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Impact and outcomes of nutritional support team intervention in patients with gastrointestinal disease in the intensive care unit

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Abstract

Nutritional support has become an important intervention for critically ill patients. Many studies have reported on the effects of nutritional support for the patients within the intensive care unit (ICU); however, no studies have specifically assessed patients with gastrointestinal diseases who may have difficulty absorbing enteral nutrition (EN) in the ICU.

Sixty-two patients with gastrointestinal disease were admitted to the ICU between August 2014 and August 2016 at a single tertiary university hospital. We analyzed 2 different patient groups in a retrospective cohort study: those who received nutritional support team (NST) intervention and those who did not.

Forty-four (71.0%) patients received nutritional support in ICU and 18 (29.0%) did not. Variables including male sex, high albumin or prealbumin level at the time of ICU admission, and short transition period into EN showed statistically significant association with lower mortality on the univariate analysis (all $P < .05$). Multivariate analysis revealed that longer length of hospital stay ($P = .013$; hazard ratio [HR], 0.972; 95% confidence interval [CI], 0.951–0.994), shorter transition into EN ($P = .014$; HR, 1.040; 95% CI, 1.008–1.072), higher prealbumin level ($P = .049$; HR, 0.988; 95% CI, 0.976–1.000), and NST intervention ($P = .022$; HR, 0.356; 95% CI, 0.147–0.862) were independent prognostic factors for lower mortality.

In conclusion, NST intervention related to early initiated EN, and high prealbumin levels are beneficial to decrease mortality in the acutely ill patients with GI disease.

Abbreviations: BMI = body mass index, CI = confidence interval, EN = enteral nutrition, GI = gastrointestinal, HR = hazard ratio, ICU = intensive care unit, IQR = interquartile range, LOS = length of stay, NRS = nutritional risk screening, NS = nutritional support, NST = nutritional support team, PN = parenteral nutrition, SNSI = severance nutrition screening index.

Keywords: gastrointestinal disease, intensive care unit, nutritional support team, prognostic factor

1. Introduction

Nutritional support (NS) has received increasing attention and is now considered a crucial intervention for critically ill patients,[1] who are commonly described as patients with systemic inflammatory diseases accompanied by dysfunction of multiple organs, extended hospital stay, increased morbidity due to infection, and even mortality.[2] NS for critically ill patients is conventionally seen as supplemental care for the purpose of providing exogenous fuels to maintain lean body mass and supporting the patient during a stress response. In recent years, many advances have been made to nutrition therapy, and feeding is thought to help prevent oxidative cellular injury, lessen the metabolic response to stress, and favorably regulate immune responses.[2] Sigalet et al summarized the mechanistic relationships between enteral feeding (EN) and immunity.[3] In addition, they reported that extensive immunological changes within the bowel system, including the population of immune cells, cytokine profile, and secretory IgA production, can be accomplished by nutrition support with total parenteral nutrition. Among the available routes, EN has gained favor due to the fact that it can be used to provide metabolic substrates and possibly adjust the role of the gastrointestinal (GI) tract in the systemic inflammatory response[4,5] by enabling our body to keep the nonspecific immune barriers in the enteric system which include enterocytes, local microflora, tight junctions, gut-associated lymphoid tissue, and systemic immunity through extraintestinal mucosa-associated lymphoid tissue.[3] Early EN, appropriate macro- and micronutrient delivery, and meticulous glycemic control can improve the clinical course of critical illness.[2] A proactive therapeutic strategy to provide early nutrition support, mainly by the enteral route, may decrease disease severity, reduce complications, shorten length of stay (LOS) in

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the intensive care unit (ICU), and favorably impact patient outcomes.[2]

Several previous studies have shown the effects of nutritional support on clinical outcomes for patients at nutritional risk,[6,7] thus demonstrating the importance of useful nutritional parameters and a nutritional support team (NST) approach to avoid the risk of malnutrition[1,8] in critically ill patients within the ICU. NST as a standardized feeding approach has been shown to both increase appropriate macro- and micronutrient delivery and minimize risks.[9,10] As an example, a decision-tree format was utilized by Schwartz[11] as a method to improve interdisciplinary performances through communicating NS strategies to clinicians in their local hospitals. This approach improved NS practice, which lead to cost savings and quality improvement. As far as we know, however, no studies have focused on the impact and outcomes of NST intervention in patients with GI disease in the ICU. Nutritional intake is pivotal and needs to be carefully managed through EN, especially for patients with GI bleeding, acute pancreatitis, inflammatory bowel disease, and GI malignancy who are at greater risk of nutritional deficiency.[2,12] The present study was designed to evaluate the effect of NST intervention on clinical outcomes in patients with GI disease in the ICU.

