

# Complications Of PEG – Prevention And Management

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## Citation

R Naik, V Joshipura, N Patel, S Haribhakti. *Complications Of PEG – Prevention And Management*. The Internet Journal of Gastroenterology. 2008 Volume 8 Number 1.

## Abstract

Per cutaneous gastrostomy (PEG) is one of the most common procedure performed by the gastroenterologist for various indications. It has its own complications and morbidity. Complications are divided in the forms of minor and major, though majority of them are minor still they are higher in incidence with high morbidity. This review article illustrates the complications associated with PEG and various methods to prevent and manage the complications.

## INTRODUCTION

Since endoscopic insertion of a gastrostomy tube was first described in 1980<sup>1</sup>, a multitude of commercial kits and variations of the percutaneous endoscopic gastrostomy (PEG) technique have been introduced, including the push (Sachs-Vine), pull (Ponsky), introducer (Russell), and Versa (t-fastener). The most commonly performed are the push and pull techniques, which have been shown to have efficacy and safety in controlled trials. Approximately 100,000 to 125,000 PEG procedures are performed annually in the United States<sup>2</sup>. Despite their overall safety, a number of complications can occur following PEG placement.

## INCIDENCE OF COMPLICATIONS

Several large prospective trials of PEG placement have evaluated the efficacy and safety of the procedure. The frequency of complications observed in the various reports depends upon the definitions used and the population under study. In one series, for example, complications were described in 70 percent of 97 patients of which 88 percent were considered to be minor, including tube dislodgement, peristomal wound leakage, and PEG wound infection<sup>3</sup>. A much lower rate of complications was observed in another report of 314 patients of whom 13 percent had minor and 3 percent had major complications, including gastric perforation, gastric bleeding, and hematoma development<sup>4</sup>. Most studies have suggested that complications are more likely to occur in elderly patients with comorbid illnesses, particularly those with an infectious process or who have a history of aspiration<sup>5</sup>.

**MINOR COMPLICATIONS** — As mentioned above, complications from PEG tube placement can be classified as

major or minor. Minor complications include wound infection, wound leakage, wound bleeding, cutaneous or gastric ulceration, pneumoperitoneum, temporary ileus, and gastric outlet obstruction.

**Wound infection** — Wound infection is more likely to occur when a PEG has been placed through a contaminated procedure field or with poor technique in debilitated patients and those who did not receive antibiotic prophylaxis<sup>6,7,8</sup>.

Most PEG wound infections will respond to a first generation cephalosporin or a quinolone. Methicillin resistant *Staphylococcus aureus* have emerged as an important cause of PEG-site infections in some centers<sup>9</sup>.

At least two studies found that nasopharyngeal decontamination of patients with MRSA (in addition to standard prophylactic antibiotics) significantly reduced the incidence of wound infections<sup>10,11</sup>. Another study found that administration of a third generation cephalosporin intravenously and a povidone-iodine spray to the abdominal wall pre-PEG procedure reduced wound infections compared with the intravenous cephalosporin or the povidone-iodine spray used separately<sup>12</sup>. Fungal-related PEG infectious complications occur, although much less commonly than bacterial infectious complications. These include fungal peristomal cellulitis, candidal peritonitis and intra-abdominal abscesses<sup>13,14,15,16</sup>.

**Peristomal leakage** — Peristomal leakage usually occurs within the first few days after PEG placement. It is more likely to occur in malnourished patients and those with diabetes who may have poor tissue healing and are prone to wound breakdown. In addition, placement of the external

bolster of the PEG tube too tightly against the external abdominal wall will lead to poor tissue blood flow, wound breakdown, and peristomal leakage.

Treatment should include correction of comorbidities such as malnutrition and elevated blood sugar, loosening of the external bolster, and local measures to address skin breakdown (such as powdered absorbing agents or a skin protectant such as a paste of zinc oxide). Placement of a larger size PEG tube through the same PEG tube tract will not solve the problem. Once the PEG tube tract has started to leak, placing larger gastrostomy tubes through the same tract will serve only to further distend and distort the tract and will not promote tissue growth or healing.

