Gut and Liver
https://doi.org/10.5009/gnl230174
pISSN 1976-2283 eISSN 2005-1212

Original Article

A Multicenter Survey of Percutaneous Endoscopic Gastrostomy in 2019 at Korean Medical Institutions

Jun Woo Park[1], Tae Gyun Kim[1], Kwang Bum Cho[2], Jeong Seok Kim[2], Jin Woong Cho[3], Jung Won Jeon[4], Sun Gyo Lim[5], Chan Gyoo Kim[6], Hong Jun Park[7], Tae Jun Kim[8], Eun Sun Kim[9], Su Jin Jeong[10], Yong Hwan Kwon[1,11], The Research for Multidisciplinary Therapeutic Endoscopy group of Korean Society of Gastrointestinal Endoscopy

[1]Department of Internal Medicine, Kyungpook National University Hospital, Daegu, Korea; [2]Department of Internal Medicine, Keimyung University School of Medicine, Daegu, Korea; [3]Department of Internal Medicine, Presbyterian Medical Center, Jeonju, Korea; [4]Department of Internal Medicine, Kyung Hee University Medical Center, Seoul, Korea; [5]Department of Gastroenterology, Ajou University School of Medicine, Suwon, Korea; [6]Center for Gastric Cancer, National Cancer Center, Goyang, Korea; [7]Department of Internal Medicine, Yonsei University Wonju College of Medicine, Wonju, Korea; [8]Department of Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea; [9]Department of Gastroenterology, Korea University College of Medicine, Seoul, Korea; [10]Department of Pediatric Gastroenterology, CHA Bundang Medical Center, CHA University, Seongnam, Korea; [11]Department of Internal Medicine, School of Medicine, Kyungpook National University, Daegu, Korea

Article Info
Received May 14, 2023
Revised July 27, 2023
Accepted August 1, 2023
Published online November 28, 2023

Corresponding Author
Yong Hwan Kwon
ORCID https://orcid.org/0000-0002-0520-9685
E-mail tear1480@hanmail.net

Background/Aims: This study aimed to review the indications, methods, cooperation, complications, and outcomes of percutaneous endoscopic gastrostomy (PEG).

Methods: Questionnaires were sent to 200 hospitals, of which 62 returned their questionnaires, with a response rate of approximately 30%. Descriptive statistics were calculated to analyze the responses to the questionnaires.

Results: In 2019, a total of 1,052 PEGs were performed in 1,017 patients at 62 hospitals. The main group who underwent PEG was older adult patients with brain disease, particularly stroke. Nutritional supply was an important purpose of the PEG procedure. "The pull method" was the most commonly used for initial PEG insertion. The complications related to PEG were mostly mild, with leakage being the most common. Patients who underwent PEG procedures were primarily educated regarding the post-procedure management and complications related to PEG. Preoperative meetings were skipped at >50% of the institutions. Regarding the cooperation between the nutrition support team (NST) and the physician performing PEG, few endoscopists answered that they cooperated with NST before and after PEG. Moreover, the rate of NST certification obtained by physicians performing PEG and the frequency of attendance at NST-related conferences were relatively low.

Conclusions: This study shows a similar trend to that found in the previous PEG guidelines. However, it covers new aspects, including team-based work for PEG procedure, nutrition support, and education for patients and guardians. Therefore, each medical institution needs to select an appropriate method considering the medical environment and doctor's abilities. **(Gut Liver 2024;18:77-84)**

Key Words: Surveys and questionnaires; Percutaneous endoscopic gastrostomy; Enteral nutrition

INTRODUCTION

Difficulties in oral feeding may occur for various reasons, particularly in patients with underlying acute and chronic illness, stress-related catabolism, decreased appetite, trauma, and ongoing inflammation.[1-4] These patients are at an increased risk of malnutrition, thereby leading to adverse outcomes, higher mortality, and increased hospital costs.[5] Enteral nutrition (EN) and intravenous nutrition supplies are used to nourish patients with malnutrition. Several studies have re-

ported that EN has advantages over intravenous nutrition in terms of cost, continuous nutrient supply, and decreased risk of hospital-acquired infection.[6,7] Nutrition supply through the nasogastric tube is easy and convenient. However, it has several disadvantages, including difficulty in maintaining the position, esophageal damage, possibility of aspiration, and limitations on long-term nutritional supply.[2-4,8] Percutaneous endoscopic gastrostomy (PEG) provides a safe and effective way to provide supplemental EN to these patients.[5,7,9,10] To date, several novel methods for PEG are performed depending on patient's characteristics and the endoscopist's abilities. Although PEG is known a relatively safe procedure, it has the potential risk of serious side effects such as bleeding, aspiration pneumonia, colonic perforation, and even leading to death caused by procedure.[8,10,11] However, there has been no clear consensus and guidelines on PEG insertion and management in Korea. Recently, the European Society of Gastrointestinal Endoscopy (ESGE) presented a PEG guideline; however, discrepancies with real-world clinical practices in Korea were noted.[9,12-14] This study aimed to determine the current status of PEG, including indications, methods, side effects, and outcomes, and help establish a systematic PEG guideline suitable for Korea, based on a survey conducted on doctors who perform PEG procedures in Korea.

