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Percutaneous Endoscopic Gastrostomy

Bravo JGP*, de Moura ETH and de Moura EGH

Department of Gastroenterology, Clinical Hospital of the University of Sao Paulo, Brazil

***Corresponding author:** José Gonçalves Pereira Bravo, Gastrointestinal Endoscopy Unit, Department of Gastroenterology, Clinical Hospital of the University of Sao Paulo, Av: Dr. Enéas de carvalho de aguiar, 255, Cep: 05403-00 – Sao Paulo-SP, Brazil, Tel: (005511)2661-0000; Email: pereirabravo@outlook.com

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ABSTRACT

Introduction: Gastrostomy is a medical procedure used to access the gastric cavity for the purpose of feeding patients unable to be fed by mouth for long periods, as a result of various diseases, including head and neck tumors and neurological disorders. Over the years various gastrostomy techniques have been developed to facilitate access to the stomach. Percutaneous endoscopic gastrostomy, using the traction or "pull" technique developed in 1980 by Gauderer-Ponsky, is widely regarded as being a simpler, quicker and cheaper method with a low prevalence of complications and mortality compared to the surgical method, which is more expensive and bears a higher risk of complications and morbidity. However, many complications have been observed with the endoscopic method and new questions have arisen relating to these complications, regarding anticoagulation, prophylaxis, the initiation of feeding and indications. While neurological disorders used to account for most indications, the procedure is now recommended frequently based on little evidence in the literature. With few absolute contra-indications, the method has increasingly come to be regarded as the best feeding route, while

new major and minor complications have emerged, contributing to an increase in mortality directly related to the procedure, given that most patients undergoing the procedure have other serious comorbidities and have been bedridden or confined to hospital for long periods of time. Many complications are related to inadequate care of the feeding tube by hospital staff or family members. This review aims to provide an update of advances regarding this procedure described in the literature.

Methods: MEDLINE was searched (via PubMed), with no restrictions on language, for articles published between 1996 and 2015 using the following search terms: gastrostomy, complications, indications, contraindications, enteral feeding, management, prophylaxis, gastropexy, sedation, anticoagulation.

Results: The initial search produced 6550 articles, of which 87 were considered eligible for the final review, for providing information on the gastrostomy technique from indication to care of the feeding tube.

Conclusion: Percutaneous endoscopic gastrostomy is the method of choice for enteral feeding in patients unable to be fed orally, but attention should be paid to indications and contraindications as a way of avoiding complications and mortality related to the procedure, conducting an adequate evaluation of the patient prior to the procedure and providing appropriate guidance for health workers and family members who care for the patient and the feeding tube, in view of the increasing number of complications arising from shortcomings regarding indication and care reported in the literature.

Keywords: Gastrostomy; Complications; Indications; Contraindications; Enteral feeding; Management; Prophylaxis; Gastropexy; Sedation; Anticoagulation

INTRODUCTION

Gastrostomy is a medical procedure used to access the gastric cavity as a way of providing alternative feeding for patients unable to ingest food orally for long periods of time as a result of head and neck tumors, neurological disorders, traumas, motor disorders, congenital deformity, old age, decompression of the gastrointestinal tract, malnutrition and other conditions. Access to the stomach can be obtained using various gastrostomy techniques involving surgical (open and laparoscopic), endoscopic and radiological methods. All of these, however, are associated with complications and mortality directly related to the procedure. Percutaneous endoscopic gastrostomy has been highly regarded owing to the low prevalence of complications, speed, low cost, and shorter morbidity time associated with the procedure and the lack of need for general anesthesia in most cases. It has thus become the method of choice for almost all hospital services around the world. However, although the procedure is safe, it is also associated with complications. Patients thus need to undergo an appropriate evaluation to ensure that they will truly benefit from gastrostomy and to avoid complications directly associated with the procedure.