2. Materials and methods

2.1. Patients

Between August 2014 and August 2016, we retrospectively reviewed 15,178 files of patients admitted to the ICU at the Severance Hospital, Yonsei University College of Medicine, Seoul, Korea. Among them, 127 patients admitted to the ICU for GI diseases, and 65 patients were excluded from our study for the reasons following; transferred to other departments during ICU admission (n=32); required surgery and postoperative care (n=5); and expired within 7 days (n=28) (Fig. 1). Finally, 62 patients were selected. All patients admitted to the ICU are routinely subject to NST collaboration.

The NST has been reimbursed since August 2014, when the national insurance for NST was initiated in Korea. From July 2015 to February 2016, NST activity had been temporarily suspended due to personnel shortages at the hospital, and the patients admitted to ICU at that time were classified as the control group. This study was performed in accordance with the ethical guidelines of the 1975 Declaration of Helsinki and approved by the institutional review board of Severance Hospital.

2.2. Baseline characteristics

The baseline characteristics of the patients were obtained, including demographics; comorbidities; body mass index (BMI); ventilator care; transition period into EN; nutritional requirements including total calories (kcal/d), protein, and real nutritional supplement at ICU admission; nutritional risk; laboratory findings such as serum albumin, protein, glucose, and prealbumin levels; length of ICU stay; and mortality.

2.3. Nutritional support team

Our hospital has a NST consisting of nurses, dietitians, pharmacists, and physicians.[13] They are specialized for advanced nutritional assessment including proper nutritional risk and counseling. Especially when the patients are admitted to ICU, they are required to consult with NST, and the dietitians attend the rounding every morning to identify the patients. Therefore, when the physicians consult with NST, nurse, dietitian, pharmacist, and specialized physicians, specific questions such as the nutritional requirement and recommendation for proper fluid, nutrients, and proper timing to EN could be answered quickly. We strictly followed the protocols and applied them to the patients.[13,14]

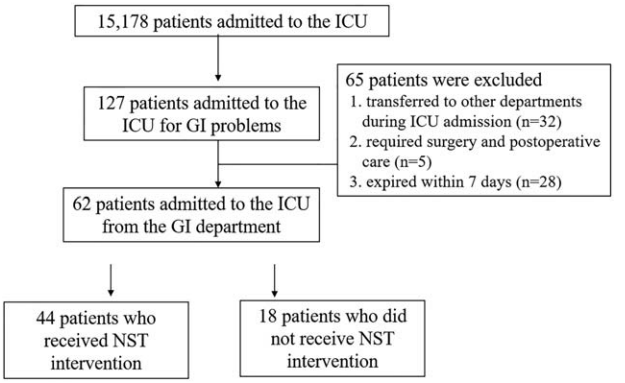

Figure 1. Flow diagram of patient enrollment. A total of 127 patients admitted to the ICU for GI disease, and 65 patients were excluded. Finally, 62 patients were selected for the statistical analysis. GI=gastrointestinal, ICU=intensive care unit.