MATERIALS AND METHODS

This study was a questionnaire-based internet survey conducted at approximately 200 hospitals affiliated with the Korean Society of Gastrointestinal Endoscopy. In December 2020, questionnaires were sent to physicians performing PEG through the Google platform. The survey covered the overall contents related to PEG procedures performed at each hospital during 2019 and consisted of 46 questions, including characteristics of individuals undergoing PEG procedures, indications of PEG, methods of PEG, and related complications. Most of the questions were to select one answer; for some questions, multiple choices were allowed. Furthermore, some questions were answered in a narrative form without choices. Finally, 62 hospitals, excluding those not performing PEG and not responding to questionnaires, answered the questionnaire, with a response rate of approximately 30%. We analyzed the responses to the questionnaires using descriptive statistics. The questionnaire is presented in Supplementary Material 1.

RESULTS

1. Characteristics of responding medical institutions

In 2019, a total of 1,052 PEGs were performed on 1,017 patients at 62 hospitals participating in this survey. When classifying hospital institutions by size, general hospitals (45%) accounted for the largest number of institutions, followed by tertiary general hospitals (34%), community hospitals (10%), clinics (10%), and medical check-up centers (1%). The number of PEGs performed by medical institutions was the highest at tertiary hospitals (65%), followed by general hospitals (27%), primary hospitals (4%), and community hospitals (4%) (Fig. 1). The number of PEG performers in each institution was 3–4 (39%), followed by 1–2 (34%), and 9–10 (2%). In most hospitals, gastroenterologists (98%) performed PEG; pediatricians, surgeons and radiologist also performed PEG.

2. Characteristics of patients who underwent PEG

The baseline characteristics of patients who underwent PEG are presented in Table 1. The most common reason for PEG was for supplying EN (95%), followed by structural obstruction (3%), and other reasons (2%). Neurological dysfunction (70%), particularly cerebral infarction (45%), cerebral hemorrhage (17%), dementia (5%), and Alzheimer disease (3%), was the most common underlying disease in patients who underwent PEG. Cancer (18%), particularly esophageal cancer (43%), throat cancer (23%), and stomach cancer (14%), was the second most common underlying disease. The primary clinical manifestation of PEG was dysphagia (35%) followed by repeated aspiration pneumonia (26%). The factors responsible for failure of the PEG procedure were mainly the inability to access the stomach from the abdominal wall (e.g., anatomical abnormality of the gastrointestinal tract, position change after surgery, or underlying disease), followed by inability to insert an endoscope (e.g., oropharyngeal cancer), and

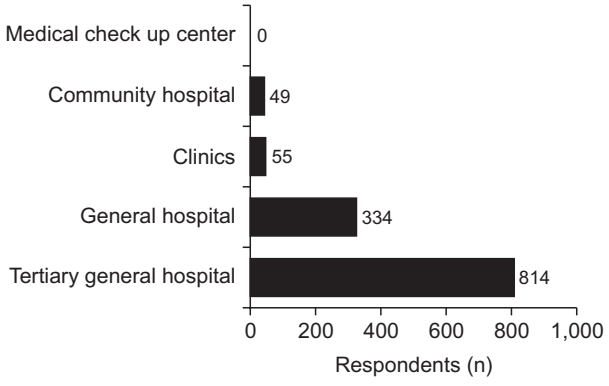

Fig. 1. Percutaneous endoscopic gastrostomy number by the medical institution.

Table 1. Clinical Characteristics of Patients Undergoing Percutaneous Endoscopic Gastrostomy

Characteristic	No. (%)*
Sex	
Male	563 (63)
Female	328 (37)
Age group, yr	
≥50	851 (83)
20 to <50	86 (10)
<20	80 (7)
Indication	
Nutritional support	937 (95)
Structural obstruction	30 (3)
Others	24 (2)
Underling diseases	
Cerebral infarction	455 (45)
Cancer	182 (18)
Cerebral hemorrhage	174 (17)
Dementia	52 (5)
Alzheimer's disease	29 (3)
Traumatic injury	28 (3)
Decompression therapy	1 (0)
Others	96 (9)

*Total response numbers of each question could be different due to response rate.

respiratory suppression following sedation. Procedures selected following PEG failure were nasogastric tube insertion (44%), surgical gastrostomy or jejunostomy (33%), percutaneous endoscopic jejunostomy (12%), and percutaneous transesophageal gastric tube intubation (6%).

