Original Article

Indications, effectiveness and safety of percutaneous endoscopic gastrostomy: A single center experience and literature review

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Background and Objectives: Percutaneous endoscopic gastrostomy (PEG) has been widely used since 1980 in enteral feeding of patients that are not able to be fed orally for a long time. The aim of this study is to evaluate the PEG indications, effectiveness and PEG related complications from a single center in Istanbul, Turkey. **Methods and Study Design:** 265 patients with PEG who were followed up by the clinical nutrition team of a university hospital between 2010-2018 were evaluated retrospectively. Nutritional Risk Screening-2002 (NRS-2002) test, anthropometric measurements, bioelectrical impedance analysis and laboratory data were used to evaluate the patients' nutritional status. **Results:** The most common indications for PEG were dementia (35.1%), amyotrophic lateral sclerosis (22.6%), stroke (15.8%), and cancer (14%). The mean body weight of the patients was increased after PEG (63.5±12.2 vs 62.0±12.7 kg). Mid upper arm circumference and calf circumference of the patients increased after PEG (27.5±2.5 vs 25.4±3.1 cm and 32.2±7.9 vs 29.6±5.9 cm, respectively). Serum albumin of the patients was increased significantly after PEG (3.34±0.69 g/dL to 3.64±0.65 g/dL) without any significant change in serum CRP. Subgroup analyses showed a significant increase in the mean serum albumin of patients with dementia after PEG (3.23±0.67 g/dL to 3.54±0.58 g/dL). Local insertion site infection occurred in 15 patients (5.6%) and only 3 patients had systemic inflammatory symptoms after local infection (1.1%). **Conclusions:** The results of our study showed that long-term enteral feeding with PEG is an effective and safe method that provides improvement in nutritional status.

Key Words: malnutrition, enteral nutrition, percutaneous endoscopic gastrostomy

INTRODUCTION

Malnutrition can be defined as "a state resulting from lack of intake or uptake of nutrition that leads to altered body composition and body cell mass, leading to diminished physical and mental function and impaired clinical outcome from disease".[1] Sarcopenia, immune system suppression and delay in wound healing are related with malnutrition and can increase morbidity and mortality.[2]

Enteral nutrition (EN) is used in the treatment of malnutrition where oral intake is not possible or inadequate. EN can be administered by oral nutrition supplements (ONS) or by tube feeding products. Depending on the underlying pathology and feeding time, the stomach or intestine can be accessed in various ways. While nasoenteral tubes are preferred for short-term treatment, percutaneous endoscopic gastrostomy (PEG) is recommended for patients whose feeding period is expected to be longer than 4-6 weeks.[3]

Our knowledge on the factors that affect the success of PEG is still limited whilst the application of this treatment is gradually increasing over the past two decades. The aim of this study is to evaluate the PEG indications, effectiveness and PEG related complications from a single center in Istanbul, Turkey.

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METHODS

Study design and population

All of the patients with PEG tube followed-up by the Clinical Nutrition Team of Istanbul University Medical Faculty Hospital between 2010 and 2018 were included in the study. Inpatient files and consultation forms, Clinical Nutrition Outpatient Clinic files and homecare patient reports were examined retrospectively. Patients' gender, age, primary disease and comorbidities, anthropometric measurements, nutritional risk screening, laboratory tests, PEG duration, feeding method (intermittent bolus or pump infusion), EN products, PEG complications, caregiver effect and survival time were noted.

Nutritional Assessment

Nutritional Risk Screening 2002 (NRS-2002) test,[4] anthropometric measurements (height, weight, body mass index (BMI), limb circumferences) and laboratory data (serum albumin, C reactive protein (CRP)) were used to evaluate the patients' nutritional status. Daily energy needs of the patients were calculated using Harris Benedict formula.[5]

Anthropometric measurements

Mid upper arm circumference (MUAC, cm) was measured at the mid-point between the tip of the shoulder and the tip of the elbow.[6] Calf circumference (CC, cm) was measured at the thickest part of both calves.[7]

Bioelectrical impedance analysis

Fat free mass (FFM, kg) was measured using bioelectrical impedance analysis (BIA, Tanita BC 532, Japan).

