The presurgical Controlling Nutritional Status (CONUT) score is independently associated with severe peristomal skin disorders: a single-center retrospective cohort study

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Abstract

Purpose: While nutritional interventions may potentially lower the risk of peristomal skin disorders (PSDs) and their exacerbation, no prior studies have evaluated the relationship between PSDs and nutritional status using the Controlling Nutritional Status (CONUT) score. Therefore, the purpose of this study was to assess the impact of preoperative nutritional status on stoma development, and determine risk factors for postoperative PSDs and their increased severity.

Methods: A retrospective analysis was performed in 116 consecutive patients with rectal cancer who underwent radical surgery with stoma creation, including ileostomy and colostomy.

Results: PSDs were diagnosed in 32 patients (27.6%); 10 (8.7%) cases were defined as severe based on the ABCD-stoma score. A multivariate analysis indicated that the laparoscopic approach (odds ratio [OR], 3.221; 95% confidence interval [CI], 1.001–10.362; P = 0.050) and ileostomy (OR, 3.394; 95% CI, 1.349–8.535; P = 0.009) were both independent risk factors for PSD. In a separate multivariate analysis for severe PSD, the only independent risk factor was the CONUT score (OR, 11.298; 95% CI, 1.382–92.373; P = 0.024).

Conclusion: Severe PSDs are associated with preoperative nutritional disorders, as determined via the CONUT score. Furthermore, PSDs may potentially increase in severity, regardless of stoma type.

Introduction

Following the creation of a stoma, up to 80% of patients experience stoma-related complications, which predominantly consist of peristomal skin disorders (PSDs). While the majority are not severe, PSDs commonly cause itching and pain, which lower patient quality of life. They also necessitate the frequent replacement of the stoma appliance, which increases the financial burden on the patient [1-4]. While standardized best practice guidelines (e.g., preoperative stoma site marking, ongoing involvement of a stoma care nurse, correct use of stoma appliances) are used to prevent PSDs, the incidence of this postoperative complication remains high. Therefore, there is a need for the further development of interventions to reduce or eliminate PSD occurrence.

The Controlling Nutritional Status (CONUT) score has been reported to be a valuable objective and comprehensive tool for assessing a patient's general nutritional status. The CONUT score is based on three parameters: serum albumin, total cholesterol concentration, and total peripheral lymphocyte count, which reflect protein metabolism, lipid metabolism, and immune function, respectively [5]. The validity and cost-effectiveness of the CONUT score have been previously reported [6,7]. However, its utility has not been assessed in patients with stoma, and no prior studies have evaluated its relationship with PSD severity.

The purpose of this study was to evaluate the impact of preoperative nutritional status, as assessed by the CONUT score, prognostic nutritional index (PNI), and geriatric nutritional risk index (GNRI), on stoma development. Furthermore, we aimed to determine risk factors for postoperative PSDs and their increased severity.

Methods

Patient data collection

This retrospective study included 116 consecutive patients with rectal cancer who underwent radical surgery with stoma creation, including ileostomy and colostomy, from June 2013 to March 2020 at the Gunma University Hospital, Japan. Patient (sex, age, body mass index [BMI], diabetes mellitus [DM], history of preoperative treatment, preoperative nutritional status, clinical stage, and use of adjuvant chemotherapy) and surgical characteristics (operation type, approach type [laparoscopy or open], operation time, blood loss, stoma type [ileostomy or colostomy], temporary stoma, and stoma position [upper or lower abdomen]) were extracted from medical and surgical reports. The condition of the stoma was observed during hospitalization by surgeons and nurses (including wound, ostomy, and continence nurses). Thereafter, the patients were assessed during the follow-up outpatient visits. The study protocol was approved by the Institutional Review Board of Gunma University Hospital (approval no. HS2020-196).

