1)     0.734       Corticosteroids     10 (5.0)     3 (3.7)     7 (5.8)     0.497       Enteral nutrition     70 (36.1)     29 (35.8)     41 (33.9)     0.779	Perianal disease	59 (29.2)	24 (29.6)	35 (28.9)	0.914
Laparoscopic surgery     120 (59.4)     60 (74.1)     60 (49.6)     0.001       Conversion     40 (19.8)     11 (13.6)     29 (24.0)     0.069       Preoperative treatment     39 (19.3)     17 (21.0)     22 (18.2)     0.620       Infliximab     24 (11.9)     8 (9.9)     16 (13.2)     0.471       5-ASA     55 (27.2)     21 (25.9)     34 (28.1)     0.734       Corticosteroids     10 (5.0)     3 (3.7)     7 (5.8)     0.497       Enteral nutrition     70 (36.1)     29 (35.8)     41 (33.9)     0.779	Operative time <sup>a</sup> , min	191.1±4.2	182.0±6.9	197.3±5.1	0.071
Conversion     40 (19.8)     11 (13.6)     29 (24.0)     0.069       Preoperative treatment     39 (19.3)     17 (21.0)     22 (18.2)     0.620       Infliximab     24 (11.9)     8 (9.9)     16 (13.2)     0.471       5-ASA     55 (27.2)     21 (25.9)     34 (28.1)     0.734       Corticosteroids     10 (5.0)     3 (3.7)     7 (5.8)     0.497       Enteral nutrition     70 (36.1)     29 (35.8)     41 (33.9)     0.779	First time operated	131 (64.9)	54 (66.7)	77 (63.6)	0.658
Preoperative treatment     39 (19.3)     17 (21.0)     22 (18.2)     0.620       Infliximab     24 (11.9)     8 (9.9)     16 (13.2)     0.471       5-ASA     55 (27.2)     21 (25.9)     34 (28.1)     0.734       Corticosteroids     10 (5.0)     3 (3.7)     7 (5.8)     0.497       Enteral nutrition     70 (36.1)     29 (35.8)     41 (33.9)     0.779	Laparoscopic surgery	120 (59.4)	60 (74.1)	60 (49.6)	0.001
Azathioprine39 (19.3)17 (21.0)22 (18.2)0.620Infliximab24 (11.9)8 (9.9)16 (13.2)0.4715-ASA55 (27.2)21 (25.9)34 (28.1)0.734Corticosteroids10 (5.0)3 (3.7)7 (5.8)0.497Enteral nutrition70 (36.1)29 (35.8)41 (33.9)0.779	Conversion	40 (19.8)	11 (13.6)	29 (24.0)	0.069
Inflixinab     24 (11.9)     8 (9.9)     16 (13.2)     0.471       5-ASA     55 (27.2)     21 (25.9)     34 (28.1)     0.734       Corticosteroids     10 (5.0)     3 (3.7)     7 (5.8)     0.497       Enteral nutrition     70 (36.1)     29 (35.8)     41 (33.9)     0.779	Preoperative treatment		1		
5-ASA     55 (27.2)     21 (25.9)     34 (28.1)     0.734       Corticosteroids     10 (5.0)     3 (3.7)     7 (5.8)     0.497       Enteral nutrition     70 (36.1)     29 (35.8)     41 (33.9)     0.779	Azathioprine	39 (19.3)	17 (21.0)	22 (18.2)	0.620
Corticosteroids     10 (5.0)     3 (3.7)     7 (5.8)     0.497       Enteral nutrition     70 (36.1)     29 (35.8)     41 (33.9)     0.779	Infliximab	24 (11.9)	8 (9.9)	16 (13.2)	0.471
Corticosteroids     10 (5.0)     3 (3.7)     7 (5.8)     0.497       Enteral nutrition     70 (36.1)     29 (35.8)     41 (33.9)     0.779	5-ASA				0.734
Enteral nutrition     70 (36.1)     29 (35.8)     41 (33.9)     0.779	Corticosteroids				0.497
	Enteral nutrition				0.779
	Others	14 (6.9)	3 (3.7)	11 (9.1)	0.140

**Table 1.** Baseline characteristics of all the patients. Values in parentheses are percentages unless indicatedotherwise. BMI, body mass index; CONUTS, controlling nutritional status score. <sup>a</sup>Values are mean  $\pm$  SE.

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for postoperative complications in CD. To the best of our knowledge, this was the first study to determine the correlation between the preoperative CONUT score and postoperative outcomes in CD patients. In addition, this study found that the CONUT score was better than other clinical predictors for evaluating nutritional status, such as ALB and PNI.

The CONUT score is determined by the serum albumin concentration, total cholesterol concentration, and total lymphocyte count. The concentration of serum albumin will be affected by the nutritional status and other factors, including infection, inflammatory response, and fluid retention status<sup>19,20</sup>. Malnutrition is common in CD, especially in active CD. Studies have reported that hypoalbuminemia is a risk factor for complications following gastrointestinal surgery<sup>21</sup>. Galata et al.<sup>22</sup> reported that a preoperative albumin level greater than 32.6 g/L was associated with a reduced risk of complications, and hypoalbuminemia was the only independent risk factor for major postoperative complications in CD patients undergoing colorectal surgery. Preoperative nutritional optimization in CD was recommended in patients with low albumin levels to minimize postoperative complications<sup>11</sup>. Our results were consistent with previous findings. Our study revealed that CD patients with postoperative complications had significantly lower serum albumin concentrations.