As a treatment method, the PEG tube can be removed occasionally for 24 to 48 hours, permitting the tract to close slightly; a replacement gastrostomy tube can then be placed through the same, partially closed tract<sup>17</sup>. This technique works well for patients whose PEG tube tract started to leak a month or more after initial insertion. It does not work as well for patients with early tract leakage since these patients are usually experiencing poor wound healing from comorbid disease processes.

In many patients with a mature PEG tract and peristomal leakage, the PEG tube will need to be fully removed, allowing the tract to close completely. Another PEG tube can then be placed at a different location on the abdominal wall. In our experience, the new PEG tube can be placed when there is at least 50 percent closure of the old PEG tube tract, at which point the initiation of feedings will not have a significant impact on leakage or inhibition of tissue healing through the old PEG tube.

**Pneumoperitoneum** — Pneumoperitoneum is common post-PEG placement<sup>18</sup>. Its etiology is thought to be secondary to the insufflation of air associated with the endoscopic procedure and needle puncture of the gastric wall. In the absence of peritonitis it has no consequence and should not preclude feedings. However, pneumoperitoneum may cause confusion for clinicians in those patients where clinical features raise concern about a ruptured viscus. In these settings, a contrast radiology study should be obtained to confirm the position of the PEG tube within the stomach and to exclude a leak.

Subcutaneous air has also been described after PEG placement. It occurs from air being introduced between the cutaneous and subcutaneous tissues<sup>19</sup>. In the absence of

other findings, it is inconsequential and should not preclude feeding<sup>19</sup>.

**Ileus** — Some patients develop nausea and vomiting after PEG placement, which may be due to transient gastroparesis. In rare patients, an ileus develops, a complication that may be more likely in patients with significant pneumoperitoneum<sup>20</sup>. After a gastric or duodenal perforation has been excluded, patients who develop an ileus should be treated with bowel rest and, if necessary, nasogastric decompression. These patients can be identified by the presence of post-procedure abdominal distention, vomiting, and absence of bowel sounds. Feedings should be held until the ileus resolves.

**Bleeding** — Hemorrhage following PEG tube placement is rare. There have been case reports of significant bleeding following PEG including an aortic perforation, gastric artery perforation, and a retroperitoneal hemorrhage<sup>21,22,23</sup>. Most bleeding can be controlled by simple pressure over the abdominal wound. Appropriate measures should be taken to improve abnormal coagulation parameters. Gastric wall and rectus sheath hematomas have been described<sup>24</sup>. These have generally been self-contained lesions that did not require surgical intervention.

Bleeding occasionally develops in the PEG tube tract itself. In such cases, we suggest tightening the external bumper against the abdominal wall, thereby pulling the internal bumper against the gastric mucosa and compressing the PEG tube tract. Compression should be released within 48 hours to avoid PEG tube tract wound breakdown. Only rarely will surgical intervention be necessary for PEG associated bleeding complications.

One case of severe upper gastrointestinal bleeding has been reported following the use of T-fasteners to secure the stomach to the abdominal wall prior to PEG tube placement<sup>25</sup>. Six weeks after PEG placement, a retained metal T-fastener was found imbedded in the abdominal wall at the site of a major arterial bleeding event. Bleeding did not respond to endoscopic intervention and ultimately required surgery.

It is also necessary to attempt improvement of significantly abnormal blood coagulation parameters prior to traction removal of PEG tubes to prevent PEG tract hemorrhage. However, gastrostomy tube replacement devices with a balloon tip can be placed percutaneously safely in patients with abnormal blood coagulation parameters unless it is

anticipated that the gastrostomy tube tract will require dilation prior to insertion.