2.4. Nutritional risk screening

2.4.1. NRS-2002. To evaluate nutritional risk, we used the Nutritional Risk Screening (NRS)-2002, which is recommended by the European Society of Parenteral and Enteral Nutrition for nutritional screening in hospitalized patients.[15] Following the protocols from the NRS-2002, all the patients were examined for nutritional status and disease severity within 24 hours after admission. Calculations for the NRS score were performed by summation of the nutritional status score of 0 to 3 and the severity of disease score of 0 to 3, and additional 1 point was added for patients who were ≥70 years.[15] The 3 determinants of the nutritional status score are the quartiles of diminished oral food intake in the week before admission, a low BMI score with compromised condition in general, and weight loss of at least 5% during the past 1 to 3 months. The severity of disease status was classified as none, slight, moderate, or severe with scores of 0 to 3, respectively. The total NRS score ranges from 0 to 7. According to recommendations by Kondrup et al, an NRS score ≥3 indicates a patient who is nutritionally at risk, and a NRS score <3 means there is no nutritional risk.[7,15]

2.4.2. Severance nutrition screening index. The severance nutrition screening index (SNSI) is a new nutrition screening tool and validated for 2 medical and 2 surgical wards patients for use in tertiary hospitals.[16] The SNSI was calculated as follows: SNSI = 1.5 × albumin + 1.0 × BMI + 4.5 × intake change + 1.5 × weight loss (for albumin <3.0, BMI <20, and decreased intake and weight loss >5% of usual body weight) (Table 1).

Intake change was scored as 1 (no change or increase in intake) or 2 (decrease). Weight loss was determined by using the previous month's weight as the base and scored as 1 (no change, increased or decrease <5% of usual body weight) or 2 (decrease ≥5%). Serum albumin was scored as 1 (≥3.5 g/dL) or 2 (<3.5 g/dL) and BMI as 1 (≥20 kg/m^2) or 2 (<20 kg/m^2) (Table 1).[16]

Table 1

Model of the newly developed SNSI[16].

Variable	Value
SNSI	Model = (1.5 s-alb) + (1.0 BMI) + (4.5 food intake change) + (1.5 weight change)
Albumin, g/dL	≥3.5 = 1, <3.5 = 2
BMI, kg/m^2	≥20 = 1, <20 = 2
Food intake change	No change or increase = 1, decrease = 2
Weight change	No change, increase, or decrease <5% of usual body weight = 1, decrease ≥5% = 2

BMI = body mass index, s-alb = serum albumin, SNSI = severance nutrition screening index.

2.4.3. Statistical analysis. Variables are expressed as median (interquartile range, IQR) or n (%). The baseline characteristics were compared using independent Student *t* tests (or Mann–Whitney *U* tests) for continuous variables, and chi-squared tests (or Fisher exact tests) were used for categorical variables, as appropriate. The overall survival rates were analyzed using the Kaplan–Meier method and compared with log-rank tests. Independent predictors of mortality were analyzed using Cox proportional hazard regression analysis. Hazard ratios (HRs) and the corresponding 95% confidence intervals (CIs) were calculated. Data analysis was performed with SPSS software (version 20.0; SPSS Inc., Armonk, NY). A *P*-value <.05 was considered statistically significant.

3. Results

3.1. Patient characteristics

A total of 62 patients were admitted to the ICU via the GI department between August 2014 and August 2016. The median age (64 years [IQR, 55–74] vs 71 years [IQR, 61–76]), male sex (68.2% vs 55.6%), BMI (22.7 kg/m^2 [IQR, 20.1–26.0] vs 23.9 kg/m^2 [IQR, 20.5–25.9]), and laboratory findings at ICU admission and at discharge from the ICU were not significantly different between the NST intervention group (n = 44) and the control group (n = 18) (all $P > .05$). Nutritional risk screening tools such as the median NRS-2002 score ($P = .628$, 4.0 [IQR, 3–5] vs 4.0 [IQR, 3–5]) and SNSI score ($P = .416$, 11.0 [IQR, 10.0–14.5] vs 13.0 [IQR, 10.0–14.7]) did not reveal significant differences between the groups. Additionally, the nutritional requirements including EN and parenteral nutrition (PN) were high for both the NST intervention group and control group (1400 kcal/d [IQR, 1300–1600] vs 1489 kcal/d [IQR, 1310–1646], $P = .695$). The actual nutritional supplementation at ICU admission was low for both group (355 kcal/d [IQR, 206–930] vs 340 kcal/d [IQR 330–1048], $P = .900$). Other baseline characteristics were not significantly different between the 2 groups (Table 2).