The most widely used method has been the technique described in 1980 by Gauderer-Ponsky known as "pull". With few contraindications, the method has increasingly come to be regarded as the best feeding route, while new major and minor complications have emerged, contributing to an increase in mortality directly related to the procedure, given that most patients undergoing the procedure have other serious comorbidities and have been bedridden or confined to hospital for long periods. Many complications are related to inadequate care of the feeding tube by hospital staff or family members. This review aims to provide an update of advances in relation to this procedure described in the literature.

ASPECTS TO BE TAKEN INTO ACCOUNT PRIOR TO THE PROCEDURE

Term of Consent

Although it is a less invasive procedure, gastrostomy does involve some risks of which patients should be aware and a term of consent should be provided, clearly explaining the risks associated with the procedure in terms of complications and death and those related to sedation and anesthesia. In the case of patients unable to give consent, the procedure should be authorized by their legal representative [1-4].

Antiplatelet Medication and Anticoagulation

Most patients undergoing placement of a PEG are elderly and have numerous comorbidities. Many are being treated for thrombosis, which may increase the risk of bleeding. Endoscopic procedures are classified as low or high risk with regard to their potential to cause severe hemorrhage. A high-risk endoscopic procedure is defined as any process with a risk of severe hemorrhage > 1%. Such high-risk endoscopic procedures include Percutaneous Endoscopic Gastrostomy (PEG), with a risk of bleeding of 2.5%. The risk of hemorrhage in a patient undergoing anti-thrombosis treatment being submitted to a PEG is not known [5-8].

González et al., in 2010, in a retrospective study of 91 patients, assessed the risk of bleeding in patients undergoing placement of a PEG among whom anti-thrombosis medication had been withdrawn earlier than recommended by the ASGE and found no statistically significant difference. Randomized studies with a larger sample are needed to evaluate this further [9-13].

In a retrospective study of 990 patients undergoing PEG, including 60 using aspirin and 52 using clopidogrel at the time of the procedure, the use of aspirin or clopidogrel was not found to be associated with hemorrhage after PEG [9-13]. In another study, Dushyant et al. evaluated 1541 patients undergoing PEG and found that, even in the presence of antiplatelet and anticoagulant medication, bleeding occurred in only 51 patients and that the length of stay in hospital and the infusion of heparin were the strongest predictors of bleeding with a statistical significance of p=0.018/0.029 [8-11].

The new JGES guidelines, such as ASGE, recommend continued use of aspirin for all endoscopic gastrointestinal procedures with a high risk of bleeding, but also recommend that Clopidogrel

be discontinued 5-7 days prior to any procedure in which therapeutic intervention is planned. Warfarin should be suspended 3-5 days prior to any high-risk endoscopic procedure. During this period, low molecular weight heparin may be administered but should be interrupted 8-12 hours prior to the procedure. If non-fractioned heparin is administered intravenously, it should be suspended for at least three hours prior to endoscopy and subcutaneous administration for at least six hours [12,13].

New Anticoagulants

New anticoagulants have become available as alternatives to warfarin for prophylaxis of thromboembolic complications, including Dabigatran, which should be suspended for two days in patients with normal kidney function and a high risk of bleeding [5,6].

Rivaroxaban should be interrupted at least 24h prior to any procedure in individuals with normal kidney function. A period of 48h is recommended for patients with impaired kidney function [5,6].

Bivalirudin (Angiomax) given its short half-life, an infusion of bivalirudin need only be interrupted prior to anesthesia in a patient with normal kidney function [5,6].

Prasugrel (Effient) should be interrupted at least 7 days before any procedure [5,6].

Ticagrelor (Brillinta) should be interrupted at least 5 days before any procedure. *Tirofiban (Aggrastat)* may be interrupted at the beginning of the process without harmful hematological effects [5,6].

Eptifibatide (Integrilin) should be interrupted 2-4 h before any therapeutic intervention procedure [5,6].

Abciximab (Reopro) should be interrupted 12-24 h before any procedure, preferably 24h. Coagulation parameters at the time of the procedure with platelets over 50000 and INR below 1.4 [5,6].

