Body Mass Index Is a Marker of Nutrition Preparation Sufficiency Before Surgery for Crohn’s Disease From the Perspective of Intra-Abdominal Septic Complications

A Retrospective Cohort Study

Min Zhang, MD, Xiang Gao, PhD, Yuanhan Chen, MD, Min Zhi, PhD, Huangwei Chen, MD, Jian Tang, MD, Minli Su, MD, Jiayin Yao, MD, Qinglan Yang, MD, Junrong Chen, MD, Pinjin Hu, MD, and Huanliang Liu, PhD

Abstract: Poor preoperative nutritional status for individuals with Crohn’s disease (CD) is associated with intra-abdominal septic complications (IASCs). The present study aimed to investigate the association of the common nutrition indices serum albumin and body mass index (BMI) with IASCs. Sixty-four CD patients who had received elective intestinal operations were retrospectively investigated. Among these patients, 32 had received individualized fortified nutrition support. IASCs occurred in 7 patients (10.9%). Compared with non-IASC patients, IASC patients had a lower BMI (17.6 ± 2.7 vs 15.6 ± 1.3 kg/m², \(P = 0.048\)). The area under the receiver operating characteristic curve according to the BMI-based IASC prediction was 0.772 (95% confidence interval [CI], 0.601–0.944; \(P = 0.020\)) with an optimum diagnostic cutoff value of 16.2 kg/m². A BMI < 16.2 kg/m² significantly increased the risk of developing an IASC (odds ratio [OR], 10.286; 95% CI, 1.158–91.386). Even after correction with the simplified CD activity index (CDAI), a low BMI level remained associated with IASCs (OR, 7.650; 95% CI, 0.808–72.427; \(P = 0.076\)). Serum albumin was not associated with IASCs. Although the fortified nutrition support group had an albumin level comparable to the control group, this group had a higher simplified CDAI score, a lower BMI level, and a comparable incidence rate of IASCs. Thus, BMI more accurately reflects the basic preoperative nutritional status of CD patients than serum albumin. BMI can aid in guiding preoperative nutrition support and judging the appropriate operation time for CD.

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Abbreviations: BMI = body mass index, CD = Crohn’s disease, CDAI = Crohn’s disease activity index, IASCs = intra-abdominal septic complications, PG-SGA = patient-generated subjective global assessment.

INTRODUCTION

Crohn’s disease (CD) is a nonspecific chronic inflammation of the intestine. Approximately 70% of CD patients must undergo operations even after active pharmacological treatment. However, intestinal operations in patients with CD have a high complication incidence, among which intra-abdominal septic complications (IASCs) are one of the most challenging conditions in clinical practice. An IASC prolongs the hospital stay, significantly increases the postoperative relapse rate, and decreases the patient’s quality of life. IASCs include anastomotic fistulas, external intestinal fistulas, and intra-abdominal abscesses and have an incidence as high as 5% to 20%. To date, no effective intervention strategies have been found for IASCs.

Nutrition disorder complications occur in 20% to 85% of CD patients. This specific condition becomes more serious during the active phase of CD, which is associated with decreased food intake, intestinal absorption dysfunction, drug side effects, and active inflammation. Recent studies have shown that the nutritional status of CD patients is closely associated with complications after intestinal operations. Yamamoto et al retrospectively analyzed 343 patients who underwent 566 intestinal anastomosis operations and found that an albumin level < 30 g/L was an independent risk factor for IASCs. Alves et al investigated the risk factors for IASCs in 161 CD patients who had received an enterectomy for the first time and found that a 10% decrease in body weight within the 6 months before the operation increased the risk of an IASC by more than 5-fold. Because of the importance of nutrition, the Expert Consensus on Nutritional Support Therapy for Inflammatory Bowel Diseases (Consensus for short) was released in China in 2013. This report suggested that malnutrition increases the complication incidence and mortality after CD operations, whereas nutrition support decreases the risk of postoperative complications.

Many indices have been used to evaluate the nutritional status of CD patients. Although body composition measurement is the most sensitive method, it entails special equipment, which, consequently, greatly restricts its clinical application. Evaluations based on nutritional risk screening (NRS-2002) and patient-generated subjective global assessment (PG-SGA) must be conducted by professional nutritionists. Therefore, simpler clinical examination indices, such as serum albumin, body mass index (BMI), triceps skinfold thickness, hemoglobin, and cholesterol, have been used more frequently to evaluate the
nutritional status of CD patients in clinical practice. However, the most appropriate indices to accurately and easily evaluate nutrition preparation sufficiency before CD operations remain unknown.

This study primarily analyzed the associations of nutrition indices with the occurrence of IASCs in postoperative CD patients. The results may provide useful data for the selection of appropriate operation times for CD patients.

METHODS

Patients
Clinical data from patients who underwent intestinal operations for CD at the Sixth Affiliated Hospital of Sun Yat-Sen University between March 2008 and May 2014 were retrospectively analyzed. This institution is a center for inflammatory bowel diseases that was established in July 2012 to conduct comprehensive treatment of inflammatory bowel diseases based on multi-disciplinary cooperation (including the gastrointestinal department, the gastrointestinal surgery department, the nutritional department, the type-B ultrasonic department, and the pathology department). Three CD patients who underwent emergency operations were excluded, and 64 CD patients who underwent elective intestinal operations were included.