3.2. Reasons for ICU admission for GI patients

The most common reason for ICU admission was septic shock (43.5%), followed by GI bleeding (38.7%), liver-related cause

Table 2

Clinical characteristics of GI patients in the ICU.

Variables	Total (n = 62)	NST group (n = 44, 71.0%)	No intervention group (n = 18, 29.0%)	*P*-value*
Male sex, n (%)	40 (64.5)	30 (68.2)	10 (55.6)	.346
Age, y	68 (58–75)	64 (55–74)	71 (61–76)	.121
BMI, kg/m^2	22.9 (20.3–25.8)	22.7 (20.1–26.0)	23.9 (20.5–25.9)	.111
Underlying disease, n (%)				
Hypertension	30 (48.4)	18 (40.9)	12 (66.7)	.065
Diabetes	31 (50.0)	23 (52.3)	8 (44.4)	.576
Hepatitis	14 (22.6)	9 (20.5)	5 (27.8)	.531
Ventilator care, n (%)	40 (64.5)	28 (63.6)	12 (66.7)	.821
Length of ICU stay, d	7 (3–11)	7 (3–13)	7 (3–10)	.485
Laboratory findings				
Albumin at ICU admission, g/dL	2.6 (2.3–2.9)	2.6 (2.3–3.0)	2.6 (2.3–2.9)	.426
Albumin at ICU discharge, g/dL	2.7 (2.4–3.0)	2.7 (2.4–3.1)	2.7 (2.3–2.9)	.307
Protein at ICU admission, g/dL	5.1 (4.7–6.0)	5.1 (4.8–6.0)	5.1 (4.5–6.4)	.989
Protein at ICU discharge, g/dL	5.3 (4.7–6.0)	5.2 (4.7–6.1)	5.4 (4.8–5.9)	.892
Glucose at ICU admission, mg/dL	163 (117–228)	163 (116–251)	157 (125–200)	.283
Glucose at ICU discharge, mg/dL	138 (112–178)	140 (111–183)	131 (113–163)	.702
Cholesterol, mg/dL	96 (78–130)	97 (76–139)	94 (76–126)	.552
Prealbumin, mg/L	90 (75–120)	90 (71–120)	90 (83–116)	.642
Number of patients who have stopped feeding, n (%)	58 (93.5)	41 (93.2)	17 (94.4)	.854
Nutritional requirements				
Total kcal/d	1431 (1300–1600)	1400 (1300–1600)	1489 (1310–1646)	.695
Protein, g	62 (53–71)	63 (52–75)	61 (53–66)	.097
Nutritional supplement at ICU admission				
Total kcal/d	340 (284–955)	355 (206–930)	340 (330–1048)	.900
Protein, g	18 (0–49)	29 (0–49)	22 (0–49)	.129
Carbohydrate, g	100 (50–100)	100 (74–100)	100 (50–103)	.787
Lipid, g	41 (34–45)	41 (34–42)	45 (7–45)	.568
NRS-2002	4 (3–5)	4 (3–5)	4 (3–5)	.628
SNSI	11.0 (10.0–14.5)	11.0 (10.0–14.5)	13.0 (10.0–14.7)	.416

Data are expressed as median (interquartile range) or n (%).

BMI = body mass index, GI = gastrointestinal, ICU = intensive care unit, NRS = nutritional risk screening, NST = nutritional support team, SNSI = severance nutrition screening index.

* *P*-value for comparing patients with NST group and no intervention group.

Table 3

Reasons for ICU admission for GI patients.

Variable	Total (n = 62)	NST group (n = 44, 71.0%)	Control group (n = 18, 29.0%)	*P*-value*
Reasons for ICU admission				.104
GI bleeding	24 (38.7)	20 (45.5)	4 (22.2)	
Liver-related causes	8 (12.9)	3 (6.8)	5 (27.8)	
Septic shock	27 (43.5)	19 (43.2)	8 (44.4)	
Others (seizure, perforation)	3 (4.8)	2 (4.5)	1 (5.6)	

Data are expressed as n (%).

GI = gastrointestinal, ICU = intensive care unit, NST = nutritional support team.

