Complications of enteral access

Stephen A. McClave, MD, Wei-Kuo Chang, MD
Louisville, Kentucky, and Taiwan, Republic of China

The perceived health benefits of enteral feeding have placed increasing demands on endoscopists to acquire the expertise needed to establish enteral access, to monitor patients undergoing enteral feeding, and to manage the complications arising from the initial access procedure. In the setting of acute critical care, the provision of enteral feeding is seen as therapy that reduces systemic bacterial challenge to the host, attenuates the stress response, downregulates both innate and acquired immune responses, and improves outcomes for the patient.1 In long-term chronic care, achieving enteral access may serve to decrease the risk of aspiration by diverting the feeding stream to more distal segments of the GI tract,2 to reduce the morbidity that accompanies protein-calorie malnutrition, to provide an effective bridge for patients expected to regain neurologic function, and to facilitate efficient supportive management and utilization of health care resources.

Complications are inherent to the moderately invasive endoscopic procedures for achieving enteral access. Older age and the existence of comorbid conditions increase this risk. Proper patient selection and appropriate modification of endoscopic technique to suit the peculiarities to the individual case may decrease risk during initial tube placement. Proper monitoring, early recognition of impending complications, and quick, often simple, endoscopic solutions can reduce the frequency and the severity of enteral access–associated complications.

REVIEW OF METHODOLOGY

A comprehensive review of the English language publications was undertaken. Key words relating to enteral access (percutaneous endoscopic gastrostomy, jejunostomy, endoscopic nasoenteric tube, enteral access, and nasogastric tube) were used to search the MEDLINE database for citations from 1980 to the present, and the reference citations for all publications were retrieved and reviewed. Although particular attention was given to prospective, randomized, controlled trials, these level I studies, unfortunately, are few in number and tend to focus only on highly specific issues. The vast majority of studies reviewed were non-randomized level II to III cohort studies or consecutive case series, and were more often retrospective than prospective in design.

SCOPE OF THE PROBLEM

Since the original introduction of the technique in 1980,3 in the United States, a steadily increasing number of PEG tubes have been placed. In a review of all endoscopic procedures performed in the Department of Veteran Affairs Medical Centers nationwide over a 3-year period, there was a 14.6% increase in the number of PEG tubes placed, from 2247 in 1990 to 2576 in 1992.4 A similar review of Medicare beneficiaries hospitalized from 1988 to 1995 found an even greater percentage increase in numbers of PEG tubes placed nationwide.4,5 Although exact numbers differ among the various reports, approximately 61,000 PEG tubes were placed in 1988, 77,400 to 81,105 in 1991, and 121,000 in 1995.4,5 These statistics indicate that the number placed in the United States in hospitalized patients greater than 65 years of age doubled over the 8-year period from 1988 to 1995. If this growth has continued in a linear fashion, the numbers would double by the present year of 2003, such that more than 240,000 PEG procedures would be anticipated to be performed in the United States this year. The increase in the number of PEGs placed from 1991 to 1995 (representing an increase from 49% to 56%) appears substantially greater than that seen from 1988 to 1991 (a 26% to 33% increase), suggesting that the actual increase will be greater than predicted based on linear growth alone. The predicted placement of 240,000 PEGs this year may be an underestimate, because this figure reflects PEGs placed only in hospitalized patients and does not include those placed in the outpatient setting or in the 6% of Medicare beneficiaries who have health maintenance organization–based insurance plans.4,5 Grant et al.5 found that 10% of all nursing home patients are fed via tubes and that from 0.8% to 1.7% of Medicare beneficiaries over the age of 85 years undergo gastrostomy. As the “baby boomer” generation expands the demographics of the older age brackets, the provision of enteral access for patients...
will generate a growth industry and should increase demand on health care resources over the next several decades.

