Preoperative Neutrophil–lymphocyte Ratio Is a Predictor of High-output Ileostomy After Colorectal Surgery

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Abstract. *Background/Aim: High-output ileostomy (HOI) can affect quality of life, however, its primary cause remains unknown. This study aimed to identify a predictor of HOI after colorectal surgery. Patients and Methods: The medical records of forty-five patients who had undergone colorectal surgery with temporary ileostomy without postoperative complications, such as intra-abdominal abscess, paralytic ileus, outlet obstruction, or suture rupture, at our hospital between January 2016 and December 2017 were retrospectively investigated. Results: Significant differences in age, gender, operative situation, duration of operation, intraoperative blood loss, operation procedure, operation approach, preoperative body mass index, and preoperative hematological/biochemical parameters, such as leucocyte counts, hemoglobin, serum total protein, albumin, C-reactive protein, and preoperative complications, were not identified between the two groups. Preoperative neutrophil-to-lymphocyte ratio (NLR) of the HOI group was significantly higher than that of the non-HOI group (p=0.004). Conclusion: Preoperative NLR seems to be a useful predictor of HOI after colorectal surgery.*

High-output ileostomy (HOI) is often observed after anus-preserving procedures such as low anterior resection and intersphincteric resection, since an ileostomy is required to reduce the risk of severe anastomotic leakage (1-3). HOI occurs secondly to the intra-abdominal abscess and other similar conditions due to the resulting paralytic ileus that prevents absorption of small intestinal drainage (4-8). However, the primary cause of development of HOI remains unknown. This study aimed to identify a predictor of HOI after colorectal surgery.

Patients and Methods

Patients. The Ethics Committee for Biomedical Research of the Jikei Institutional Review Board approved the protocol [30-415(9436)], and all patients or their family members provided their written informed consent to participation. Between January 2016 and December 2017, forty-five patients who had undergone colorectal surgery with temporary ileostomy without postoperative complications, such as intra-abdominal abscess, paralytic ileus, outlet obstruction, or suture rupture, at our hospital were identified and their medical records were retrospectively examined. Ileostomy was created approximately 30-40 cm away from the ileocecal valve or iliac pouch in all patients, who had the same postoperative care pathway. HOI was defined when the maximum output was more than 2,000 ml/day for three or more consecutive days and biochemical disturbances were imminent (7).

This study included 22 patients with high-output ileostomy (HOI) and 23 patients with non-high-output ileostomy (non-HOI). The hematological/biochemical parameters measured before surgery included levels of leucocyte counts, hemoglobin, serum total protein, albumin, and C-reactive protein. Preoperative neutrophil to lymphocyte ratio (NLR) was calculated by the number of neutrophils and lymphocytes. Body mass index (BMI) was calculated using the standard formula: weight (kg)/height (m^2).

Statistical analysis. Continuous variables are expressed as the means and ranges. The Wilcoxon rank-sum test was used to compare the continuous variables, and the Chi-square test was used to compare the categorical data. The receiver operating characteristic (ROC) curve analysis was used to determine an optimal cut-off value categorized for the two groups (9). A *p*-value of less than 0.05 was used to indicate significance. All data were analyzed using the Statistical Package for Social Sciences (SPSS) 24.0, (IBM SPSS, Tokyo, Japan).

Results

Comparison of clinical features between the non-HOI and the HOI group. The mean age of the HOI group was 56.0 years (range=20-77 years), while that of the non-HOI group was 63.0 years (range=28-85 years). There was not significant

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Table I. *Comparison of clinical features between the HOI and the non-HOI group.*

Characteristic	HOI group (n=22)	Non-HOI group (n=23)	*p*-Value
Mean age (range), years	56.0 (20-77)	63.0 (28-85)	0.186
Gender, n (%)			0.873
Male	10 (45)	11 (48)	
Female	12 (55)	12 (52)	
Postoperative hospital stay (rang), days	38.8 (18-90)	15.3 (12-22)	<0.001
Emergency operation			0.912
Presence, n (%)	8 (36)	8 (35)	
Absence, n (%)	14 (64)	15 (65)	
Operative time (range), min	217.2 (133-374)	211.5 (105-329)	0.871
Blood loss (range), ml	86.4 (0-490)	73.0 (0-410)	0.748
Operative procedure			0.912
Laparosocpic surgery, n (%)	14 (64)	15 (65)	
Open surgery, n (%)	8 (36)	8 (35)	
Operative approach			0.987
Proctocolectomy, n (%)	4 (18)	4 (17)	
Low anterior resection, n (%)	10 (46)	11 (48)	
Partial colectomy, n (%)	8 (36)	8 (35)	
Body mass index (range), kg/m^2	20.3 (15.6-26.6)	21.9 (16.3-29.1)	0.058
Leucocyte counts (range), /ml	7868.2 (2300-14200)	8017.4 (3200-13800)	0.786
NLR (range)	7.3 (3.1-34.5)	2.5 (1-3.4)	0.004
Total protein (range), g/dl	6.1 (4.3-7.7)	6.3 (4.2-8.2)	0.528
Albumin (range), g/dl	3.1 (1.5-4.4)	3.2 (2-4.5)	0.618
Hemoglobin (range), g/dl	11.9 (8.2-16.7)	12.0 (7.5-16)	0.762
C-reactive protein (range), g/ml	3.8 (0.1-20.4)	3.0 (0.1-11.5)	0.546
Preoperative complications			0.629
Heart disease, n (%)	2 (9)	2 (9)	
Kidney disease, n (%)	0 (0)	0 (0)	
Diabetes mellitus, n (%)	2 (9)	1 (4)	

