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Percutaneous endoscopic gastrostomy

Results in 316 patients and review of literature

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Summary. Three hundred and sixteen patients underwent 330 percutaneous endoscopic gastrostomies (PEG) of the Russell or introducer type. Seventy-five percent of the patients had neurological conditions that precluded swallowing. Absolute contraindications included pharyngeal or esophageal obstruction, uncorrectable coagulopathy or inability to perform endoscopy. The mean age of the patients was 75 years. The procedure took an average of 17.5 min to perform. PEG could not be performed in 14 patients (4.1%). Major complications occurred in 2.1% of patients, including 5 who developed peritonitis. No infections occurred at the gastrostomy tube site. The procedure mortality was 0.6%. PEG never required general anesthesia. For patients with long-term swallowing abnormalities, PEG is preferred to nasogastric feeding, operative gastrostomy or parenteral alimentation.

Key words: Percutaneous endoscopic gastrostomy – Contraindications – Indications.

Percutaneous endoscopic gastrostomy (PEG) has become the procedure of choice for gastrostomy. The pull technique, described by Gauderer et al. in 1980 [5] and the introducer method described by Russell et al. in 1984 [23] are both safe and effective. By avoiding celiotomy, PEG has simplified a procedure that is often performed on elderly poor-risk patients. Our experience [16] has demonstrated that operative gastrostomy (OG) is more complicated and expensive than PEG.

To date, there have been approximately 1,500 PEGs reported in the literature. We continue to be enthusiastic about PEG [18] and the purpose of this report is to update our experience with particular emphasis on technical success, complications and procedure, and hospital mortality.

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Materials and methods

Between November 1984 and October 1988, 316 patients underwent PEG using the Russell technique at St. Luke's-Roosevelt Hospital Center. There were 170 men and 146 women and it was necessary to perform a repeat PEG on 14 patients. Thus, our experience with 330 consecutive PEGs forms the basis of this report.

The majority of patients (75%) had neurological conditions that precluded swallowing. Other indications for PEG included oropharyngeal cancer, gastroesophageal disease, respirator dependency, aspiration pneumonia and severe debilitation from systemic diseases, such as metastatic cancer, AIDS, collagen vascular diseases and chronic sepsis.

PEG is absolutely contraindicated in complete pharyngeal or esophageal obstruction, uncorrectable coagulopathy or inability to perform endoscopy. Relative contraindications include ascites, severe gastroesophageal reflux, portal hypertension with esophageal varices, gastric cancer and gastroenteric fistulae. Obesity and prior abdominal surgery are not contraindications. Forty-seven patients (15%) had undergone a variety of previous abdominal operations.

The stepwise technique of PEG has been thoroughly described [18, 23]. Briefly, following a complete esophagogastroduodenoscopy, the patient is placed in the supine position. The surgeon indents a spot, usually in the left upper quadrant of the abdomen which the endoscopist confirms by visualizing a clear indentation of the gastric wall. The abdominal wall at the site of indentation is anesthetized and a 7 cm 18-gauge needle is inserted percutaneously into the stomach. A J-wire guide is threaded into the stomach after which the needle is removed. A 1-cm incision is made in the skin at the exit site of the wire. The dilator and sheath (Cook, Russell Gastrostomy Tray-Cook, Bloomington, Ind., USA) are threaded over the

wire and thrust into the stomach. The inner dilator is removed and a Foley catheter inserted into the stomach via the outer sheath. The sheath is peeled away, the Foley balloon inflated with saline and the catheter snugged up against the gastric wall. Finally, the catheter is sutured to the skin.