Diagnosis of PSDs

The ABCD-stoma score was used for the diagnosis of PSDs and the assessment of their severity. This score was determined by evaluating changes in the skin, including erythema, erosion, blisters, pustules, ulcers, tissue overgrowth, and pigmentation (Figure 1). The ABCD-stoma score was developed and published by the Japanese Society of Wound, Ostomy, and Continence Management in 2012. The scoring scale evaluates the peristomal skin in three areas close to the stoma: adjacent (A), barrier (B), and circumscribing (C). It also evaluates discoloration (D). PSD severity was evaluated by medical staff as erythema 1, erosion 2, blister/pustule 3, or ulcer/tissue overgrowth 15 in the three skin areas. A score of 4 or higher, which requires a treatment period of >28 days, was defined as severe PSD [8].

PSDs that occurred within 30 days after surgery were investigated because early PSDs may be related to preoperative nutrition. Severe PSDs that developed more than 30 days after surgery were only included if their initial onset was within 30 days after surgery.

Evaluation of preoperative nutritional status

Preoperative nutritional status was assessed by the CONUT, PNI, and GNRI. The CONUT score was determined by measuring serum albumin and total cholesterol levels, as well as the total lymphocyte count, as described previously [5]. The normal cutoffs for serum albumin, total cholesterol, and total lymphocytes were 3.5 g/dL, 180 mg/dL, and 1600/mm^3, respectively. PNI was calculated by inputting the serum albumin level and total lymphocyte count into the following formula: (1) $10 \times serum\ albumin\ value\ (g/dL) + 0.005 \times peripheral\ lymphocyte\ count\ (per\ mm^3)$ [9]. If the total yielded by equation (1) was less than 40, a PNI score of 1 was assigned; this was indicative of a severe nutritional disorder, while a PNI score of 0 reflected a normal preoperative nutritional status. GNRI was calculated by inputting the serum albumin level and both the actual and ideal body weights into the following formula: (2) $1.489 \times albumin\ (g/L) + 41.7 \times (actual\ body\ weight/ideal\ body\ weight)$ [10]. If the total yielded by equation (2) was >98, the nutritional status was defined as normal. Blood samples from all patients were obtained within 1 month prior to surgery.

Statistical analysis

Categorical variables are reported as the number and percentage of patients, and were compared via the Chi-square test or Fisher's exact test. Quantitative variables are reported as median and range. Univariate and multivariate analyses of patient and surgical characteristics were conducted to compare cases with and without PSDs, as well as non-severe PSDs with severe PSDs (based on the ABCD-stoma score). Age, sex, BMI, DM, preoperative treatment, PNI, GNRI, CONUT, operation time, blood loss, approach type, stoma type, and stoma position were used as the independent factors for both comparisons. The multivariate analysis was performed using logistic regression with the backward stepwise method. Factors with $p < 0.10$ in the univariate analyses were included in separate multivariate analyses for all PSDs and severe PSDs. All statistical analyses were performed using SPSS (version 22.0; SPSS Inc., Chicago, IL, USA), with the level of statistical significance set at $P < 0.05$.

Results

Of the 116 patients, 83 were men (71.6%) and 33 were women (28.4%). The median age was 66 (39–88) years, and the median BMI was 22.0 (14.0–40.9) kg/m^2. DM was present in 16 patients (13.8%), and 41 (35.3%) had received preoperative treatment, including neoadjuvant chemotherapy or chemoradiotherapy. Laparoscopic and open approaches were performed in 85 (73.30%) and 31 (26.7%) patients, respectively. Stoma types comprised ileostomy in 63 patients (54.3%) and colostomy in 53 patients (45.7%). Upper and lower abdominal stomas were used in 21 (18.1%) and 95 (81.9%) patients, respectively. Patient characteristics are shown in Table 1.

PSDs were diagnosed in 32 patients (27.6%) at a median of 12.0 (1.0–29.0) postoperative days. The approach type (p = 0.033) and stoma type (p = 0.006) were significantly associated with PSDs in the univariate analysis (Table 2). The laparoscopic approach (odds ratio [OR], 3.221; 95% confidence interval [CI], 1.001–10.362; p = 0.050) and ileostomy (OR, 3.394; 95% CI, 1.349–8.535; p = 0.009) were independent risk factors for all PSDs in the multivariate analysis.