**COMPLICATIONS OF ENDOSCOPIC NASOENTERIC TUBE PLACEMENT**

**Overview**

The overall success rate for endoscopic nasoenteric tube (ENET) placement within the small bowel is fairly consistent, ranging between 90% and 95%, regardless of the technique used.\(^6\)\(^-\)\(^8\) Although the success rate for post-pyloric placement approaches 95% to 100%,\(^6\)\(^,\)\(^7\) that for placement in the proximal jejunum decreases to approximately 84% to 90%,\(^5\)\(^,\)\(^9\) with even lower success rates (25% to 35%) for placement distal to the ligament of Treitz.\(^9\) There is no difference in success rates between transoral and transnasal techniques,\(^9\) and the success rate for placement of combination nasogastric/nasojejunal aspiration/feeding tubes in one study was similar (94%) to that for placement of standard nasoenteric tubes.\(^10\)

**Procedure-related complications**

The overall procedure-related complication rate reported for ENET placement is approximately 10.6%.\(^11\) Epistaxis occurred after ENET placement in 1.8% to 4.7% of cases,\(^7\)\(^,\)\(^10\) and, surprisingly, there was no difference in frequency for transnasal (11%) vs. transoral techniques (10%).\(^9\) Procedure-related epistaxis usually is self-limited and rarely requires packing of the nasopharynx. Aspiration during initial placement is infrequent, occurring in 0% to 1.8% of cases.\(^10\)\(^,\)\(^12\)\(^,\)\(^13\) In one study, circulatory/respiratory compromise was significantly more frequent with transoral (14%-16%) as opposed to transnasal technique (3.8%) \((p < 0.04)\).\(^9\)

Endoscopic placement of nasoenteric tubes does not increase the risk for the many pulmonary complications associated with blind bedside placement of such tubes.\(^14\) Specifically, ENET placement does not increase the frequency of inadvertent placement in the respiratory tract, pulmonary/pharyngeal perforation, hydrothorax, pneumothorax, or empyema and pulmonary abscess.\(^14\)

**Specific complications**

Once in place, the endoscopically placed nasoenteric feeding tube is associated with many of the same complications that occur with any nasoenteric tube, regardless of placement technique. Migration proximally out of the small bowel occurs in 12.5% to 16% of cases,\(^12\)\(^,\)\(^13\) and inadvertent dislodgment occurs in 25% to 41% of cases.\(^7\)\(^,\)\(^12\)\(^,\)\(^15\) Inadvertent displacement does not always occur within the typical scenario of a patient with altered mental status. Alert, cooperative patients in the course of routine nursing care, physical therapy, or transport throughout the hospital may change position suddenly and dislodge the tube, or the tube may become caught on extraneous devices.\(^15\) Although securing the distal tip with hemoclips helps to prevent temporary migration of the tube out of the small bowel, the chance of inadvertent displacement can only be reduced by securing the proximal end of the tube. In one study in which 66 patients were randomly assigned to ENET placement alone or ENET placement with a nasal bridle, use of the bridle significantly reduced the frequency of inadvertent displacement from 38% to 4% \((p < 0.05)\).\(^11\) However, use of a bridle for more than 4 to 8 weeks presents a risk for erosion of the nasal septum (Fig. 1). Mechanical malfunction with cracking or breaking of the tubing occurs in 11% to 20% of patients\(^6\)\(^,\)\(^10\); kinking occurs in 6%.\(^10\) Just over 20% of patients complain of dysphagia after placement.\(^16\) The use of radiographic opacification studies of the sinuses tends to overestimate the occurrence of sinusitis associated with ENET placement at 25%, whereas needle puncture with aspiration and culture of the frontal and ethmoid sinuses has more accurately demonstrated a frequency of 11.4% to 13%.\(^17\)

**Tube occlusion**

Clogging of the nasoenteric tube is a frequent problem (9%-20% of cases).\(^6\)\(^,\)\(^10\) Occlusion because of clogging appears to be related to a number of factors, such as increasing length of tube, decreasing caliber, inadequate irrigation with water, continuous (as opposed to bolus) infusion, instillation of medications, and use of the tube to estimate gastric residual
Complications of enteral access

S McClave, W-K Chang

VOLUME 58, NO. 5, 2003 GASTROINTESTINAL ENDOSCOPY

Regurgitation occurs more frequently than aspiration, between 0% and 1.8%, whereas the frequency of procedure-related aspiration is extremely low, being difficult to determine because of varying definitions (e.g., aspiration of radiolabeled contents, witnessed overt aspiration event, new pulmonary infiltrate on chest radiograph). The frequency of aspiration related to long-term nasoenteric tube placement has been described in one patient with burns. Although esophageal stricture is a potential long-term complication of any nasoenteric tube placement, the exact frequency of this complication is uncertain. Duodenal perforation after nasoenteric tube placement has been described in one patient with burns.