The total peripheral lymphocyte count, one necessary component of the CONUT score, indicates the immunological status of the patient<sup>23</sup>. Various studies have indicated that T lymphocytes affected by the systemic

Characteristics	All (n=202)	Low CONUTS (81)	High CONUTS (121)	P value
Postoperative complications	66 (32.7)	14 (17.3)	52 (43.0)	< 0.001
Mild complications (grade I to II)	41 (20.3)	8 (9.9)	33 (27.3)	0.003
Wound infection	21 (10.4)	4 (4.9)	17 (14.0)	-
Early postoperative bowel obstruction	13 (6.4)	2 (2.5)	11 (9.1)	-
Postoperative blood transfusions	5 (2.5)	2 (2.5)	3 (2.5)	-
Line sepsis	2 (1.0)	0 (0)	2 (1.7)	-
Major complications (grade III to IV)	34 (16.8)	9 (11.1)	25 (20.7)	0.075
Gastrointestinal bleeding	12 (5.9)	4 (4.9)	8 (6.6)	-
Anastomotic leakage	6 (3.0)	3 (3.7)	3 (2.5)	-
Abdominopelvic collection	4 (2.0)	0 (0)	4 (3.3)	-
Pleural effusion	1 (0.5)	0 (0)	1 (0.8)	-
Intra-abdominal abscess	4 (2.0)	1 (1.2)	3 (2.5)	-
Stoma complications	4 (2.0)	1 (1.2)	3 (2.5)	-
Septic shock	1 (0.9)	0 (0)	1 (0.8)	-
Sepsis	2 (1.0)	0 (0)	2 (1.7)	-
Grade V	0 (0)	0 (0)	0 (0)	-
Postoperative stay <sup>a</sup> , days	$10.1 \pm 0.4$	8.6±0.6	11.1±0.5	0.002

**Table 2.** Comparison of postoperative complications between CD patients with high- and low preoperativeCONUTS. Values in parentheses are percentages unless indicated otherwise.  $^{a}$ Values are mean ± SE.

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inflammatory response play an important role in the depression of innate cellular immunity in cancer patients<sup>24</sup>. A poor prognosis in cancer patients was correlated with decreased T lymphocytes due to an inadequate immune response<sup>20</sup>. Neubauer et al.<sup>25</sup> found the role of apoptosis of peripheral lymphocytes in intestinal inflammation in CD patients. Additionally, peripheral B1a lymphocytes were decreased in association with the severity of disease activity in CD, and B1a lymphocytes played a vital role in immune protection<sup>26</sup>. Thus, the total peripheral lymphocyte count might be associated with postoperative complications in CD. PNI, which includes the total peripheral lymphocyte count, has already been demonstrated to predict complications in CD; the cut-off value is less than 40<sup>10</sup>. Similarly, the CONUT score in our study also included the total peripheral lymphocyte count and was found to be an independent risk factor for complications in CD.

The compositional difference between the PNI and CONUT score lies in the total cholesterol concentration. It is suggested that a lower cholesterol concentration has a detrimental effect on postoperative outcomes by affecting antioxidant reserve and inflammatory response<sup>27</sup>. Takagi et al. reported that a low cholesterol level was associated with postoperative complications in patients who underwent gastrointestinal and hepatopancreatobiliary surgery<sup>18</sup>. The serum cholesterol level also plays an important role in the poor prognosis of cancer patients, because cell membrane fluidity is influenced by hypocholesterolemia, which is related to the mobility of cell surface receptors and the ability to transmit transmembrane signals<sup>28</sup>. Therefore, a higher CONUT score including a low cholesterol level predicted poor outcomes in CD patients undergoing surgical therapy.

Although there are some common factors between the CONUT score, PNI, and ALB, the prediction values of these three indicators are different. The ROC analyses revealed that the predictive accuracy of the CONUT score was better than that of PNI and ALB. This might be because of the higher emphasis placed on the serum albumin concentration, total cholesterol concentration, and total lymphocyte count. The combinations of these three factors enhance the utility of the CONUT score for evaluating patients' general condition, which is consistent with previous results in cancer patients<sup>16,20</sup>.

The current study has several limitations to acknowledge. First, this was a retrospective observational analysis, and some residual confounding factors remained. First is the selection bias created due to the exclusive recruitment of CD patients. Second, the cutoff value needs to be evaluated in other cohorts to verify the conclusion of the current study. Last but not least, a multi-centre prospective observational study is warranted, because the outcomes might be influenced by our local experience.

In conclusion, the current study confirmed that the preoperative CONUT score predicted postoperative complications in CD patients undergoing bowel resection. The CONUT system was better than ALB and PNI at predicting postoperative complications in CD. CD patients with a CONUT score over 3.5 should be intensively monitored so that postoperative complications can be detected early.

### Materials and methods

**Patients.** This study was a retrospective review of 202 CD patients undergoing surgical resection from June 2016 to June 2019 at the IBD Center, a teaching hospital of Zhejiang University. All the CD patient data were collected from patients' medical charts in the IBD database. All CD patients were diagnosed using the accepted criteria<sup>29</sup>. This study was approved by the Ethics Committee of our hospital and conformed to the ethical guide-lines of the 1975 Declaration of Helsinki. Written informed consent was obtained from all patients.