Percutaneous endoscopic gastrostomy insertion process

Standard percutaneous endoscopic gastrostomy kit in diameter of 20F (6.7mm) (Boston Scientific®, USA) was applied to the patients with the pull technique. After marking the area on the abdomen wall where the PEG tube will be placed by monitorization of gastroscopy. Local anesthesia with lidocaine was applied to this area. After approximately 15 mm of incision, the puncture needle was inserted into the stomach, which was adequately filled with air by gastroscopy, and after that insertion wire was inserted into the stomach through this puncture cannula. With the snare inserted from the gastroscopy, insertion wire was grasped and taken out of the mouth with the gastroscope. The silicone PEG tube was attached with the insertion wire and the other end of the wire which was extending out from the incision on the anterior surface of the abdomen, was pulled, and the c-clamps were placed according to the skin thickness of the patients. After the replacement of the PEG tube the position of the PEG catheter was evaluated by gastroscopy in each patient, and then the procedures were terminated.

Laboratory analysis

Blood sample analyses were performed after overnight fasting. Serum albumin and CRP were measured using spectrophotometry with a Roche Cobas 8000 c 702 analyzer.

Statistical analysis

The data obtained from the study were evaluated with SPSS 21.0. Mean, standard deviation, lowest, highest, median, percentage and frequency values were used in descriptive statistics of the data. Categorical variables were compared with chi-square test. The means of the variables were compared with Mann-Whitney U, Student T test and Wilcoxon. p value below 0.05 was considered significant.

Ethics committee approval

The study protocol was approved by the Istanbul University Istanbul Faculty of Medicine, Clinical Research Ethics Committee. (No: 21 – 22.12.2017).

RESULTS

265 patients were included in the study (50.2% men, 49.8% women). 42.6% of the patients were outpatients, 31.7% were inpatients, and 25.7% were home care patients. The mean age was 65.3±18.3 years (18-103 years; ≥65 years: 58.5%). Baseline characteristics of the patients were shown in Table 1. Reasons for PEG were dysphagia in 97.4% and recurrent aspiration pneumonia in 2.6% of the patients.

The mean weight of the patients before the PEG was 62±12.7 kg and the mean BMI was 22.9±4.6 kg/m^2. Distributions of middle-aged and old aged patients according to BMI are shown in Figure 1. Before the PEG, 52.7% of the patients had NRS-2002 score ≥5. Mean MUAC, CC, FFM, serum albumin and CRP of the patients were, 25.4±3.1 cm, 29.6±5.9 cm, 43.2±8.3 kg, 3.34±0.69 g/dL and 36.4±51.2 mg/L, respectively.

Enteral nutrition was done through intermittent bolus feeding in 49.8%, intermittent infusion in 31%, and continuous infusion in 19.2%. Table 2 showed different types of enteral nutrition products (ENP) used during tube feeding. The most commonly used ENP was high calorie/protein/fiber containing product. Other nutrition supplements were modular protein powder (34.4% of the patients), 3-hydroxy 3-methyl butyrate powder (%20.9) and omega-3 fatty acids (2.3%).

PEG was successfully placed in all patients. The mean PEG duration was 21.7±20.7 months (1-120 months) and the mean PEG change duration was 12.9±11.4 months (1-60 months). During the follow-up, 5.6% (n=15) of the patients had insertion site soft tissue infection, 4.9% (n=13) had tube obstruction, 3.4% (n=9) had peristomal granulomatous tissue and 1.1% (n=3) had systemic symptoms secondary to local infection (Table 3).

After PEG tube feeding, the mean weight, BMI, MUAC, CC and FFM of the patients were 63.5±12.2 kg, 23.4±4.2 kg/m^2, 27.5±2.5 cm, 32.2±7.9 cm and 43.0±9.1 kg respectively. It was found that 42.8% of the patients had increased weight, 14.4% had decreased weight, and 42.8% did not show weight loss. After PEG tube feeding, 83% of the patients showed NRS 2002 score <3 (no malnutrition risk), 17% had score ≥3 and 2.4% had score ≥5, which indicated a significant decrease after PEG (p<0.001). Mean MUAC, CC and serum albumin of the patients was increased significantly, without any change in FFM and serum CRP (Table 4).

Table 1. Baseline characteristics of patients

	Number	%
Men	133	50.2
Women	132	49.8
Age (year)	65.3±18.3 (18-103)	
Weight (kg)	62±12.7 (24-98)	
BMI (kg/m^2)	22.9±4.6 (12.0-37.1)	
Albumin (g/dL)	3.34±0.69	
CRP (mg/L)	36.4±51.2	
Medical Diagnosis of Patients		
Dementia	93	35.1
Alzheimer's disease	42	15.8
Vascular dementia	12	4.5
Frontotemporal dementia	12	4.5
Other	11	4.2
Lewy Body Dementia	7	2.6
Mixed Dementia	6	2.3
Parkinson's dementia	2	0.8
Multiple system atrophy	1	0.4
ALS	60	22.6
Neuromuscular Diseases	72	27.1
Stroke	42	15.8
Parkinson's disease	17	6.4
Muscular Dystrophy	13	4.9
Other	156	58.9
Cancer	37	14
DM	53	20
Heart Disease	16	6
Respiratory Disease	8	3
GIS Disease	7	2.6
Rheumatismal Diseases	4	1.5
CKD	16	6
Infection	2	0.8

ALS: Amyotrophic lateral sclerosis, BMI: Body mass index, CKD: Chronic kidney disease, CRP: C reactive protein, DM: Diabetes mellitus, GIS: Gastrointestinal system.

