Short Communication

The application of a feeding protocol in older patients fed through percutaneous endoscopic gastrostomy tubes by the intermittent or bolus methods: a single-center, retrospective chart review

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Background: While previous studies have reported that feeding protocols improved clinical outcomes in critical care settings, the evidence supporting the application of feeding protocols in older patients has not yet been assessed. Here, we evaluated the effects of a feeding protocol in older patients fed through percutaneous endoscopic gastrostomy (PEG) tubes. Methods: We conducted a retrospective chart review of 109 patients aged ≥65 who underwent PEG placement between April 2010 and March 2012 at a single acute care hospital. The protocol group was administered enteral nutrition (EN) according to a feeding protocol, while the non-protocol group was administered EN at the attending physician's discretion. Results: Length of hospital stay (LOS) overall and after EN initiation were significantly shorter in the protocol group than in the non-protocol group. (LOS: p=0.001; LOS after EN initiation: p=0.026). During the second week after EN initiation, significantly fewer patients had percutaneous oxygen saturation (SpO_2) <93% and required oxygen therapy in the protocol group (p=0.032 for both comparisons). Nutrition intakes via PEG in the protocol group were significantly greater from Days 6 to 13 for energy and from Days 6 to 11 for protein compared with the non-protocol group. Conclusion: The application of a feeding protocol after PEG placement in older patients was associated with shorter LOS, more efficient EN delivery, and lower incidence of low SpO_2 than non-protocol group. Larger prospective studies are required to determine whether a feeding protocol is useful in improving health outcomes in this population.

Key Words: enteral nutrition, feeding protocol, percutaneous endoscopic gastrostomy, older patients, swallowing difficulty

INTRODUCTION

Although enteral nutrition (EN) is the preferred route for providing nutrients to patients who cannot meet their nutrition requirements orally, it is not without adverse events. Previous studies have reported that feeding protocols optimized EN delivery and improved clinical outcomes in critical care settings.[1-9] However, little evidence supports the clinical application of an EN feeding protocol in older patients with swallowing difficulties.

Percutaneous endoscopic gastrostomy (PEG), while originally developed for a pediatric population,[10] has become the preferential route for treating geriatric populations in whom nutritional support is expected to be necessary for longer than four weeks.[11] In this study, we evaluated the effects of a feeding protocol in older patients fed through PEG tubes.

MATERIALS AND METHODS

We conducted a retrospective chart review of 109 consecutive patients who underwent PEG placement at a single acute care hospital between April 2010 and March 2012. Approval for the study was obtained from the Ethics Committee of this institution. Exclusion criteria were as follows: age <65 years, received an oral diet >15 kcal/kg/day, or received EN < 3 days at this institution.

The protocol group included patients who were administered EN in bolus or an intermittent manner, in accordance with the EN feeding protocol (Figure 1). The non-protocol group included the patients who were administered EN based on their attending physician's prescription.

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EN Feeding Protocol (Bolus or Intermittent Feeding)

	Morning	Noon	Afternoon	Evening	Night	Total	
	EN Formula (ml)	EN Formula (ml)	Water (ml)	EN Formula (ml)	Water (ml)	EN Formula (ml)	Water (ml)
Day 1	-	50	-	-	-	50	0
Day 2	50	50	-	50	-	150	0
Day 3	100	100	-	100	-	300	0
Day 4	200	200	-	200	200	600	200
Day 5	300	300	-	300	300	900	300
Day 6	400	400	-	400	400	1200	400
Day 7	400	400	300	400	400	1200	700
After Day 8	Change the amount of formula and/or water according to patients' individual requirements.						

Figure 1. Enteral feeding protocol after percutaneous endoscopic gastrostomy placement. EN, enteral nutrition

The decision whether to use the protocol or not was made by respective attending physician.

Analysis of clinical outcomes

The analyzed clinical outcomes included in-hospital mortality, length of hospital stay (LOS), LOS after PEG placement, LOS after EN initiation, and duration of parenteral nutrition (PN) after EN initiation. Because EN is withheld for at least 24 hours after PEG placement in this institution, PN was usually provided for all patients at the time of EN initiation and decreased gradually according to the amount of energy intake through PEG.