**Ulceration** — In patients with longstanding PEG tubes, an ulcer may develop underneath the internal PEG tube bolster or on the gastric wall. This often responds to loosening of the external bolster, which allows the internal PEG tube bolster to be released from the gastric mucosa. In patients who have a rigid internal bolster, the PEG should be exchanged for one with a flexible internal bolster to reduce the potential for future gastric ulceration.

Ulceration of the contralateral gastric wall from the site of the gastrostomy tube can occur with balloon gastrostomy replacement tubes. In some of these tubes, the tip of the PEG may extend out from the inflated balloon and act as a mechanical irritant. The balloon gastrostomy tube should be removed and replaced with a non-balloon replacement gastrostomy tube or a replacement gastrostomy tube in which the gastrostomy tube tip is contained within the inflated balloon <sup>26</sup>.

**Clogging** — One of the most common problems is tube dysfunction secondary to clogging from medications or the enteral formula. All medications should be dissolved in water or an appropriate liquid substance or delivered in liquid form, if available. A clinical pharmacist should be consulted if there are questions. Bulking agents such as psyllium and resins such as cholestyramine should never be placed through the PEG tube. Patients and caregivers should be educated in the importance of flushing water through the PEG tube after all medication and enteral formula delivery. In the event of a PEG tube obstruction, flushing the tube with a 60 cc syringe is recommended.

The best irrigant is warm water, which is superior to other liquids such as juices or colas <sup>27</sup>. Pancreatic enzymes (dissolved in a bicarbonate solution and left to dwell within the PEG prior to water flushing) can also be effective <sup>28</sup>. If this technique fails, the gastrostomy tube can be cleared with a specially designed gastrostomy tube declogging brush.

**Tube dysfunction** — As discussed above, one of the most common causes of tube dysfunction is clogging from medications or the enteral formula. Another common cause is deterioration of the PEG tube. Deterioration can be recognized by the presence of pitting, ballooning, and a characteristic smell. Although this presents no real risk to the patient, the tube can develop leaks and break, which makes tube feedings difficult or impossible. Microscopic

examinations have demonstrated that tube deterioration is caused by yeast implantation into the wall of the tube <sup>29</sup>. A randomized controlled trial suggested that deterioration leading to tube dysfunction was significantly more common with silicone compared with polyurethane PEG tubes <sup>30</sup>.

No preventative measures have been established as being effective for preventing this problem. In my own practice, I recommend flushing the tube daily with 3 to 5 cc of ethanol in an attempt to “sterilize” the tube lumen. There is no absolute time period that PEG tubes should be removed and exchanged to prevent tube dysfunction. The standard of care is to permit the tubes to remain in place until some tube dysfunction, such as clogging or deterioration, prevents adequate feedings or medication.

Another aspect of gastrostomy tube failure is the early deflation of the balloon, which serves as the internal bolster. This is usually encountered with the use of balloon gastrostomy replacement tubes. There are no prospective data comparing one manufacturer's gastrostomy tube balloon to another manufacturer's gastrostomy tube balloon. Evaluation of PEG tube materials suggest that balloons constructed of polyurethane may be more durable than balloons constructed of silicone <sup>31</sup>. There are commercially available gastrostomy replacement tube devices where a flexible bolster, rather than a balloon, serves as the internal bolster. The internal bolster is distended with a rigid stylet and passed through the PEG ostomy site. This resolves the balloon deflation issue. However, the stylet can cause damage to the existing PEG tube tract on insertion if not placed properly.

**Gastric outlet obstruction** — PEG tubes can migrate forward into the duodenum and cause gastric outlet obstruction <sup>32</sup>. This occurs if the external bolster on the PEG tube is allowed to migrate away from the abdominal wall, allowing the PEG tube to slide forward through the gastrostomy tract and into the duodenum. A similar problem has been reported with balloon gastrostomy tubes, where the inflated balloon is allowed to migrate through the pylorus resulting in an obstruction <sup>33</sup>. This complication can be avoided by making sure the external bolster remains at the same centimeter mark on the gastrostomy tubes after initial proper positioning.