Aspiration

Aspiration is a fairly common event in patients who undergo nasoenteric tube feeding, but the true frequency is difficult to determine because of varying definitions (e.g., aspiration of radiolabeled contents, witnessed overt aspiration event, new pulmonary infiltrate on chest radiograph). The frequency of procedure-related aspiration is extremely low, between 0% and 1.8%, whereas the frequency of aspiration related to long-term nasoenteric tube feeding may be higher, between 25% and 40%. Regurgitation occurs more frequently than aspiration, 31.9% vs. 19.3% in one study. For patients with a reduction in the level of consciousness, the occurrence of aspiration nearly doubles compared with patients with normal mental status. The frequency of aspiration associated with an endotracheal tube is 50% to 70%, nearly twice the rate observed with enteral feeding tubes alone. Progression of an aspiration event to pneumonia is difficult to predict. Aspiration may occur from the antegrade passage of contaminated oropharyngeal secretions or the retrograde passage of contaminated gastric contents into the larynx. The results of at least 3 studies suggest that colonization of the oropharynx may be more significant than colonization of gastric contents with respect to the source for colonization of the upper respiratory tree.

The consensus statement of the North American Summit on Aspiration in the Critically Ill Patient indicates that major risk factors for aspiration (those indicating a possible need for a change in management strategy) include documented episodes of aspiration, decreased level of consciousness, neuromuscular disease or structural abnormalities of the aerodigestive tract, overt vomiting or regurgitation, a need for a prolonged supine position, and persistently high gastric residual volumes. Minor risk factors include intermittent bolus feeding, delayed gastric emptying, poor oral hygiene, and advanced age.

The risk for aspiration in the patient with an endoscopically placed nasoenteric tube may be reduced by several changes in management strategy. Changing the level of infusion of enteral feeding from the stomach to the small bowel significantly reduces aspiration and regurgitation. Although published studies of the impact of the level of feeding on the occurrence of aspiration pneumonia include small numbers of patients and are thus underpowered, a meta-analysis of the aggregated data found that small bowel feeding significantly reduces the frequency of aspiration pneumonia compared with intragastric feeding.

A number of other strategies can be used to modify risk, such as reassessing the need for and choice of sedative and analgesic medications, elevation of the head of the bed to greater than 30° to 45°, switching from bolus intermittent to continuous infusion, and optimizing oral care through the use of chlorhexidine mouth washes. Addition of a prokinetic agent (e.g., metoclopramide or erythromycin) is recommended, but other strategies to reduce aspiration, such as switching to total parenteral nutrition, adding acid to the enteral formula, or treatment with antibiotics to selectively decontaminate the gut, are not.

Intestinal ischemia

When providing enteral tube feeding to critically ill patients (who may be experiencing intermittent splanchnic circulatory hypotension), common symptoms of GI intolerance may, on rare occasions, progress to a syndrome of abdominal distention, hypotension, and shock, with the development of small bowel ischemia or necrosis. Some controversy exists as to whether placement of a percutaneous feeding tube can precipitate this complication by disruption of the vascular arcade in the intestinal wall. Although this complication is described more commonly after surgical jejunostomy...
The overall success rate for PEG placement is fairly consistent at 95% to 98% in all studies, regardless of technique.33–36 There is no appreciable difference in success rates for the Ponsky “pull” vs. the Sachs-Vine “push” technique,37 and both techniques compare favorably with fluoroscopic placement by a radiologist (success rate 98%).38,39 Common reasons for unsuccessful PEG-tube placement include esophageal or pharyngeal obstruction caused by cancer, inadequate transillumination, intraprocedural deterioration in the clinical status of the patient (from respiratory distress or laryngospasm), anatomic alterations (e.g., large diaphragmatic hernia, prior gastrectomy with Billroth II anastomosis, esophageal stricture), an incidental finding of gastric cancer, and development of a hematoma at the gastrostomy site.33,36