3. Status PEG team support

In the investigation of conducting preoperative meetings for risk assessment, nutritional status assessment, and future status review, more than half of the institutions (60%) answered that they did not conduct meetings. Only 3% of the institutions reported conducting preoperative meetings in all PEG cases. Regarding the cooperation between the nutrition support team (NST) and the physician performing the PEG, respondents who answered that they cooperated were fewer than those who answered that they did not cooperate. Regarding the acquisition of NST certificates for doctors performing PEG, only 7% of institutions answered that all physicians acquire a license for NST. On the other hand, about half of the institutions (49%) responded that physicians do not get certified and 44% of institutions responded that some of physicians obtain NST certificates. Approximately 20% of the physicians performing PEG stated that they regularly participate in NST-related conferences.

4. PEG methods

1) Preparing PEG insertion

PEG was performed mostly in the endoscopy unit (92%), followed by the pediatric intensive care unit (2%), operating room (2%), and fluoroscopy room (2%). Abdominal X-ray (32%) was the most frequently performed preoperative examination, followed by chest X-ray (29%) and blood tests (29%). The most frequently performed preoperative anesthesia was conscious sedation (76%) (Table 2). In the survey regarding antibiotic use, the most common response was to use antibiotics only before the procedure (48%), followed by using them both before and after the procedure (28%), and only after the procedure

Table 2. Preparations for PEG

Variable	No. (%)
Placement performing PEG	
Endoscopy room	57 (92)
Operating room	1 (2)
Other	2 (3)
No response	2 (3)
Tests before PEG*	
Abdomen X-ray	45 (32)
Chest X-ray	41 (29)
Blood test	41 (29)
Abdomen CT	10 (7)
Endoscopy	1 (1)
None	2 (2)
Sedation before PEG	
Conscious sedation	47 (76)
General anesthesia	2 (3)
Anesthesia of the pharynx alone	2 (3)
Determined on a case-by-case basis	8 (13)
No response	3 (5)

PEG, percutaneous endoscopic gastrostomy; CT, computed tomography.
*Multiple response question.

Table 3. Drugs for Percutaneous Endoscopic Gastrostomy

Variable	No. (%)
Anticholinergics	
Use	15 (24)
Do not use	44 (71)
No response	3 (5)
Time to start antibiotics	
Pre-procedure	30 (48)
Pre- and post-procedure	17 (28)
Post-procedure	10 (16)
No response	5 (8)
Antacid	
Use	25 (40)
Do not use	34 (55)
No response	3 (5)
Duration of using antibiotics	
1 day	33 (53)
2–3 day	21 (34)
More than 1 wk	3 (5)
No response	5 (8)

(16%). Regarding the duration of antibiotic use, only 1 day (53%) was the most frequent response, followed by 2 to 3 days (34%) and more than 1 week (5%). Anticholinergics and antacids were not mainly used as preoperative medications. Among antacids, proton pump inhibitors (PPIs) were used the most commonly used (Table 3). Regarding the needle puncture method, pressing on the abdominal wall with endoscopy using an endoscope (72%) was the most frequently used method. The first choice of PEG insertion method was the pull method (51%), followed by the introducer technique (32%) and push technique (5%).

Table 4. Techniques for PEG Insertion and Tube Types According to Fixed Position

Variable	No. (%)
Method of needle puncture	
Pressing on the abdominal wall with endoscopy	45 (72)
After abdominal CT, localization through endoscopy	6 (10)
Using fluoroscopy	1 (2)
No response	10 (16)
Method of PEG insertion*	
Pull technique	33 (51)
Introducer technique	21 (32)
Push technique	3 (5)
Pull or introducer technique	6 (10)
Pull or push technique	1 (2)
PEG tube type fixed inside the stomach	
Balloon type	36 (58)
Bumper type	8 (13)
Balloon or bumper type	14 (23)
No response	4 (6)
PEG tube type fixed outside the stomach	
Tube type	46 (74)
Button type	7 (11)
Combination of tube and button type	5 (8)
No response	4 (7)

PEG, percutaneous endoscopic gastrostomy; CT, computed tomography.
*Multiple response question.

Regarding the method used to fix the PEG tube inside the stomach, the balloon type (58%) was used more than the bumper type (13%). The tube type (74%) was the most common device used to fix the PEG tube outside the body (Table 4).