Prophylactic Antibiotics

Most patients who are candidates for PEG are immuno depressed, bedridden, elderly, and patients with multiple comorbidities, which puts them at risk of acquiring hospital infections, and PEG, as it is an invasive procedure, increases this risk. Many antibiotic regimens have been proposed and most have produced good results [14-19]. However, many centers recommend the use of antibiotics one hour prior to the procedure. No statistically significant difference has been found between the use of penicillins or cephalosporin, and amoxicillin/clavulanate or cefazolin/cefotaxime can be used in a single IV dose. If the patient is already on antibiotics, it should be established whether the spectrum provides adequate coverage or whether a new antibiotic is needed [16,17,20-25]. In a meta-analysis of 13 randomized clinical trials, covering a total of 1637 patients, that sought to evaluate the use of antibiotics and their ability to reduce infections

associated with PEG there was found to be a statistically significant reduction in the incidence of peristomal infection with the use of prophylactic antibiotics prior to the procedure (OR 0.36, 95% CI 0.26-0.50) [23].

In another recent study, Engelmann et al. evaluated 101 children undergoing PEG by dividing them into two groups: 33 patients who had received prophylactic antibiotics and 70 who had not. The authors found that the incidence of local or systemic infection related to PEG after placement was not significantly different among patients with and without antibiotic prophylaxis. They did, however, observe alterations in temperature indicative of bacteremia and thus recommended the use of prophylactic antibiotics in children undergoing this procedure [15].

Sedation and Analgesia

PEG may be carried out with the patient conscious but under sedation or under anesthesia, depending on the ASA of the patient. It is recommended that, in patients with ASA I and II, the procedure be carried out by trained endoscopic physicians. For patients with ASA higher than II, the presence of an anesthetist is recommended, as most of such patients have many comorbidities that may increase the risk of anesthesia [26-29]. The drugs normally used for sedation are propofol and benzodiazepines, although many centers prefer to use propofol alone, since it has a short half-life which facilitates patient recovery [30-33]. A retrospective study by Somchai et al. assessed the incidence of complications related to sedation in 191 patients, divided into two groups, one using propofol and the other benzodiazepines. They found that there were no significant differences in the characteristics of the patients, duration of sedation, complications relating to anesthesia or mortality rate between the two groups. For most procedures, analgesia is provided by the use of fentanyl opioids [34].

INDICATIONS FOR GASTROSTOMY

Percutaneous Endoscopic Gastrostomy (PEG) is mostly used by centers as the method of choice for enteral feeding in patients with a normal gastrointestinal tract who, nevertheless, require long-term enteral feeding, as they are unable to be fed orally for various reasons. There are various reasons for indicating gastrostomy, but 80 to 90% of cases involve neurological causes. However, other indications are on the rise and the procedure is now being used for some benign diseases and among the growing population of elderly patients [35-39]. PEG is thus generally considered in patients with moderate to severe risk of malnutrition, after two to three weeks of feeding by nasoenteric tube. The decision to insert the tube depends on the individual patient's needs and preferences, the diagnosis and life expectancy. The aim is not only to improve the chances of survival and nutritional status of the patient, but also to enhance his or her quality of life, which is not necessarily related to improved nutrition. The long-term survival rate of some patients is also low, owing to the various comorbidities with which such patients may be afflicted and this should be taken into account when indicating the procedure and evaluating the costs and benefits for the patient [40-43] (Table 1).

Table 1: Main indications for percutaneous endoscopic gastrostomy.