Analysis of EN-related complications, medications, C-reactive protein, and hyperthermia

We collected the following data during the first and second weeks after EN initiation:

1. **Respiratory complications:** results of sputum culture; percutaneous oxygen saturation (SpO_2); and requirement of oxygen therapy. Sputum culture was considered positive if there was a positive culture at any point during each week. SpO_2 was considered low when it was <93% at least once during each week. Oxygen therapy was considered positive if it was used at least once during each week.
2. **Gastrointestinal (GI) complications:** Vomiting, diarrhea, and constipation were each considered positive if they were present at least once per week. Diarrhea was defined as the passage of loose or liquid stool three or more times a day. Constipation was defined as a stool frequency of less than three times a week.
3. **Medications:** daily total amount of antibiotics; requirement of antacids and motility agents. Antacids and motility agents considered positive if they were prescribed at least once per week.
4. **CRP:** considered positive when CRP ≥6.0 mg/dL at least once per week.[12]
5. **Hyperthermia:** considered positive when axillary temperature, measured 3 times a day, was higher than 38.0 °C at least once per week.

Analysis of nutrition intakes

Daily nutrition intakes through the PEG tube were recorded during the first 14 days after EN initiation, unless a patient died or was discharged from the hospital during this period.

Statistical analysis

We use the Mann-Whitney U test for continuous data and the chi-square test or the Fisher's exact test for categorical data. All statistical analyses were performed using SPSS Statistics software version 19 (IBM, Armonk, NY, USA), and a *p-value* <0.05 was considered statistically significant.

RESULTS

A total of 109 patients underwent PEG placement during the study period. Twenty-one patients were excluded as follows: 11 for being <65 years of age, 4 for receiving oral intake >15 kcal/kg/day after EN initiation, 6 for receiving EN <3 days at this institution. Of the remaining 88 patients, 59 were included in the protocol group and 29 were included in the non-protocol group.

Patient demographics did not differ between the groups. Most patients were older than 80 years of age and undernourished, with body mass index lower than 20.0 kg/m^2 in both groups. The most common indications for PEG were swallowing difficulties caused by stroke, dementia, or Parkinson's disease. The median scores of Charlson index were 2.0 (interquartile range 1.0-2.0) in the protocol group and 2.0 (interquartile range 2.0-3.0) in the non-protocol group (p=0.214).[13] The number of patients who had history of GI surgery, hiatal hernia, and gastroesophageal reflux disease was not different between the groups. The median days to initiate EN after PEG placement was significantly shorter in the protocol group: 2.0 (Q1=1.0, Q3=2.0) than the non-protocol group: 2.0 (Q1=2.0, Q3=4.5), p=0.006. Feeding methods were significantly different between the two groups (p=0.010). All patients in the protocol group were administered EN in bolus or an intermittent manner. Meanwhile, 13.8% of the patients in the non-protocol group were administered EN

in a continuous manner, and the remainder employed a bolus or an intermittent manner.

Clinical outcomes

Overall LOS and LOS after PEG placement and EN initiation were significantly shorter in the protocol group (overall LOS: 44 vs 69 days, p=0.001; LOS after PEG placement: 21 vs 32 days, p=0.016; and LOS after EN initiation: 20 vs 27 days, p=0.026). However, we noted no significant differences in the in-hospital mortality or duration of PN after EN initiation between groups.

EN-related complications, medications, C-reactive protein, and hyperthermia (Table 1)

The number of patients with positive sputum culture, vomiting, diarrhea, constipation, CRP ≥6.0 mg/dL, and hyperthermia were similar between the groups. During the second week after EN initiation, significantly fewer patients had SpO_2 <93% (12.5% vs 32.1%; p=0.032) or required oxygen therapy (12.5% vs 32.1%; p=0.032) in the protocol group than in the non-protocol group. The amount of antibiotics prescribed after EN initiation and the number of patients who were prescribed antacids or motility agents were not significantly different between the groups in each week.