**MAJOR COMPLICATIONS** — Major complications include necrotizing fasciitis, esophageal perforation, gastric perforation, colcutaneous fistula, buried bumper syndrome, and inadvertent PEG removal.

Necrotizing fasciitis — Necrotizing fasciitis (necrosis of the fascia layers) is a rare complication of PEG placement<sup>34,35</sup>. Patients with diabetes, wound infections, malnutrition, and a poor immune system are at increased risk.

Traction and pressure on the PEG wound that can predispose to the development of necrotizing fasciitis. One study demonstrated that patients who had their PEG tube external bolster set directly against the abdominal wall were more likely to develop wound infection, peristomal drainage, and fasciitis compared to patients whose external PEG bolster was left 3 cm from the abdominal wall<sup>36</sup>. It was hypothesized that the distant placement of the external bumper prevented compression of the tissue in the PEG tube tract and wound breakdown. This hypothesis was confirmed in a study on dogs in which gastric mucosal histology showed severe inflammation when the PEG tube external bolsters were placed directly against the abdominal wall as compared to external bolsters that were left 4 cm from the abdominal wall<sup>37</sup>.

Prevention of necrotizing fasciitis is imperative since treatment requires large surgical debridement, antibiotics, and extensive hospital support. It is important to allow the external bolster of the PEG tube to “free-float” 1 to 2 cm from the abdominal wall after PEG placement to prevent this complication. Loose apposition of the stomach to the abdominal does not result in peritoneal leakage since an early PEG tube tract forms as a result of tissue edema and associated tissue secretions.

It is also important to make at least a 1 cm skin incision prior to PEG placement to avoid creating too tight a PEG tube tract wound once the PEG tube is pulled through the wound following PEG placement. However, there is some controversy with this practice. A controlled trial randomly assigned 50 patients to PEG placement with and without an abdominal wall incision<sup>38</sup>. There was no difference in wound healing between the two groups at seven days. Twelve percent of the no abdominal wall incision group ultimately required an abdominal wall incision for the PEG tube procedure to be completed.

Wound care is important following PEG tube placement. As with any other surgical procedure, less manipulation is better with regard to tampering with a fresh wound. There are no prospective evaluations supporting the use of topical antibiotics as a preventative measure for wound infection following PEG placement. It is my practice to simply clean the wound with full strength hydrogen peroxide and to cover

the wound with gauze dressing. The gauze dressing is changed and the PEG wound is cleansed with hydrogen peroxide daily for seven days. Following this, the wound can be cleaned with simple soap and water. The gauze dressing can be eliminated unless there is leakage around the PEG tube that is soiling a patient's clothing.

Gastric and esophageal perforation with upper endoscopy is a known, but rare complication. There are no large reports from which to derive estimates of how frequently these occur.

Buried bumper syndrome — Buried bumper syndrome is a long-term consequence of tight apposition of the external bolster of the PEG tube against the abdominal wall<sup>39</sup>. The internal bolster of the PEG tube slowly erodes into the gastric wall as tension is created on the PEG tube tract, which ultimately causes pain and the inability to infuse feedings. The diagnosis can be confirmed on endoscopy, which will demonstrate the internal bumper buried within the gastric mucosa.

The treatment of buried bumper syndrome depends upon the type of PEG tube<sup>40</sup>. If the internal bolster is collapsible, as it is on externally removable PEG tubes, the PEG tube can be removed by simple external traction. In a modification of this technique, the buried bumper PEG tube can be cut short and a guidewire is passed through the stump into the gastric cavity<sup>40</sup>. The guidewire is snared and pulled out of the oral cavity and attached to a new PEG. The guidewire at the abdominal surface is pulled, dragging the new PEG into the gastric cavity. The dilating portion of the new PEG engages the buried bumper on the old PEG. As the new PEG is pulled through the abdominal wall, the old PEG is pushed out of the abdominal wall and removed.