Men91 (66.9)44 (66.7)0.972BMT, kg/m²19.1 0.218.1 0.30.01175.131.4 0.30.01175.13.45.50.852Hypertension75.14.6.1.0.790Preoperative hemoglobin³12.0 ± 0.211.5 ± 0.20.092Preoperative creative protein³10.7 ± 1.518.3 ± 5.20.071Preoperative creative protein³10.7 ± 1.518.3 ± 5.20.075Preoperative creative protein³10.7 ± 1.514.6 ± 0.050.357Preoperative erythrocyte sedimentation rate³15.5 ± 1.217.2 ± 2.00.768Preoperative erythrocyte sedimentation8.6 ± 0.206.4 ± 0.350.057Preoperative erythrocyte sedimentation4.0 ± 0.25.1 ± 0.30.002Mean disease duration before surgery*, mont8.0 ± 2.05.1 ± 0.30.002Matria classification10.71.1.50.578A1 (≤ 16)10.071.1.50.548A2 (17-40)87 (64.0)49 (74.2)0.131Location10.71.1.50.541L2 (colonic)10 (7.4)9.136.00.511L3 (leocolonic)10 (7.4)9.136.00.512L3 (leocolonic)67 (49.3)28 (42.4)0.321L3 (leocolonic)67 (49.3)28.10.10.673L3 (leocolonic)10 (7.4)19.08.00.611L3 (leocolonic)8 (50.9)48.(72.7)0.673B3 (penetrating)8 (59.9)48.(72.7)	Characteristics	Without complications (136)	With complications (66)	P value
Comorbidities     Image: Comorbidities       Diabetes mellitus     7 (5.1)     3 (4.5)     0.852       Hypertension     7 (5.1)     4 (6.1)     0.790       Preoperative moglobin*     12.0 ± 0.2     11.5 ± 0.2     0.091       Preoperative albumin*     36.7 ± 0.5     34.8 ± 0.8     0.021       Preoperative albumin*     10.7 ± 1.5     18.3 ± 5.2     0.074       Preoperative creative protein*     10.7 ± 1.5     18.3 ± 5.2     0.075       Preoperative white blood cell*     5.6 ± 0.20     6.4 ± 0.35     0.030       Preoperative coNUTS     4.0 ± 0.2     5.1 ± 0.3     0.030       Preoperative coNUTS     4.0 ± 0.2     5.0 ± 5.5     0.758       Material classification     4.2 ± 2     50.2 ± 5.5     0.758       Al ( 516)     1 (0.7)     1 (1.5)     0.548       A2 (17-40)     87 (64.0)     49 (74.2)     0.144       A3 (>40)     48 (35.3)     16 (24.2)     0.131       Location     110 (7.4)     9 (13.6)     0.511       L1 (leal)     48 (35.3)     28 (42.4)     0.361	Men	91 (66.9)	44 (66.7)	0.972
Diabetes mellitus7 (5.1)3 (4.5)0.852Hypertension7 (5.1)4 (6.1)0.790Preoperative hemoglobin*12.0 ± 0.211.5 ± 0.20.092Preoperative albumin*36.7 ± 0.534.8 ± 0.80.021Preoperative creactive protein*10.7 ± 1.518.3 ± 5.20.074Preoperative erythncyte sedimentation rate*16.5 ± 1.217.2 ± 0.06.46 ± 0.350.057Preoperative erythncyte sedimentation rate*4.27 ± 0.054.16 ± 0.082.238Preoperative cround before surgery* month48.0 ± 4.250.2 ± 5.50.074Mean disease duration before surgery* month48.0 ± 4.250.2 ± 5.50.057Mean disease duration before surgery* month48.0 ± 4.250.2 ± 5.50.057Mean disease duration before surgery* month48.0 ± 4.250.2 ± 5.50.058Mottreal classification10.71 (1.5)0.548A 1 ( ≤ 16)1 (0.7)1 (1.5)0.548A 2 (17-40)87 (64.0)49 (74.2)0.144A 3 ( > 40)48 (53.3)16 (24.2)0.151Li (cloinc)10 (7.4)9 (13.6)0.511Li (cloinc)10 (7.4)9 (13.6)0.51Li (cloinc)10 (7.4)9 (13.6)0.51Li (leoper gastrointestinal)18 (13.2)8 (42.4)0.321Behavior1111 (1.5)0.63Bi (perturing)9 (69.9)48 (72.7)0.673Bi (perturing)9 (69.9)48 (72.7)0.673Bi (perturing)	BMI <sup>a</sup> , kg/m <sup>2</sup>	19.1±0.2	18.1±0.3	0.011
Hypertension     7 (5.1)     4 (6.1)     0.790       Preoperative hemoglobin*     12.0 ± 0.2     11.5 ± 0.2     0.092       Preoperative endboloin*     12.0 ± 0.2     11.5 ± 0.2     0.092       Preoperative endboloin*     16.7 ± 0.5     34.8 ± 0.8     0.021       Preoperative end blood cell*     16.5 ± 1.2     17.2 ± 2.0     0.768       Preoperative end blood cell*     5.66 ± 0.20     6.46 ± 0.35     0.052       Preoperative end blood cell*     4.0 ± 0.2     5.1 ± 0.3     0.002       Mean disease duration before surgery*, month     48.0 ± 4.2     50.2 ± 5.5     0.758       Mottraal classification     4.1 (10.7)     1 (1.5)     0.544       A2 (17-40)     48 (35.3)     16 (24.2)     0.113       Location     1     10.7     1 (1.5)     0.54       L1 (ifeal)     48 (35.3)     28 (42.4)     0.321       L2 (clonic)     10 (7.4)     9 (13.6)     0.51       L3 (ideocolnic)     67 (49.3)     28 (42.4)     0.361       L4 (upper gastrointestinal)     18 (13.2)     8 (12.1)     0.853	Comorbidities	1	1	
International     Interna     International     International<	Diabetes mellitus	7 (5.1)	3 (4.5)	0.852
Preoperative albumin*     36.7±0.5     34.8±0.8     0.021       Preoperative C-reactive protein*     10.7±1.5     18.3±5.2     0.074       Preoperative crythrocyte sedimentation rate*     16.5±1.2     17.2±2.0     0.768       Preoperative reythrocyte sedimentation rate*     16.5±1.2     17.2±2.0     0.0768       Preoperative red blood cell*     4.0±0.2     5.1±0.3     0.002       Mean disease duration before surgery*, month     48.0±4.2     50.2±5.5     0.758       Montreal classification     10.71     1 (1.5)     0.548       A1 (≤16)     1 (0.7)     1 (1.5)     0.548       A2 (17-40)     87 (64.0)     49 (74.2)     0.144       A3 (>40)     48 (35.3)     16 (24.2)     0.131       Location     10 (7.4)     9 (13.6)     0.511       L2 (colonic)     10 (7.4)     9 (13.6)     0.511       L3 (leocolonic)     16 (74.9)     8 (12.1)     0.824       Behavior     2     13.2     0.673       B3 (penetrating)     8 (59.9)     2 (3.0)     0.613       B3 (penetrating)     95	Hypertension	7 (5.1)	4 (6.1)	0.790