2) Tube exchange

Regarding the reasons for changing the PEG tube, replacement according to the cycle accounted for the highest percentage, and other reasons, including self-removal, and functional abnormalities, were noted. The average duration of tube replacement was 6 to 12 months (70%), more than 12 months (16%), and less than 6 months (14%). The average replacement period according to the internal fixation method (balloon or bumper type) was 6 to 12 months, similar to the previous result. PEG tube exchange was performed under endoscopic observation (42%), manual exchange (18%), and a combination of both (40%). As a method for checking tube placement located inside the stomach during the exchange, endoscopy (64%) was the most common, followed by air injection via PEG (13%), fluorography (8%), influx of gastric acid to the tube (6%), and case by case (9%). When fixing the PEG tube inside the stomach, the balloon type (62%) was used more frequently than the bumper type (14%). Particularly, as a method for removing the tube when exchanging the bumper-type PEG, pulling and removing through the gastrostomy hole (69%) was the most commonly used, followed by endoscopic removal after excision of the PEG tube (23%). Furthermore, regarding problems that occurred upon tube removal, bleeding and skin damage from the gastrostomy hole were the most frequently experienced problems (64%), followed by injury to the oral cavity and esophagus when the endoscope was removed following PEG tube resection (25%) and complications due to intestinal obstruction during spontaneous discharge (12%).

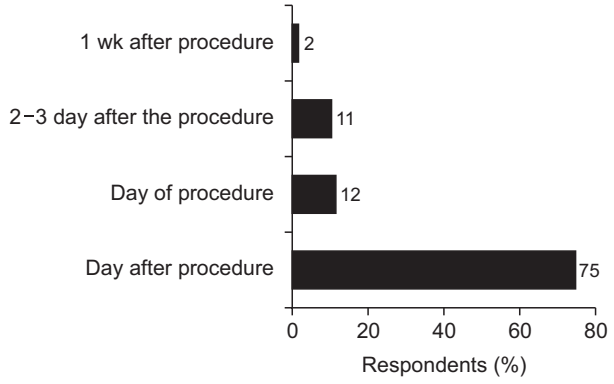

Fig. 2. Timing of nutrient supply through a tube after the percutaneous endoscopic gastrostomy procedure.

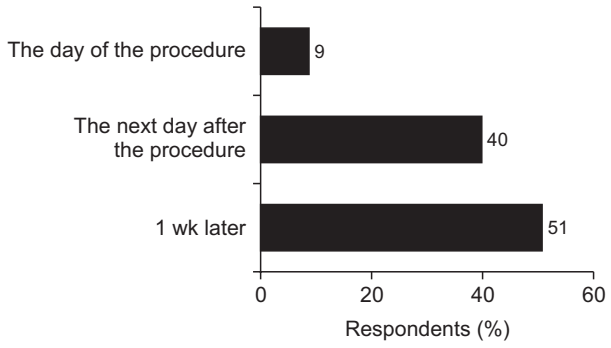

Fig. 3. Timing of shower for the first time after percutaneous endoscopic gastrostomy procedure.

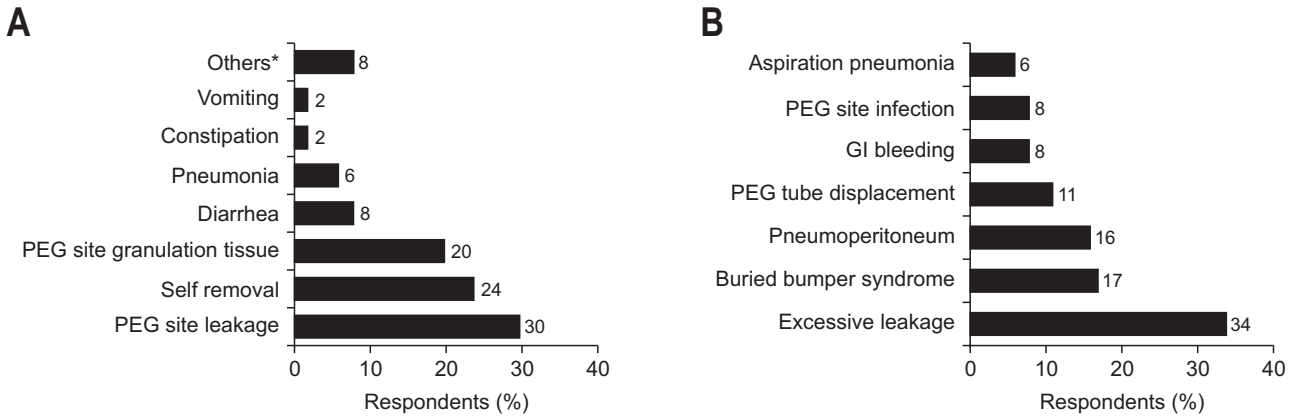

Fig. 4. The rates of complications reported within 2 weeks (A) and 1 year (B) following percutaneous endoscopic gastrostomy insertion. PEG, percutaneous endoscopic gastrostomy; GI, gastrointestinal. *Others; incision site bleeding, incision site pain.