Severe PSDs (based on an ABCD-stoma score ≥4) were diagnosed in 10 patients (8.7%) at a median of 20.5 (14.0–37.0) postoperative days. The CONUT score (p = 0.006) was the only factor significantly associated with severe PSDs in the univariate analysis (Table 3), and remained so in the multivariate analysis (OR, 11.298; 95% CI, 1.382–92.373; p = 0.024).

Discussion

The results of this study indicated that severe PSDs were strongly associated with preoperative nutritional disorders, as evaluated by the CONUT score. Furthermore, severe PSDs occurred in patients with stoma and preoperative nutritional disorders, regardless of stoma type. While ileostomy was a significant predictor of PSDs, supporting the results of prior studies, almost all of these associated PSDs were non-severe. These findings highlight the importance of stoma care, and that clinicians should be especially vigilant in the prevention of PSDs in cases of ileostomy and poor preoperative nutritional status. Additionally, severe PSDs may be prevented by the appropriate management of preoperative nutritional disorders.

Preoperative nutritional disorders evaluated via the CONUT score were associated with severe PSDs. Nutritional deficiencies are a well-established cause of skin disorders [11]. Although the skin functions normally when adequate nutrition is provided, a deficiency of essential fatty acids increases epidermal permeability and transepidermal water loss [12]. As a result, the skin becomes vulnerable to mechanical stimulation, such as that which occurs during stoma appliance replacement and drainage of feces; the changing of stoma appliances requires a pulling force to remove the pouch system, which is attached to the skin with an adhesive paste. This leads to the removal of the stratum corneum [13], and severe PSDs can result from the separation of the epidermis from the dermis, particularly when skin function is impaired due to a poor nutritional status. While initial changes may only comprise peristomal skin erythema, prolonged mechanical damage can result in erosion, ulceration, and blistering [14]. Additionally, nutritional disorders can hinder the recovery of skin damage and increase the risk of severe PSDs. This may account for our observation that nutritional disorders (as evaluated by the CONUT score) were only significantly associated with severe PSDs, and not all PSDs (including both mild and severe PSDs). Our results indicate that the CONUT score is a useful and cost-effective method for the objective and comprehensive evaluation of a patient's nutritional status. Furthermore, it may be used to predict the severity of postoperative PSD.

In preoperative nutritional evaluations, only CONUT scores were associated with severe PSDs. The lipid bilayer of the stratum corneum has an important role in the barrier function of the skin, and requires ceramides, which are naturally occurring lipids [15]. Ceramides are essential for the prevention of transepidermal water loss, as they fuse corneocytes in the stratum corneum, thus forming a protective layer. In contrast to other nutritional indices such as PNI and GNRI, the CONUT score includes the cholesterol level as a lipid indicator. Therefore, only preoperative CONUT scores, including the indicator of a lipid involved in an important role in the barrier function of the skin, were associated with severe PSDs.

Ileostomy was associated with both mild and severe PSDs, supporting the results of previous studies [16,17]; the majority of these PSDs were not severe. Ileostomy commonly results in PSDs, as the liquid removed from the stoma contains a highly active and caustic soft stool, which has digestive and proteolytic enzymes; furthermore, frequent changes in stoma appliance are required [18]. Nevertheless, severe PSDs were documented with both ileostomy and colostomy. PSDs in cases involving ileostomy generally improve without the development of severe PSDs in patients with a normal nutritional status, as all skin functions are in intact. However, increased vigilance is required to monitor the development of severe PSDs in patients with preoperative nutritional disorders, regardless of the type of stoma created. Preventive management should not only include the selection of appropriate appliances and the use of ceramide-containing skin protectants to minimize damage to the skin [3], but also interventions to improve preoperative nutritional status.