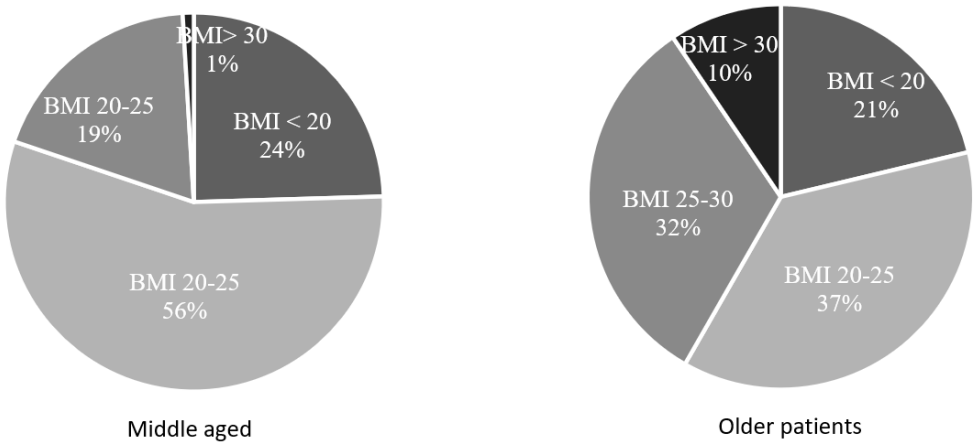

Figure 1. Distribution of middle-aged and older patients over the age of 65 according to BMI before PEG.

98 patients (38%) died within the study period; underlying disease 36.7%, lower respiratory tract infection 19.4%, other acute medical conditions 9.2%, unknown reason 34.7%. 30-day mortality rate was 0.7% (n=2). None of them was associated with PEG tube.

In the subgroup analyses, 93 patients (35.1%) had dementia (84.9% were ≥65 years and 50.5% were men). High energy/protein/fiber products were used in 36.6% of the patients, diabetes specific products in 21.5%, high energy/protein products in 16.1%, and isocaloric/fiber enriched products in 12.9%. After PEG, body weight was increased in 32.4% of the patients, decreased in 8.5% and did not decreased in 59.2%. The mean serum albumin and CRP before and after PEG were 3.23±0.7 vs 3.54±0.58 g/dL (p=0.003) and 34.4±47.6 vs 38.1±71.1 mg/L (p=0.87), respectively. During the follow-up period, 34 dementia patients died (37%); existing disease complication (n=10), pneumonia (n=9) and other medical reasons (n=15). The mean PEG duration in those patients was 22.5±18.1 months and the mean PEG change time was 14.1±11.1 months.

60 patients had amyotrophic lateral sclerosis (ALS) patients (41.7% were ≥65 years, 55% were women). High energy/protein/fiber products were used in 33.9% of the

Table 2. Enteral nutrition products (ENP) used during tube feeding

Content	Number	%
High energy/protein/fiber	98	37.4
High energy/protein	52	19.8
Diabetes specific	46	17.6
Isocaloric/fiber enriched	30	11.5
Isocaloric	14	5.3
Immunonutrition	10	3.8
Disease specific	7	2.7
High protein	5	1.9
Modular protein supplement	91	34.4
Hydroxy methyl butyrate supplement	56	21.1

Table 3. PEG related complications

Complications	Number	%
Insertion site soft tissue infection	15	5.6
Tube obstruction	13	4.9
Peristomal granulomatous tissue	9	3.4
Systemic symptoms secondary to local infection	3	1.1

Table 4. Changes in Weight, BMI, NRS-2002 score, MUAC, CC, BIA-FFM, Albumin and CRP after PEG

	Before PEG	After PEG	*p* value
Weight (kg)	62±12.7	63.5±12.2	0.047
BMI (kg/m^2)	22.9±4.6	23.4±4.2	0.682
NRS-2002 score ≥3	96.6%	17.0%	<0.001
MUAC (cm)	25.4±3.1	27.5±2.5	0.005
CC (cm)	29.6±5.9	32.2±7.9	0.012
FFM (kg)	43.2±8.3	43.0±9.1	0.232
Albumin (g/dL)	3.34±0.69	3.64±0.65	<0.001
CRP (mg/L)	36.4±51.2	32.4±55.9	0.148