This study was performed in accordance with the Helsinki Declaration and was approved by the Ethics Committee of the Sixth Affiliated Hospital of Sun Yat-Sen University. All participants signed an informed consent form.

Evaluation of the Patients’ Condition
CD was typed according to the Montreal classification in combination with imaging, enteroscopy, and operation research. CD activity was evaluated according to the simplified Crohn’s disease activity index (CDAI).

Nutrition Support Schemes
After the Center for Inflammatory Bowel Diseases was established, a protocol was developed to provide individualized nutritional support for CD intestinal operations via the gastrointestinal nutritionists at a rate of no <30 kcal/kg/day. Thirty-two patients receiving this support were grouped into the fortified nutritional support group. In this group, 4 patients (12.5%) received total parenteral nutrition, 15 patients (46.9%) received parenteral nutrition combined with (or in sequence with) enteral nutrition, and 13 patients (40.6%) received enteral nutrition, with a nutritional support treatment time of 23 ± 16 days (ranging from 5 to 69 days). Before the center was established, patients who underwent CD intestinal operations were given short-term (5–10 days) preoperative parenteral nutritional support. In this group, 4 patients (12.5%) received total parenteral nutrition, 15 patients (46.9%) received parenteral nutrition combined with (or in sequence with) enteral nutrition, and 13 patients (40.6%) received enteral nutrition, with a nutritional support treatment time of 23 ± 16 days (ranging from 5 to 69 days). Before the center was established, patients who underwent CD intestinal operations were given short-term (5–10 days) preoperative parenteral nutritional support. In this group, 4 patients (12.5%) received total parenteral nutrition, 15 patients (46.9%) received parenteral nutrition combined with (or in sequence with) enteral nutrition, and 13 patients (40.6%) received enteral nutrition, with a nutritional support treatment time of 23 ± 16 days (ranging from 5 to 69 days). Before the center was established, patients who underwent CD intestinal operations were given short-term (5–10 days) preoperative parenteral nutritional support. In this group, 4 patients (12.5%) received total parenteral nutrition, 15 patients (46.9%) received parenteral nutrition combined with (or in sequence with) enteral nutrition, and 13 patients (40.6%) received enteral nutrition, with a nutritional support treatment time of 23 ± 16 days (ranging from 5 to 69 days). Before the center was established, patients who underwent CD intestinal operations were given short-term (5–10 days) preoperative parenteral nutritional support. In this group, 4 patients (12.5%) received total parenteral nutrition, 15 patients (46.9%) received parenteral nutrition combined with (or in sequence with) enteral nutrition, and 13 patients (40.6%) received enteral nutrition, with a nutritional support treatment time of 23 ± 16 days (ranging from 5 to 69 days).

Medication
According to clinical conditions, the patients were continually given mesalazine (2–4 g/day) and immunosuppressive agents (azathioprine 1–2 mg/kg/day or 6-mercaptopurine 0.5–1 mg/kg/day). Biological agents were withdrawn, and the amount of hormone was gradually decreased. For cases that were complicated with abdominal inflammation, the decision to administer antibiotics, including ciprofloxacin, imidazoles, or cephalosporin, was made based on clinical experience or according to the results of a bacterial culture of B ultrasound-guided abscess puncture fluid.

Operational Approach
All operations were performed by the surgeons in the gastrointestinal surgery department, and each surgeon had at least 8 years of experience in CD surgery. Forty-seven patients (73%) underwent a partial intestinal resection; 13 patients (20%) underwent a partial intestinal resection plus an anastomosis; 1 patient (2%) underwent an anastomosis alone; and the remaining 3 patients (5%) underwent other operations, such as intestinal perforation repair. Of the study patients, 46 (72%) were subjected to end-to-end intestinal anastomoses, and 7 (11%) received side-to-side intestinal anastomoses.

Observational Indices
Postoperative short-term abdominal complications were observed, including hemorrhage, complications at the abdominal incision/stoma (inflammation, splitting, and fat liquefaction), and IASCs (anastomotic fistulas, external intestinal fistulas, and intra-abdominal abscesses). Short term was defined as a hospital stay duration for the time of the operation (normally within 3 months).

Statistical Analysis
The data were analyzed with SPSS 13.0 software. The measurement data are presented as means ± standard deviation of the mean (x ± s) or medians (interquartile range) (M [Q25, Q75]). The t test or the Mann–Whitney U test was used to compare between groups. Numeration data are presented as cases and percentages (%), and the χ² test or Fisher’s exact probability test was used to compare between groups. The receiver operating characteristic (ROC) curve was drawn to explore the differentiation value of the nutrition index for IASCs. The maximum point of the correct diagnosis index (sensitivity + specificity – 1) was selected as the cutoff value of the variable. The odds ratio (OR) of the occurrence of an IASC and the 95% confidence interval (CI) were calculated using the logistic regression model. A bilateral P < 0.05 was considered significant.