In contrast, if the internal bumper on the PEG tube is rigid, as it is on endoscopic only removable PEG tubes, the PEG tube may have to be removed by PEG wound tract cut-down or the push-pull T-technique<sup>41</sup>. The push-pull T-technique requires the PEG tube to be cut 3 cm from the abdominal wall. The patient is endoscoped and a snare is passed through the PEG tube opening in the gastric wall to the outside through the PEG tube. An additional short piece of PEG tube is cut from the excess PEG tubing. The snare is opened and this short piece of tubing is grasped and pulled back against the PEG tube creating a T-shape. A Kelly clamp is placed across the T-shape. The endoscopist slowly removes the endoscope, snare, and PEG tube orally as a second operator pushes the Kelly clamp and PEG tube into

the gastric lumen. This combined procedure frees the internal bumper from the gastric wall. Once the PEG tube is removed, a new PEG tube can be placed back through the existing PEG tract using direct endoscopic visualization. A standard PEG tube placement technique should be used to permit the PEG tube dilator to re-expand the partially closed PEG tube tract.

Prevention of the buried bumper syndrome requires good nursing care and patient instruction. As mentioned above, the external bolster of the PEG tube should be left 1 to 2 cm from the abdominal wall. Gauze pads should be placed over the external bolster, not underneath, which would create pressure on the PEG tube tract. In addition, the gastrostomy tube itself should be pushed forward into the wound slightly and rotated during daily nursing care. This will ensure that the internal bumper does not become buried into the gastric mucosa. After rotation, the PEG should be placed back into its original position.

**Colocutaneous fistula** — A colocutaneous fistula is a rare complication associated with PEG placement<sup>42</sup>. It occurs as a result of interposition of bowel, usually the splenic flexure, between the anterior abdominal wall and the gastric wall. The PEG tube is placed directly through the bowel into the stomach.

Patients in whom this complication has occurred are often asymptomatic, except for transient fever or ileus. The problem is usually discovered months after initial PEG tube placement when the original PEG tube is removed for gastrostomy tube replacement. As the replacement gastrostomy tube is passed blindly at the bedside, it is pushed through the PEG tract opening in the abdominal wall and into the colon, but cannot find its way back into the stomach. Once the tube feedings are restarted, the patient develops diarrhea from colonic tube feedings and dehydration from not receiving fluids or nutrition.

This complication can often be treated by removing the PEG tube to allow the fistula to close<sup>43</sup>. However, surgery is sometimes necessary to correct the internal gastric-bowel fistula.

Prevention of this complication is related to the initial PEG tube procedure. Relying on the combination of transillumination and finger palpation of the abdominal wall in choosing an appropriate PEG tube site rather than one of these techniques alone will assure a safe PEG tube entrance site. In questionable situations, an 18 or 22 gauge needle

should be passed through the PEG tube site prior to PEG tube placement. The needle should be withdrawn slowly with an attached syringe creating back pressure. The presence of a sudden bolus of air or stool within the syringe suggests passage through the bowel. However, this technique has not been subjected to a prospective evaluation. In questionable situations where a safe access site cannot be determined, ultrasound or CAT scan guidance can assist in delineating a safe location.

**Inadvertent PEG tube removal** — Inadvertent PEG tube removal is a common complication usually occurring in combative or confused patients who pull on the tube. Many PEG tubes today are designed to be externally removed with 10 to 14 pounds of external pull pressure.

PEG tubes that are inadvertently removed within the first four weeks of PEG tube placement should not be replaced blindly at the bedside. Because the PEG tube tract may not have matured adequately, the gastric wall and the abdominal wall may have separated, leaving a rent in the gastric wall. Thus, blind replacement of the PEG tube at the bedside may result in its placement in the peritoneal cavity.

If a patient has their PEG tube removed early (prior to four weeks after initial placement) the patient can immediately be brought back to the endoscopy suite for repeat PEG tube placement through the same PEG tube site<sup>44</sup>. Patients should be treated with intravenous antibiotics, and monitored for signs of peritonitis, which would require surgical intervention. If there is ever a concern about the possibility of a replacement gastrostomy tube being positioned into the peritoneal cavity, a water soluble contrast study through the gastrostomy tube should be obtained to confirm proper position prior to the initiation of feedings.