Neurological disorders
• Cerebrovascular disorder
• Motor neurone disease (amyotrophic lateral sclerosis)
• Multiple sclerosis
• Parkinson's disease
• Alzheimer's disease
• Cerebral palsy
• Dementia
• Brain tumor
• Psychomotor retardation
Alterations in level of consciousness
• Brain trauma
• Patients in intensive care
• Prolonged coma
Cancer
• Head and neck
• Esophageal
Other
• Burns
• Congenital anomaly
• Fistulas
• Cystic fibrosis
• Short intestine syndromes
• Inflammatory bowel disease
• Facial surgery
• Multiple trauma
• Chronic kidney failure
• HIV / AIDS
• Stomach decompression
• Abdominal malignancy
• Epidermolysis bullosa
• Pediatric disorders
• Administration of unpalatable medication
• Recirculation of bile
• To facilitate access to dilation of the esophagus

NEUROLOGICAL DISORDERS

These account for 80 to 90% of indications and most patients present with dysphagia and have great difficulty breathing. For this reason, most of these patients undergo the procedure under general anesthesia, in order to provide them with greater respiratory comfort. Dysphagia is a common consequence of a cerebrovascular accident, with a high incidence of around 45% among those admitted to hospital. Some specialists recommend that patients who are not capable of meeting their nutritional needs by way of oral ingestion should be provided with nutrition through a nasogastric tube for the first 24h after a CVA. In patients who need nutritional support for less than four weeks, the nasogastric tube may be kept in place, but, after four weeks, PEG should be considered. Early nutrition by PEG is also desirable in patients with CVA, but the decision should be carefully considered in patients with temporary dysphagia or in those with a reduced life-expectancy owing to underlying diseases.

PEG is a standard feeding method in patients with Amyotrophic Lateral Sclerosis (ALS). In some patients, the PEG tube insertion technique should be modified to account for associated anatomical deformity. These patients frequently experience difficulty swallowing, which may lead

to malnutrition, retarded growth and development, chronic pulmonary aspiration and infection. A prospective study evaluating the benefits of gastrostomy in 345 patients with ALS found that, in 25% of those who gained weight, the gain was small and the clinical benefits questionable, as weight loss continued for three months after gastrostomy and was also associated with lower survival rates. The data suggest that, the higher the percentage weight loss at the time of the gastrostomy, the lower the probability of gaining this weight after gastrostomy. This finding was most evident in patients who, at the time of the gastrostomy, had loss more than 10% of their weight on diagnosis and this subgroup of patients also had significantly lower survival rates compared to those who had lost up to 10%. These results suggest that patients may benefit from early gastrostomy before possibly irreversible weight loss begins [43,44].

Most patients with dementia cannot independently perform everyday activities including feeding themselves. These patients often present with dysphagia and loss of mechanisms for protection of the airways, leading to repeated incidents of aspiration [45]. Eating problems are generally considered to be one of the symptoms of advanced dementia. The data in the literature are controversial. One systematic review by Sampson EL et al. studied the benefits of enteral feeding in elderly patients with advanced dementia and found that there was no evidence of increased survival that were fed through a enteric tube and no evidence of benefits in terms of nutritional status [46,47].

ALTERATIONS IN LEVEL OF CONSCIOUSNESS

These may occur in patients for various reasons, ranging from physical trauma to degenerative disease. The decision regarding how to feed such patients is fundamental for maintaining their nutritional status. Data in the literature disagree as to the timing of initiation of PEG and the benefits for these patients of early initiation of the procedure. The evidence is weak and many studies are retrospective and based on very small samples. However, there is a consensus that PEG should be performed when long-term enteral nutrition is desired [48-50]. In the case of seriously injured patients with brain damage it is difficult to predict how long recovery will take and their final physical and mental state. It is thus hard to foresee, at the time of admission to hospital, how long the patient will need nutritional support and whether a special feeding device that carries risks for the patient is justified. Thus, despite weak evidence, we believe that many patients would benefit from PEG, including patients with brain damage who have not recovered within 14 days, compared to an enteral tube which is associated with many complications and losses. Many of these patients are candidates for tracheostomy, which would justify a combined approach. Studies show that such a combined approach leads to significant improvement. A retrospective study by Moore et al. assessed 27 patients with severe head trauma who had undergone early PEG and tracheostomy and found that this group of patients benefits from this combination of procedures to provide access to the digestive and respiratory tracts [48-53].

