

Percutaneous Endoscopic Gastrostomy: The Technique of Choice?

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Background/Purpose: The percutaneous endoscopic gastrostomy (PEG) is contested on the ground that it could cause gastroesophageal reflux (GER). The authors studied the complications of PEG to ponder the validity of this contraindication.

Methods: The authors followed up with a group of 81 patients subjected to PEG to assess their complications, GER in particular.

Results: In half of the patients, PEG was performed under deep sedation in the intensive care unit and the other half under general anesthesia. The procedure lasted about 12 minutes in both subgroups. Early complications were not observed. Late complications relating to the care of the tube were similar to those reported for other techniques. GER appeared in 8%, but surgical treatment was

unnecessary, whereas in patients that presented GER before surgery, it subsided in 38%. A colocolic fistula observed in one patient was a consequence of previous interventions.

Conclusions: PEG is minimally invasive, general anesthesia may be avoided, the procedure is rapid, major complications are conspicuously absent, and the incidence of GER is smaller than that associated with alternative techniques. In addition, the cost is low. The authors consider PEG the technique of choice because it has important advantages compared with open or laparoscopic techniques.

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IN CHILDREN, gastrostomy is indicated usually as nutritional access to bypass the pharynx and esophagus in diseases that ordinarily do not involve the gastrointestinal tract. The most frequent indications are cerebral palsy, swallowing dysfunctions, metabolic diseases, deficient caloric intake, malabsorption syndromes, and other conditions that require permanently assisted enteral feeding.

To perform a gastrostomy, 3 major techniques are currently used: open, percutaneous, and laparoscopic gastrostomies. Percutaneous endoscopic gastrostomy (PEG), described by Gauderer and Ponsky¹ more than 20 years ago, is the least invasive and well tolerated, and is of low cost. However, after PEG, the incidence of postoperative gastroesophageal reflux (GER) evaluated with radiology and 24-hour pH monitoring ranges between 15%² and 27%.³ This complication has stirred a debate. On one hand, to prevent GER, an antireflux procedure has been recommended along with the gastrostomy,⁴⁻⁸ which rules out the plain percutaneous technique. However, Langer et al,⁹ Borowitz et al,¹⁰ and

Puntis et al¹¹ found that GER did not increase inordinately after PEG, and for this reason they dismissed the concomitant antireflux procedure. Notwithstanding, gastrostomy complemented with an antireflux procedure currently prevails.

We evaluated prospectively the complications of PEG, and GER in particular, to establish the technique of choice.

MATERIALS AND METHODS

For the severity of GER, we used the nomenclature taken from Isch et al.¹² Briefly, GER is considered severe when the patient presents secondary undernutrition, esophagitis III-IV, anemia, repetitive respiratory infections, frequent vomiting, and, radiologically, the barium meal reflows up to the mouth or airway; GER is considered moderate when the respiratory infections are sporadic, the esophagitis is mild, and the barium meal reaches the upper thoracic esophagus; finally, GER is mild when no clinical symptoms are present, but the barium meal reflows to the lower esophagus.

The protocol described below was approved by the Ethical Committee of the corresponding hospitals. All children (n = 81) referred for gastrostomy to our hospitals between October 1997 and December 2001 were included in this study, except those with hiatal hernia or severe GER. They were followed up for 30 ± 5 (±SEM) months (range, 5 to 44). Patients were evaluated by a team formed by a pediatrician, a gastroenterologist, a nutritionist, a radiologist, and a surgeon. A barium meal upper gastrointestinal series was used to assess swallowing, transit through esophagus, stomach and duodenum, anatomic abnormalities, GER, and gastric emptying. Patients with normal radiologic findings but with retching, vomiting, choking, or aspirative pneumonia, ie, clinical symptoms of GER, were subjected to 24-hour pH monitoring. The indication of PEG was the responsibility of the team, and the parents gave informed consent to the procedure.

Before surgery, all patients received prophylactic antibiotics (peni-

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Table 1. Gastroesophageal Reflux in Patients Subjected to PEG

Preoperative Condition		Postoperative Condition		
		No Reflux	M Reflux	Severe Reflux
No reflux	65	60 (92%)	5 (8%)	
Mild reflux	16	6 (38%)	9 (56%)	1 (6%)*

Abbreviation: M reflux, mild or moderate reflux.