Preoperative C-reactive protein*10.7±1.518.3±5.20.074Preoperative erythrocyte sedimentation rate*16.5±1.217.2±2.00.768Preoperative erythrocyte sedimentation rate*16.5±1.217.2±2.00.768Preoperative red blood cell*4.27±0.054.16±0.080.238Preoperative red blood cell*4.0±0.25.1±0.30.002Mean disease duration before surgery*, month48.0±4.250.2±5.50.758Montreal classification0.220.240.74Al (≤16)1 (0.7)1 (1.5)0.5480.22A 2 (17-40)87 (64.0)49 (74.2)0.144A3 (>40)48 (35.3)16 (24.2)0.131Location11.20.1360.151L2 (colonic)10 (7.4)9 (13.6)0.151L3 (ideocolonic)67 (49.3)28 (42.4)0.361L4 (upper gastrointestinal)18 (13.2)8 (12.1)0.824B1 (inflammatory/failure of medical therapy)8 (5.9)2 (3.0)0.361B2 (stricturing)95 (69.9)48 (72.7)0.161B3 (penetrating)18 (5.2)24 (36.4)0.191Operative time*, min186 (4.4.920.9±7.50.101First time operated94 (69.1)37 (56.1)0.682Laparoscopic surgery86 (63.2)34 (51.5)0.112Conversion28 (22.5)23 (34.8)0.091First time operated31 (22.8)8 (12.1)0.613Laparoscopic surgery86 (63.2)33 (	Preoperative hemoglobin <sup>a</sup>	12.0±0.2	11.5±0.2	0.092
Preoperative erythrocyte sedimentation rate <sup>4</sup> 16.5 ± 1.2     17.2 ± 2.0     0.768       Preoperative white blood cell <sup>4</sup> 5.66 ± 0.20     6.46 ± 0.35     0.057       Preoperative red blood cell <sup>4</sup> 4.27 ± 0.05     4.16 ± 0.08     0.238       Preoperative CONUTS     4.0 ± 0.2     5.1 ± 0.3     0.002       Mean disease duration before surgery <sup>4</sup> , month     48.0 ± 4.2     50.2 ± 5.5     0.758       Motteral classification      1     0.02     0.144       A1 (≤ 16)     1 (0.7)     1 (1.5)     0.548       A2 (17-40)     87 (64.0)     49 (74.2)     0.144       A3 (>40)     48 (35.3)     16 (24.2)     0.131       Location     11.1     11.1     0.361       L1 (ileal)     48 (35.3)     28 (42.4)     0.327       L2 (colonic)     10 (7.4)     9 (13.6)     0.511       L3 (ileocolonic)     67 (49.3)     28 (42.4)     0.361       L4 (upper gastrointestinal)     18 (13.2)     8 (12.1)     0.673       Ba (avic     9 (13.6)     0.511     0.531       L3 (ileocoloni	Preoperative albumin <sup>a</sup>	36.7±0.5	34.8±0.8	0.021
Preoperative white blood cell*     5.66 ± 0.20     6.46 ± 0.35     0.057       Preoperative red blood cell*     4.27 ± 0.05     4.16 ± 0.08     0.238       Preoperative CONUTS     4.0 ± 0.2     5.1 ± 0.3     0.002       Mean disease duration before surgery*, month     48.0 ± 4.2     50.2 ± 5.5     0.758       Motteal classification       1.6     0.02       Age, years     I     1.1.5     0.548       A2 (17-40)     47 (64.0)     49 (74.2)     0.144       A3 (>40)     48 (35.3)     16 (24.2)     0.131       Location     111 (ileal)     48 (35.3)     28 (42.4)     0.327       L2 (colonic)     10 (7.4)     9 (13.6)     0.151     1.3 (ileocolonic)     6.7 (49.3)     28 (42.4)     0.361       L4 (upper gastrointestinal)     18 (13.2)     8 (12.1)     0.361     0.432       Behavior      23.00     0.361     0.432       B2 (stricturing)     95 (69.9)     48 (72.7)     0.673       B3 (penetrating)     47 (34.6)     19 (28.8)     0.412       <	Preoperative C-reactive protein <sup>a</sup>	10.7±1.5	18.3±5.2	0.074
Preoperative red blood cell <sup>a</sup> 4.27±0.05     4.16±0.08     0.238       Preoperative CONUTS     4.0±0.2     5.1±0.3     0.002       Mean disease duration before surgery <sup>a</sup> , month     48.0±4.2     50.2±5.5     0.758       Montreal classification      0.02     0.02       Al (≤16)     1 (0.7)     1 (1.5)     0.548       A2 (17-40)     87 (64.0)     49 (74.2)     0.144       A3 (>40)     48 (35.3)     16 (24.2)     0.131       Location      11 (1.5)     0.532       L1 (ileal)     48 (35.3)     28 (42.4)     0.327       L2 (colonic)     10 (7.4)     9 (13.6)     0.151       L3 (ileocolonic)     67 (49.3)     28 (42.4)     0.361       L4 (upper gastrointestinal)     18 (13.2)     8 (12.1)     0.824       Behavior      2 (3.0)     0.361       L2 (colonic)     19 (28.8)     0.412       Perianal disease     35 (25.7)     2 (3.0)     0.673       B3 (penetrating)     47 (34.6)     19 (28.8)     0.412       Perianal	Preoperative erythrocyte sedimentation rate <sup>a</sup>	16.5±1.2	17.2±2.0	0.768
Preoperative CONUTS4.0 ± 0.25.1 ± 0.30.002Mean disease duration before surgery*, month48.0 ± 4.250.2 ± 5.50.758Montreal classificationAge, years11.1.50.548A1 (≤ 16)1 (0.7)1 (1.5)0.548A2 (17-40)87 (64.0)49 (74.2)0.114A3 (> 40)48 (35.3)16 (24.2)0.113Location110 (7.4)9 (13.6)0.517L2 (colonic)10 (7.4)9 (13.6)0.511L3 (ileocolonic)67 (49.3)28 (42.4)0.361L4 (upper gastrointestinal)18 (13.2)8 (12.1)0.824Behavior11119 (23.6)0.361B2 (stricturing)95 (69.9)48 (72.7)0.673B3 (penetrating)47 (34.6)19 (28.8)0.412Operative time*, min186 4± 4.9200.9 ± 7.50.101First time operated94 (69.1)37 (56.1)0.668Laparoscopic surgery86 (63.2)34 (51.5)0.112Conversion28 (20.6)12 (18.2)0.671Infliximab11 (8.1)13 (19.7)0.017S-ASA32 (23.5)23 (34.8)0.909Corticosteroids6(4.4)4 (6.1)0.618	Preoperative white blood cell <sup>a</sup>	5.66±0.20	$6.46 \pm 0.35$	0.057