BMI: body mass index; CC: calf circumference; CRP: C-reactive protein; FFM: fat free mass; MUAC: mid upper arm circumference; NRS-200: Nutritional Risk Screening 2002.

patients, high energy/protein products in 25.4% and isocaloric/fiber enriched products in 15.3%. After PEG, body weight was increased in 46.5% of the patients, decreased in 25.6% and did not show any decrease in 27.9% of the patients. The mean albumin and CRP before and after PEG were 3.66±0.53 vs 3.88±0.65 g/dL (p=0.12) and 39.4±53.3 vs 31.9±50.8 mg/L (p=0.14), respectively. 28 patients (47%) died; existing disease complication (n=12), pneumonia (n=6) and other medical reasons (n=10). The mean PEG duration was 26.96±18.69 months and the mean change time was 14.2±11.4 months.

DISCUSSION

Malnutrition is an important health issue that adversely affects the prognosis of the diseases and increases the risk of morbidity and mortality. Early detection of malnutrition and initiation of an appropriate nutrition plan is very important for the treatment.[8]

Since 1980, when PEG was first described, it has been widely used in enteral feeding of patients with functional gastrointestinal system who cannot be fed orally for a long time. When compared with nasogastric (NG) feeding tube, PEG does not lead to nasal ulcerations or chronic sinusitis, gastroesophageal reflux and tracheal aspiration are less frequent, patients have better tolerance and PEG is cosmetically more acceptable than NG.[9] In the Cochrane review, PEG and NG tubes did not show any statistically significant difference in terms of complications and PEG tube was associated with less intervention in the follow-up. PEG was thought to be an effective and safe method in long-term enteral nutrition.[10]

In the previous studies, the most common indications for PEG were neurological diseases and head/neck cancer.[11-24] In our study, the most common indications were dementia, ALS, stroke and cancer, that was in concordance with the literature (Table 5). We had low number of head and neck cancer patients which was related with the number of referrals from different departments to the Clinical Nutrition Team.

Enteral nutrition with PEG is thought to prevent weight loss. Löser et al., reported an average weight loss of 11.4±1.5 kg before PEG and 3.5 kg weight gain after PEG.[21] Erdil et al., compared anthropometric values before and after PEG and they found a statistically significant increase in body weight, BMI, and upper mid arm circumference.[12] Schneider et al., showed a statistically significant increase in mean BMI after PEG.[24] Kimyagarov et al., reported that PEG EN was resulted with an increased energy and protein intake without any associated improvement in body composition (lean mass, skeletal mass and BMI). The lack of changes in body composition despite the increased energy and protein intake has been associated with impaired myostatin modulation in conditions such as aging, multimorbidity and immobility.[25]

In our study, it was found that most of our patients had preserved or increased body weight after PEG together

Table 5. Previous studies on PEG indications, effectiveness and complications

Study (author, journal, year)	Population	Indications	Success	Weight change	Sarcopenia, Serum protein	PEG period	Minor complications	Major complications
Akcan et al.,[11] T Klin Gastro-enterohep., 1999	41 pts: 21 M, 20 F 62 yrs (12-86)	34 stroke 2 MG 2 IC mass 1 ALS 1 MS 1 other	100%			106 days (1-650)	2 leakage 5 wound infections 1 distension 2 obliteration	1 aspiration 2 buried bumper 1 mortality
Erdil et al.,[12] J Gastr and hepatol., 2005	85 pts: 63 M, 22 F 55.9±16.1 yrs (20-87)	26 stroke 20 OP disorders 11 head trauma 9 dementia 5 encephalitis 4 cancer 2 ALS 8 others	100%	Before: 52.16±9.9 kg After: 56.82±9.4 kg (p=0.002)	MUAC (cm) Before 22.5±3.3 After 24.5±3.3 (p=0.003)		4 occlusion 6 wound infections 4 leakage 2 local pain 5 reflux/vomiting	7 buried bumper 1 peritonitis 1 fistula 2 pneumonia
Ozguc et al.,[13] Ulusal Cerrahi Dergisi, 2011	134 pts: 71% M, 29% F 50.7 yrs (14-90)	82 neurodegenerative diseases 22 cancer 18 prolonged mechanical ventilation 12 others	97%			98.4 days (1-518)	21 leakage 8 displacement 2 wound infections 2 obstruction	
Cakır, et al.,[14] Dicle Medical Journal, 2012	700 pts: 57% M, 43% F	46% stroke 21% hypoxic encephalopathy 19% head trauma 12% cancer 2% others				130 days (10-425)	50 wound infections 18 leakage 16 peristomal bleeding 12 displacement	
Tuna et al.,[15] Cumhuriyet Medical Journal, 2012	172 pts: 112 M, 60 F 53.5 yrs (10-89)	53 head trauma 49 stroke 32 dementia 30 cancer 6 hypoxic encephalopathy 2 others	100%			31 months (1-96)	17 wound infections 15 leakage 11 deflated balloon 4 peristomal granulomatous tissue 3 pain 4 displacement	9 aspiration pneumonia 6 abscesses 3 peritonitis 2 GI bleeding
Demirci et al.,[16] Endoscopy, 2015	642 pts: 63.1% M 36.9% F 64.2 yrs (18-97)	37.8% stroke 22.4% cancer 13.8 head trauma 13.7% dementia 6% encephalitis 2.9% Parkinson 1.7% ALS 1.7% others	99%				31 obstruction 28 pain 22 wound infections 20 displacement 8 vomiting 2 leakage	8 aspiration pneumonia 6 peritonitis 4 buried bumper 3 GI bleeding 1 GI fistula