CANCER/HEAD AND NECK TUMORS

There is a broad tendency in the literature to recommend prophylactic PEG at the start of treatment for cancer, even before chemotherapy, radiotherapy or surgery, to prevent weight loss and avoid unnecessary admission to hospital. However, there is in fact little evidence to back up these recommendations. One systematic review of ten randomized clinical trials involving 134 participants assessed the impact on patients with head and neck tumors of various forms of nutrition, including nasogastric tube, oral and parenteral nutrition. This study also evaluated the use of prophylactic PEG in these patients, comparing it with a nasogastric tube and found short-term, but not long-term benefits, for nutritional status. A comparison of patients fed via prophylactic PEG and those not fed in this way did not find any effect on nutritional status or mortality and highly inconsistent effects on quality of life. However, this review involved various studies with a small sample and high risk of bias and only two studies found very different results for prophylactic PEG. There is thus a need for more randomized studies with a large sample size and follow-up to evaluate the true impact of the procedure [54-56].

In these patients, feeding by enteral tube is often necessary because of dysphagia, odynophagia or other side-effects of treatment that lead to dehydration and/or weight loss during or after treatment [57].

There are various advantages associated with early use of the procedure:

1. Avoiding weight loss during chemotherapy;

2. Enabling better recovery of weight;

3. Improved tolerance of treatment;

4. Fewer unplanned admissions to hospital and shorter duration of stay, which may lead to a significant reduction in costs associated with health.

In the pediatric population, PEG for enteral nutrition has become widely accepted, after having been shown to be an efficient and safe technique even in small children, despite being associated with an acceptable level of complications. The range of clinical experience indicating improvement in or maintenance of adequate nutritional status in patients with a variety of underlying disorders and a high level of acceptance by caregivers has been reflected in an increase in the number of medical conditions for which PEG is recommended. Recommendation of PEG for pediatric oncology has increased rapidly in recent years. In these particular situations of early feeding, PEG is capable of reversing weight loss and is a relatively safe way of avoiding malnutrition in children with cancer and subsequently improving the oncological outcome [53,57-62].

CONTRAINDICATIONS OF GASTROSTOMY

There are various contraindications and these may be relative or absolute. The absolute contraindications for PEG include mainly technical limitations, anatomical alterations, lack of

transillumination and so forth. In patients who have previously undergone abdominal surgery, a PEG tube can be inserted after confirming there is a "safe track" with no interposition of the intestinal loop. In obese patients, PEG, with small modifications, can be safely performed, even in patients with an extreme body mass index (> 60 kg / m^2) [58]. During pregnancy, insertion of the PEG tube may be complicated by potential risks to the uterus and damage to the fetus. However, there are reports of cases involving pregnant women, but risks and benefits need to be discussed with an obstetrician [59] (Table 2).

Table 2: Contraindications for percutaneous endoscopic gastrostomy.

Absolute Contraindications
• Severe ascites
• Interposition of organs
• History of total gastrectomy
• Obstruction of gastric outlet (if to be used for feeding)
• Severe gastroparesis
• Lack of informed consent for procedure
• Significant coagulation disorders (INR> 1.5, platelets <50000)
• Sepsis
• Short life expectancy (less than 2 months)
• Pyloric stenosis
Relative Contraindications
• Peritonitis
• Accentuated peritoneal carcinomatosis
• Infection of the wall of the abdomen.
• Hemodynamic imbalance
• Esophagogastric varices
• Hepatomegaly
• Subtotal gastrectomy
• Morbid obesity
• Voluminous hiatal hernia
• Ventriculoperitoneal catheter

METHODS FOR INSERTING GASTROSTOMY TUBE

The insertion of a gastrostomy tube requires, on average, three people, two doctors trained in endoscopy and one nurse. The procedure is carried out with the patient in dorsal decubitus, sedated or intubated. The exact location of insertion of the PEG is determined by transilluminated endoscopy and manual palpation to confirm adequate positioning. The exact location is ideally on the median line [63-66].