3) Feeding following PEG insertion

Regarding when to start supplying nutrients through the tube following the PEG procedure, the next day after the procedure (75%) was the most preferred time, followed by the day of the procedure (12%), 2 to 3 days following the procedure (11%), and 1 week following the procedure (2%) (Fig. 2). The first shower allowed following PEG insertion was usually 1 week later (51%), the next day after the procedure (40%), and the day of the procedure (9%) (Fig. 3).

5. PEG-related complications

Regarding major complications, one patient died within 1 month following PEG insertion and one case of death during PEG exchange. Minor complications occurred in 46% within 2 weeks following PEG insertion. Types of complications were PEG site leakage (30%), self-removal (24%), PEG site granulation tissue (20%), diarrhea (8%), pneumonia (6%), constipation (2%), vomiting (2%), and others (8%). When examining complications 1 year following PEG insertion, excessive leakage at the PEG insertion site (34%), buried bumper syndrome (17%), pneumoperitoneum (16%), PEG tube displacement (11%), gastrointestinal bleeding (8%), PEG site infection (8%), and aspiration pneumonia (6%) were evaluated (Fig. 4).

6. Education for PEG

Education for patients who underwent PEG or their guardians included the following two main topics: post-procedure management and PEG-related complications. Of the two topics, post-procedure management education was covered more than PEG-related complications. When dividing "post-procedure management" in detail, education on preventing and managing PEG-related infections (e.g., how to check infection and the method of disinfection) was predominantly provided. Additionally, education on tube management (e.g., position and self-removal), tube feeding method (e.g., posture during and after feeding and feeding time), and replacement time were covered. Regarding education on complications, PEG insertion site-related problems (e.g., skin redness, infection, leakage, and bleeding) were mainly dealt with.

DISCUSSION

Our results showed that the PEG procedure was commonly performed by gastroenterologists in the endoscopy units of tertiary hospitals under conscious sedation. PEG was primarily performed in older adult patients with an underlying brain disease, particularly stroke (45%), and nutrition supply was the most important purpose of the PEG procedure. These trends have been observed in other studies as well.[3,4,15] The main reason why PEG could not be performed was that it was difficult to access the stomach anatomically and structurally. If the PEG procedure could not be performed, "nasogastric-tube insertion (44%)" and "surgical ostomy (33%)" were the next alternatives.[10] As a preoperative examination, simple tests, including X-rays, and blood tests, were primarily performed in most cases in Korean endoscopists. Before performing PEG, it is significant to determine the contraindications of the procedure. Regarding potential hemorrhagic risk, percutaneous access (e.g., PEG and percutaneous endoscopic jejunostomy) is a high-risk procedure.[11,12] Moreover, patients undergoing PEG frequently take antiplatelet agents, direct oral anticoagulants, or warfarin owing to underlying diseases, which increases the risk of bleeding.[16] Therefore, the ESGE guidelines recommend performing complete blood count (with particular attention to the platelet count) and coagulation test in the preprocedure access (the recommended thresholds are a platelet count of >50,000/μL and an inter-

national normalized ratio of <1.5). Furthermore, to check structural and anatomical abnormalities, including bowel obstruction, altered/unfavorable gastric anatomy, impaired gastric emptying, and the presence of ascites, which can worsen the maturation of the stomal track and increase the risk of bacterial peritonitis, X-rays can be performed.[17,18] Moreover, if a more accurate image examination is needed, computed tomography can be considered.[12,17]

One of the distinctive aspects of this study is the team-based work for PEG. Approximately 80% of institutions reported not conducting pre-meetings among workers related to PEG procedures. Additionally, the acquisition of a nutritional intensive care team certificate and attendance of NST-related conferences by physicians performing PEG was low, and there was a lack of cooperation between NST and physicians performing PEG. For the efficacy of EN support and to prevent potential complications, the ESGE guidelines recommend that patients with enteral tubes are regularly monitored by a dedicated multidisciplinary team (in collaboration with home caregivers, nurses, and general practitioners). However, NST-related activities were not sufficiently performed in most Korean institutions. PEG is only focused on providing a nutritional supply route for patients; therefore, it appears that awareness of the need for proper nutritional supply for patients with PEG is deficient among physicians, and objective indicators of NST are inadequate. Employing several opportunities for educating NST and encouraging teamwork for PEG is necessary.