ALS: Amyotrophic lateral sclerosis, CC: Calf circumference, CNS: Central nervous system, CRP: C reactive protein, CVA: Cerebrovascular accident, F: Female, FFM: Fat free mass, GI: Gastrointestinal, IC: İntracranial mass, M: Male, MG: Myasthenia gravis, MS: Multiple sclerosis, MUAC: Mid upper arm circumference, OP: Oropharyngeal, PEG: percutaneous endoscopic gastrostomy, Pts: Patients, w/o: Without, Yrs: Years.

Table 5. Previous studies on PEG indications, effectiveness and complications (cont.)

Study (author, journal, year)	Population	Indications	Success	Weight change	Sarcopenia, Serum protein	PEG period	Minor complications	Major complications
Aksoy et al.,[17] Journal of Ankara University School of Medicine, 2019	203 pts: 101 M, 102 F 77 yrs (18-96)	34% stroke 28.6% dementia 10.8% cancer 6.9% Parkinson 3.9% ALS 15.8% others	100%				30 displacement 25 obstruction 7 wound infections 9 stomal bleeding	1 fistula
Sheehan et al.,[18] Ir Med J, 2003	238 pts	76% CNS disorders (97 pts with CVA) 10% cancer 14% others	100%				43 wound infections 54 other minor complications	3 Aspiration pneumonia 1 Peritonitis 2 Perforation (4 related deaths)
Larson et al.,[19] Gastroenterology, 1987	314 pts: 185 M, 129 F (3-92 yrs)	235 Neurologic 42 Oropharyngeal 11 Anorexia/ cachexia 6 Aspiration 8 Esophageal stricture/cancer/ fistula 3 Short bowel	95%				18 wound infection 6 tube pulled out 4 ileus/Ogilvie's 3 fever 3 aspiration 2 stoma1 leak 1 anorexia 1 tube migration 1 hematoma	3 death 4 gastric perforations 2 gastric bleeds. 1 hematoma
Hull et al.,[20] The Lancet, 1993	49 pts: 64 yrs	16 Neurologic 13 Motor neuron disease 4 Multiple sclerosis 8 Head/neck cancer 8 others	100%			175 days (30-560)	8 gastrostomy site infection 10 tube blockage 3 tube replacement 7 hub replacement	
Löser et al.,[21] Digestive Diseases and Sciences, 1998	210 pts: 137 M, 74 F 61.3 yrs	47.1% Neurological 29.1% Ear-nose-throat disease 23.8 % Internal disease	100%	Before: 58.8±6 11.9 kg Total body weight gain: 3.5±6 1.7 kg		133.6 days (1-1498)	25 wound infection 6 fever 8 local pain 3 bleeding from PEG channel 1 local PEG-induced ulceration 3 dislocation of PEG tube 4 leakage from PEG channel 2 mechanical problems	1 gastric perforation 1 local peritonitis 1 aspiration during PEG placement 5 wound infection

ALS: Amyotrophic lateral sclerosis, CC: Calf circumference, CNS: Central nervous system, CRP: C reactive protein, CVA: Cerebrovascular accident, F: Female, FFM: Fat free mass, GI: Gastrointestinal, IC: İntracranial mass, M: Male, MG: Myasthenia gravis, MS: Multiple sclerosis, MUAC: Mid upper arm circumference, OP: Oropharyngeal, PEG: percutaneous endoscopic gastrostomy, Pts: Patients, w/o: Without, Yrs: Years.