Mean disease duration before surgery*, month     48.0 ± 4.2     50.2 ± 5.5     0.758       Montreal classification	Preoperative red blood cell <sup>a</sup>	$4.27 \pm 0.05$	$4.16 \pm 0.08$	0.238
Montreal classification       Age, years     I       A1 (≤16)     1 (0.7)     1 (1.5)     0.548       A2 (17-40)     87 (64.0)     49 (74.2)     0.114       A3 (>40)     48 (35.3)     16 (24.2)     0.113       Location     11 (1.6)     0.327     0.122       L1 (ileal)     48 (35.3)     28 (42.4)     0.327       L2 (colonic)     10 (7.4)     9 (13.6)     0.151       L3 (ileocolonic)     67 (49.3)     28 (42.4)     0.361       L4 (upper gastrointestinal)     18 (13.2)     8 (12.1)     0.824       Behavior     2     2 (3.0)     0.361       B2 (stricturing)     95 (69.9)     48 (72.7)     0.673       B3 (penetrating)     47 (34.6)     19 (28.8)     0.412       Perianal disease     35 (25.7)     24 (36.4)     0.119       Operative time <sup>a</sup> , min     186.4±4.9     200.9±7.5     0.101       First time operated     94 (69.1)     37 (56.1)     0.068       Laparoscopic surgery     86 (63.2)     34 (51.5)     0.112	Preoperative CONUTS	4.0±0.2	5.1±0.3	0.002
Age, yearsImage: Constraint of the section of the sectio	Mean disease duration before surgery <sup>a</sup> , month	48.0±4.2	$50.2 \pm 5.5$	0.758
A ( ≤16)     1 (0.7)     1 (1.5)     0.548       A2 (17-40)     87 (64.0)     49 (74.2)     0.144       A3 (>40)     48 (35.3)     16 (24.2)     0.113       Location     11 (ieal)     48 (35.3)     28 (42.4)     0.327       L2 (colonic)     10 (7.4)     9 (13.6)     0.151       L3 (ieocolonic)     67 (49.3)     28 (42.4)     0.361       L4 (upper gastrointestinal)     18 (13.2)     8 (12.1)     0.824       Behavior     10 (7.4)     2 (3.0)     0.361       B2 (stricturing)     95 (69.9)     48 (72.7)     0.673       B3 (penetrating)     47 (34.6)     19 (28.8)     0.412       Perianal disease     35 (25.7)     24 (36.4)     0.119       Operative time*, min     186.4±4.9     200.9±7.5     0.101       First time operated     94 (69.1)     37 (56.1)     0.668       Laparoscopic surgery     86 (63.2)     34 (51.5)     0.112       Conversion     28 (20.6)     12 (18.2)     0.687       Preoperative treatment     21 (18.2)     0.687 <	Montreal classification	4	1	
A2 (17-40)     87 (64.0)     49 (74.2)     0.144       A3 (>40)     48 (35.3)     16 (24.2)     0.113       Location     11     11 (1eal)     48 (35.3)     28 (42.4)     0.327       L2 (colonic)     10 (7.4)     9 (13.6)     0.151     0.151       L3 (ileocolonic)     67 (49.3)     28 (42.4)     0.361       L4 (upper gastrointestinal)     18 (13.2)     8 (12.1)     0.824       Behavior     10 (7.4)     2 (3.0)     0.361       B2 (stricturing)     95 (69.9)     48 (72.7)     0.673       B3 (penetrating)     47 (34.6)     19 (28.8)     0.412       Perianal disease     35 (25.7)     24 (36.4)     0.119       Operative time <sup>4</sup> , min     186.4±4.9     200.9±7.5     0.101       First time operated     94 (69.1)     37 (56.1)     0.668       Laparoscopic surgery     86 (63.2)     34 (51.5)     0.112       Conversion     28 (20.6)     12 (18.2)     0.687 <b>Properative treatment</b> 31 (22.8)     8 (12.1)     0.071       Infiximab	Age, years			
A3 (> 40)     48 (35.3)     16 (24.2)     0.113       Location     11 (ileal)     48 (35.3)     28 (42.4)     0.327       L1 (ileal)     48 (35.3)     28 (42.4)     0.327       L2 (colonic)     10 (7.4)     9 (13.6)     0.151       L3 (ileocolonic)     67 (49.3)     28 (42.4)     0.361       L4 (upper gastrointestinal)     18 (13.2)     8 (12.1)     0.824       Behavior     18 (13.2)     8 (12.1)     0.824       Behavior     18 (13.2)     8 (12.1)     0.673       B1 (inflammatory/failure of medical therapy)     8 (5.9)     2 (3.0)     0.361       B2 (stricturing)     95 (69.9)     48 (72.7)     0.673       B3 (penetrating)     47 (34.6)     19 (28.8)     0.412       Perianal disease     35 (25.7)     24 (36.4)     0.119       Operative time <sup>a</sup> , min     186.4±4.9     200.9±7.5     0.101       First time operated     94 (69.1)     37 (56.1)     0.068       Laparoscopic surgery     86 (63.2)     34 (51.5)     0.112          Conversion     28 (20.6)	A1 (≤16)	1 (0.7)	1 (1.5)	0.548
Location     Initial     Value	A2 (17–40)	87 (64.0)	49 (74.2)	0.144