The use of antibiotics for preventing infection is significant because the PEG procedure has a risk of infection.[3,6,9,12,19] In this study, Antibiotics tended to be given the day before the procedure as a single dose. This shows a similar tendency to "administration as a single dose before surgery" as recommended by the ESGE guidelines.[9,13,14] However, there was a lack of details, including the type of antibiotic and route of administration, in this study. The effects of anticholinergics on PEG have not been studied, reflecting their clinical disuse in this study. Conversely, it is known that PPIs can minimize peristomal leakage by inhibiting gastric acid secretion and help prevent various complications, including gastrocutaneous fistula.[13,20,21] However, our study showed a tendency not to use PPI. Based on previous studies on the effect of PPIs on PEG so that those who perform PEG can recognize the need for PPIs and actively use it, must be undertaken.[21,22] Regarding the techniques of PEG, the pull technique was most commonly used when performing PEG for the first time. Currently, this is the method recommended as the basic PEG insertion in the ESGE guidelines and used as the primary choice in most institutions not only for adults but also for children.[3,9,21,23] If problems regarding the function of the PEG tube were not observed, it was mainly replaced according to the exchange cycle; the period was approximately 6 to 12 months in this study.[14] The replacement period according to the internal fixation type of PEG was also the same at 6 to 12 months. Replacement processes, including the confirmation of the tube placement, were mainly performed under endoscopy observation.[14] When exchanging the bumper-type PEG, the method of pulling the tube and removing it through the gastrostomy hole was the most commonly used, and major complications during this process included bleeding and skin damage.[14,22] Regarding when to start EN following gastrostomy creation, approximately 75% of the cases started on the day following the PEG procedure. This result was somewhat different from the ESGE guidelines' strong recommendation that EN may be started within 3 to 4 hours following uncomplicated placement; however, it was consistent with starting EN within 24 hours recommended in several previous studies.[3,9,24,25] In other words, it is a common opinion to begin supplying EN through the tube as soon as possible when contraindications are not observed.[9,25,26] In particular, this study additionally investigated the suitable time for a shower following the PEG procedure, which may be considered one of the important things for a patient's quality of life. This issue has not been addressed in previous studies or guidelines, and providing what patients need in actual clinical practice is meaningful. There are very few cases of serious complications, including PEG-related deaths. However, after the procedure, postoperative leakage at the PEG insertion site occurred most frequently regardless of the time duration following PEG.[21,27,28] From this point of view, the ESGE guidelines strongly recommend considering peristomal leakage as the main PEG-related post-procedural complication and suggest that effort for treating any underlying predisposing diseases should be made in the case of peristomal leakage.[9,12] To prevent leakage, local treatment with absorbing agents, stoma adhesive powder, and zinc oxide can be used to reduce skin irritation in the puncture site. In the case of leakage occurrence, the PEG tube should be removed, and a new PEG tube should be placed at a different site.[3,9,19,29] As previously mentioned, the possibility of complications following the procedure exists at any time; therefore, PEG education for patients, and guardians is highly significant. Post-procedure management is particularly important in situations where medical help is unavailable. Considering that the outside and inside of the body are connected through the tube, and feeding continuously progresses through this passage, it is easily exposed to infection.[8,29,30] In fact, infection-related education was most covered; however, the emphasized details of education were different for each institution

in this study.[9,31] In previous guidelines, the educational part of PEG, including infection, was not dealt with sufficiently.[9,12,31] Consequently, essential points regarding PEG education have not been delivered well to patients in real clinical practice.[9] Therefore, the results of this study indicate that education for PEG needs to be formulated more systematically in the future. Recently, the current Korean PEG guideline was introduced and this study will supplement the shortcomings of the current guideline.[3,10,11,13,14,22]

There are several limitations of this study. The first is the low response rate to the survey (about 30%). In terms of research methods, it can be seen as one of the limitations of web-based survey using Google Forms. Also, most low-grade medical institutions that do not perform PEG procedures cannot participate in the survey because PEG is restrictively performed at tertiary hospitals with capable doctors and equipment in Korea. The difference in response rate for each question is considered as another limitation. It means that there are some questions that are difficult or impossible for respondents to answer. This probably indicates that, due to the lack of consensus on PEG, each hospital performs PEG according to their own conditions and circumstances. For example, NSTs do not exist in some hospitals and even in hospitals where NST exists, there are no clear guidelines of NST for PEG. That could be the reason why the response rate for NST-related questions is low or different.

