

Special Review



Percutaneous Endoscopic Gastrostomy: Procedure, Complications and Management

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HIGHLIGHTS

- Percutaneous endoscopic gastrostomy is considered in patients who needs long time enteral feeding.
- Patients' selection, proper endoscopic insertion technique, early recognition of complication and management are important.

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Conflict of Interest

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Percutaneous Endoscopic Gastrostomy: Procedure, Complications and Management

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ABSTRACT

Percutaneous endoscopic gastrostomy (PEG) is considered in patients with insufficient oral intake who need enteral feeding or therapeutic gastric decompression. PEG tube feeding is generally superior to nasogastric tube feeding in terms of patients' comfort, long-term use, and feeding efficiency. Patient selection for PEG, the proper endoscopic insertion technique, early recognition of complications, and appropriate management are important for patient care. During preparation, adequate management of anticoagulation and antithrombotic agents are important to prevent bleeding, and prophylactic antibiotics prevent wound infection. Most complications are minor; however, major complications that require surgical correction or are life-threatening may occur, such as wound infection, bleeding, buried bumper syndrome, colocutaneous fistula, perforation, volvulus, and injuries to other organs. This review presents practical guidelines for the selection and preparation of patients, endoscopic insertion methods, and complication management strategies.

Keywords: Gastrostomy; Endoscopy; Enteral Nutrition

INTRODUCTION

Enteral or parenteral feeding is considered in patients with insufficient oral intake who need an adequate nutrition supply. Compared with parenteral nutrition, enteral feeding has some advantages (**Table 1**) [1]. Enteral feeding can be supplied with several methods [2,3]: a nasogastric tube, a nasoenteric tube (nasoduodenal or nasojejunal tube), percutaneous gastrostomy, percutaneous jejunostomy, and gastrojejunostomy (**Table 2**). In patients with

Table 1. Advantages of enteral feeding compared with parenteral nutrition

Advantages
Enteral feeding maintains digestive function.
Enteral feeding has a high efficiency of nutrient utilization.
The risk of cholecystitis is also lower compared to fasting or supplying only parenteral nutrition.
IgA secretion of the intestinal lymphoid tissue (gut-associated lymphoid tissue, GALT) prevents bacterial translocation.
The burden of medical expenses is low.
Infection complications are infrequent.

Table 2. Various methods of enteral feeding: indications and advantages.

Methods	Detail	Advantage
Nasogastric tube	<ul style="list-style-type: none"> • Suitable for short term use • Involves a risk of tube blockage because of the small tube diameter 	Easy to insert and fix
Nasoenteric tube	<ul style="list-style-type: none"> • Suitable for short-term use. • Can be considered if the risk of aspiration is high, such as in patients with postoperative intestinal obstruction, ileus, and gastric paresis • The remaining amount in the stomach cannot be checked. • Continuous slow feeding is possible. • Feeding can be started when the patient is hemodynamically stable. 	Reduced risk of aspiration
Percutaneous gastrostomy	<ul style="list-style-type: none"> • Suitable for long-term use • Inappropriate if there is a high risk of reflux or aspiration. 	No need for continuous feeding It can be used as gastrojejunostomy
Transgastric jejunostomy	<ul style="list-style-type: none"> • Suitable for short-term use. • Can be considered if the risk of aspiration is high, such as in patients with postoperative intestinal obstruction, ileus, and gastric paresis. • The remaining amount in the stomach cannot be checked. • Continuous slow feeding is possible • Feeding can be started when the patient is hemodynamically stable. 	Reduced risk of aspiration
Percutaneous jejunostomy	<ul style="list-style-type: none"> • Suitable for short-term or long-term use • Can be considered if the risk of aspiration is high, such as in patients with postoperative intestinal obstruction, ileus, and gastric paresis. • The remaining amount in the stomach cannot be checked. • Continuous slow feeding is possible • Feeding can be started when the patient is hemodynamically stable. 	Reduced risk of aspiration

intact airway reflexes, nasogastric, nasoduodenal, and nasojejunal tube feeding is suitable for short-term (< 30 days) enteral feeding. Nasogastric tube feeding may cause complications such as aspiration pneumonia, reflux esophagitis, esophageal ulcer due to mechanical stimulation, erosion, sinusitis, irritation, ulceration, bleeding, esophageal reflux, and aspiration pneumonia, as well as resulting in discomfort and even reducing feeding efficacy. Because of the small tube diameter, feeding efficiency with a nasogastric tube is lower than with percutaneous endoscopic gastrostomy (PEG). Nasogastric tube feeding is suitable for patients who are expected to be able to consume food after rehabilitation. In comparison, PEG tubes can be kept in place for a long time (i.e., more than a month) and have a wider diameter, making it easier to supply nutrition. The choice between a nasogastric tube and a PEG tube depends on the patient’s needs, preferences, nutrition status, diagnosis, and life expectancy [4,5]. The goal of enteral nutrition is to improve patients’ nutritional status and quality of life. This review covers the selection and preparation of patients, endoscopic insertion methods, and complication management strategies.