Nutrition intakes (Figure 2)

Energy and protein intakes in the protocol group were significantly smaller on days 1 and 2 but significantly greater from days 6 to 13 (except day 8) for energy and from days 6 to 11 for protein compared with the non-protocol group. Fluid intake was significantly smaller on days 1 to 3 but was significantly greater from days 7 to 9 in the protocol group.

DISCUSSION

In this single-center retrospective study, we compared the clinical outcomes of older patients fed through a PEG tube with or without a feeding protocol. Patient demographics and clinical profiles were similar between the groups. Although days to initiate EN after PEG placement and the feeding methods were significantly different between the groups, the reasons for these were not clear because the timing of EN initiation and feeding methods were individually decided by physician.

Overall LOS, LOS after PEG placement, and LOS after EN initiation were all significantly shorter in the protocol group. The non-protocol group initially received larger amounts of energy and protein through the PEG tube than the protocol group until day 2 after EN initiation. After day 6 the amounts of energy and protein through the PEG tube in the protocol group exceeded that of the non-protocol group (Figure 2). In addition, the incidences of low SpO_2 and requirement of oxygen therapy in the second week were significantly higher in the non-protocol group (Table 1). To analyze the relationship between decreased nutrition intake and increased incidence of low SpO_2 in the second week in the non-protocol group, additional daily analyses during the first 14 days after EN initiation were conducted to compare the number of patients with low SpO_2 and those who required oxygen therapy between the two groups. In the non-protocol group, the incidence of low SpO_2 was significantly higher on days 4, 7, 10, 11, and 14, and the requirement of oxygen therapy was significantly higher on day 8. It is possible that the incidence of low SpO_2 starting on day 4 may have led physicians to delay the increase of EN volumes after day 6 to prevent the occurrence of further EN-related complications. Of note, the protocol of the first week had a residual effect on the second week; however, the reason for this effect remains unclear.

We have to consider that the structures and contents of feeding protocols differed between the previous studies and the present study. The protocols used in the previous

Table 1. EN-related complications, medications, C-reactive protein, and hyperthermia during the first and second weeks after EN initiation

	First week			Second week		
	Protocol	Non-protocol	p	Protocol	Non-protocol	p
Respiratory complications						
Positive sputum culture, No (%)	7 (11.9)	4 (13.8)	1.000	4 (7.1)	3 (10.3)	.681
SpO_2 <93%, No (%)	8 (13.6)	7 (24.1)	.238	7 (12.5)	9 (32.1)	.031
Oxygen therapy, No (%)	10 (16.9)	10 (34.5)	.065	7 (12.5)	9 (32.1)	.031
Gastrointestinal complications						
Vomiting, No (%)	4 (6.8)	6 (20.7)	.075	5 (8.9)	5 (17.9)	.290
Diarrhea, No (%)	19 (32.2)	9 (31.0)	.912	17 (30.4)	9 (32.1)	.867
Constipation, No (%)	8 (13.6)	3 (10.3)	1.000	3 (6.4)	4 (14.8)	.250
Medications						
Antibiotics, g/day, median (Q1, Q3)	0 (0, 0.57)	0 (0, 0.25)	.621	0 (0, 1.07)	0 (0, 2.12)	.873
Antacids, No (%)	34 (57.6)	20 (69.0)	.305	30 (53.6)	19 (67.9)	.211
Motility agents, No (%)	18 (30.5)	14 (48.3)	.103	21 (37.5)	15 (53.6)	.161
CRP ≥6.0 mg/dL, No (%)	13 (22.0)	3 (17.2)	.600	9 (16.1)	7 (25.0)	.326
Hyperthermia (BT ≥38.0 ºC), No (%)	16 (27.1)	10 (34.5)	.477	10 (17.9)	10 (35.7)	.070

Data are expressed as number (%) or median (interquartile range). Comparisons between the two groups were done using the Mann-Whitney U test for continuous variables and the Chi-square test or the Fisher's exact test for categorical variables.
Sputum culture was considered positive if there was a positive culture at any point during each week. Diarrhea was defined as the passage of loose or liquid stool 3 or more times a day. Constipation was defined as a stool frequency of less than 3 times per week. Antacids include proton pump inhibitors and H2 blockers. Motility agents include metoclopramide, mosapride, itopride, panthenol, daikenchuto, and rikkunshito. No. corresponds to the number of patients who exhibited each event at least once a week.
BT, body temperature; CRP, C-reactive protein; EN, enteral nutrition; SpO_2, percutaneous oxygen saturation.