L1 (ileal)     48 (35.3)     28 (42.4)     0.327       L2 (colonic)     10 (7.4)     9 (13.6)     0.151       L3 (ileocolonic)     67 (49.3)     28 (42.4)     0.361       L4 (upper gastrointestinal)     18 (13.2)     8 (12.1)     0.824       Behavior     5     59.9     2 (3.0)     0.361       B2 (stricturing)     95 (69.9)     48 (72.7)     0.673       B3 (penetrating)     47 (34.6)     19 (28.8)     0.412       Perianal disease     35 (25.7)     24 (36.4)     0.119       Operative time <sup>a</sup> , min     186.4±4.9     200.9±7.5     0.101       First time operated     94 (69.1)     37 (56.1)     0.068       Laparoscopic surgery     86 (63.2)     34 (51.5)     0.112       Conversion     28 (20.6)     12 (18.2)     0.687       Properative treatment     11 (8.1)     31 (19.7)     0.017       Infliximab     11 (8.1)     13 (19.7)     0.017       5-ASA     32 (23.5)     23 (34.8)     0.090       Corticosteroids     6(4.4)     4(6.1)     <	A3 (>40)	48 (35.3)	16 (24.2)	0.113
L2 (colonic)     10 (7.4)     9 (13.6)     0.151       L3 (ileocolonic)     67 (49.3)     28 (42.4)     0.361       L4 (upper gastrointestinal)     18 (13.2)     8 (12.1)     0.824       Behavior     10 (7.4)     9 (13.6)     0.361       B1 (inflammatory/failure of medical therapy)     8 (5.9)     2 (3.0)     0.361       B2 (stricturing)     95 (69.9)     48 (72.7)     0.673       B3 (penetrating)     47 (34.6)     19 (28.8)     0.412       Perianal disease     35 (25.7)     24 (36.4)     0.119       Operative time <sup>4</sup> , min     186.4±4.9     200.9±7.5     0.101       First time operated     94 (69.1)     37 (56.1)     0.068       Laparoscopic surgery     86 (63.2)     34 (51.5)     0.112       Conversion     28 (20.6)     12 (18.2)     0.687       Preoperative treatment     11 (8.1)     13 (19.7)     0.017       Infliximab     11 (8.1)     13 (19.7)     0.017       5-ASA     32 (23.5)     23 (34.8)     0.090       Corticosteroids     6 (4.4)     4 (	Location	4	1	
L3 (ileocolonic)     67 (49.3)     28 (42.4)     0.361       L4 (upper gastrointestinal)     18 (13.2)     8 (12.1)     0.824       Behavior	L1 (ileal)	48 (35.3)	28 (42.4)	0.327
IA (upper gastrointestinal)     18 (13.2)     8 (12.1)     0.824       Behavior     B1 (inflammatory/failure of medical therapy)     8 (5.9)     2 (3.0)     0.361       B2 (stricturing)     95 (69.9)     48 (72.7)     0.673       B3 (penetrating)     47 (34.6)     19 (28.8)     0.412       Perianal disease     35 (25.7)     24 (36.4)     0.119       Operative time <sup>a</sup> , min     186.4 ± 4.9     200.9 ± 7.5     0.101       First time operated     94 (69.1)     37 (56.1)     0.068       Laparoscopic surgery     86 (63.2)     34 (51.5)     0.112       Conversion     28 (20.6)     12 (18.2)     0.673       Preoperative treatment     31 (22.8)     8 (12.1)     0.071       Infliximab     11 (8.1)     13 (19.7)     0.017       5-ASA     32 (23.5)     23 (34.8)     0.090       Corticosteroids     6 (4.4)     4 (6.1)     0.618	L2 (colonic)	10 (7.4)	9 (13.6)	0.151
Behavior     2 (3.0)     0.361       B1 (inflammatory/failure of medical therapy)     8 (5.9)     2 (3.0)     0.361       B2 (stricturing)     95 (69.9)     48 (72.7)     0.673       B3 (penetrating)     47 (34.6)     19 (28.8)     0.412       Perianal disease     35 (25.7)     24 (36.4)     0.119       Operative time <sup>a</sup> , min     186.4±4.9     200.9±7.5     0.101       First time operated     94 (69.1)     37 (56.1)     0.068       Laparoscopic surgery     86 (63.2)     34 (51.5)     0.112       Conversion     28 (20.6)     12 (18.2)     0.687       Preoperative treatment     31 (22.8)     8 (12.1)     0.071       Infliximab     11 (8.1)     13 (19.7)     0.017       5-ASA     32 (23.5)     23 (34.8)     0.090       Corticosteroids     6 (4.4)     4 (6.1)     0.618       Enteral nutrition     52 (38.2)     18 (27.3)     0.125	L3 (ileocolonic)	67 (49.3)	28 (42.4)	0.361
B1 (inflammatory/failure of medical therapy)     8 (5.9)     2 (3.0)     0.361       B2 (stricturing)     95 (69.9)     48 (72.7)     0.673       B3 (penetrating)     47 (34.6)     19 (28.8)     0.412       Perianal disease     35 (25.7)     24 (36.4)     0.119       Operative time <sup>a</sup> , min     186.4±4.9     200.9±7.5     0.101       First time operated     94 (69.1)     37 (56.1)     0.068       Laparoscopic surgery     86 (63.2)     34 (51.5)     0.112       Conversion     28 (20.6)     12 (18.2)     0.687       Preoperative treatment     31 (22.8)     8 (12.1)     0.071       Infliximab     11 (8.1)     13 (19.7)     0.017       5-ASA     32 (23.5)     23 (34.8)     0.090       Corticosteroids     6 (4.4)     4 (6.1)     0.618	L4 (upper gastrointestinal)	18 (13.2)	8 (12.1)	0.824
B2 (stricturing)     95 (69.9)     48 (72.7)     0.673       B3 (penetrating)     47 (34.6)     19 (28.8)     0.412       Perianal disease     35 (25.7)     24 (36.4)     0.119       Operative time <sup>a</sup> , min     186.4±4.9     200.9±7.5     0.101       First time operated     94 (69.1)     37 (56.1)     0.068       Laparoscopic surgery     86 (63.2)     34 (51.5)     0.112       Conversion     28 (20.6)     12 (18.2)     0.687       Properative treatment     January     January     January       Azathioprine     31 (22.8)     8 (12.1)     0.017       Infliximab     11 (8.1)     13 (19.7)     0.017       5-ASA     32 (23.5)     23 (34.8)     0.090       Corticosteroids     6 (4.4)     4 (6.1)     0.618       Enteral nutrition     52 (38.2)     18 (27.3)     0.125	Behavior	1	1	