**Procedure-related complications**

Procedure-related complications are infrequent (1.5% to 4% of cases).4,40 Aspiration directly related to the procedure occurs in only 0.3% to 1.0%.33,41 Risk factors for aspiration include supine position, advanced age, need for sedation, and neurologic impairment.42 The risk of aspiration during the procedure can be reduced by performing the PEG expeditiously, avoiding over-sedation, minimizing air insufflation, and thoroughly aspirating gastric contents before tube placement.43 Acute hemorrhage also is infrequent (approximately 1% of cases)4,40 and is either because of direct puncture of a blood vessel in the gastric wall or traumatic erosions of the esophageal or gastric mucosa.42 Complete laceration or puncture of the stomach, the small bowel, and the colon have been described, but, fortunately, this occurs in less than 0.5% to 1.8% of cases.4,40,43 Transient pneumoperitoneum, described in 40% to 56% of routine PEG-tube placement procedures,44,45 in the absence of signs of peritoneal inflammation, is of no clinical consequence and does not preclude initiation of feeding via the PEG tube at 4 hours after the procedure. Pneumoperitoneum may be accompanied by the acute development of an air-filled stomach, which is easily decompressed after the procedure by uncapping the PEG tube.46 Prolonged ileus occurs in up to 3% of cases,33,47 a hematoma occurs in less than 1%.4,33 Stridor after the procedure has been described infrequently.48

**Specific complications**

The overall complication rate reported for PEG-tube placement ranges from 4.9% to 10.8%.4,40,41,49 Complications in one study were more common in patients who were malnourished (as evidenced by low body mass index) or who had advanced malignancy.40 The results of another study suggested that complications were more common among patients who underwent the procedure on an out-patient basis compared with patients in whom the PEG procedure was performed while in the hospital.50 Minor complications that usually require only conservative therapy are two to 3 times more common (10.3%-10.7% of cases) than major complications that often necessitate further endoscopic procedures or surgical intervention (1.0%-2.4% of cases).47,51 There has

**COMPLICATIONS OF PEG AND DIRECT PERCUTANEOUS ENDOSCOPIC JEJUNOSTOMY TUBE PLACEMENT**

**Overview**

The overall complication rate reported for PEG-tube placement ranges from 4.9% to 10.8%.4,40,41,49 Complications in one study were more common in patients who were malnourished (as evidenced by low body mass index) or who had advanced malignancy.40 The results of another study suggested that complications were more common among patients who underwent the procedure on an out-patient basis compared with patients in whom the PEG procedure was performed while in the hospital.50 Minor complications that usually require only conservative therapy are two to 3 times more common (10.3%-10.7% of cases) than major complications that often necessitate further endoscopic procedures or surgical intervention (1.0%-2.4% of cases).47,51 There has
been little change in the frequency of complications over the past 10 to 15 years. The procedure-related mortality rate is negligible (<1%). The long-term mortality rate related to PEG-tube placement is extremely low, ranging from 0.6% to 2%.

PEG placement in patients with dementia

Although the complication rate for PEG-tube placement may appear to be higher in certain patient populations (e.g., those with HIV, malignancy, or neurologic impairment), the complication rate invariably reflects the severity of the underlying disease instead of the particular etiology. The varying frequency of complications in different patient populations has led to the perception in publications dealing with geriatric medicine that PEG-tube placement in patients with dementia may be problematic. PEG tubes placed in patients with advanced dementia are regarded as ineffective, with claims that they fail to change survival, reduce the frequency of aspiration, prevent or promote healing of pressure sores, or improve patient quality of life. PEG-tube placement in this patient population is described as a high-risk, invasive procedure, with 30-day and 1-year mortality rates of, respectively, 27% and 50%. Approximately 25% of patients with dementia die during the hospitalization in which the PEG tube was placed. However, the majority of these studies are flawed in that they are non-randomized and most often retrospective. None indicate that PEG-tube placement hastens patient demise or that patients randomized to tube placement have higher morbidity/mortality rates than age- and gender-matched control patients from the same population. Such reports provide misleading information. One stated that “nursing home residents with dementia with PEGs have a higher prevalence of pressure sores than those that don’t have PEGs.” Such statements obscure the true situation in which factors such as evidence of aspiration, pressure sores, stroke, or dysphagia increase the likelihood for PEG-tube placement in certain patients and not others within the same population. No prospective, randomized, controlled trial in geriatric patients with dementia exists that indicates that the tolerance of these patients for the PEG procedure is worse or that PEG tube placement worsens outcome in this patient group. Survival overwhelmingly is determined by the severity of the underlying condition. In one study, hospitalized patients who had PEG tubes placed (36% had dementia) had a mortality rate that was 7 times higher than an age-matched group of outpatients from a nursing home (87% had dementia) who had PEG tubes placed. Prospective, randomized, controlled trials in other patient populations have shown that diversion of the feeding stream to a lower level in the GI tract does decrease the frequency of aspiration pneumonia. Cultural, religious, and emotional factors complicate the decision to place a PEG tube in this patient population, and often it is the quality of life of the family that is improved instead of that of the patient.