**Other intra-abdominal complications** — A variety of intra-abdominal complications have been described in case reports. Although rare, they must be recognized by the interventional endoscopist.

**Small bowel obstruction** from a small bowel wall hematoma following PEG placement<sup>45</sup>. The hematoma was on a jejunal loop of bowel near the stomach. An operative procedure allowed evacuation of the hematoma and resolution of the small bowel obstruction.

**Intrahepatic placement** of a PEG tube<sup>46</sup>. The originally inserted PEG tube malfunctioned and was replaced with a balloon gastrostomy tube two and one-half years after placement. The replacement tube was difficult to push back

through the PEG fistula site. A contrast study showed that the balloon gastrostomy tube was inflated within the liver. Contrast from the tube entered the portal venous system. A fistula tract had developed between the liver and the stomach. Subsequent surgical exploration allowed the tube to be removed safely with resection of the gastrohepatic fistula tract, argon gas plasma coagulation of the liver bed to prevent bleeding and replacement of the PEG with a Stamm gastrostomy.

Herniation of the stomach through a PEG tube fistula site <sup>47</sup>. The patient was noted to have a leaking PEG site one year following PEG tube insertion. A bulge was noted at the PEG tube site on the abdominal wall when the patient coughed. A CAT scan demonstrated that a portion of the stomach had herniated through the PEG site. The PEG was removed, but the PEG fistula remained open. Surgical repair of the fistula was suggested. However, the patient died of aspiration pneumonia prior to definitive surgical therapy.

Abdominal wall pain can occur and persist after PEG placement. Work-up should include a full examination to rule out infection of the abdominal wall. This may include a CT scan to rule out an abdominal wall abscess. In some cases the pain will be consistent with neuropathic pain, in which case the remedy is often removal of the PEG and insertion at a different site. Abdominal wall injection with an anesthetic agent may also be helpful.

Peritonitis has been reported from leakage of gastric contents from the gastrostomy site into the peritoneal cavity with the PEG tube in situ <sup>48</sup>. In addition, infusion of tube feeding formula can lead to a combination of a chemical and bacterial peritonitis <sup>4</sup>. It is hypothesized that peritonitis develops when the introducer needle enters the stomach tangentially rather than directly through the abdominal wall, leading to a long laceration along the greater curvature which allows for escape of gastric contents.

PEG tract tumor seeding — Patients with proximal GI tract cancers, such as head and neck and esophageal cancers are at risk of tumor seeding from the tumor site to the PEG tube tract by mechanical transfer <sup>49,50</sup>. The PEG tube can transfer tumor cells as it is pushed or pulled by the tumor into its final position across the gastric and abdominal wall. The use of an overtube across the proximal GI tract tumor site should allow the PEG tube to be placed through the overtube without the risk of PEG tube tract seeding. There are currently no prospective studies comparing overtube versus no overtube PEG placements in patients with proximal GI

tract cancers as a mechanism for preventing PEG tube tract tumor seeding.

### PEG VERSUS SURGICAL GASTROSTOMY —

Studies comparing surgical gastrostomy to PEG have shown no difference in morbidity or mortality <sup>51</sup>. However, PEGs are less expensive and save time. Thus, it seems prudent to reserve surgical gastrostomy for patients who are already going to the operating room for another surgical procedure or for patients in whom an endoscopy cannot be performed or where an anatomical aberration prevents a safe percutaneous approach for PEG placement.

An alternative to surgery in patients in whom a PEG cannot be placed for anatomical reasons is a combination endoscopic and radiologic approach in which a CT scan or ultrasound is used to determine a safe site to access the stomach <sup>52</sup>. An interventional radiologist can also place a gastrostomy tube using similar radiographic assistance to locate a safe access site.

