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ORIGINAL ARTICLE

Preprocedural control of nutritional status score and prediction of early death after percutaneous endoscopic gastrostomy

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Abstract

Background and Aim: Percutaneous endoscopic gastrostomy (PEG) is often associated with early mortality. We therefore investigated factors associated with early death after PEG.
Methods: The present study comprised patients who had undergone PEG between April 2014 and March 2020. Patients were divided into two groups: an early mortality group who died within 1 month of PEG, and a non-mortality group whose clinical course could be followed for more than 1 month after the procedure. Patient background, hematological data, and procedural duration were compared between groups.
Results: Univariate analysis identified older age, high blood urea nitrogen (BUN), low prognostic nutritional index (PNI), and high controlling nutritional status (CONUT) score as factors associated with early death after PEG. In multivariate analysis, high CONUT score remained an independent prognostic factor ($P = 0.0035$).
Conclusion: A high CONUT score may be a prognostic factor for early mortality after PEG.

Introduction

In recent years, percutaneous endoscopic gastrostomy (PEG) has played an important role as a means of enteral nutrition in patients with feeding disorders, as happens following cerebrovascular disease. PEG is a minimally invasive procedure compared to surgical gastrostomy but has recognized complications that include mortality.[1–4] Previous studies have identified certain preexisting medical conditions and serological tests as prognostic factors for early mortality after PEG[5–10]; however, these results have been inconsistent between studies. Other studies have reported that preoperative nutritional status is associated with prognosis in patients undergoing gastrointestinal surgery.[11–15] Despite the inconsistent results of previous studies, the controlling nutritional status (CONUT) score,[16] a relatively new nutritional index, has been reported to have utility as a predictor of prognosis following surgery for various diseases and cancers.[13,14]

We therefore evaluated the CONUT score and other clinical parameters as risk factors for early mortality after PEG.

Methods

Subjects. This retrospective record review study comprised patients who had undergone PEG between April 2014 and March 2020. Patients were divided into two groups: The non-mortality group comprised patients who could be followed for more than 1 month after PEG, and the early mortality group comprised patients who died within 1 month of PEG. Patient background, hematological data, and procedural duration were compared between the groups. Eligibility criteria were patients with oral feeding difficulties and aged 20 years or older. Exclusion criteria were pharyngeal or esophageal obstruction, PEG for decompression, and post-gastrectomy patients. The present study was conducted with approval obtained in advance from the Ethics Committee of Toho University Ohashi Medical Center (approval number H22083-H22057). Information regarding the present study is available at the institution's website.

Table 1 Onodera's prognostic nutritional index (PNI)

PNI = 10 × Alb + 0005 × TLC

Alb, serum albumin (g/dl); TLC, total lymphocyte count (/μl).

Endoscopic procedure. All procedures were performed by one responsible physician (YY) with the assistance of another physician. In those who were under antithrombotic medication, the decision to continue or interrupt such medication before PEG, the timing of interruption if any, and the use of heparin bridges were based primarily on Japanese guidelines that became available in Japan in 2012.[17] In case of interruption, antithrombotic medications were resumed the day after PEG. All patients underwent PEG placement by the pull method using a One Step Button (24 Fr, 1.7–4.4 cm; Boston Scientific, Natick, MA, USA). Gastric wall fixation was not conducted in all cases. The catheter length was selected using a measuring device. All patients received a single dose of 1 g cefazolin if not receiving antibiotics for other reasons, with additional antimicrobial therapy administered in the event of systemic infection, including aspiration pneumonia or peritonitis. Patients with other complications were treated as appropriate.

Study design. Evaluated parameters included patient background such as age, sex, underlying diseases, serological tests, and PEG placement time. Serological data included white blood cell count, lymphocyte count, hemoglobin, platelets, albumin, blood urea nitrogen (BUN), C-reactive protein (CRP), and CRP/albumin ratio before PEG, based on previous reports.[5–10] Serological results from blood samples taken on the day of PEG or the day before were used. In addition, the prognostic nutritional index (PNI) developed by Onodera *et al.*[18] (Table 1) and the CONUT score[16] (Table 2), which are based on serological results only, were used to evaluate nutritional status.

Statistical analyses. Nonparametric data are presented as median values. Fisher's exact test and the Mann–Whitney *U* test were used to compare factors between the two groups. For multivariate analysis, multiple logistic regression analysis was used. Prior to analysis, the multicollinearity of each independent variable was checked, and those with a correlation coefficient of 0.5 or more were excluded from each other. In all cases, *P*-values <0.05 were considered statistically significant. EZR Ver. 1.54 (Saitama Medical Center, Jichi Medical University, Saitama, Japan) was used for statistical analyses.