PEG-site infection

Infection at the PEG site is the most common complication of the PEG procedure. Factors that increase the risk of infection may be patient related (diabetes, obesity, malnutrition, chronic treatment with corticosteroids), technique related (pull or push technique more so than introducer technique, small incisions, or lack of antibiotic prophylaxis), or nursing care related (excessive traction of the external bolster against the internal bolster). The majority of infections (>70%) are minor, and the overall frequency is difficult to determine but appears to range from as low as 5.4% to 6% to as high as 17% to 30%. Major infections requiring medical or surgical intervention are extremely rare (less than 1.6% of cases). Administration of antibiotics as a prophylactic measure significantly reduces the risk for wound infection. Three prospective, randomized trials have demonstrated significant reductions in the frequency of infection with administration of a single broad spectrum antibiotic (usually a third-generation cephalosporin). If the patient is already being treated with antibiotic(s), it is not necessary to add another antibiotic agent. Setting proper tension with the external bolster at initial placement and leaving a figure over the patient’s bed (Fig. 2) guides nurses in resetting the external bolster when cleaning the PEG site, thus, reducing the risk of subsequent infection (and buried bumper syndrome). Treatment of local infection includes wound care and intravenous administration of antibiotics. Surgical incision and drainage is rarely required.

Peritonitis as a progression of PEG-site infection occurs infrequently (0.4%-1.6% of cases). Development of signs of peritoneal irritation and rebound tenderness differentiate peritonitis from simple PEG-site wound infection. Radiographic contrast studies are required in this situation to rule out the presence of a leak, which would require surgical intervention. If no leak is demonstrated, intravenous administration of broad spectrum intravenous antibiotics should be sufficient.

Necrotizing fasciitis is a rare but potentially lethal complication of PEG-site infection that has
been described mainly in case reports. Patients present early with localized abdominal wall edema, erythema, and ecchymoses, and then progress to bullae formation and eventually septic shock. Management includes aggressive treatment with systemically administered antibiotics to cover polymicrobial infection and early surgery with wide debridement of the wound.

**Excessive leakage**

Excessive leakage around the PEG site is one of the more common complications of long-term PEG placement, although the reported frequency is only 1% to 2%. Risk factors that promote increased leakage include the use of corrosive agents (e.g., infusion of ascorbic acid for wound healing, increased gastric acid secretion because of stop orders for prescribed acid-suppressive medication, and continued washing of the PEG site with hydrogen peroxide after initial placement) (Fig. 3), cutaneous fungal infection around the site (Fig. 4), bacterial PEG-site infection, and the development of exophytic granulation tissue around the stoma (Fig. 5). Mechanical factors such as side torsion on the tube with ulceration on one side of the tract (Fig. 6), absence of an external bolster (allowing to and fro motion of the PEG tube) (Fig. 7), and buried bumper syndrome (Figs. 8 to 10) may promote excess leakage. Management is determined by the specific exacerbating factor. An initial examination should be made of the PEG site to rule out infection, to ensure that there is no fixation of the tube suggesting buried bumper syndrome, and to be certain there is no ulceration of the tract indicating side torsion of the tube. The list of medications should be reviewed; treatment should be initiated with a proton pump inhibitor, infusion of ascorbic acid should be stopped, and an antifungal cream or zinc oxide applied to the site as appropriate. Side torsion with ulceration in the tract may require stabilization of the PEG tube with a commercial clamping device that prevents side-to-side motion (Fig. 11). Silver nitrate sticks

---

**Figure 2.** Example of figure to be placed over patient’s bed to guide nursing care with regard to setting proper tension for external bolster after initial placement.