In conclusion, PEG is a relatively safe and effective procedure using an endoscope; however, patients undergoing PEG were frequently in poor nutritional status and had underlying diseases, particularly older adults. Therefore, physicians must select a proper workup and an effective technique for PEG and educate regarding PEG management considering the characteristics of the patient group. This study was conducted for Korean medical institutions in the form of a questionnaire about PEG. By comparing and analyzing the results of the survey with the existing guidelines and, in particular, by dealing with details not mentioned in the previous guidelines, we attempted to reach a consensus on safe and effective PEG. Therefore, each medical institution needs to select an appropriate method considering the medical environment and the physician's expertise.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

AUTHOR CONTRIBUTIONS

Study concept and design: Y.H.K. Data acquisition: K.B.C., J.S.K., J.W.C., J.W.J., S.G.L., C.G.K., H.J.P., T.J.K., E.S.K., S.J.J. Data analysis and interpretation: T.G.K., J.W.P. Drafting of the manuscript: J.W.P., Y.H.K. Critical revision of the manuscript for important intellectual content: Y.H.K. Statistical analysis: J.W.P. Administrative, technical, or material support; study supervision: Y.H.K. Approval of final manuscript: all authors.

ORCID

Jun Woo Park https://orcid.org/0009-0006-5522-7140
Tae Gyun Kim https://orcid.org/0009-0002-3644-7640
Kwang Bum Cho https://orcid.org/0000-0003-2203-102X
Jeong Seok Kim https://orcid.org/0000-0003-1007-564X
Jin Woong Cho https://orcid.org/0000-0002-0296-8045
Jung Won Jeon https://orcid.org/0000-0003-3087-086X
Sun Gyo Lim https://orcid.org/0000-0003-2045-5099
Chan Gyoo Kim https://orcid.org/0000-0002-1651-2559
Hong Jun Park https://orcid.org/0000-0001-9320-9978
Tae Jun Kim https://orcid.org/0000-0001-8101-9034
Eun Sun Kim https://orcid.org/0000-0003-1820-459X
Su Jin Jeong https://orcid.org/0000-0002-7388-8368
Yong Hwan Kwon https://orcid.org/0000-0002-0520-9685

SUPPLEMENTARY MATERIALS

Supplementary materials can be accessed at https://doi.org/10.5009/gnl230174.

REFERENCES

1. Felekis D, Eleftheriadou A, Papadakos G, et al. Effect of perioperative immuno-enhanced enteral nutrition on inflammatory response, nutritional status, and outcomes in head and neck cancer patients undergoing major surgery. Nutr Cancer 2010;62:1105-1112.
2. Sharma K, Mogensen KM, Robinson MK. Pathophysiology of critical illness and role of nutrition. Nutr Clin Pract 2019;34:12-22.
3. Tae CH, Lee JY, Joo MK, et al. Clinical practice guidelines for percutaneous endoscopic gastrostomy. Clin Endosc 2023;56:391-408.
4. Dietrich CG, Schoppmeyer K. Percutaneous endoscopic gastrostomy: too often? Too late? Who are the right patients for gastrostomy? World J Gastroenterol 2020;26:2464-2471.