Results

Three hundred and sixteen patients underwent 330 PEGs. The patients ranged in age from 16 months to 102 years with a mean of 75 years. Four patients were under 2 years of age. The entire procedure, including endoscopy, averaged 17.5 min with a range from 4 to 60 min while the operative component averaged 5 min. PEG was unsuccessful in 14 additional patients (4.1%). In 4, the stomach could not be entered because of esophageal obstruction, while prior Billroth II gastrectomy prevented safe placement in three patients. A variety of procedural reasons accounted for failure in the remaining 7 patients. These included inadequate insufflation of the stomach due to instrument failure, gastric wall tunneling of the dilator and sheath and pneumoperitoneum. Operative gastrostomy was performed in these 14 patients. In no instance did lack of patient cooperation prevent successful PEG. Thus, the technical success rate was 95.9%.

There were no complications from the endoscopy itself. Tube displacement from Foley balloon failure occurred in 11 patients and required a second PEG or operative gastrostomy. Seven patients developed minor transient aspiration pneumonia. There were no wound hematomas or infections. Post-procedure pain was negligible and no patient developed a paralytic ileus. There were seven major complications. Five patients developed peritonitis due to early post-procedure Foley catheter balloon failures. In four the balloon deflated while in one gastric wall-parietal peritoneum apposition was inadequate. Four of these patients had either a successful repeat PEG (2) or conversion to operative gastrostomy (2) while the fifth patient died of sepsis in spite of prompt celiotomy and Stamm gastrostomy. One patient developed a gastrocolic fistula that closed spontaneously after removal of the gastrostomy tube and creation of a new PEG. Finally, an extremely debilitated patient died of massive aspiration pneumonia. Therefore, the major complication rate was 2.1% and the procedure mortality was 0.6%. The 7-day, 30-day and overall hospital mortality was 8%, 17% and 29.7%, respectively. In these cases, death was due to the primary illness.

Table 1. Failure to perform Gauderer-Ponsky PEG

Reason	Reference
Obesity	Kirby et al. [14]
Poor apposition of stomach to peritoneum	Kirby et al. [14], Larson et al. [17]
Inability to transilluminate	Larson et al. [17]
Inability to pass endoscope	Grant [7], Larson et al. [17], Rosenberg and Fried [22], Sangster et al. [25]
Billroth II gastrectomy	Larson et al. [17]
Gastric cancer	Larson et al. [17]
Aspiration during endoscopy	Larson et al. [17]
Hematoma gastrostomy site	Larson et al. [17]
Inability to pull tube	Larson et al. [17], Rosenberg and Fried [22]
Obstructed esophagus	Rosenberg and Fried [22], Sangster et al. [25]
"Thickened stomach or abdomen"	Thatcher et al. [29]
Laryngospasm	Larson et al. [17]

Discussion

Gastrostomy without celiotomy originated in the research laboratory. In 1967, Jascalevich [12] described an introducer technique using a Hurwitz trocar and Foley catheter in dogs, while Hall [9] reported the Pull technique in rat pups in 1975. In 1979, Sacks and Glotzer [24] described the non-endoscopic percutaneous placement of a gastrostomy tube through the site of a healed Stamm gastrostomy in two patients. Two years later, Preshaw [21] performed non-endoscopic percutaneous gastrostomy in 17 patients using a Stamey percutaneous cystostomy catheter following insufflation of the stomach with oxygen via a double-lumen intestinal tube with balloon. None of these innovative techniques, however, utilized the safeguard afforded by the endoscopic methods of Gauderer and Ponsky [5] and Russel [23]. The former technique requires two passages of the gastroscope, and a specially prepared mushroom catheter is pulled through the mouth, pharynx and esophagus, and seated in the stomach. The Russell technique requires a single gastroscopy and a sterile Foley catheter is inserted percutaneously directly into the stomach via a peel-away sheath introduced over a previously placed wire guide. For these reasons we chose the Russell PEG.