Three different PEG tube insertion methods have been described:

The Pull Method (Gauderer-Ponsky)

Described in 1980, this consists of gastric insufflation and transillumination, after identification of an appropriate location for insertion. Lidocaine is injected locally into the abdominal wall in the place identified by transillumination and palpation and a small 1-cm incision is made in the skin. A 14-caliber needle is then passed through the incision to the interior of the stomach under endoscopic visualization with a long guide wire and fastened by a polypectomy loop. Once the thread has been attached to the loop, it is pulled through the oral cavity, where it is joined to the tube by a knot to keep it in place and pulled into the interior of the stomach. The endoscope is then

reinserted to ensure appropriate placement of the tube. It is then pulled out and fastened to the wall. A bumper is put in place to keep the abdominal and stomach walls together [63-66].

The Push Technique (Sachs-Vine)

A guide wire is passed through the needle and, on reaching the stomach, fastened by a polypectomy loop and the needle removed. The endoscope is removed with the loop and the guide wire lubricated and passed through the mouth. The other endoscopist keeps the guide wire taut, while the tube is inserted and, when it emerges through the abdominal wall, it is held by one end. After the feeding tube has passed through the skin, the guide wire is removed and a bumper affixed to keep the stomach and abdominal wall together [63-66].

The Introducer Technique (Russel)

Described in 1984, this technique involves a puncture followed by removal of the needle. Then the wire guides the passage of a dilator which has an external sheath. The dilator and the guiding thread are removed and the gastrostomy tube is passed through the sheath. The internal bumper is insufflated and fastened to an external bumper to keep the stomach and abdominal walls together [63-66].

The Gastropexy Technique (Hashiba)

In this technique, described in 1987, anesthesia of the gastrostomy point is followed by insertion of a needle that guides a suture thread to the gastric cavity under endoscopic visualization. A second needle, with a chamfer, located parallel to the first, is introduced, allowing the thread to be recovered and brought out of the body, forming a U-shaped point. A further two to four points are created and a small incision made with a scalpel in the central area, in which a trocar is inserted and the gastrostomy tube passed through this. Then the bumper is insufflated and the trocar removed. A knot is tied to keep the gastric and abdominal walls together [63-66].

Various studies comparing these methods have observed that the traction technique is associated with fewer complications and easier to perform. A retrospective study investigating complications of gastrostomy using various techniques found that the incidence of major complications requiring medical intervention or surgery was lower in the gastropexy group, while there was no significant difference in the incidence of minor complications between the PEG techniques [63,68].

The gastropexy technique has been shown to be superior to the other methods in preventing infection in patients with head and neck cancer and in prophylactically preventing wound infection and the establishment of cancer metastases [69-73]. The reason gastropexy has not become the method of choice in most services seems to be its complexity and the duration of the procedure compared to the traction technique, which is relatively easy technically and can be performed rapidly [72,73] (Table 3).

Table 3: The advantages and disadvantages of endoscopic gastrostomy by gastropexy.

Advantages:	Disadvantages:
• The main advantage is the reduction of infections and peristomal inflammation. • It avoids peritonitis in the case of accidental removal of the gastrostomy tube, before maturation of the gastrostomy pathway. • In gastropexy, the walls of the abdomen and stomach are rigidly secured and the gastrostomy pathway matures rapidly, causing less damage to the gastrostomy tract when changing the gastrostomy tube.	• The complexity and duration of the procedure. • Bleeding as a result of multiple punctures • The cost of the gastropexy apparatus. • Difficulty of peristalsis through fixation.

COMPLICATIONS

There is no consensus in the literature regarding the classification of complications related to gastrostomy and studies classify them in different ways. There is also a tendency for new complications to emerge as new techniques and apparatuses are developed.

Complications may be secondary to the endoscopy, such as cardiopulmonary complications, hypoxemia, phlebitis, bacteremia, perforation, and bleeding, or directly related to gastrostomy. They can thus be classified in terms of severity into minor complications, treated conservatively, and major ones that may require hospitalization, blood transfusions, and endoscopic or surgical interventions. Complications may occur early (in the first fortnight) or late (after 15 days) [3] (Table 4).