### EARLY VERSUS DELAYED FEEDING AFTER PEG —

PEG feedings have traditionally been delayed for several hours to overnight after PEG placement because of concern that earlier feeding would increase the risk of peritoneal leakage or aspiration. However, several studies have suggested that early feeding ( $\leq 4$  hours after PEG placement) may be as safe as later feeding <sup>53</sup>. A meta-analysis of six studies that compared early versus delayed or next day feeding (with a total of 467 patients) found no statistically significant differences in patient complications or death <sup>53</sup>. By contrast, a statistically significant increase in gastric residual volumes during day one was noted in the early group, the clinical consequences of which were unclear.

However, the relatively small number of patients included leaves uncertainty about this practice. This was reflected in the 95 percent confidence interval for the risk of death within 72 hours in the above meta-analysis, which ranged from an 80 percent decrease in the risk with early feeding to as much as a 75 percent increase in the risk. Thus, more studies are needed before such a practice can be confidently adopted. At our institution, we begin with water and medications through the PEG tube on the same day as PEG placement, often four hours post-procedure. Tube feedings are initiated the following day.

SPECIAL SETTINGS — A number of settings may be encountered in which placement of a PEG is riskier, or that require modification of the standard technique.

**Prior abdominal surgery** — Patients who have had prior abdominal surgery can undergo placement of a PEG. However, extra care needs to be taken to avoid passing the tube through interpositioned bowel<sup>54</sup>. In these settings, PEG placement should never be performed without confirming a safe access site by both finger palpation and transillumination.

**Obesity** — It may be difficult to transilluminate the abdominal wall in patients who are obese or have a thick abdominal wall. In such patients, an adequate percutaneous access site can usually be palpated. A larger bedside incision can be made, and the fat tissue spread until the anterior rectus fascia is reached, after which standard PEG tube can be placed using conventional technique<sup>55</sup>. The external wound should be closed with sutures or clips.

**Use of a spinal needle (9 cm long) as the introducer needle** has been described in patients who are markedly obese (BMI >40 kg/m<sup>2</sup>)<sup>56</sup>. In most instances abdominal wall transillumination could not be obtained, but finger palpation could be seen on the gastric mucosa with the endoscope. As the spinal needle was advanced, continuous aspiration on the needle was maintained to monitor for entry into the colon or small intestine. A .025 cm guidewire was required to fit through the spinal needle. This technique has been reported with success and without complications in six patients with a BMI >60 kg/m<sup>2</sup><sup>57</sup>.

**Pregnancy** — Case reports have demonstrated safe percutaneous approaches in women as late as 26 weeks of pregnancy<sup>58</sup>. The risk of conscious sedation must be weighed against the need for nutritional support in these patients. An anesthesia consult can assist in delivering safe sedation.

**Ascites** — The presence of ascites in the abdominal cavity is often a contraindication to PEG placement because of the fear of abdominal fluid leakage and peritonitis. However, case reports have demonstrated that large volume paracentesis before and for the first week after PEG placement combined with use of broad spectrum antibiotics has been associated with good patient outcomes<sup>59</sup>. There have been no prospective trials confirming the safety of this technique.

### SUMMARY AND RECOMMENDATIONS

Despite their overall safety, a number of complications can occur following PEG placement. Most studies have suggested that complications are more likely to occur in

elderly patients with comorbid illnesses, particularly those with an infectious process or who have a history of aspiration.

Minor complications include wound infection, wound leakage, wound bleeding, cutaneous or gastric ulceration, pneumoperitoneum, temporary ileus, and gastric outlet obstruction.

Major complications include necrotizing fasciitis, esophageal perforation, gastric perforation, major gastrointestinal bleeding, colocutaneous fistula, buried bumper syndrome, and inadvertent PEG removal.

A number of settings may be encountered in which placement of a PEG is riskier, or that require modification of the standard technique.

A variety of intra-abdominal complications have been described in case reports. Although rare, they must be recognized by the interventional endoscopist.

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