**Figure 3.** Corrosive injury around PEG site.

**Figure 4.** Cutaneous fungal infection at PEG site.

**Figure 5.** Exophytic granulation tissue around PEG.
may be used to treat and reduce granulation tissue around the PEG. Absence of an external bolster is corrected by replacement with a commercial device (a replacement PEG) or an external bolster “home-made” from the funneled end of a Foley catheter. In more severe cases of PEG tract damage, it may be necessary to divert the infused formula into the small bowel by conversion of the PEG to a PEG-jejunostomy (PEG-J) or to completely remove the PEG tube and place a nasoenteric aspiration/feeding tube to allow the site to heal.

**Buried bumper syndrome**

Buried bumper syndrome occurs in up to 21.8% of cases (Figs. 8 to 10), but the frequency of incomplete buried bumper syndrome is probably higher. The severity of this complication ranges from simple ulceration beneath the internal bolster, to complete outward erosion of the tube through the gastric and abdominal walls (Fig. 10). The most common precipitating factor is excessive tension between the external and internal bolsters. Additional factors include a stiff internal bolster (polyurethane is stiffer than silicone), malnutrition and poor wound healing, and significant weight gain in response to enteral feeding. Buried bumper syndrome may present simply as increased leakage around the PEG tube, infection at the PEG site, immobility of the catheter, resistance to infusion, or abdominal pain with infusion of formula. A variety of techniques for management of this complication are described (Fig. 12). It is necessary to determine which will be least traumatic to the PEG tract; either pulling the tube through the abdominal wall or back into the stomach. In cases where the tube has not been used for an extended period of time, the
internal bolster may be entirely covered by gastric mucosa (Fig. 8). In such cases, it may be necessary to electrosurgically incise the mucosa down to the dome of the bolster with a needle-knife papillotome to gain access to the device (Fig. 12).

**Tumor implantation**

Tumor implantation or metastasis at the PEG site is a rare complication. As of the year 2000, only 22 cases were reported. The median time to development of this complication is approximately 8 months post-PEG placement. Occlusion of the tube usually does not occur, and feeding may continue. Usually no therapy is given. There is a single case report in which palliative radiotherapy was delivered to the PEG site, and a second case report where surgical en bloc resection of a mass at the PEG site was required. Although hematogenous spread is possible, the mechanism of implantation is thought to be most likely direct seeding of the tumor as the PEG tube shears off cells during placement. In light of this potential complication, consideration should be given to use of the Russel introducer-type PEG placement (in which the tube is passed directly through the abdominal wall) instead of the more routine push/pull techniques (in which the tube is dragged through the oropharynx and esophagus) in patients with bulky, exophytic tumors of the larynx, the oropharynx, or the esophagus.

**GI bleeding**

GI bleeding occurs in 0.6% to 1.2% of cases after PEG-tube placement. Acute bleeding may be procedure related, either because of puncture of a blood vessel or a traumatic mucosal tear in the esophagus, the stomach, or the duodenum. Subsequent to placement, however, concomitant peptic ulcer disease, buried bumper syndrome, or erosion of the posterior gastric wall opposite the internal bolster may lead to significant upper-GI bleeding.

**Gastrocolocutaneous fistula**

Reports of a gastrocolocutaneous fistula after PEG placement are numerous (Figs. 13 and 14). This complication develops through perforation of a loop of bowel, either acutely by inadvertent puncture of intervening bowel during tube placement or through erosion over time into adjacent bowel. Factors that promote the development of this complication are insufficient transillumination, inadequate gastric insufflation, and previous abdominal surgery with resultant trapping of a bowel loop. Patients may present acutely with peritonitis, infection, fasciitis, or obstruction to the infusion of the formula. More commonly, the presentation is insidious, with chronic manifestations such as stool appearing around the PEG tube, unexplained weight loss or diarrhea, with stools being described as identical to the infused formula. Occasionally, this complication becomes apparent only when the PEG tube is removed. Management involves documentation of the complication by radiographic contrast studies. The device can be removed manually and a dressing placed over the site. Surgery is required only in the rare case where the fistula fails to close.
Inadvertent extubation of the PEG tube occurs in 1.6% to 4.4% of cases. Half of these occur before maturation of the PEG site (which usually requires 7 to 10 days). In the presence of chronic treatment with corticosteroid, malnutrition or ascites, maturation of the PEG tract may be delayed by up to 3 to 4 weeks. In the patient with an immature tract, inadvertent dislodgement can result in the stomach falling away from the anterior abdominal wall, so that, in effect, a free intra-abdominal perforation has developed. If this complication is identified immediately, a second tube can be inserted endoscopically by using the same opening in the abdominal wall. Although the new PEG tube may not pass exactly through the original opening in the gastric wall, the original opening, nevertheless, is sealed as the stomach is pulled against the anterior abdominal wall. If identification of this complication is delayed, management in the absence of signs of peritoneal inflammation is straightforward: decompression by placement of a nasogastric Salem sump tube, treatment with broad spectrum antibiotics, and placement of a new PEG tube within 7 to 10 days.