The present study had several limitations. First, it utilized a single-center retrospective design, and the sample size was relatively small, especially for severe PSDs. Further studies with larger sample sizes are required to clarify the association between PSDs and nutritional status. Second, information on the number of stoma leaks, appliance replacements, and stoma height were not available in the medical records; these factors have been previously associated with PSDs. Third, we could not directly evaluate the relationship between the preoperative skin condition and nutrition, as the former was not adequately evaluated and documented in the clinical records. Nonetheless, the results of this study indicate that the CONUT score can be used to facilitate the identification of patients at a high risk of severe PSDs, who require nutritional intervention.

In conclusion, severe PSDs were strongly associated with preoperative nutritional disorders, as evaluated by the CONUT score. Furthermore, severe PSDs occurred in stoma patients with preoperative nutritional disorders, regardless of stoma type. While PSDs were significantly associated with ileostomy, the majority were not severe. Our findings emphasize the importance of stoma care, and that clinicians should be especially vigilant in the prevention of PSDs in cases of ileostomy and poor preoperative nutritional status.

Declarations

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Conflicts of interest/Competing interests: The authors have no conflicts of interest to declare that are relevant to the content of this article.

Ethics approval: This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Institutional Review Board of Gunma University Hospital (approval no. HS2020-196). Patients were not required to give informed consent to the study because the analysis used anonymous clinical data. And also, we applied Opt-out method to obtain consent on this study by using information disclosure document. The document was approved by the Institutional Review Board of Gunma University Hospital.

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Figure legends

Fig. 1 Peristomal skin disorders diagnosed according to the ABCD-stoma score. (a) Erosion on the upper side of the area near the stoma, where the skin barrier has dissolved (score: 2, non-severe peristomal skin disorders). (b) Erosion on the right side of the area near the stoma, where the skin barrier has dissolved. Erosion is observed in the region contacting the ostomy appliance (score: 4, severe peristomal skin disorders)

Table 1. Characteristics of patients

		N = 116
Sex, N (%)	Male	83 (71.6)
	Female	33 (28.4)
Age, median (range), years		66 (39–88)
Body mass index, median (range), kg/m^2		22.0 (14.0–40.9)
Diabetes mellitus, N (%)	Absence	100 (86.28)
	Presence	16 (13.8)
Preoperative treatment, N (%)	Absence	75 (64.7)
	Presence	41 (35.3)
cStage, N (%)	I	40 (34.5)
	II	30 (25.9)
	III	40 (34.5)
	IV	6 (5.2)
Operation type, N (%)	High anterior resection	4 (3.4)
	Low anterior resection	51 (44.0)
	Intersphincteric resection	14 (12.1)
	Hartmann	7 (6.0)
	Abdominal perineal resection	33 (28.4)
	Total pelvic exenteration	6 (5.2)
	Total colectomy	1 (0.9)
Approach type, N (%)	Laparoscopy	85 (73.3)
	Open	31 (26.7)
Operation time, median (range), minutes		424.5 (146.0–809.0)
Blood loss, median (range), mL		195 (0–5507)
Stoma type, N (%)	Ileostomy	63 (54.3)
	Colostomy	53 (45.7)
Temporary stoma, N (%)		71 (61.2)
Stoma position, N (%)	Upper abdomen	21 (18.1)
	Lower abdomen	95 (81.9)
Adjuvant chemotherapy, N (%)	Absence	80 (69.0)
	Presence	36 (31.0)

Table 2. Risk factors for all peristomal skin disorders

		No PSDs, N = 84	PSDs, N = 32	Univariate analysis	Multivariate analysis	
				p	OR (95% CI)	p
Sex, N (%)	Male	60 (71.4)	23 (71.9)	0.962		
	Female	24 (28.6)	9 (28.1)			
Age, N (%)	<65 years	36 (42.9)	13 (40.6)	0.828		
	≥65 years	48 (57.1)	19 (59.4)			
Body mass index, N (%)	<22 kg/m^2	39 (46.4)	21 (65.6)	0.064		
	≥22 kg/m^2	45 (53.6)	11 (34.4)			
Diabetes mellitus, N (%)	Absence	73 (86.9)	27 (84.4)	0.466		
	Presence	11 (13.1)	5 (15.6)			
Preoperative treatment, N (%)	Absence	52 (61.9)	23 (71.9)	0.315		
	Presence	32 (38.1)	9 (28.1)			
PNI, N (%)	≤40	33 (39.3)	13 (40.6)	0.895		
	>40	51 (60.7)	19 (59.4)			
GNRI, N (%)	Normal	60 (71.4)	26 (81.3)	0.280		
	Low-severe	24 (28.6)	6 (18.8)			
CONUT score, N (%)	Normal	43 (51.2)	17 (53.1)	0.852		
	Light-severe	41 (48.8)	15 (46.9)			
Operation time, N (%)	<360 minutes	32 (38.1)	12 (37.5)	0.953		
	≥360 minutes	52 (61.9)	20 (62.5)			
Blood loss, N (%)	<100 mL	25 (29.8)	14 (43.8)	0.154		