HOI: High-output ileostomy; NLR: neutrophil/lymphocyte ratio.

difference between the two groups. Postoperative hospital stay of the HOI group was significantly longer than that of the non-HOI group. Significant differences in gender, operative situation, operation duration, intraoperative blood loss, operation procedure, operation approach, preoperative body mass index, and preoperative hematological/biochemical parameters such as leucocyte counts, hemoglobin, serum total protein, albumin, C-reactive protein, and preoperative complications, were not identified between the two groups. Whereas preoperative NLR of the HOI group was significantly higher than that of the non-HOI group (*p*=0.004) (Table I).

The cut-off value of NLR categorized for the two groups. For categorizing for the two groups, the optimal cut-off value was calculated 3.0 by the ROC curve analysis, and the area under the curve (AUC) was 0.972 (Figure 1).

Discussion

Several studies have reported that HOI develops in 16-24% of patients after creation of ileostomy (4, 8, 10). HOI can affect quality of life, however, its cause remains unknown. Factors such as intra-abdominal infections, temporary bowel obstruction, residual small bowel less than 200 cm, enteritis such as *Clostridium difficile* (11) or salmonella, sudden drug withdraw (steroids, opiates), and the administration of prokinetic drugs such as metoclopramide (8) are considered to contribute to HOI development. Those secondary causes of development of HOI have been clearly identified, however, the primary cause of development of HOI after creation of ileostomy remains unknown. Therefore, the medical records of patients who had undergone colorectal surgery with temporary ileostomy without postoperative complications, such as intra-abdominal abscess, paralytic ileus, outlet obstruction, or suture rupture, at our hospital were retrospectively examined.

Takeda has reported that diabetes and proctocolectomy were preoperative predictors of HOI after creation of ileostomy (10). In our study, preoperative NLR was the only identified potential preoperative predictor of HOI after colorectal surgery. The total leukocyte and neutrophil counts have historically been used as markers of infection. The NLR which is defined by the absolute number of neutrophils divided by the absolute number of lymphocytes is also considered an inflammatory biomarker. Several studies have
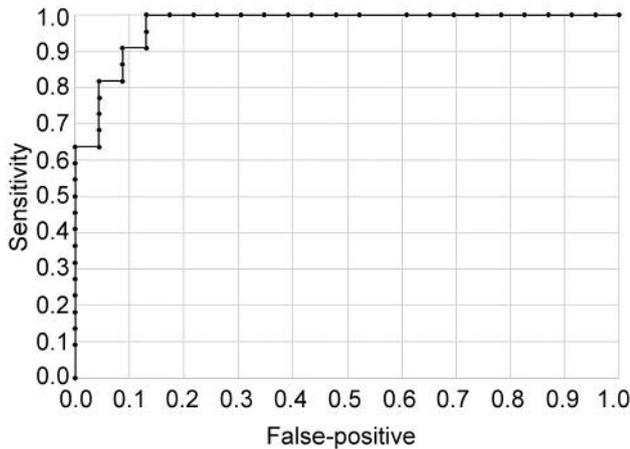
Figure 1. *The receiver operating characteristic (ROC) curve analysis was used to determine an optimal cut-off value categorized for the two groups. The optimal cut-off value was calculated 3.0 by the ROC curve analysis and the area under the curve (AUC) was 0.972.*

reported that an elevated NLR is associated with a poor prognosis in patients with various types of malignant diseases (12-17). However, the ideal cut-off value has still been controversial, however, there have been some reports that a cut-off value of more than 3-5 could be a useful predictor of the prognosis of patients with malignant diseases (18, 19).

In this present study, the optimal cut-off value categorized for the HOI group or the non-HOI group was 3.0 calculated by the ROC curve analysis. Because the NLR of the HOI group was significantly higher than that of the non-HOI group, immune depression may be strongly associated with HOI after creation of ileostomy. However, a large-scale prospective or retrospective study is needed to clarify this issue.

In conclusion, preoperative NLR seems to be a useful predictor of HOI after colorectal surgery.

Conflicts of Interest

The Authors declare that there are no conflicts of interest regarding this study.

Authors' Contributions

All Authors performed operations, analyzed the data of patients regarding their clinical features, and have been involved in drafting the manuscript. KY had given final approval of the version to be published. All Authors read and approved the final manuscript.

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