Miscellaneous complications

A number of additional miscellaneous complications of PEG-tube placement have been described. These include development of an aortogastric fistula, subcutaneous emphysema, gastric volvulus, subcostal neuralgia, reversible apnea, laceration of a low-lying lobe of the liver, bronchoesophageal fistula, and persistence of a gastrocutaneous fistula after PEG tube removal.

Combinations of PEG-Jejunostomy and Direct Percutaneous Endoscopic Jejunostomy

Complications arising from PEG-J and direct percutaneous endoscopic jejunostomy (DPEJ) tube placement are nearly identical to those described for routine placement of PEG tubes. The most unique complication arising from PEG-J tube placement is migration of the jejunal tube from the small bowel back into the stomach (27%-42% of cases). Factors that promote this complication may be patient related (a large dilated atonic stomach or recurrent nausea/vomiting) or, more commonly, to the original PEG-J procedure itself (failure to cut the
PEG tube down to a short enough length, shortened length of jejunal tube, placement of the initial PEG tube high in the body or fundus, or surgically placed PEG tubes tunneled toward the gastroesophageal junction. The use of fairly simple techniques during initial tube placement may reduce the occurrence of this complication. Cutting the PEG tube to a length of less than 10 cm and placing the tube close to the umbilicus and to the right of the midline may position the PEG tube in the antrum closer to the pylorus. Selecting a jejunal extension tube with the greatest length, ensuring that there is no loop in the stomach after placement, and securing the distal end of the jejunal tube with hemoclips or an anchor device (Fig. 15), all help prevent proximal migration.

The most unique complication arising from DPEJ-tube placement is intermittent small bowel obstruction by a large balloon-type internal bolster. PEG tubes used for this procedure should have a low profile internal bolster. Volvulus progressing to necrotic bowel has been described in association with DPEJ, as has jejunocolocutaneous fistula.

**CONCLUSIONS**

Endoscopists skilled in the techniques for establishing enteral access are essential to in-hospital nutrition support and long-term care. They should have mastery of a number of endoscopic techniques for percutaneous and nasoenteric tube placement, should be capable of monitoring patients who undergo enteral feeding at any level in the GI tract, and

---

**Figure 12.** Management options for buried bumper syndrome. A, The tapered tip of the new push-type PEG engages the embedded PEG. (Reprinted with permission from Venu et al, Gastrointest Endosc 2002;56:582-4.) B, The replacement PEG is pulled into position, removing the embedded PEG out through the abdominal wall. (Reprinted with permission from Fay et al, Gastrointest Endosc 1990;36:298-300.) C, The needle-knife makes radial incisions in the gastric mucosa covering the dome of the PEG. (Reprinted with permission from Ma et al, Gastrointest Endosc 1995;45:505-8.) D, A balloon dilates the tract over a guidewire. (Reprinted with permission from McClave et al, Tech Gastrointest Endosc 2001;3:62-8.) E, A snare is used for the push-pull T technique. (Reprinted with permission from Boyd et al, Gastrointest Endosc 1995;41:508-11.)
should be able to troubleshoot problems related to tolerance, tube malfunction, and impending complications. In the future, innovations in endoscope design (e.g., battery-powered portable endoscopes, ultra-small diameter instruments that can be passed through the feeding tube, and small diameter endoscopes suitable for transnasal passage and long enough for insertion distal to the Ligament of Treitz), as well as improvements in accessories should facilitate these access techniques. The endoscopist trained in the techniques for enteral access should be equally knowledgeable of the methods, which are often simple, for management of complications. Optimal technique for initial tube placement, prompt recognition of impending problems, and immediate implementation of endoscopic solutions should reduce the overall frequency and morbidity from complications of long-term enteral access.

REFERENCES

Complications of enteral access

S McClave, W-K Chang

VOLUME 58, NO. 5, 2003 GASTROINTESTINAL ENDOSCOPY 751