INDICATIONS

PEG tube feeding is indicated if long-term difficulty in swallowing or prolonged failure of oral feeding is expected, such as in patients with obstruction of the oropharynx or esophagus, a pharyngeal tumor or esophageal tumor, or neuromuscular disorders such as stroke. It can be used for palliative gastric decompression or for therapeutic purposes in pediatric patients. The indications and contraindications of PEG tube placement are summarized in **Tables 3** and **4** [6-8]. The patient’s medical needs must be established prior to PEG tube insertion. If an oral diet is expected to be possible in a short period of time or after rehabilitation, there is no need to insert a PEG tube.

Table 3. Indications of PEG tube insertion

Indications	Diseases
Long-term partial failure of intestinal function requiring supplementary intake	· Short bowel, fistulae, cystic fibrosis
Neuromuscular disorders of swallowing/psychomotor retardation	· Motor neuron disease (amyotrophic lateral sclerosis) · Multiple sclerosis, cerebral tumor · Parkinson's disease, cerebrovascular accident, multiple sclerosis, motor neuron disease, cerebral palsy. · Dementia, psychomotor retardation
Reduced level of consciousness	· Head injury, intensive care patients, prolonged coma
Mechanical obstruction	· Head and neck cancer, esophageal cancer
Miscellaneous long-term failure of oral feeding, long-term difficulty in swallowing is expected	· Burns · Congenital anomaly (e.g., trachea esophageal fistula) · Fistulae · Cystic fibrosis · Short bowel syndrome (e.g., after surgery for Crohn's disease) · Facial surgery · Poly-trauma · Chronic renal failure · Gastric decompression · Abdominal malignancy

PEG, percutaneous endoscopic gastrostomy.

Table 4. Contraindications of PEG tube insertion

Absolute contraindications	Relative contraindications
<ul style="list-style-type: none"> · Serious coagulation disorders or bleeding tendency · Partial or subtotal gastrectomy · Esophageal/gastric varices · Hemodynamic instability · Short life expectancy (less than 1 month) · Sepsis · Severe ascites · Peritoneal dialysis · Peritonitis · Abdominal wall infection at the selected site of placement · Marked peritoneal carcinomatosis · Endoscopic access is impossible due to an esophageal or oropharyngeal obstruction · Colonic interposition · Cardiorespiratory disease that prevents endoscopy 	<ul style="list-style-type: none"> · Oral eating is expected to be possible in a short period of time after rehabilitation · Non-obstructing oropharyngeal or esophageal malignancy, hepatomegaly, splenomegaly, esophageal obstruction · Extreme obesity · Previous midline laparotomy (can hinder the location of the puncture site)

PEG, percutaneous endoscopic gastrostomy.

PREPARING THE PATIENT FOR PEG TUBE INSERTION

Anticoagulation and antithrombotic medications

PEG placement is considered an endoscopic procedure that involves a high risk of bleeding. According to the clinical guidelines of European Society of Gastrointestinal Endoscopy (ESGE) [9], aspirin has been shown not to increase the risk of bleeding and can be continued [10]. Aspirin discontinuation should be considered on an individual patient basis depending on the risks of thrombosis versus hemorrhage. In patients using anticoagulation and antithrombotic medications, normal coagulation parameters should be present or abnormal parameters corrected [9,11].

For PEG tube insertion in patients at low risk of thrombosis, the ESGE Clinical Guideline recommends:

- Discontinuing P2Y₁₂ receptor antagonists (clopidogrel, prasugrel, ticlopidine, cangrelor, ticagrelor, etc.) 7 days before the procedure (strong recommendation, moderate-quality evidence).
- In patients on dual antiplatelet therapy, continuing aspirin (strong recommendation, low-quality evidence).
- Discontinuing warfarin for 5 days before the procedure (strong recommendation, high-quality evidence). The international normalized ratio should be checked prior to the procedure to ensure that it is appropriate.
- Administering the last dose of a direct oral anticoagulant 3 days before the procedure (strong recommendation, low quality evidence).
- Administering the last dose of dabigatran 5 days prior to the procedure for patients with a creatinine clearance or estimated glomerular filtration rate of 30–50 mL/min (strong recommendation, low quality evidence).

Antibiotics

The placement of a PEG tube is not considered a sterile procedure, and peristomal infection is a common complication of PEG. Wound infections are mainly caused by contamination of the internal bumper by bacteria in the oral cavity or skin incisions [12]. A systematic review with a meta-analysis of randomized controlled trials demonstrated a significant reduction in the incidence of peristomal infection when intravenous prophylactic antibiotics were administered (pooled odds ratio [OR], 0.31; 95% confidence interval [CI], 0.22–0.44) [13]. Broad-spectrum antibiotic administration starting 30 minutes before PEG insertion and lasting for 3 days after the procedure prevents local and systemic infections after the PEG procedure [14,15].

Proton pump inhibitors and histamine receptor blockers

Proton pump inhibitors (PPIs) and histamine receptor blockers-increase gastric acidity, stimulating gastric bacterial growth and increasing the risk of post-PEG wound infection; therefore, it is recommended to discontinue these medications before PEG insertion. However, PPIs and histamine receptor blockers can be used to reduce gastric secretion leakage (e.g., gastric acid leaking through the gastrostomy tube), when post-PEG bleeding is observed, or if ischemia and tissue ulcers occur due to internal bumps in the PEG gastrostomy tube [6].