Table 4: Classification of complications.

Major	Minor
Intestinal perforation Gastrointestinal hemorrhage Gastrocutaneous fistula, Intra-abdominal abscess, Peristomal abscess, Peritonitis requiring surgery Loss of catheter Aspiration pneumonia, Sepsis, Buried Bumper Syndrome, Inadvertent early removal of tube. Metastatic implant in stoma Necrotizing fasciitis	Dislocation of tube, Inadvertent late removal of tube, Malfunctioning of tube, Peristomal leakage, Peristomal infection, Slight skin necrosis, granulation of wounds, Minor wound bleeding, wound bruising, Temporary ileus, Symptomatic pneumoperitoneum, Subcutaneous emphysema, Regurgitation, Unsuccessful procedure

Buried Bumper Syndrome

First described in 1988, this is considered a late and rare complication of PEG. It occurs when the inner bumper of the feeding tube corrodes in the stomach wall leading to ischemic necrosis and ultimate migration of the inner bumper to a place between the stomach wall and the skin. One of the proposed causes of this is excessive tension between the external and internal bumper. Other factors include alterations in the gastric acid and the internal bumper, the quality of the gastrostomy apparatus (e.g. rigid plastic) and lack of adequate care of the patient. The complication occurs in > 8% of patients, who initially complain of abdominal pain, difficulty following the diet and washing the tube, an inability to move the tube forward or rotate it, and peristomal leakage. On diagnosis, the tube should be removed as soon as possible [74-78], since the situation may result in serious complications, such as perforation of the stomach, peritonitis and death, if not adequately treated. Depending on the situation and characteristics of the material, the tube can be removed by endoscopy, surgical incision or simply pulling it out manually. Additional techniques have recently been described, such as the use of an angioplasty dilator with a balloon, under radiological orientation to avoid surgery. In a recent study of 38 patients with buried bumper syndrome, Richter et al. have proposed a classification of the syndrome based on the extent and internal migration of the bumper and established a relation with the endoscopic therapy to be implemented and the risk it poses, especially that of perforation. The authors classified the syndrome as IA: partially extracorporeal or subcutaneous internal plate with or without fistula; IB: fully extracorporeal retention plate; II: partially visible endoluminal internal plate, with high mobility; III: Sub mucous or deeper internal plate with or without, with high mobility; IV: "Deep type" stomach wall or lower, significant mobility. This classification serves as an aid and takes into account both treatment experience and the safety of the patient. It also enables the risk of the intervention to be evaluated in view of its migration. Although this is an innovative strategy, the physician should explain the treatment alternatives to the patient, in order to reach a decision regarding the best surgical or endoscopic treatment method [74]. This complication can easily be avoided by regular checking of the position of the PEG tube and leaving a small distance between the external bumper and the skin. The tube should be rotated daily between 180 and 360 degrees [2].

Gastrointestinal Hemorrhage

Massive hemorrhage may occur as a result of puncture of the gastric artery or the spleen, damage to the mesenteric vein, or ulceration of the gastric mucous, with significant hemodynamic instability. The bleeding can generally be controlled by applying simple pressure to the abdominal wound, although endoscopic or surgical intervention may be needed to explore the source of the bleeding in some cases. The use of a standard technique, taking into consideration the anatomical structures and correcting coagulation disorders prior to insertion of the PEG tube, may help to prevent bleeding [1-4].

Aspiration Pneumonia

Aspiration pneumonia is a serious complication with a high mortality rate. Although PEG is widely used, the insertion of a PEG tube in patients with neurological dysphagia does not reduce the risk of aspiration pneumonia. Aspiration pneumonia is fairly common in these patients and the risk increases with high volume feeding. It seems that this risk may be reduced to a minimum by adequate positioning, appropriate diet and the use of antibiotics in certain clinical situations [1-4].