Table 5. Previous studies on PEG indications, effectiveness and complications (cont.)

Study (author, journal, year)	Population	Indications	Success	Weight change	Sarcopenia, Serum protein	PEG period	Minor complications	Major complications
Lin et al.,[22] The Laryngoscope, 2001	103 pts: 74 M, 29 F (18-84 yrs)	84 Head and neck cancer 19 Neurologic					4 cellulitis 3 prolonged ileus 2 leakage, 1 tube extrusion, 1 clogged lumen	1 PEG site metastasis
Cortez-Pinto et al.[23] Clinical Nutrition, 2002	144 pts: 89 M, 55 F 62 yrs (18-85)	56 ALS 12 Stroke 5 Dementia 6 Dystonia 4 Post-traumatic encephalopathy 2 Cranial tumor 2 Post-anoxic encephalopathy 10 Miscellaneous neurological diseases 32 Head and neck cancer 6 Esophageal cancer 6 Trachea-esophageal fistula 3 Other	99.3%				80 Peristomal inflammation (redness) 14 Peristomal extrusion of granulation tissue 3 Minor bleeding 1 Buried bumper syndrome	3 sudden death 1 aspiration pneumonia (death) 1 laryngeal spasm (death) 1 gastro-colic fistula 1 migration of a replacement button 1 peritonitis
Schneider et al.,[24] Scandinavian Journal of Gastro-enterology, 2014	119 pts: 82 M, 37 F 63 yrs (21–91)	57 head–neck tumor 11 esophagus 35 neurological 16 other		BMI (kg/m^2) Before: 21.1±4 After: 22.6±3.6 p=0.022				6 pneumonia 1 aspiration 6 severe pain
Current study	265 pts: 133 M 132 F 65.3±18.3 yrs (18-103)	35.1% dementia 22.6% ALS 15.8% stroke 14% cancer 6.4% Parkinson 4.9% muscular dystrophy 1.2% others	100%	Before 62±12.7 kg After 63.5±12.2 kg p=0.047	· MUAC (cm) Pre-/post PEG 25.4±3.1 vs 27.5±2.5 p=0.005 · CC (cm) Pre-/post PEG 29.6±5.9 vs 32.2±7.9 p=0.012 · FFM (kg) Pre-/post PEG 43.2±8.3 vs 43.0±9.1 p=0.232 · Albumin (g/dL) Pre-/post PEG 3.34±0.69 vs 3.64±0.65 p<0.001 (w/o change in serum CRP)	21.7±20.7 months (1-120)	15 wound infections 13 obstruction 9 peristomal granulomatous tissue	3 systemic infections related with local infection

ALS: Amyotrophic lateral sclerosis, CC: Calf circumference, CNS: Central nervous system, CRP: C reactive protein, CVA: Cerebrovascular accident, F: Female, FFM: Fat free mass, GI: Gastrointestinal, IC: İntra-cranial mass, M: Male, MG: Myasthenia gravis, MS: Multiple sclerosis, MUAC: Mid upper arm circumference, OP: Oropharyngeal, PEG: percutaneous endoscopic gastrostomy, Pts: Patients, w/o: Without, Yrs: Years.

with a significant improvement in serum albumin independent of serum CRP. Mid upper arm and calf circumference of our patients were improved after PEG tube feeding. This was a retrospective analysis, and we could only achieve fat free mass (FFM; bioelectrical impedance) measurements in 15.3% of the cases. According to this data, pre- and post-PEG tube feeding measurements of the FFM did not show any significant change. These results show that PEG feeding could prevent or improve weight loss and hypoalbunemia in chronic inflammatory disorders. In our clinical practice, the basal energy needs of the patients were calculated using Harris Benedict formula, and the total energy requirement was obtained by the sum of basal energy need, activity and stress factors. For example, in ALS and dementia, EN supplementation was done mainly with high energy/protein/fiber products. They were well tolerated and related with increased serum albumin.