ENDOSCOPIC INSERTION TECHNIQUE

The endoscopic insertion is performed using one of three techniques. The pull type (Sacks-Vine technique), is commonly used. Other techniques are the push type (Ponsky-Gauder technique) and introducer type (Russell technique) [16-19].

Pull-type technique

1. Choose the puncture site (the closest site to the anterior wall of the stomach) using transillumination of the inserted endoscope and palpation of the stomach.

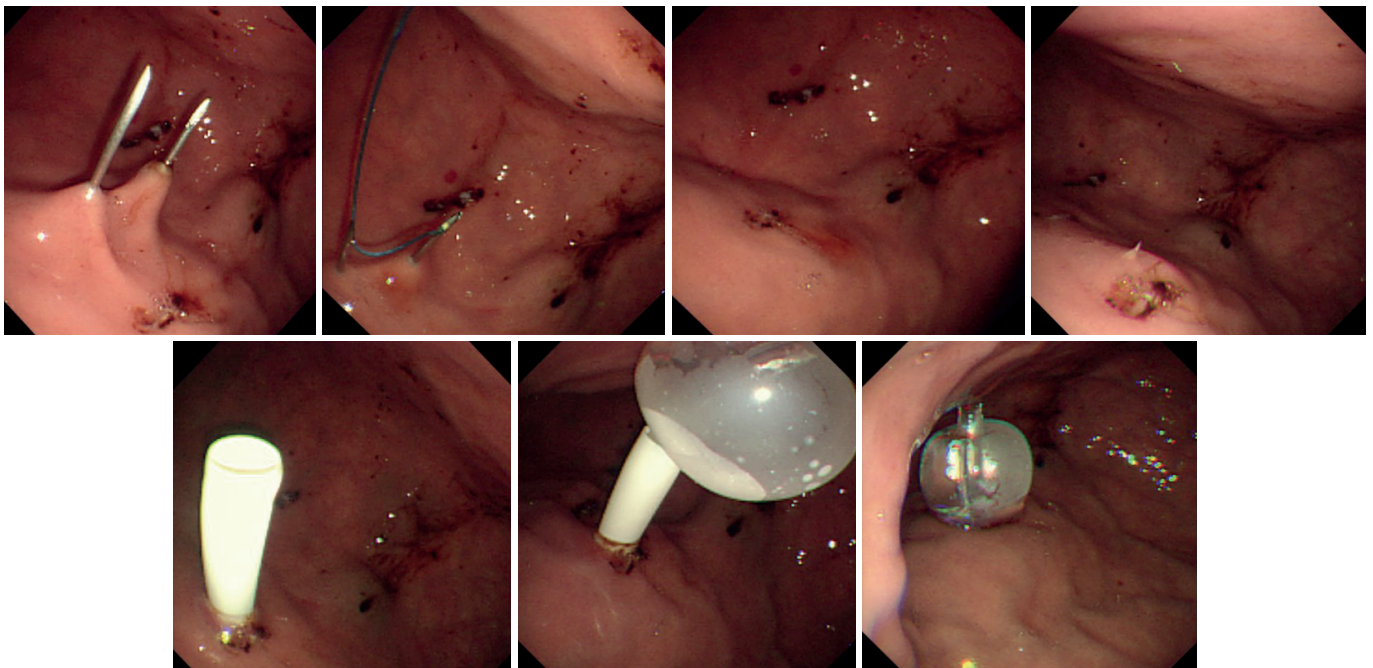


Fig. 1. PEG endoscopic insertion: introducer technique.

2. Disinfect this area with povidone-iodine and alcohol, and after local anesthesia, puncture the gastric lumen.
3. Insert the guide wire through the catheter in the puncture needle and perform a skin incision sufficient to pass the PEG tube. The guide wire inserted into the gastric lumen is caught with biopsy forceps and discharged into the body.
4. Pull the guide wire at the punctured area of the abdominal wall from the mouth to the stomach.
5. Insert the PEG tube into the stomach through the esophagus, and fix it to the stomach wall by an internal buffer attached to the end of the PEG tube.
6. The procedure ends when the PEG tube protruding from the body through the abdominal wall is fixed by an external buffer.

The introducer technique is a simple method developed in Japan. One can insert the gastrostomy tube directly through a trocar inserted into the abdominal wall. The risk of infection is low because the insertion of the endoscope ends once. However, it is easy for the tube to escape due to balloon damage (**Fig. 1**).

COMPLICATIONS

PEG tube insertion is usually considered a safe procedure. The incidence of complications has been reported to be 5%–40% [20-22]. Wound infection is a common complication, and most complications are minor. Nonetheless, major complications that require surgical correction or are life-threatening may occur [20-22]. These complications can generally be classified into three categories: endoscopic technical difficulties, PEG insertion procedure-related complications, and late complications associated with PEG tube use and wound care (**Table 5, Fig. 2**). Some late complications occur soon after tube placement, while others

Table 5. Complications associated with PEG tube insertion

Early complications (within 7 days) (Endoscopic procedure-related)	Late complications (After the PEG tube track matures)
<ul style="list-style-type: none"> · Over-sedation · Aspiration · Ileus · Perforation · Pneumoperitoneum · Wound infection · Bleeding · Liver, intestine, or spleen injury 	<ul style="list-style-type: none"> · Gastric outlet obstruction · Buried bumper syndrome · Tube dislodgement · Peritonitis · Leakage of tube · Wound infection · Tube obstruction · Gastric fistula · Granuloma formation

PEG, percutaneous endoscopic gastrostomy.