Loss of Catheter

Early catheter loss occurs in up to 2% of procedures. If identified early, a second gastrostomy tube can be inserted, using the same puncture site in the abdominal wall. If identification of the complication is delayed, the stomach should be decompressed using a nasogastric tube, broad-spectrum antibiotic therapy initiated and the gastrostomy performed again within 7 to 10 days [1-3].

Necrotizing Fasciitis

Necrotizing fasciitis is characterized by massive destruction of the subcutaneous and adipocyte tissue, sometimes extending to the skin. It is associated with systemic toxicity and high mortality. Early diagnosis is critical for the prognosis. Inexplicable pain is often the first sign of a systemic or skin condition. Tomography may confirm the diagnosis but surgical exploration is essential and the easy debridement of the affected tissue provides material for microbiological cultures. Treatment should be concluded in all cases with basic measures and broad protection against Gram-negative bacteria and anaerobic micro-organisms. Traction and pressure on the PEG tube are two main factors that have been shown to increase the risk of necrosis. Keeping the external bumper at a distance of around 1-2 cm from the abdominal wall may reduce the pressure of the tube on the wound and prevent this complication. Treatment requires extensive surgical debridement and broad spectrum antibiotic therapy and admission to an intensive care unit in most cases [1,3,79,80].

Peristomal Leakage

This complication is more common in debilitated patients, those who have undergone prior gastric surgery and those with underlying medical conditions that predispose them to poor healing of wounds. It normally occurs in the first few days after placement of the PEG tube, although it may also occur in patients with a mature PEG.

Investigation of the leakage should include examination of the patient for any signs of infection, ulceration, buried bumper or any other potential causes, such as dislocation of the tube, delay in emptying the stomach, or extensive gastric fistula. In patients with a mature PEG, the tube may be completely removed and the gastrostomy fully closed. When indicated, another tube may then be inserted at another site in the abdominal wall [81,82].

POST-PROCEDURE GUIDELINES

Many studies have investigated the safety of early feeding 1 to 6 hours after insertion of the PEG, including randomized clinical trials, two systematic reviews with meta-analyses and one retrospective study of 444 patients over a period of 8 years. These studies examined the differences between early feeding (i.e., liquids and/or the administration of nutritional formula in the first 3 to 4 hours after placement of the PEG) with later feeding (more than 4 hours after placement up to the following day). In the case of early feeding, there were no significant differences regarding local infections, diarrhea, bleeding, GERD, fever, vomiting, stomatitis, leakage or death. Early feeding was found not only to be safe and easily tolerated, but also to result in a reduction in costs and the need for hospitalization [1,83-85].

The stoma should be examined (for signs of pain, discoloration, swelling, exudation, pus and leakage) and cleaned daily [85].

The tube should be rotated daily around 180 degrees and, if it is changed, kept at a distance of 1-2 cm from the skin [1,83-85].

The tube should be washed before and after each feeding session and administration of medication to avoid blockage and subsequent obstruction. Such obstruction is more common in smaller-caliber tubes following feeding with formulas of inappropriate consistency. If the tube becomes obstructed, attempts can be made to clear it by inserting a 50 ml syringe filled with warm water and moving it in and out [84-86].

Removal of the tube is recommended when it is no longer needed or when complications require its removal. It should be removed by a physician specializing in endoscopy. The PEG orifice usually closes in the first few days after removal of the tube, although a gastrocutaneous fistula may occasionally persist. Various factors contribute to late maturation of the orifice, including prolonged use of the tube, localized infection and underlying scarring. The method used to close the fistula may be surgical or endoscopic (placement of a hemoclip, surgical suture) [87].

CONCLUSION

Percutaneous endoscopic gastrostomy is the method of choice for enteral feeding in patients incapable of being fed by mouth, although due attention should be paid to indications and contraindications, in order to avoid complications and mortality related to the procedure, providing an appropriate evaluation of the patient prior to the procedure and adequate guidance for health workers and family members who care for the patient regarding care of the tube, in view of the increasing number of complications reported in the literature related to inadequate indication and care.

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