* *P*-value for comparing patients with NST group and no intervention group.

(12.9%), and others including seizure, perforation (4.8%) (Table 3). The reasons for ICU admissions were not significantly different between the NST and control groups ($P = .104$)

3.3. Diagnosis for patients in the ICU

We evaluated the primary diagnoses of all patients in our study population. The most common was malignancy (38.7%), followed by liver cirrhosis (38.7%), inflammation (pancreatitis, colitis, cholangitis, and liver abscess) (11.3%), peptic ulcer disease (8.1%), and intestinal perforation or stricture (3.2%) (Table 4).

3.4. Relative risk of mortality

On the univariate analysis, variables including male sex (HR, 0.486; 95% CI, 0.245–0.964; $P = .039$), longer transition period into EN (HR, 1.023; 95% CI, 1.002–1.046; $P = .034$), lower serum albumin at ICU admission (HR, 0.513; 95% CI, 0.268–0.981; $P = .043$), and lower prealbumin levels (HR, 0.988; 95% CI, 0.978–0.998; $P = .022$) were significantly associated with mortality risk (Table 5). On multivariate analysis, along with variables including male sex, age, BMI, and albumin at the time of ICU admission, we found that longer length of hospital stay (adjusted HR, 0.972; 95% CI, 0.951–0.994; $P = .013$), shorter transition period into EN (adjusted HR, 1.040; 95% CI, 1.008–1.072; $P = .014$), high prealbumin levels (adjusted HR, 0.988; 95% CI, 0.976–1.000; $P = .049$), and NST intervention (adjusted HR, 0.356; 95% CI, 0.147–0.862; $P = .022$) were associated with lower mortality (Table 5).

The median follow-up period was 95 days (IQR, 20–490 days). However, cumulative survival rate was not significantly different between NST group and control group ($P = .199$) (Fig. 2).

Table 4

Diagnoses for patients in the ICU.

Variable	Total (n = 62)	NST intervention group (n = 44, 71.0%)	Control group (n = 18, 29.0%)	*P*-value*
Malignancy, n (%)	24 (38.7)	19 (43.2)	5 (27.8)	.258
Hepatocellular carcinoma	9 (14.5)	7 (15.9)	2 (11.1)	
Pancreatic cancer	8 (12.9)	6 (13.6)	1 (5.6)	
Cholangiocarcinoma	1 (1.6)	0 (0)	1 (5.6)	
Gallbladder cancer	1 (1.6)	1 (2.3)	0 (0)	
Esophageal cancer	1 (1.6)	1 (2.3)	0 (0)	
Stomach cancer	2 (3.2)	3 (6.8)	0 (0)	
Colon cancer	2 (3.2)	1 (2.3)	1 (5.6)	
Liver cirrhosis, n (%)	24 (38.7)	16 (36.4)	8 (44.4)	.553
Inflammation, n (%)	7 (11.3)	3 (6.8)	4 (22.2)	.082
Pancreatitis	2 (3.2)	0 (0)	2 (11.1)	
Colitis	3 (4.8)	2 (4.5)	1 (5.6)	
Cholangitis	1 (1.6)	1 (2.3)	0 (0)	
Liver abscess	1 (1.6)	0 (0)	1 (5.6)	
Others, n (%)	7 (11.3)	6 (13.6)	1 (5.6)	.361
Peptic ulcer disease	5 (8.1)	5 (11.4)	0 (0)	
Intestinal perforation or stricture	2 (3.2)	1 (2.3)	1 (5.6)	

Data are expressed as n (%).

ICU = intensive care unit, NST = nutritional support team.

* *P*-value for comparing patients with NST group and no intervention group.

Table 5

Relative risk of mortality.