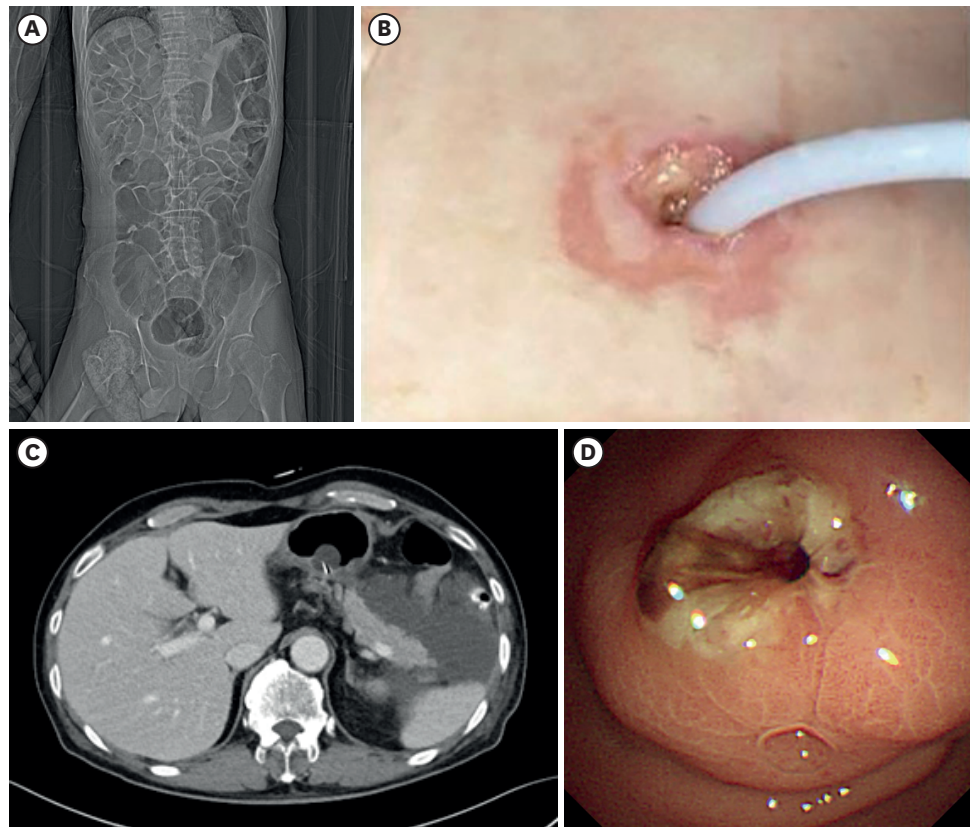


Fig. 2. PEG-related complications (A) ileus, (B) wound infection, (C) intra-abdominal hematoma, and (D) buried bumper syndrome.

develop later, when the gastrostomy tract has matured. The risk factors, prevention, and management of major or minor complications are described in **Tables 6 and 7** [23-49].

THE TIMING OF FEEDING

The timing of feeding after PEG tube placement varies somewhat from institution to institution; feeding is usually supplied after 24 hours, but there are reports that it is safe to supply feeding last 3 hours.

Table 6. Major complications associated with gastrostomy: risk factors, prevention, and management

Complications	Incidence	Risk factors, prevention, and management
Bleeding	Rare A case report of rectus sheath hematoma [20]	Risk Patients using anticoagulation and antithrombotic medications. Treatment [20-22] 1) Minor bleeding from the gastrostomy tract/abdominal wall - Usually ceases spontaneously - Apply pressure to the abdominal wound. - Tightening the external bolster will compress the bleeding in the gastrointestinal tract. 2) Severe bleeding by injury of a large vessel with intraperitoneal or retroperitoneal bleeding may need surgery
Injury to the stomach, colon, small bowel, and liver	Very rare	Risk Prior abdominal surgery with postoperative adhesions Prevention Careful adherence to proper insertion technique with trans-illumination and palpation of the stomach is important
Necrotizing fasciitis		Broad-spectrum antibiotics Surgical debridement
Buried bumper syndrome [23-36]	1.5%–1.9% Usually occurs in the first four months of using the tube.	Cause Excessive tension between the internal and external bumper Prevention - Proper fixation of the PEG tube and proper daily care that the - Placement of gauze pads over the external bolster rather than underneath it to decrease pressure - Avoiding excessive tension in tube fixation Treatment depends on the type of the PEG tube - Surgical removal of bump
Tumor seeding	Head and neck or esophageal cancer	Clinical significance remains unknown
Ileus		Perforation should be ruled out by X-ray or computed tomography imaging Treatment - Nil per os status - Gastric decompression - Intravenous hydration
Volvulus		Volvulus can occur if the PEG tube is introduced into the posterior wall of the stomach Treatment Surgical repair.
Gastroparesis		Usually transient; rarely, gastroparesis progresses to ileus Treatment Withholding feeding
Colocutaneous fistula [37-40]		Symptom presentation - Acute colonic perforation or obstruction. - Chronic stool leakage around the gastrostomy tube and diarrhea resembling formula during feeding (common). Treatment - Simply removing the tube and allowing the fistula to close - Surgery if signs of peritonitis develop or the fistula fails to heal.
Aspiration pneumonia [41,42]	Any time during the procedure or later, after feeding has started.	Prevention - Avoid rapid infusion rate of enteral feeding, - Upright position for 30 minutes after feeding - Periodic check-up of gastric residual volume Treatment - Intravenous antibiotic - Convert PEG to jejunostomy if recurrent aspiration pneumonia occurs