The technical success rate of the Gauderer-Ponsky PEG ranges from 76% [29] to 99% [25] and failure has been attributed to many factors (Table 1). The reported technical success rate of the Russell PEG is 99% and failure is due to de-

Table 2. Failure to perform Russell PEG

Reason	Reference
Deflection of the gastric wall	Kozarek et al. [15]
Esophageal obstruction	Miller et al. [18]
Billroth II gastrectomy	Miller et al. [18]
Inadequate insufflation of the stomach	Present series
Sheath tunneling in the stomach wall	Present series
Pneumoperitoneum	Present series

flection of the gastric wall during sheath placement [15], esophageal obstruction [18] and prior Billroth II gastrectomy [18]. In the current series, our success rate for the Russell PEG was 95.9%. Failure was due to esophageal obstruction, prior Billroth II gastrectomy, inadequate insufflation of stomach, gastric wall tunneling of the dilator and sheath and pneumoperitoneum (Table 2).

The success of the Russell PEG technique depends on having a fully inflated stomach, clear visualization endoscopically of finger indentation of the gastric wall and not referred motion, perpendicular placement of the needle, wire guide, dilator and sheath, and snug traction on the Foley catheter to appose the stomach to the abdominal wall. Meticulous attention to detail and close cooperation between the endoscopist and surgeon are essential. A video monitor attached to the endoscope facilitates the procedure. Our experience indicates that attention to several key technical points will assure ease of placement of the gastrostomy tube [19].

In general, complications of PEG are reported as major or minor. Major complications are usually defined as requiring celiotomy, resulting in death or significantly prolonging hospitalization. Major complications of both the Gauderer-Ponsky and the Russell PEG range from 0% [23] to 4.4% [4] while minor complications occur in from 4% [28] to 16% [22] of patients. The reported complications are listed in Table 3.

In our experience with 330 PEGs the major and minor complication rates were 2.1% and 3.6%, respectively. Eleven patients had gastric tube displacement due to Foley balloon failure. Of these, 4 were major complications resulting in peritonitis. All 4 survived after either repeat PEG (2) or operative gastrostomy (2) with gastric decompression and antibiotics. Foley balloon failure should now be less frequent since the manufacturer has replaced the latex Foley catheter with a silastic one. In an additional patient, inadequate gastric wall apposition to the parietal peritoneum led to peritonitis. In spite of prompt celiotomy and Stamm gastrostomy, the patient died of sepsis. One patient developed a gastrocolic fistula, which closed spontaneously after removal of the gastrostomy tube and creation of a new PEG.

Seven patients had minor aspiration with full recovery, but another patient died of massive aspiration pneumonia. Factors that help to prevent aspiration include vigorous oropharyngeal suctioning prior to and during endoscopy, delaying tube feeding for 36 h after PEG, small volume feeds, maintenance of good bowel function, monitoring residual gastric volumes and elevating the head of the bed. If aspiration persists, the gastrostomy tube can be converted to a jejunostomy tube. There are data to suggest that PEG does not

Table 3. Reported complications PEG

Complication	Reference
Premature tube dislodgement	Gauderer et al. [5], Grant [7], Kirby et al. [14], Larson et al. [17], Ponsky et al. [20], Rosenberg and Fried [22], Thatcher et al. [29]
Leaks (internal and external)	Grant [7], Hogan et al. [11], Larson et al. [17], Sacks and Glotzer [24], Sangster et al. [25], Slezak and Kozol [26]
Tube deterioration	Slezak and Kozol [26]
Pneumoperitoneum	Gottfried et al. [6], Ponsky et al. [20], Rosenberg and Fried [22], Slezak and Kozol [26]
Wound infection	Cane et al. [1], Cohen et al. [2], Ditesheim et al. [3], Grant [7], Hogan et al. [11], Kirby et al. [14], Larson et al. [17], Ponsky et al. [20], Rosenberg and Fried [22], Russell et al. [23], Sangster et al. [25], Slezak and Kozol [26]
Aspiration	Foutch et al. [4], Grant [7], Hogan et al. [10, 11], Kirby et al. [14], Larson et al. [17], Sangster et al. [25]
Gastric perforation	Larson et al. [17], Sangster et al. [25]
Gastric hemorrhage	Grant [7], Larson et al. [17]
Gastric ulcer	Foutch et al. [4]
Wound hematoma or bleeding	Larson et al. [17], Steen [28]
Laryngospasm	Larson et al. [17]
Paralytic ileus	Larson et al. [17]
Peritonitis	Foutch et al. [4], Sangster et al. [25], Steen [28]
Peristomal hernia	Sangster et al. [25]
Gastrocolic fistula	Ponsky et al. [20]