B3 (penetrating)     47 (34.6)     19 (28.8)     0.412       Perianal disease     35 (25.7)     24 (36.4)     0.119       Operative time <sup>a</sup> , min     186.4±4.9     200.9±7.5     0.101       First time operated     94 (69.1)     37 (56.1)     0.068       Laparoscopic surgery     86 (63.2)     34 (51.5)     0.112       Conversion     28 (20.6)     12 (18.2)     0.687       Preoperative treatment     V     V     0.071       Infliximab     31 (22.8)     8 (12.1)     0.017       5-ASA     32 (23.5)     23 (34.8)     0.090       Corticosteroids     6 (4.4)     4 (6.1)     0.618       Enteral nutrition     52 (38.2)     18 (27.3)     0.125	B1 (inflammatory/failure of medical therapy)	8 (5.9)	2 (3.0)	0.361
Perianal disease     35 (25.7)     24 (36.4)     0.119       Operative time <sup>a</sup> , min     186.4±4.9     200.9±7.5     0.101       First time operated     94 (69.1)     37 (56.1)     0.068       Laparoscopic surgery     86 (63.2)     34 (51.5)     0.112       Conversion     28 (20.6)     12 (18.2)     0.687       Preoperative treatment     Xathioprine     31 (22.8)     8 (12.1)     0.071       Inflixinab     11 (8.1)     13 (19.7)     0.017       5-ASA     32 (23.5)     23 (34.8)     0.090       Corticosteroids     6 (4.4)     4 (6.1)     0.618       Enteral nutrition     52 (38.2)     18 (27.3)     0.125	B2 (stricturing)	95 (69.9)	48 (72.7)	0.673
Operative time <sup>a</sup> , min     186.4±4.9     200.9±7.5     0.101       First time operated     94 (69.1)     37 (56.1)     0.068       Laparoscopic surgery     86 (63.2)     34 (51.5)     0.112       Conversion     28 (20.6)     12 (18.2)     0.687       Preoperative treatment     31 (22.8)     8 (12.1)     0.071       Infliximab     11 (8.1)     13 (19.7)     0.017       5-ASA     32 (23.5)     23 (34.8)     0.090       Corticosteroids     6 (4.4)     4 (6.1)     0.618       Enteral nutrition     52 (38.2)     18 (27.3)     0.125	B3 (penetrating)	47 (34.6)	19 (28.8)	0.412
First time operated     94 (69.1)     37 (56.1)     0.068       Laparoscopic surgery     86 (63.2)     34 (51.5)     0.112       Conversion     28 (20.6)     12 (18.2)     0.687       Preoperative treatment       Azathioprine     31 (22.8)     8 (12.1)     0.017       Infliximab     11 (8.1)     13 (19.7)     0.017       5-ASA     32 (23.5)     23 (34.8)     0.090       Corticosteroids     6 (4.4)     4 (6.1)     0.618       Enteral nutrition     52 (38.2)     18 (27.3)     0.125	Perianal disease	35 (25.7)	24 (36.4)	0.119
Laparoscopic surgery     86 (63.2)     34 (51.5)     0.112       Conversion     28 (20.6)     12 (18.2)     0.687       Preoperative treatment     31 (22.8)     8 (12.1)     0.071       Infliximab     11 (8.1)     13 (19.7)     0.017       5-ASA     32 (23.5)     23 (34.8)     0.090       Corticosteroids     6 (4.4)     4 (6.1)     0.618       Enteral nutrition     52 (38.2)     18 (27.3)     0.125	Operative time <sup>a</sup> , min	186.4±4.9	200.9±7.5	0.101
Conversion     28 (20.6)     12 (18.2)     0.687       Preoperative treatment     31 (22.8)     8 (12.1)     0.071       Infliximab     11 (8.1)     13 (19.7)     0.017       5-ASA     32 (23.5)     23 (34.8)     0.090       Corticosteroids     6 (4.4)     4 (6.1)     0.618       Enteral nutrition     52 (38.2)     18 (27.3)     0.125	First time operated	94 (69.1)	37 (56.1)	0.068
Preoperative treatment     31 (22.8)     8 (12.1)     0.071       Infliximab     11 (8.1)     13 (19.7)     0.017       5-ASA     32 (23.5)     23 (34.8)     0.090       Corticosteroids     6 (4.4)     4 (6.1)     0.618       Enteral nutrition     52 (38.2)     18 (27.3)     0.125	Laparoscopic surgery	86 (63.2)	34 (51.5)	0.112
Azathioprine31 (22.8)8 (12.1)0.071Infliximab11 (8.1)13 (19.7)0.0175-ASA32 (23.5)23 (34.8)0.090Corticosteroids6 (4.4)4 (6.1)0.618Enteral nutrition52 (38.2)18 (27.3)0.125	Conversion	28 (20.6)	12 (18.2)	0.687
Inflixinab     11 (8.1)     13 (19.7)     0.017       5-ASA     32 (23.5)     23 (34.8)     0.090       Corticosteroids     6 (4.4)     4 (6.1)     0.618       Enteral nutrition     52 (38.2)     18 (27.3)     0.125	Preoperative treatment			
5-ASA     32 (23.5)     23 (34.8)     0.090       Corticosteroids     6 (4.4)     4 (6.1)     0.618       Enteral nutrition     52 (38.2)     18 (27.3)     0.125	Azathioprine	31 (22.8)	8 (12.1)	0.071
Corticosteroids     6 (4.4)     4 (6.1)     0.618       Enteral nutrition     52 (38.2)     18 (27.3)     0.125	Infliximab	11 (8.1)	13 (19.7)	0.017
Enteral nutrition 52 (38.2) 18 (27.3) 0.125	5-ASA	32 (23.5)	23 (34.8)	0.090
	Corticosteroids	6 (4.4)	4 (6.1)	0.618
Others 11 (8.1) 3 (4.5) 0.336	Enteral nutrition	52 (38.2)	18 (27.3)	0.125
	Others	11 (8.1)	3 (4.5)	0.336