	≥100 mL	59 (70.2)	18 (56.3)			
Approach type, N (%)	Laparoscopy	57 (67.9)	28 (87.5)	0.033	3.221 (1.001–10.362)	0.050
	Open	27 (32.1)	4 (12.5)			
Stoma type, N (%)	Ileostomy	39 (46.4)	24 (75.0)	0.006	3.394 (1.349–8.535)	0.009
	Colostomy	45 (53.6)	8 (25.0)			
Stoma position, N (%)	Upper abdomen	14 (16.7)	7 (21.9)	0.515		
	Lower abdomen	70 (83.3)	25 (78.1)			

PSDs, peristomal skin disorders; OR, odds ratio; CI, confidence interval; PNI, prognostic nutritional index; GNRI, geriatric nutritional risk index; CONUT, Controlling Nutritional Status

Table 3. Risk factors for severe peristomal skin disorders

		Non-severe PSDs, N = 106	Severe PSDs, N = 10	Univariate analysis	Multivariate analysis	
				p	OR (95% CI)	p
Sex, N (%)	Male	75 (70.8)	8 (80.0)	0.418		
	Female	31 (29.2)	2 (20.0)			
Age, N (%)	<65 years	47 (44.3)	2 (20.0)	0.123		
	≥65 years	59 (55.7)	8 (80.0)			
Body mass index, N (%)	<22 kg/m^2	53 (50.0)	7 (70.0)	0.191		
	≥22 kg/m^2	53 (50.0)	3 (30.0)			
Diabetes mellitus, N (%)	Absence	92 (86.8)	8 (80.0)	0.415		
	Presence	14 (13.2)	2 (20.0)			
Preoperative treatment, N (%)	Absence	70 (66.0)	5 (50.0)	0.248		
	Presence	36 (34.0)	5 (50.0)			
PNI, N (%)	≤40	43 (40.6)	3 (30.0)	0.384		
	>40	63 (59.4)	7 (70.0)			
GNRI, N (%)	Normal	79 (74.5)	7 (70.0)	0.505		
	Low-severe	27 (25.5)	3 (30.0)			
CONUT score, N (%)	Normal	59 (55.7)	1 (10.0)	0.006	11.298 (1.382–92.373)	0.024
	Light-severe	47 (44.3)	9 (90.0)			
Operation time, N (%)	<360 minutes	39 (36.8)	5 (50.0)	0.310		
	≥360 minutes	67 (63.2)	5 (50.0)			
Blood loss, N (%)	<100 mL	37 (34.9)	2 (20.0)	0.282		

	≥100 mL	69 (65.1)	8 (80.0)	
Approach type, N (%)	Laparoscopy	78 (73.6)	7 (70.0)	0.531
	Open	28 (26.4)	3 (30.0)	
Stoma type, N (%)	Ileostomy	57 (53.8)	6 (60.0)	0.485
	Colostomy	49 (46.2)	4 (40.0)	
Stoma position, N (%)	Upper abdomen	87 (82.1)	2 (20.0)	0.574
	Lower abdomen	19 (17.9)	8 (80.0)	

PSDs, peristomal skin disorders; OR, odds ratio; CI, confidence interval; PNI, prognostic nutritional index; GNRI, geriatric nutritional risk index; CONUT, Controlling Nutritional Status