worsen gastroesophageal reflux and may actually reduce it by raising the lower esophageal sphincter pressure [13]. Furthermore, PEG prevents the pharyngeal aspiration noted in many neurologically or nutritionally impaired patients. Long-term enteral feeding by nasogastric tube has a high incidence of failure, inadvertent removal and aspiration. This has led extended care facilities to request PEG rather than continued use of nasogastric feedings for their patients. Of particular interest is the fact that none of our patients developed either minor gastrostomy tube site infections or fatal necrotizing abdominal wall infections as described with the Gauderer-Ponsky PEG [3]. Prophylactic antibiotics, meticulous technique and the use of a sterile Foley catheter account for this difference.

The procedure mortality of PEG has ranged from 0% [2, 7, 14, 18, 20, 22, 23] to 2.5% [11] with a mean of 0.6% for approximately 1,500 cases reported. Deaths were due to excessive sedation during the procedure, aspiration, laryngospasm, peritonitis and cardiac failure. When noted, the 30-day mortality has ranged from 7% [28] to 18% [14] while overall hospital and late mortality has ranged from 11% [23] to 50% [26].

In our experience, the procedure mortality was 0.6%. Death was due to peritonitis in one patient and aspiration pneumonia in another. The 7-day, 30-day and overall hospital mortality was 8%, 14% and 29.7%, respectively, reflecting the severity of the patients' underlying medical condition. Performing a PEG earlier in a patient's course might improve the nutritional status sufficiently to avoid some of these early deaths. Another way of interpreting these data is to note that 70% of these very ill patients survived to leave the hospital. Furthermore, as pointed out by Stellato and Gauderer [27], better patient selection might further reduce the short-term procedure-related deaths.

We previously noted that PEG has many advantages when compared to operative gastrostomy [18]. PEG is easy to perform and may be employed earlier in the patient's course, thus avoiding long-term nasogastric feedings or parenteral alimentation. PEG can be performed at the bedside or in an endoscopy suite. Thus, the need for a traditional operating room is avoided. General anesthesia is not required for PEG but was used in 23% [30] to 66% [16] of operative gastrostomies. PEG can be performed quickly with a procedure time ranging from 11 to 27.5 min. It is important to note that PEG costs less than operative gastrostomy. Russell et al. [23] report a savings of $ 2,000 per gastrostomy, which is almost identical with our experience. Stern [28], reporting from a community hospital, and Grant [7], from a university medical center, confirmed these advantages. They also noted a reduced complication and mortality for PEG compared to operative gastrostomy. PEG is not useful for every situation in which gastrostomy is indicated. It is contraindicated in complete pharyngeal or esophageal obstruction, uncorrectable coagulopathy or inability to perform endoscopy. We were unsuccessful in performing PEG in 4.1% or our patients. In these 14 patients, operative gastrostomy was used.

In general, our experience indicates that PEG is easy to perform quickly and with few complications. The mortality is low and it can be done at the bedside or in the endoscopy suite. It is cost effective and can be reversed if necessary by simply removing the gastrostomy tube. We prefer the Russell PEG as compared with the Gauderer-Ponsky PEG since only one endoscopy is performed. Furthermore, a sterile Foley catheter is used. There is no need to pull the tube through the mouth, pharynx and esophagus. Accordingly, we have never had a minor or major abdominal infection. Finally, meticulous attention to detail is the key to successful PEG.

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