RESULTS

Basic Clinical Characteristics
Of the 64 patients, 48 (75%) received an elective operation due to an abdominal fistula/abscess, and 16 (25%) underwent an operation for intestinal obstruction. Thirty patients (46.9%) underwent an intestinal operation for the first time, and 19 (29.7%), 11 (17.2%), and 4 (6.3%) patients received their second, third, and fourth intestinal operations, respectively. The diseased regions included the ileocolon (55 cases, 85.9%), the terminal ileum (8 cases, 12.5%), and the colon (1 case, 1.6%). Illness behaviors were manifested as penetration in 48 patients (75%) and stenosis in 16 patients (25%).

After operation, abdominal complications occurred in 17 patients (26.6%), including incision/stoma complications in 8 patients (12.5%), IASCs in 7 patients (10.9%), and alimentary tract hemorrhage in 2 patients (3.1%). Compared with non-IASC patients, lower preoperative BMI and higher simplified CDAs were found in IASC patients. There was no significant difference in the other indices between the 2 groups (Table 1).

Clinical Values of Nutrition Indices for IASC Prediction
The analysis of the ROC curve showed that BMI had clinical predictive value for IASCs, whereas the albumin index...
BMI and serum albumin are the nutrition markers of CD patients. In recent years, researchers have investigated the effect of preoperative nutrition support on complications after CD operations. Parenteral nutrition support for 3 weeks noticeably improves CD patients' immunoglobulin levels and BMIs. In another study, preoperative enteral nutrition support significantly decreased the incidence of IASCs after operation. Jacobson found that no IASCs occurred in 15 patients who received preoperative nutrition support, whereas 27.7% of the matched 105 patients suffered complications. These results indicate that preoperative nutrition support treatment can reduce the incidence of postoperative complications.

BMI and serum albumin are the nutrition markers of CD pathogenetic conditions. These measures are used extensively in clinical practice due to their advantages of being easy to manipulate and providing a dynamic evaluation of nutritional

FIGURE 1. Receiver operating characteristic analysis of the clinical values of body mass index and serum albumin for predicting intra-abdominal septic complications.

TABLE 1. Comparison of the Basic Clinical Indices Between the IASC and Non-IASC Groups

|                | Overall (n = 64) | Non-IASC (n = 57) | IASC (n = 7) | P Value |
|----------------|-----------------|-------------------|--------------|---------|
| Age, yr        | 33 ± 9          | 32 ± 9            | 36 ± 13      | 0.258   |
| Male, %        | 49 (76.6)       | 42 (73.7)         | 7 (100.0)    | 0.185   |
| Course of disease, yr | 3 (1, 8)      | 3 (1, 8)          | 5 (2, 10)    | 0.604   |
| Simplified CDAI | 8 (6, 11)       | 7 (6, 10)         | 10 (9, 13)   | 0.030   |
| BMI, kg/m²     | 17.3 ± 2.7      | 17.6 ± 2.7        | 15.6 ± 1.3   | 0.048   |
| Albumin, g/L   | 35.8 ± 5.6      | 36.0 ± 5.6        | 33.9 ± 6.2   | 0.363   |
| Cholesterol, mmol/L | 4.0 ± 0.7   | 4.0 ± 0.7         | 3.7 ± 0.5    | 0.199   |
| Hemoglobin, g/L| 93 ± 14         | 93 ± 14           | 91 ± 18      | 0.760   |
| Platelet number, ×10⁹ | 273 ± 113    | 268 ± 107         | 320 ± 159    | 0.252   |

BMI = body mass index; CDAI = Crohn’s disease activity index; IASC = intra-abdominal septic complications.
status. Although these indices may be influenced by infusions, obesity, edema, and fluid retention,14 no such influence was significant in the 64 patients in this study. Albumin, which is synthesized in the liver, is an acute phase protein with a half-life of approximately 20 days. In contrast, BMI reflects the basic nutrition storage of the organism, which changes slowly. Although the preoperative nutrition support for 6 to 71 days significantly corrected hypoalbuminemia in the CD patients, BMI can only be improved after 3 months of postoperative home nutrition support.22

In conclusion, BMI better reflects the basic nutritional status of CD patients before operation compared with serum albumin. BMI can aid in guiding preoperative nutrition support and judging the appropriate operation time for CD. Therefore, we cannot conclude that fortified nutrition support does not contribute to IASC reduction.

This study has some limitations. First, this study was a retrospective study, which could have suffered from historical bias. To overcome this shortcoming, prospective studies are required. Second, the use of a single center and a small sample size constitute other limitations of this study. In addition, we failed to subgroup the participants to further explore the ideal BMI. Therefore, the target BMI for preoperative preparation for CD patients remains to be explored.

In conclusion, BMI better reflects the basic nutritional status of CD patients before operation compared with serum albumin. BMI can aid in guiding preoperative nutrition support and judging the appropriate operation time for CD. Therefore, much attention should be directed to this index during preoperative nutrition preparation.

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