PEG, percutaneous endoscopic gastrostomy.

Start feeding [50,51]

1. After slowly injecting 50 mL of water through the tube, check for abdominal bloating, pain, leakage, or vomiting, and if there is no abnormality, tube feeding begins.
2. Before feeding, the patient should take a 30°–60° semi-upright position.
3. The patient should lie down after 1 hour to prevent aspiration after feeding.

Table 7. Minor complications associated with PEG tubes

Variables	Prevention and management
Granuloma	Resection and/or cauterization of tissue
PEG site herniation [43-45]	Proper skin incision during PEG placement
Pneumoperitoneum [46]	Most cases resolve after about a week; clinically not significant Management - Observation, O ₂ supply
Wound infection	Cause - Excessive pressure on the stoma - Poor peristomal hygiene - Gastric fluid leakage Management - Adjust the distance between the external bumper and the stoma - Clean the stoma - Place gauze underneath the external bumper and change it daily
Tube dislodgement [47]	Suspect tube displacement if infusion of feeding is interrupted Management - Promptly manual correction of tube - Re-insertion of a new feeding tube
Peristomal leakage [48,49]	Prevention Proper skin incision during PEG Management - Nil per os status and intravenous proton pump inhibitor - Consider complete removal of the PEG tube or nasogastric tube feeding, or conversion to PEG jejunostomy, if it is intractable
Persistent gastric fistula after removal	
Tube extraction	The PEG tube comes out accidentally or voluntarily Management - Immediately replace the tube - If a new tube is not immediately available, place a Foley catheter temporarily through the stoma
Diarrhea	Cause - Hyperosmolar solution - Lactose intolerance - Poor absorption of fats Management - Use an isotonic diet and/or dilute a hypertonic diet - Suppress lactose - Use low-fat formulas
Constipation	Cause - Low fluid administration - Insufficient fiber intake Management - Administer fluids in adequate amounts - Increase the amount of fiber in the nutritional formula
Failure of stoma closure post-removal (persistent gastro-cutaneous fistula) [48,49]	Management - Endoscopic clipping, suturing, plugging, and banding techniques. - Surgical fistula closure
Catheter obstruction	Management - Irrigation with water - Continuous feeding: Wash the PEG tube with 20 to 30 mL of warm water every 4 hours - Intermittent feeding: Wash the PEG tube with at least 15 mL of water before and after meals (30–50 mL each).

PEG, percutaneous endoscopic gastrostomy.

4. After feeding, make sure to flush the inside of the tube with 30–50 mL of water and block it with a stopper.
5. Remove stitches on both sides around the PEG site after 2 weeks

Start continuous feeding

- Check hemodynamic stability in critically ill patients and decide when to start feeding.
- In the beginning, a continuous supply for 24 hours is recommended.
- Start slowly and reach the target speed within 24 to 72 hours.

- For critically ill patients, start with 10 to 40 mL/h and increase 10 to 30 mL every 8 to 12 hours to reach the target speed.
- In non-critically ill patients, start at 50 mL/h and increase 15 mL every 4 hours.

It is preferable that the injection rate of continuous feeding does not exceed 120 mL/h.

Start intermittent feeding

1. Before and after injecting the enteral nutrient solution, about 30–50 mL of water is injected.
2. For patients who are receiving enteral nutrition for the first time, start with 100–150 mL of feeding each, 3 times per day.
3. Increase the amount by 200 mL every day and gradually proceed to the target amount.

It is recommended to stop feeding through a PEG tube due to an increased risk of aspiration pneumonia when the residual amount is 200 mL or more in the stomach 2 hours after the end of feeding.

EXCHANGE OF THE PEG TUBE

Exchanging the PEG tube is usually recommended every 6 months as long as the tube does not get stuck. However, if there is no damage to the PEG tube, it can be used for more than a year. The PEG tube should be washed with 20 to 30 mL of warm water every 4 hours to prevent food waste or medicine from becoming stuck in the PEG tube. It is worthwhile to consider exchanging the tube for a button-type PEG tube for patients with high physical activity [6]. The most common reason for PEG tube replacement is accidental removal by the patient or pulling on the tube due to a change in position. If the PEG tube is removed due to an accident, it is recommended to insert a new one within 24 hours to prevent obstruction of the passage. If the immediate tube insertion procedure is not easy or if the insertion of the PEG tube is delayed, inserting a Foley catheter and fixing it to the gastric lumen with a balloon can prevent clogging of the passage. After PEG tube removal, the passage closes automatically within a week or two.'