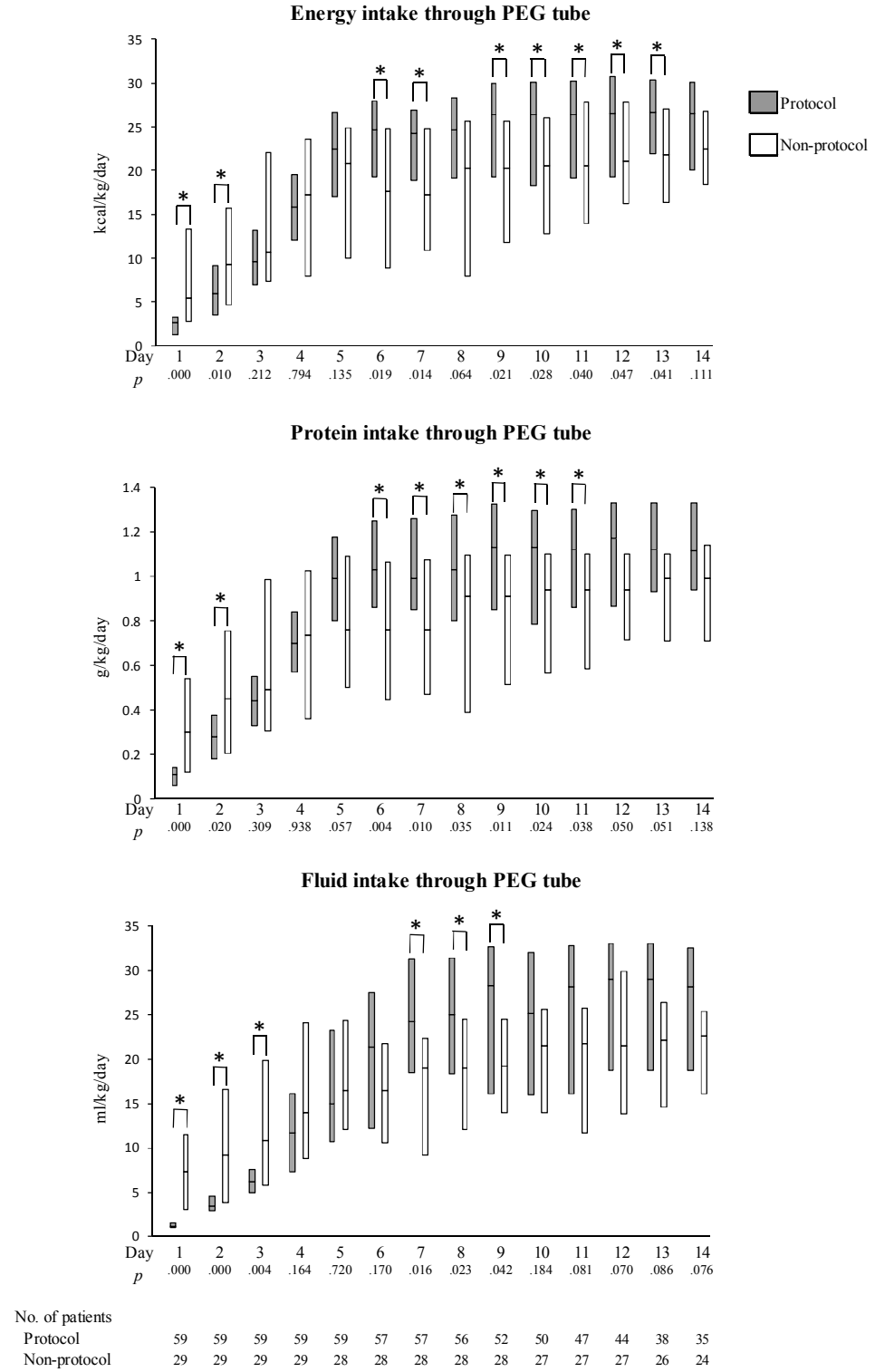

Figure 2. Energy, protein, and fluid intake through the percutaneous endoscopic gastrostomy tube during the first 14 days after EN initiation. The panels show energy (expressed in kilocalories per kilogram of body weight), protein (expressed in grams per kilogram of body weight), and fluid (expressed in milliliters per kilogram of body weight) administered through PEG tube each day during the first 14 days after EN initiation. The boxes represent interquartile ranges (Q3-Q1), and the horizontal lines within the boxes represent the medians. Comparisons between the two groups were done using the Mann-Whitney U test. * $p<0.05$. EN, enteral nutrition; PEG, percutaneous endoscopic gastrostomy.

studies were designed to initiate, monitor, and modify the administration of EN to promote earlier feeding and greater nutrition adequacy in critically ill patients.[1-9] The protocol used in the present study recommended a gradual increase in EN volume during the first week after EN initiation because the subjects of this study had higher risk of aspiration due to their older age and neurological disorders such as stroke and Parkinson's disease.[14]

Several limitations to the present study warrant mention. First, given that this study enrolled a small sample of patients from a single institution, the protocol used in the study may be location specific, limiting generalizability.