	Univariate analysis		Multivariate analysis	
Variable	*P*-value	HR (95% CI)	*P*-value	Adjusted HR (95% CI)
Male sex	.039	0.486 (0.245–0.964)	.459	0.740 (0.333–1.645)
Age, y	.298	1.015 (0.987–1.043)	.472	1.014 (0.976–1.053)
BMI, kg/m^2	.553	0.981 (0.921–1.045)	.511	0.978 (0.915–1.045)
Length of ICU stay, d	.397	1.011 (0.985–1.039)		
Length of hospital stay	.204	0.990 (0.974–1.006)	.013	0.972 (0.951–0.994)
Transition period into EN	.034	1.023 (1.002–1.046)	.014	1.040 (1.008–1.072)
Ventilator care	.374	1.390 (0.673–2.871)		
Underlying disease				
Hypertension	.120	1.741 (0.866–3.501)		
Diabetes	.746	1.120 (0.564–2.225)		
Hepatitis	.734	1.148 (0.518–2.546)		
Laboratory findings				
Albumin at ICU admission, g/dL	.043	0.513 (0.268–0.981)	.427	0.703 (0.294–1.677)
Albumin at ICU discharge, g/dL	.921	0.959 (0.415–2.216)		
Protein at ICU admission, g/dL	.527	0.899 (0.647–1.250)		
Protein at ICU discharge, g/dL	.871	1.033 (0.695–1.536)		
Glucose at ICU admission, mg/dL	.381	0.998 (0.995–1.002)		
Glucose at ICU discharge, mg/dL	.137	1.003 (0.999–1.006)		
Cholesterol, mg/dL	.257	0.995 (0.986–1.004)		
Prealbumin, mg/L	.022	0.988 (0.978–0.998)	.049	0.988 (0.976–1.000)
Diagnosis of ICU patients				
Cancer	.218	1.0 (Ref.)		
Liver cirrhosis	.168	0.589 (0.278–1.249)		
Inflammation	.125	0.316 (0.072–1.377)		
Other	.162	0.414 (0.120–1.427)		
NST	.205	0.631 (0.309–1.286)	.022	0.356 (0.147–0.862)

BMI = body mass index, CI = confidence interval, EN = enteral nutrition, HR = hazard ratio, ICU = intensive care unit, NST = nutritional support team.

4. Discussion

Our results showed that patients with GI disease in the ICU who had a longer hospital stay, shorter transition period into EN, higher prealbumin level, and NST intervention had a lower mortality. Patients in the ICU are sedated, ventilated, and

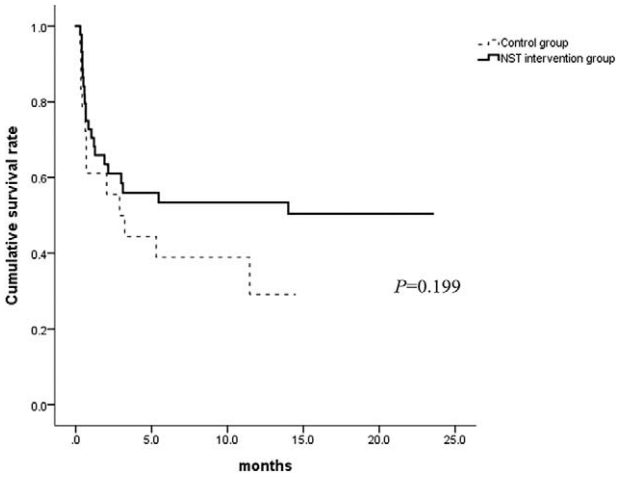

Figure 2. Cumulative survival rate between NST intervention group and control group (Kaplan–Meier graph). NST = nutritional support team.

sufficiently disabled so that volitional oral feeding is either impossible or unlikely to successfully meet nutrient requirements.[17] Additionally, critically ill patients often have more risks for malnutrition, with high mortality and morbidity rates[8] due to increased metabolic needs and the tendency for underfeeding.[18] These factors can predispose to a systemic inflammatory response, which increases muscle protein catabolism and moderately increases energy expenditure.[19] Several studies have shown favorable effects of NS for patients who are at nutritional risk within the ICU.[6,7]