SUMMARY

Patients who have PEG tubes inserted usually have underlying diseases and poor nutritional status. PEG insertion is generally considered to be a safe endoscopic procedure. However, pre-procedure and post-procedure management is important. During preparation, adequate management of anticoagulation and antithrombotic agents is important to prevent bleeding, and prophylactic antibiotics prevent wound infection. Most complications are minor, and wound infections are common; however, major complications such as bleeding, buried bumper syndrome, colcutaneous fistula, perforation, volvulus, and injuries to other organs may occur. The prevention and management of PEG-associated complications are as important as PEG tube insertion.

REFERENCES

1. Woodcock NP, Zeigler D, Palmer MD, Buckley P, Mitchell CJ, MacFie J. Enteral versus parenteral nutrition: a pragmatic study. *Nutrition* 2001;17:1-12.
[PUBMED](#) | [CROSSREF](#)
2. Taylor BE, McClave SA, Martindale RG, Warren MM, Johnson DR, Braunschweig C, McCarthy MS, Davanos E, Rice TW, Cresci GA, Gervasio JM, Sacks GS, Roberts PR, Compher CSociety of Critical Care MedicineAmerican Society of Parenteral and Enteral Nutrition. Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.). *Crit Care Med* 2016;44:390-438.
[PUBMED](#) | [CROSSREF](#)
3. Mekhail TM, Adelstein DJ, Rybicki LA, Larto MA, Saxton JP, Lavertu P. Enteral nutrition during the treatment of head and neck carcinoma: is a percutaneous endoscopic gastrostomy tube preferable to a nasogastric tube? *Cancer* 2001;91:1785-1790.
[PUBMED](#) | [CROSSREF](#)
4. Druml C, Ballmer PE, Druml W, Oehmichen F, Shenkin A, Singer P, Soeters P, Weimann A, Bischoff SC. ESPEN guideline on ethical aspects of artificial nutrition and hydration. *Clin Nutr* 2016;35:545-556.
[PUBMED](#) | [CROSSREF](#)
5. Holmes S. Enteral feeding and percutaneous endoscopic gastrostomy. *Nurs Stand* 2004;18:41-43.
[PUBMED](#) | [CROSSREF](#)
6. Stroud M, Duncan H, Nightingale JBritish Society of Gastroenterology. Guidelines for enteral feeding in adult hospital patients. *Gut* 2003;52 Suppl 7:viii-viii12.
[PUBMED](#) | [CROSSREF](#)
7. Arvanitakis M, Gkolfakis P, Despott EJ, Ballarin A, Beyna T, Boeykens K, Elbe P, Gisbertz I, Hoyois A, Mosteanu O, Sanders DS, Schmidt PT, Schneider SM, van Hooft JE. 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.
[PUBMED](#) | [CROSSREF](#)
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.
[PUBMED](#) | [CROSSREF](#)
9. Veitch AM, Radaelli F, Alikhan R, Dumonceau JM, Eaton D, Jerrome J, Lester W, Nylander D, Thoufeeq M, Vanbiervliet G, Wilkinson JR, Van Hooft JE. Endoscopy in patients on antiplatelet or anticoagulant therapy: British Society of Gastroenterology (BSG) and European Society of Gastrointestinal Endoscopy (ESGE) guideline update. *Gut* 2021;70:1611-1628.
[PUBMED](#) | [CROSSREF](#)
10. ASGE Standards of Practice CommitteeAcosta RD, Abraham NS, Chandrasekhara V, Chathadi KV, Early DS, Eloubeidi MA, Evans JA, Faulx AL, Fisher DA, Fonkalsrud L, Hwang JH, Khashab MA, Lightdale JR, Muthusamy VR, Pasha SF, Saltzman JR, Shaikat A, Shergill AK, Wang A, Cash BD, DeWitt JM. The management of antithrombotic agents for patients undergoing GI endoscopy. *Gastrointest Endosc* 2016;83:3-16.
[PUBMED](#) | [CROSSREF](#)
11. Richter JA, Patrie JT, Richter RP, Henry ZH, Pop GH, Regan KA, Peura DA, Sawyer RG, Northup PG, Wang AY. Bleeding after percutaneous endoscopic gastrostomy is linked to serotonin reuptake inhibitors, not aspirin or clopidogrel. *Gastrointest Endosc* 2011;74:22-34.e1.
[PUBMED](#) | [CROSSREF](#)
12. Sharma VK, Howden CW. Meta-analysis of randomized, controlled trials of antibiotic prophylaxis before percutaneous endoscopic gastrostomy. *Am J Gastroenterol* 2000;95:3133-3136.
[PUBMED](#) | [CROSSREF](#)
13. Jafri NS, Mahid SS, Minor KS, Idstein SR, Hornung CA, Galandiuk S. Meta-analysis: antibiotic prophylaxis to prevent peristomal infection following percutaneous endoscopic gastrostomy. *Aliment Pharmacol Ther* 2007;25:647-656.
[PUBMED](#) | [CROSSREF](#)
14. Lipp A, Lusardi G. Systemic antimicrobial prophylaxis for percutaneous endoscopic gastrostomy. *Cochrane Database Syst Rev* 2013;2013:CD005571.
[PUBMED](#) | [CROSSREF](#)
15. Locher JL, Bonner JA, Carroll WR, Caudell JJ, Keith JN, Kilgore ML, Ritchie CS, Roth DL, Tajeu GS, Allison JJ. Prophylactic percutaneous endoscopic gastrostomy tube placement in treatment of head and