Although PEG tube placement is generally considered a safe procedure, varying rates of complications may occur depending on the study population. Larson et al., reported major complication rate of 3% (gastric perforation, gastric bleeding, and hematoma) and minor complication rate of 13% (wound infection, ileus, stoma leakage). The most common minor complication was wound infection.[19] In the study conducted by Löser et al, the major complication rate was 3.8% and minor complication rate was 20%.[21] In another study conducted by Lin et al, the minor complication rate was 10.7% and they reported a patient with metastasis in the PEG region.[22] Metastasis in the PEG stoma has been associated with the "pull" technique in a patient with an advanced stage head and neck cancer. The limited number of cases reported, and the lack of prospective study data prevented this issue from being adequately examined.[26]

In our study, PEG tube was successfully applied to all patients with a major and minor complication rates of 1.1% and 13.9% (15.0% in total), respectively. Major complications such as peritonitis, perforation, haemorrhage, necrositant fasciitis, gastrocolocutaneous fistula were not reported in our patients. Systemic symptoms secondary to local infection were seen in 3 patients. Minor complications were local infection, peristomal granulomatous tissue formation and tube obstruction. In the literature, mortality rates associated with the PEG procedure was between 0-3%. Pinto et al reported 3% of procedure related mortality (sudden death in 3 ALS patients, 24-48 hours after PEG insertion) and 18% of 30-day mortality.[23] Hull et al mentioned 2% procedure-related mortality, 8% 30-day mortality and 36% total mortality rate. Peritonitis in one patient was associated with PEG.[20] Larson et al reported 1% procedure-related mortality (aspiration pneumonia) and 16% 30-day mortality. Three of these deaths were associated with PEG (aspiration pneumonia).[19] Erdil et al reported 30-day and total mortality rates of 14.1% and 37.6%, respectively. Two deaths (secondary peritonitis and aspiration pneumonia) were associated with PEG.[12] In a study conducted by Schneider et al., the 30-day mortality rate was 10.1% and the total mortality rate was 38.7%. They did not mention any PEG-related mortality.[24] In our study, 30-day mortality rate was 0.7% (n=2). They were not related with the PEG tube.

Conclusion

The results of this study indicate that long-term enteral nutrition with PEG is an effective and safe method for improving nutritional status in patients with dysphagia. Prospective studies using measurement of muscle mass and function can identify effects of PEG tube feeding on sarcopenia and frailty.

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AUTHOR DISCLOSURES

There is no conflict of interest.

REFERENCES

1. Cederholm T, Barazzoni R, Austin P, Ballmer P, Biolo G, Bischoff SC et al. ESPEN guidelines on definitions and terminology of clinical nutrition. Clin Nutr. 2017;36:49-64. doi: 10.1016/j.clnu.2016.09.004.
2. Norman K, Pichard C, Lochs H, Pirlich M. Prognostic impact of disease-related malnutrition. Clin Nutr. 2008;27:5-15. doi: 10.1016/j.clnu.2007.10.007.
3. Akıncı SB. Enteral nutrisyon uygulama yöntemleri. Klinik Gelişim. 2011;24:20-5. (In Turkish)
4. Kondrup J, Rasmussen HH, Hamberg O, Stanga Z, Ad Hoc EWG. Nutritional risk screening (NRS 2002): a new method based on an analysis of controlled clinical trials. Clin Nutr. 2003;22:321-36. doi: 10.1016/s0261-5614(02)00214-5.
5. Harris JA, Benedict FG. A Biometric Study of Human Basal Metabolism. Proc Natl Acad Sci USA. 1918;4:370-3. doi: 10.1073/pnas.4.12.370.
6. Antonelli Incalzi R, Landi F, Cipriani L, Bruno E, Pagano F, Gemma A, Capparella O, Carbonin PU. Nutritional assessment: a primary component of multidimensional geriatric assessment in the acute care setting. J Am Geriatr Soc. 1996;44:166-74. doi: 10.1111/j.1532-5415.1996.tb02434.x
7. Bonnefoy M, Jauffret M, Kostka T, Jusot JF. Usefulness of calf circumference measurement in assessing the nutritional state of hospitalized elderly people. Gerontology. 2002;48:162-9. doi: 10.1159/000052836.
8. Gundogdu H. Malnutrition. Journal of Istanbul Faculty of Medicine. 2010;17:189-202.
9. Rahnemai-Azar AA, Rahnemaiazar AA, Naghshizadian R, Kurtz A, Farkas DT. Percutaneous endoscopic gastrostomy: indications, technique, complications and management. World J Gastroenterol. 2014;20:7739-51. doi: 10.3748/wjg.v20.i24.7739.
10. Gomes CA, Jr., Andriolo RB, Bennett C, Lustosa SA, Matos D, Waisberg DR, Waisberg J. Percutaneous endoscopic gastrostomy versus nasogastric tube feeding for adults with swallowing disturbances. Cochrane Database Syst Rev. 2015;2015:CD008096. doi: 10.1002/14651858.CD008096.pub4.
11. Akcan Y, Arslan M, Arslan S, Bayraktar Y, Kansu T, Varlı K. Percutaneous endoscopic gastrostomy; The Hacettepe University Hospital experience. Turkiye Klinikleri Gastroenterohepatology. 1999;10:23-27.
12. Erdil A, Saka M, Ates Y, Tuzun A, Bagci S, Uygun A, Yesilova Z, Gulsem M, Karaeren N, Dagalp K. Enteral nutrition via percutaneous endoscopic gastrostomy and nutritional status of patients: five-year prospective study. J