5. Mogensen KM, Robinson MK, Casey JD, et al. Nutritional status and mortality in the critically ill. Crit Care Med 2015;43:2605-2615.
6. Braunschweig CL, Levy P, Sheean PM, Wang X. Enteral compared with parenteral nutrition: a meta-analysis. Am J Clin Nutr 2001;74:534-542.
7. Gramlich L, Kichian K, Pinilla J, Rodych NJ, Dhaliwal R, Heyland DK. Does enteral nutrition compared to parenteral nutrition result in better outcomes in critically ill adult patients? A systematic review of the literature. Nutrition 2004;20:843-848.
8. Rahnemai-Azar AA, Rahnemaiazar AA, Naghshizadian R, Kurtz A, Farkas DT. Percutaneous endoscopic gastrostomy: indications, technique, complications and management. World J Gastroenterol 2014;20:7739-7751.
9. Gkolfakis P, Arvanitakis M, Despott EJ, et al. Endoscopic management of enteral tubes in adult patients. Part 2: peri- and post-procedural management. European Society of Gastrointestinal Endoscopy (ESGE) Guideline. Endoscopy 2021;53:178-195.
10. Pih GY, Na HK, Hong SK, et al. Clinical outcomes of percutaneous endoscopic gastrostomy in the surgical intensive care unit. Clin Endosc 2020;53:705-716.
11. Kim Y, Lee JH, Lee GH, et al. Simulator-based training method in gastrointestinal endoscopy training and currently available simulators. Clin Endosc 2023;56:1-13.
12. Arvanitakis M, Gkolfakis P, Despott EJ, et al. Endoscopic management of enteral tubes in adult patients. Part 1: definitions and indications. European Society of Gastrointestinal Endoscopy (ESGE) Guideline. Endoscopy 2021;53:81-92.
13. Jung SO, Moon HS, Kim TH, et al. Nutritional impact of percutaneous endoscopic gastrostomy: a retrospective single-center study. Korean J Gastroenterol 2022;79:12-21.
14. Park JH, Choi BH, Choi KH, Kim JY. Clinical review of percutaneous endoscopic gastrostomy (PEG) in children. Korean J Gastrointest Endosc 2005;31:291-296.
15. Suzuki Y, Urashima M, Ninomiya H, et al. A survey of percutaneous endoscopic gastrostomy in 202 Japanese medical institutions. Japan Med Assoc J 2006;49:94-105.
16. Veitch AM, Vanbiervliet G, Gershlick AH, et al. Endoscopy in patients on antiplatelet or anticoagulant therapy, including direct oral anticoagulants: British Society of Gastroenterology (BSG) and European Society of Gastrointestinal Endoscopy (ESGE) guidelines. Endoscopy 2016;48:385-402.
17. Itkin M, DeLegge MH, Fang JC, et al. Multidisciplinary practical guidelines for gastrointestinal access for enteral nutrition and decompression from the Society of Interventional Radiology and American Gastroenterological Association (AGA) Institute, with endorsement by Canadian Interventional Radiological Association (CIRA) and Cardiovascular and Interventional Radiological Society of Europe (CIRSE). Gastroenterology 2011;141:742-765.
18. Baltz JG, Argo CK, Al-Osaimi AM, Northup PG. Mortality after percutaneous endoscopic gastrostomy in patients with cirrhosis: a case series. Gastrointest Endosc 2010;72:1072-1075.
19. Panigrahi H, Shreeve DR, Tan WC, Prudham R, Kaufman R. Role of antibiotic prophylaxis for wound infection in percutaneous endoscopic gastrostomy (PEG): result of a prospective double-blind randomized trial. J Hosp Infect 2002;50:312-315.
20. Boeykens K, Duysburgh I. Prevention and management of major complications in percutaneous endoscopic gastrostomy. BMJ Open Gastroenterol 2021;8:e000628.
21. Wei M, Ho E, Hegde P. An overview of percutaneous endoscopic gastrostomy tube placement in the intensive care unit. J Thorac Dis 2021;13:5277-5296.
22. Kim YM, Nam SO, Park JH. Massive gastric bleeding occuring after the replacement of percutaneous endoscopic gastrostomy tube. Korean J Gastrointest Endosc 2004;28:247-250.
23. ASGE Technology Committee; Kwon RS, Banerjee S, et al. Enteral nutrition access devices. Gastrointest Endosc 2010;72:236-248.
24. Bechtold ML, Matteson ML, Choudhary A, Puli SR, Jiang PP, Roy PK. Early versus delayed feeding after placement of a percutaneous endoscopic gastrostomy: a meta-analysis. Am J Gastroenterol 2008;103:2919-2924.
25. Szary NM, Arif M, Matteson ML, Choudhary A, Puli SR, Bechtold ML. Enteral feeding within three hours after percutaneous endoscopic gastrostomy placement: a meta-analysis. J Clin Gastroenterol 2011;45:e34-e38.
26. Vyawahare MA, Shirodkar M, Gharat A, Patil P, Mehta S, Mohandas KM. A comparative observational study of early versus delayed feeding after percutaneous endoscopic gastrostomy. Indian J Gastroenterol 2013;32:366-368.
27. Attam R, Arain MA, Leslie DB, et al. Endoscopic sutured gastropexy: a novel technique for performing a secure gastrostomy (with videos). Gastrointest Endosc 2014;79:1011-1014.
28. Wei MT, Ahn JY, Friedland S. Over-the-scope clip in the treatment of gastrointestinal leaks and perforations. Clin Endosc 2021;54:798-804.
29. Roveron G, Antonini M, Barbierato M, et al. Clinical practice guidelines for the nursing management of percutaneous endoscopic gastrostomy and jejunostomy (PEG/PEJ) in adult patients: an executive summary. J Wound Ostomy Continence Nurs 2018;45:326-334.
30. Burney RE, Bryner BS. Safety and long-term outcomes of percutaneous endoscopic gastrostomy in patients with head and neck cancer. Surg Endosc 2015;29:3685-3689.
31. Pironi L, Boeykens K, Bozzetti F, et al. ESPEN guideline on home parenteral nutrition. Clin Nutr 2020;39:1645-1666.