Second, the study design was retrospective and groups were not randomized, potentially introducing response and selection biases. Finally, the study period was not long enough to draw conclusions about the effectiveness of the EN feeding protocol on intermediate and long-term health outcomes, because the PEG was expected to be used for long-term nutritional support.

Conclusion

Through a single-center, retrospective chart analysis, the application of a feeding protocol in older patients was found to lead to shorter LOS, better EN delivery, and decreased incidence of low SpO_2. Large and long-term prospective studies in which patients are randomly assigned to protocol or standard care are necessary to determine whether a feeding protocol is useful to improve health outcomes in older patients with PEG.

AUTHOR DISCLOSURES

The authors declare that there are no conflicts of interest.

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灌食標準程序應用於間歇或批式灌食法對經皮內視鏡胃造口廔管之年長患者：單一中心之病歷回顧研究

背景：雖然過去研究已指出，重症照護利用灌食標準程序可以改善臨床症狀，然而，對於年長患者之灌食標準程序並沒有足夠評估證據。因此，本篇研究目的為，評估灌食標準程序對經皮內視鏡胃造口(PEG)廔管之年長患者的成效。方法：回顧一家急症照護醫院之 109 位患者的病歷，並擇出 65 歲以上，曾在 2010 年 4 月至 2012 年 3 月間接受 PEG 的患者。標準程序組是根據灌食標準程序給予腸道營養，另一非標準程序組則由主治醫師決定腸道營養的給予程序。結果:標準程序組之整體住院天數或給予腸道營養後住院天數皆顯著低於非標準程序組(整體住院天數： p=0.001；給予腸道營養後住院天數： p=0.026)。在腸道營養給予後第二週，標準程序組有顯著較少的患者其血氧濃度(SpO_2) <93%及需要氧氣治療。經由 PEG 之營養攝取，相較非標準程序組，標準程序組在第 6 天到第 13 天有較高熱量攝取，在第 6 天到第 11 天有較高蛋白質攝取。結論:對年長、有經皮內視鏡胃造口廔管的患者，應用灌食標準程序與較短住院天數、較高腸道營養給予效率、及較低的低血氧濃度發生率有關。未來需有大型前瞻性研究探討灌食標準程序是否可改善此族群之健康狀況。

關鍵字：腸道營養、灌食標準程序、經皮內視鏡胃造口術、年長患者、吞嚥困難