Gastroenterol Hepatol. 2005;20:1002-7. doi: 10.1111/j.1440-1746.2005.03892.x
13. Ozguc H, Gokce E, Altınel Y, Kırdak T. Percutaneous endoscopic gastrostomy experience in a general surgery clinic. Ulus Cerrahi Derg. 2011;27:145-8. doi: 10.5097/1300-0705.UCD.1069-11.02.
14. Cakır M, Tekin A, Küçükkartallar T, Ciftci I, Vatansev C, Aksoy F, Kartal A. Long-term results of percutaneous endoscopic gastrostomies. Dicle Medical Journal. 2012;39:162-5. doi: 10.5798/diclemedj.0921.2012.02.0120.
15. Tuna Y, Duman A. Short and long term results of percutaneous endoscopic gastrostomy. Cumhuriyet Medical Journal. 2012;34:183-8. doi: 10.7197/1305-0028.677.
16. Demirci H, Kilciler G, Öztürk K, Kantarcıoglu M, Uygun A, Bagci S. Our experience in percutaneous endoscopic gastrostomy. Endoscopy. 2015;23:73-6.
17. Aksoy EK, Sapmaz F, Akpınar M, Goktas Z, Uzman M, Nazlıgul Y. Long-term follow-up results of patients with percutaneous endoscopic gastrostomy and factors affecting survival. Journal of Ankara University School of Medicine. 2019;72:179-83. doi: 10.4274/atfm.galenos.2019.36854.
18. Sheehan JJ, Hill AD, Fanning NP, Healy C, McDermott EW, O'Donoghue DP, O'Higgins NJ. Percutaneous endoscopic gastrostomy: 5 years of clinical experience on 238 patients. Ir Med J. 2003;96:265-7.
19. Larson DE, Burton DD, Schroeder KW, DiMagno EP. Percutaneous endoscopic gastrostomy. Indications, success, complications, and mortality in 314 consecutive patients. Gastroenterology. 1987;93:48-52.
20. Hull MA, Rawlings J, Murray FE, Field J, McIntyre AS, Mahida YR, Hawkey CJ, Allison SP. Audit of outcome of long-term enteral nutrition by percutaneous endoscopic gastrostomy. Lancet. 1993;341(8849):869-72.
21. Löser C, Wolters S, Folsch UR. Enteral long-term nutrition via percutaneous endoscopic gastrostomy (PEG) in 210 patients: a four-year prospective study. Dig Dis Sci. 1998;43:2549-57. doi: 10.1023/a:1026615106348
22. Lin HS, Ibrahim HZ, Kheng JW, Fee WE, Terris DJ. Percutaneous endoscopic gastrostomy: strategies for prevention and management of complications. Laryngoscope. 2001;111:1847-52. doi: 10.1097/00005537-200110000-00033.
23. Cortez-Pinto H, Correia AP, Camilo ME, Tavares L, De Moura MC. Long-term management of percutaneous endoscopic gastrostomy by a nutritional support team. Clin Nutr. 2002;21:27-31. doi: 10.1054/clnu.2001.0499
24. Schneider AS, Schettler A, Markowski A, Luettig B, Kaufmann B, Klamt S et al. Complication and mortality rate after percutaneous endoscopic gastrostomy are low and indication-dependent. Scand J Gastroenterol. 2014;49:891-8. doi: 10.3109/00365521.2014.916343
25. Kimyagarov S, Turgeman D, Fleissig Y, Klid R, Kopel B, Adunsky A. Percutaneous endoscopic gastrostomy (PEG) tube feeding of nursing home residents is not associated with improved body composition parameters. J Nutr Health Aging. 2013;17:162-5. doi: 10.1007/s12603-012-0075-3.
26. Huang AT, Georgolios A, Espino S, Kaplan B, Neifeld J, Reiter ER. Percutaneous endoscopic gastrostomy site metastasis from head and neck squamous cell carcinoma: case series and literature review. J Otolaryngol Head Neck Surg. 2013;42:20. doi: 10.1186/1916-0216-42-20.