Results

The study analysis comprised 100 patients who had undergone PEG and met the inclusion criteria during the study period. Of these, 93 were in the non-mortality group and 7 in the early mortality group. The causes of early mortality were aspiration pneumonia in three, sepsis in twos, acute respiratory failure in one, and peritonitis in one. Early complications included aspiration pneumonia in three, sepsis in two, and wound infection in one in the early mortality group, whereas aspiration pneumonia in seven, sepsis in one, and wound infection in five in the non-mortality group. Patient age was significantly higher in the early mortality group ($P = 0.031$). BUN levels were significantly higher in the early mortality group ($P = 0.0275$). Lower PNI ($P = 0.0258$) and significantly higher CONUT score ($P = 0.00127$) were observed in the early mortality group (Table 3). Univariate analysis identified older age, high BUN, low PNI, and high CONUT score as factors associated with early death after PEG. A strong negative correlation was observed between CONUT scores and PNI ($R = -0.796$; $P < 0.001$). PNI was therefore excluded from the model of independent variables. Multivariate analysis using age, BUN, and CONUT showed that CONUT score was an independent prognostic factor (odds ratio [OR], 1.58; 95% confidence internal [CI], 1.04–2.40; $P = 0.0335$; Table 4).

Discussion

PEG was first reported in 1980 by Gauderer *et al.*[19] Although PEG has been performed at many centers, as it is minimally invasive and easy to perform, PEG has a number of recognized complications including death. The mortality rate within 30 days of PEG is reportedly between 3.9 and 18%,[5,20,21] and 7% in this study.

The results of the present study indicate that the CONUT score, which is a nutritional indicator, is associated with early mortality after PEG. The CONUT score is an objective screening test for malnutrition developed by de Ulíbarri *et al.* in 2005.[16] Although there are many tools for nutritional assessment,[22–25] these require the assessment of height, weight, weight change, and change in dietary intake. The utility of nutritional assessment tools is limited in patients undergoing PEG because of difficulties in measuring height and weight, let alone weight change. However, the PNI and CONUT score used in this study are objective scoring criteria that are solely based on serological data, with results

Table 2 Controlling nutritional status scores

Parameters	Normal	Mild	Moderate	Severe
Serum albumin (g/dl)	≧3.5	3.0–3.4	2.5–2.9	<2.5
Score	0	2	4	6
Total lymphocyte count (/μl)	≧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
Total score	0–1	2–4	5–8	9–12
Dysnutritional status	Normal	Mild	Moderate	Severe

Table 3 Factors included in univariate analysis

	Early mortality group ($n = 7$)	Non-mortality group ($n = 93$)	*P*-value
Age	87 (86–88)	82 (74–86)	0.031*
Sex (male: female)	3:4	49:44	0.707
Procedure time (s)	540 (512.5–615)	540 (460.0–600.0)	0.267
Underlying disease			
Cerebrovascular disease	3	34	0.708
Dementia	1	14	1
Neurological disorders	1	21	1
Diabetes mellitus	3	15	0.108
White blood cell count (/μl)	5700 (5200–6200)	6200 (4700–7800)	0.612
Lymphocyte count (/μl)	858 (706–1340)	1302 (950–1668)	0.102
Serum albumin (g/dl)	2.4 (2.2–2.6)	2.9 (2.5–3.2)	0.0843
Hemoglobin (g/dl)	11.7 (9.6–11.95)	11.5 (10.3–12.70)	0.504
Platelet count (/μl)	172 000 (138 000–200 000)	226 000 (174 000–284 000)	0.0642
BUN (mg/dl)	25 (22.5–28.5)	18 (12–24.0)	0.0275*
CRP (mg/dl)	1.38 (0.665–1.525)	0.82 (0.200–2.310)	0.418
PNI	28.6 (28.4–30.7)	35.8 (31.1–39.9)	0.0258*
CONUT score	9 (8.5–9.5)	6 (4.0–8.0)	0.0127*
CRP/Alb ratio	0.55 (0.30–0.77)	0.27 (0.07–0.86)	0.292

*$P < 0.05$.
Data are represented as median (interquartile range).
Alb, serum albumin; BUN, blood urea nitrogen; CONUT, controlling nutritional status; CRP, C-reactive protein; PNI, prognostic nutritional index.

obtained from blood samples only. The CONUT score comprises serum albumin, lymphocyte count, and total cholesterol as variables, while the PNI uses serum albumin and lymphocyte count as variables. A strong negative correlation was observed between the PNI and CONUT score in the present study, which may be attributed to the inclusion of serum albumin and lymphocyte count in both criteria.