According to the systemic review from DeLegge and Kelley,[14] many hospitals and other organizations in the healthcare field have been gradually reducing the number of NSTs lately even with their proven efficacy through literature, because they try to find ways to lower expenses. According to the 2008 survey by the American Society for Parenteral and Enteral Nutrition (ASPEN), only 42% of the respondents, who practice in a hospital setting, reported that they had official NSTs. This shows a gradual decrease, because 44% and 65% of participants reported that they had formal NSTs in years 2005 and 1995, respectively.[20,21] Unlike this misconception with formal NSTs causing increased costs with minimal benefits, many studies[22,23] actually showed that when a proper management is done by an NST, there are significant improvements in the nutritional status of patients and in clinical outcomes, and it even leads to reductions in the expenses for hospitals.[14] Based on these findings, NST intervention for critically ill patients with GI disease would be expected to reduce mortality and morbidity. Martin et al[24] performed a multicenter, cluster-randomized clinical trial that compared characteristics between patients from 7 control hospitals (n = 214) and 7 nutrition intervention hospitals (n = 248). Those treated at intervention hospitals showed a trend toward reduced mortality. Malnutrition is often accompanied by serious clinical and other consequences which may include financial cost, extended LOS, infection, and increased morbidity and mortality rates.[25–27] In addition, factors including late initiation of EN, slow advancement of infusion rate, underprescription, dysfunction of gastrointestinal system, failure in proper delivery of prescribed nutrition, and interruption of EN may all lead to insufficient enteral feeding.[25,28]

The Society of Critical Care Medicine (SCCM) and ASPEN recently reported new guidelines for nutrition support therapy in critically ill adult patients.[2] They have suggested determining nutrition risk using methods such as NRS-2002 for all patients admitted to the ICU for whom volitional intake is anticipated to be insufficient. When screening methods identify patients at nutritional risk, they should be transitioned to EN early.[2] In our study population, the median NRS-2002 score was 4.0 (NRS score ≥3, high risk), and most of them received PN at initial admission in the ICU (n = 56). On the multivariate analysis, a longer transition period into EN was also determined to be an independent risk factor for mortality. The reason for the small number of patients (n = 6) who received EN in the ICU at admission was that most of patients suffered from GI bleeding (n = 24) or were intubated (n = 40) when first admitted. GI bleeding can be caused by peptic ulcer disease, variceal bleeding, and cancer bleeding, and EN is not recommended until it stops. As important as EN duration, prealbumin level is the earliest laboratory indicator of nutritional status and has emerged as the preferred marker for malnutrition because it correlates with patient outcomes in a wide variety of clinical conditions.[29] Patients who need aggressive NS can be monitored using the prealbumin level.[30] Our study confirmed that prealbumin level is an independent predictive factor of mortality and a useful indicator for effects of NS.

As far as we know, this is the first study to examine the impact of NST intervention on patients with GI disease in the ICU. Longer hospital stay, shorter transition period into EN, higher prealbumin levels, and NST were independent factors of reduced mortality. Our study also has limitations. Firstly, the design was retrospective with a relatively small sample size and heterogeneity of patients with diverse digestive system diagnoses who were treated at a single hospital which could leading to selection bias[31,32] and weak statistical power. Retrospective cohort study is not possible to establish causal effects caused by confounders,[31] and our study populations were too small to perform sensitivity analysis. Nevertheless, it is a large tertiary hospital with >2400 beds. Additionally, our cohort research design is unprecedented due to the unique hospital environment allowing comparison of the effect of NST on ICU patients in 1 center. Therefore, although the statistical power is weak, our study is meaningful to find the NST related factors as an exploratory purpose. Secondly, although we excluded patients who died within 7 days, most of them still had a short median length of ICU stay that hampered evaluation of the effect of NST intervention. However, NST was found to be beneficial even with a small patient number and relatively short ICU stay. This study, therefore, reminds GI physicians of the importance of NST. Prospective studies with improved designs are warranted to determine the effect of NST in patients with GI diseases, not only in ICU but also in general wards and outpatient clinics.

5. Conclusion

In conclusion, our results demonstrate that longer hospital stay, shorter transition period into EN, higher prealbumin levels, and NST intervention were influencing factors for lower mortality in patients with gastrointestinal disease in the ICU. This suggests that acutely ill adult patients with GI disease should be properly evaluated for nutrition risk, initiated early on EN, and undergo NST intervention.

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