- neck cancer: a comprehensive review and call for evidence-based medicine. *JPEN J Parenter Enteral Nutr* 2011;35:365-374.
[PUBMED](#) | [CROSSREF](#)
16. Russell TR, Brotman M, Norris F. Percutaneous gastrostomy. A new simplified and cost-effective technique. *Am J Surg* 1984;148:132-137.
[PUBMED](#) | [CROSSREF](#)
 17. Sacks BA, Vine HS, Palestrant AM, Ellison HP, Shropshire D, Lowe R. A nonoperative technique for establishment of a gastrostomy in the dog. *Invest Radiol* 1983;18:485-487.
[PUBMED](#) | [CROSSREF](#)
 18. Tucker AT, Gourin CG, Ghegan MD, Porubsky ES, Martindale RG, Terris DJ. 'Push' versus 'pull' percutaneous endoscopic gastrostomy tube placement in patients with advanced head and neck cancer. *Laryngoscope* 2003;113:1898-1902.
[PUBMED](#) | [CROSSREF](#)
 19. Friginal-Ruiz AB, Lucendo AJ. Percutaneous endoscopic gastrostomy: a practical overview on its indications, placement conditions, management, and nursing care. *Gastroenterol Nurs* 2015;38:354-366.
[PUBMED](#) | [CROSSREF](#)
 20. Bruckstein AH. Managing the percutaneous endoscopic gastrostomy tube. *Postgrad Med* 1987;82:143-146.
[PUBMED](#) | [CROSSREF](#)
 21. Boeykens K, Duysburgh I. Prevention and management of major complications in percutaneous endoscopic gastrostomy. *BMJ Open Gastroenterol* 2021;8:e000628.
[PUBMED](#) | [CROSSREF](#)
 22. Gkolfakis P, Arvanitakis M, Despott EJ, Ballarin A, Beyna T, Boeykens K, Elbe P, Gisbertz I, Hoyois A, Mosteanu O, Sanders DS, Schmidt PT, Schneider SM, van Hooft JE. 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.
[PUBMED](#) | [CROSSREF](#)
 23. Klein S, Heare BR, Soloway RD. The "buried bumper syndrome": a complication of percutaneous endoscopic gastrostomy. *Am J Gastroenterol* 1990;85:448-451.
[PUBMED](#)
 24. El AZ, Arvanitakis M, Ballarin A, Devière J, Le Moine O, Van Gossum A. Buried bumper syndrome: low incidence and safe endoscopic management. *Acta Gastroenterol Belg* 2011;74:312-316.
[PUBMED](#)
 25. Chung RS, Schertzer M. Pathogenesis of complications of percutaneous endoscopic gastrostomy. A lesson in surgical principles. *Am Surg* 1990;56:134-137.
[PUBMED](#)
 26. McClave SA, Chang WK. Complications of enteral access. *Gastrointest Endosc* 2003;58:739-751.
[PUBMED](#) | [CROSSREF](#)
 27. Cyrany J, Rejchrt S, Kopacova M, Bures J. Buried bumper syndrome: a complication of percutaneous endoscopic gastrostomy. *World J Gastroenterol* 2016;22:618-627.
[PUBMED](#) | [CROSSREF](#)
 28. Mueller-Gerbes D, Hartmann B, Lima JP, de Lemos Bonotto M, Merbach C, Dormann A, Jakobs R. Comparison of removal techniques in the management of buried bumper syndrome: a retrospective cohort study of 82 patients. *Endosc Int Open* 2017;5:E603-E607.
[PUBMED](#) | [CROSSREF](#)
 29. Boyd JW, DeLegge MH, Shamburek RD, Kirby DF. The buried bumper syndrome: a new technique for safe, endoscopic PEG removal. *Gastrointest Endosc* 1995;41:508-511.
[PUBMED](#) | [CROSSREF](#)
 30. Gençosmanoğlu R, Koç D, Tözün N. The buried bumper syndrome: migration of internal bumper of percutaneous endoscopic gastrostomy tube into the abdominal wall. *J Gastroenterol* 2003;38:1077-1080.
[PUBMED](#) | [CROSSREF](#)
 31. Costa D, Despott EJ, Lazaridis N, Koukias N, Murino A. Minimally invasive endoscopic management of buried bumper syndrome by use of a novel dedicated resection device. *VideoGIE* 2019;4:366-368.
[PUBMED](#) | [CROSSREF](#)
 32. Hindryckx P, Dhooghe B, Wannhoff A. A novel device for the endoscopic management of buried bumper syndrome. *Endoscopy* 2019;51:689-693.
[PUBMED](#) | [CROSSREF](#)
 33. Wolpert LE, Summers DM, Tsang A. Novel endoscopic management of buried bumper syndrome in percutaneous endoscopic gastrostomy: the Olympus HookKnife. *World J Gastroenterol* 2017;23:6546-6548.
[PUBMED](#) | [CROSSREF](#)