Previous studies have reported albumin, lymphocyte count, and total cholesterol as risk factors for death after PEG.[8,9,26–29] Albumin is the most abundant protein in human serum and has been used for decades as an indicator of malnutrition in clinically stable patients.[30] Several studies have reported that albumin is a good predictor of surgical outcomes[31,32]; however, the relative contributions of malnutrition and advanced disease to hypoalbuminemia was not clear in these studies. More recently, studies have reported that low serum albumin levels are not a reflection of malnutrition but rather the result of an underlying inflammatory response.[33] Lymphocyte counts have been posited to be low in malnourished patients due to reduced lymphocyte maturation. This finding can be considered an indication of malnutrition but it is not specific and its use as a diagnostic tool for malnutrition alone is limited, as immune status, comorbidities, and severe stress responses may also have an impact on the nutritional status.[34] Total cholesterol reflects lipid metabolism. Low total cholesterol levels are associated with increased mortality; however, the sensitivity and specificity of total cholesterol levels for detecting malnutrition are considered low.[35] In the present univariate analysis, serum albumin levels and lymphocyte counts were lower in the early mortality group, although there were no significant differences between the two groups.

Table 4 Multivariate analysis of factors associated with early mortality

	Odds ratio	95% confidence interval	*P*-value
Age	1.08	0.949–1.240	0.2380
BUN	1.06	0.975–1.150	0.1750
CONUT score	1.58	1.040–2.400	0.0335*

*$P < 0.05$.
BUN, blood urea nitrogen; CONUT, controlling nutritional status.

Previous studies have reported prognostic factors for early mortality after PEG (Table 5). Although no parameters have consistently been shown to be associated with early mortality after PEG, many studies reported inflammatory markers such as albumin and CRP as prognostic predictors.[6,8–10,26] Inflammation, which may be caused by chronic disease or uncontrolled infection, is reported to be associated with poor prognosis. Poor nutritional status, such as anemia and high BUN, is also associated with poor prognosis.[5,7] Although consistent results may not be obtained when a single parameter is assessed, new insights may be obtained by combining several parameters that reflect protein reserves, immune status, and lipid metabolism, as in the CONUT score. Although various internal and external factors contribute to early mortality after PEG that cannot be simply quantified, the results of the present study indicate that the CONUT score may have utility in identifying patients at risk of early mortality after PEG.

The limitations of the present study include its retrospective nature and the small sample size. Prospective studies comprising a larger number of cases are required to validate the results of the present study.

In conclusion, low nutritional status, particularly in cases with high CONUT scores, may be associated with early mortality

Table 5 Factors reported to be associated with early mortality after percutaneous endoscopic gastrostomy

Source	Variables	OR (95% confidence interval)	*P*-value
Pih *et al.*[6]	Platelet < 100 000	OR 14.294 (3.358–60.851)	0.000*
	CRP ≥ 5.00 mg/dl	OR 3.101 (1.021–9.414)	0.046*
Duzenli *et al.*[7]	CRP/albumin ratio > 10.46	OR 6.670 (1.873–23.752)	0.003*
	Urea > 37.5 mg/dl	OR 3.783 (1.407–10.171)	0.008*
Gumaste *et al.*[8]	Albumin	OR 0.4443 (0.2156–0.9159)	0.0288*
	Female	OR 0.2386 (0.1005–0.5663)	0.0012*
	Positive urine cultures	OR 2.5524 (1.0857–6.0006)	0.0325*
Onder *et al.*[9]	Albumin ≥ 3.0 g/dl	OR 4.09 (1.08–15.5)	0.038*
Barbosa *et al.*[10]	CRP ≥ 35.9 mg/dl	OR 1.008 (1.001–1.014)	0.029*
Lee *et al.*[26]	CRP > 21.5 mg/l	OR 8.55 (3.11–23.45)	<0.001*
	Serum albumin < 31.5 g/l	OR 3.01 (1.27–7.16)	0.012*
Lang *et al.*[27]	Serum albumin < 3 g/dl	OR 2.82 (1.34–5.96)	0.007*
	Diabetes mellitus	OR 2.44 (1.20–4.97)	0.014*
	Chronic obstructive pulmonary disease	OR 2.79 (1.26–6.14)	0.011*

*P <0.05.
CRP, C-reactive protein; OR, odds ratio.

after PEG. Nutritional status should be assessed in patients considered candidates for PEG placement. Larger prospective studies are required to validate the results of the present study.

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Informed consent

Informed consent was obtained in the form of opt-out on the web site.

Data availability statement. The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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