**Table 3.** Univariate analysis of risk factors associated with postoperative complications. Values in parentheses are percentages unless indicated otherwise. CONUTS, controlling nutritional status score; BMI, body mass index. <sup>a</sup>Values are mean ± SE.

	Multivariate	Multivariate										
Characteristics	P value	OR	95% CI									
BMI	0.070	1.797	0.954-3.388									
Preoperative albumin	0.878	0.943	0.445-1.999									
Preoperative CONUTS	0.003	3.507	1.522-8.079									
Infliximab	0.039	2.619	1.050-6.531									

**Table 4.** Multivariate analysis of factors associated with postoperative complications. BMI, body mass index;CONUTS, controlling nutritional status score.



**Figure 1.** ROC curve for preoperative CONUTS, PNI, ALB predictive of postoperative complications. ROC, receiver operating characteristic; CONUTS, controlling nutritional status score; PNI, prognostic nutritional index; ALB, albumin.

Variable	Normal	Mild	Moderate	Severe
Serum albumin (g/dL)	≥3.50	3.00-3.49	2.50-2.99	< 2.50
Score	0	2	4	6
Total lymphocyte count (/mm <sup>3</sup> )	≥1600	1200-1599	800-1199	< 800
Score	0	1	2	3
Total cholesterol (mg/dL)	≥180	140-179	100-139	<100
Score	0	1	2	3

**Table 5.** The evaluation of Controlling Nutritional Status (CONUT) score. CONUT: controlling nutritional status.

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**Inclusion and exclusion criteria.** Patients with radiologic, endoscopic, and histological diagnosis of CD according to the European Crohn's and Colitis Organisation (ECCO) guidelines and undergoing intestinal resection due to failure of medical therapy or developed complications (structuring or penetrating) were included in this study<sup>29</sup>. Patients with undetermined IBD or UC, those without a surgical bowel resection, those younger than 18 years old, those with malignant disease, and those with incomplete laboratory data were excluded. Patients with emergency surgery were also excluded. Thus, 148 patients were excluded in total, 80 due to incomplete laboratory data.

**Data collection.** All the baseline characteristics data, perioperative data, and laboratory data were collected from the IBD database. Baseline characteristics included age, body mass index (BMI), sex, comorbidity, smoking history, medication, and Montreal classification. CD patients exposed to preoperative infliximab were defined as having a documented dose of infliximab more than 4 weeks before surgery. For patients on preoperative corticosteroids, attempts were made to wean them to a daily dose of 5 mg prednisolone or 4 mg methylprednisolone 4 weeks before surgical intervention. Intraoperative data included operation time and surgical approach (open vs laparoscopy). Laboratory data included white blood count (WBC), red blood count (RBC), haemoglobin (Hb), total blood cholesterol, albumin (ALB), C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), and lymphocyte count. The prognostic nutritional index (PNI) was calculated from the serum ALB level and total peripheral lymphocyte count (TLC), and the formula was PNI =  $10 \times ALB (g/dL) + 0.005 \text{ TLC (per mL)}^{30}$ . The CONUT score was calculated based on serum albumin level, peripheral lymphocyte counts, and total cholesterol concentrations as in a previous study<sup>15</sup>. The details of the CONUT scoring system are shown in Table 5.

**Definition of outcomes.** The primary outcome of this study was to evaluate the predictive value of the CONUT score for postoperative complications. Postoperative complications were defined as those occurring within 30 days from the date of operation or discharge, and complications were documented using the Clavien-

Dindo system<sup>31</sup>. A follow-up telephone interview was carried out when necessary. Mild complications included those classified grades I to II according to the Clavien-Dindo system, and major complications included those classified grades III to IV. For secondary outcomes, comparison of the prediction value between the CONUT score and other scoring systems, such as ALB and PNI, was performed.

**Statistical analysis.** All of the statistical analyses were conducted using SPSS 21.0 (Armonk, NY: IBM Corp). The mean ± SD or median (range) is used to represent continuous data, while categorical data are presented as numbers (%). Student's t test or the Mann–Whitney U test for continuous variables was performed depending on the normality of the data distribution, and the Pearson  $\chi^2$  test or Fisher's exact test was used to analyse the categorical variables, as appropriate. Significant associations from the univariate analyses (p < 0.05) were evaluated, and the identified independent predictors of infectious complications were then analysed by multivariate logistic regression analysis. The accuracy of predictors was assessed by receiver operating characteristic (ROC) curve analysis. A P value < 0.05 was considered to be statistically significant.

#### Data availability

The datasets generated during and/or analyzed during the current study are available from the first author or corresponding author on reasonable request.

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# Author contributions

X.G. and W.Z. contributed to study conception and design, W.L., W.Q., X.Y. and X.D. contributed to acquisition of data, L.Y. and X.D. contributed to analysis and interpretation of data, X.G., X.D. and S.T. contributed to drafting of manuscript, X.G. contributed to critical revision.

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# **Competing interests**

The authors declare no competing interests.

# Additional information

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