34. Casper M, Lammert F. How to improve success rates of endoscopic management for buried bumper syndrome. *QJM* 2018;111:467-472.
[PUBMED](#) | [CROSSREF](#)
35. Venu RP, Brown RD, Pastika BJ, Erikson LW Jr. The buried bumper syndrome: a simple management approach in two patients. *Gastrointest Endosc* 2002;56:582-584.
[PUBMED](#) | [CROSSREF](#)
36. Peck J, Sapp K, Wilsey A, Wilsey M. Wire guided cannulation facilitates endoscopic management of buried bumper syndrome: a novel technique. *Pediatr Gastroenterol Hepatol Nutr* 2019;22:86-89.
[PUBMED](#) | [CROSSREF](#)
37. Silva HM, Lima R, Pereira F, Küttner-Magalhães R. Endoscopy-assisted suture of gastrocutaneous fistula: a promising approach in pediatric patients. *Am J Gastroenterol* 2018;113:1562-1564.
[PUBMED](#) | [CROSSREF](#)
38. Singhal S, Changela K, Culliford A, Duddempudi S, Krishnaiah M, Anand S. Endoscopic closure of persistent gastrocutaneous fistulae, after percutaneous endoscopic gastrostomy (PEG) tube placement, using the over-the-scope-clip system. *Therap Adv Gastroenterol* 2015;8:182-188.
[PUBMED](#) | [CROSSREF](#)
39. Heinrich H, Gubler C, Valli PV. Over-the-scope-clip closure of long lasting gastrocutaneous fistula after percutaneous endoscopic gastrostomy tube removal in immunocompromised patients: a single center case series. *World J Gastrointest Endosc* 2017;9:85-90.
[PUBMED](#) | [CROSSREF](#)
40. Gay-Chevallier S, Lupu A, Rivory J, Rostain F, Ponchon T, Saurin JC, Pioche M. Closure of non-healing gastrocutaneous fistula after percutaneous endoscopic gastrostomy by endoscopic submucosal dissection and over-the-scope clip. *Endoscopy* 2019;51:E125-E126.
[PUBMED](#) | [CROSSREF](#)
41. Murphy LM, Bickford V. gastric residuals in tube feeding:How much is too much? *Nutr Clin Pract* 1999;14:304-306.
[CROSSREF](#)
42. Mullan H, Roubenoff RA, Roubenoff R. Risk of pulmonary aspiration among patients receiving enteral nutrition support. *JPEN J Parenter Enteral Nutr* 1992;16:160-164.
[PUBMED](#) | [CROSSREF](#)
43. Boldo-Roda E, Peris-Trias A, de Lucia-Peñalver GP, Martinez-Ramos D, Miralles-Tena JM. Reflections in front of a case of ventral hernia after PEG tube removal. *Gastrointest Endosc* 2005;62:323-324.
[PUBMED](#) | [CROSSREF](#)
44. Chuang CH, Chen CY. Gastric herniation through PEG site. *Gastrointest Endosc* 2003;58:416.
[PUBMED](#) | [CROSSREF](#)
45. Kachare MD, Rossi AJ, Mahpour NY, Davidov T. Incisional hernia after percutaneous endoscopic gastrostomy tube placement: importance of avoiding the linea alba. *ACG Case Rep J* 2019;6:e00120.
[PUBMED](#) | [CROSSREF](#)
46. Roberts PA, Wrenn K, Lundquist S. Pneumoperitoneum after percutaneous endoscopic gastrostomy: a case report and review. *J Emerg Med* 2005;28:45-48.
[PUBMED](#) | [CROSSREF](#)
47. Agnihotri A, Barola S, Hill C, Mishra P, Fayad L, Dunlap M, Moran RA, Singh VK, Kalloo AN, Khashab MA, Kumbhari V. Endoscopic suturing for the management of recurrent dislodgment of percutaneous endoscopic gastrostomy-jejunostomy tube. *J Dig Dis* 2018;19:170-176.
[PUBMED](#) | [CROSSREF](#)
48. Schrag SP, Sharma R, Jaik NP, Seamon MJ, Lukaszczyk JJ, Martin ND, Hoey BA, Stawicki SP. Complications related to percutaneous endoscopic gastrostomy (PEG) tubes. A comprehensive clinical review. *J Gastrointest Liver Dis* 2007;16:407-418.
[PUBMED](#)
49. Fang JC. Minimizing endoscopic complications in enteral access. *Gastrointest Endosc Clin N Am* 2007;17:179-196.
[PUBMED](#) | [CROSSREF](#)
50. Choudhry U, Barde CJ, Markert R, Gopalswamy N. Percutaneous endoscopic gastrostomy: a randomized prospective comparison of early and delayed feeding. *Gastrointest Endosc* 1996;44:164-167.
[PUBMED](#) | [CROSSREF](#)
51. Kirby DF, Delegge MH, Fleming CR. American Gastroenterological Association technical review on tube feeding for enteral nutrition. *Gastroenterology* 1995;108:1282-1301.
[PUBMED](#) | [CROSSREF](#)