*For this patient, see text.

cillin and gentamycin) in the usual doses, and those with a ventricular peritoneal shunting received vancomycin as a supplement. PEG was performed either under endotracheal general anesthesia in the operating room or under deep sedation (midazolam 0.2 mg/kg plus Fentanyl 2 μ g/kg intravenously) in the intensive care unit. The technique was that of Gauderer and Ponsky¹ with a siliconized tube, 16F. As postoperative analgesia, patients were given acetaminophen via rectum (20 mg/kg), and, when necessary, ketorolac, 0.5 mg/kg intravenous, was used. Patients were discharged when the enteral route could be used safely. Problems arising in the care of the tube and complications were assessed in the postoperative period. Three months after surgery, a radiologic study of the upper digestive tract was performed, and in those patients with clinical symptoms of GER, a 24-hour pH monitoring was carried out. The parents relayed the time required for feeding the patient at home.

RESULTS

Patients

Our group consisted of 81 children, 43 boys and 38 girls; their age was 2.6 ± 0.4 years (\pm SEM), range, 1 month to 12 years. The weight was 6.5 ± 0.7 kg, ranging between 2.8 and 35 kg. Indications of PEG were (1) swallowing dysfunction (89%) mostly caused by cerebral palsy, (2) special feeding requirements (5%), and (3) inadequate caloric intake (6%). Caloric-proteic undernutrition was present in 86% of patients. The feeding time, 40 minutes by mouth before gastrostomy, dropped to 25 minutes through the tube a few weeks later.

In this study, neither a moderate GER (Table 1) nor previous abdominal surgery was considered a contraindication for PEG. Five patients (6%) already had undergone an abdominal intervention, namely, atresia of extrahepatic biliary ducts ($n = 1$), ventricular peritoneal shunting ($n = 3$), and intestinal atresia type III b ("apple peel").

Procedure

PEG was carried out under endotracheal general anesthesia in 42 patients (52%) and under deep sedation in 39 (48%) in the intensive care unit. The procedure lasted 12.3 ± 1.0 minutes (\pm SEM), range, 5 to 25 minutes; the duration was similar in anesthetized and sedated patients. The endoscopic exploration found alteration in 6 patients (7.5%), namely, gastric deformation caused by previous interventions ($n = 4$), mild esophagitis ($n = 1$), and sclerosed esophageal varices ($n = 1$). The procedure was performed smoothly in all but 3 patients (4%). In a

patient, the omentum prolapsed; in another, the puncture was difficult owing to previous surgery; and in the third, endotracheal intubation was required during the procedure owing to a respiratory depression caused by the sedatives. For postoperative analgesia, acetaminophen was used routinely; only 1 patient required a parenteral analgesic for more than 24 hours. Refeeding started at 10.5 ± 1.5 hours (\pm SEM), range, 3 to 24 hours. The patients were discharged 30 hours after the procedure, range, 18 to 72 hours. The scar of the skin was minimal in most patients.

Complications

Early complications were not observed. Late complications other than GER appeared in 14 patients (17%). These were (1) external migration of the tube caused by excessive pull, which was replaced easily through the fistula; (2) internal migration of the tube, the balloon of which caused a pyloric obstruction; the syndrome subsided as soon as the tube was pulled back; (3) peristomal infection; and (4) a colcutaneous fistula that occurred 6 months after PEG. This patient, subjected previously to several abdominal interventions, was explored radiologically before PEG searching for anatomic alterations, in particular, adhesions of bowel between stomach and anterior abdominal wall, which were not found. Conservative care carried out at home obliterated the fistula.

GER

Table 1 summarizes the data. Of 65 GER-free patients, less than 8% had GER after PEG, which responded satisfactorily to a conservative treatment. In patients that presented a mild or moderate GER, it subsided in 38% after PEG. In one patient, medicated with Diazepam for the primary disease, the moderate preoperative reflux became severe as shown by the pHmetric recording; the acidification of the esophagus occurred as soon as the drug was administered. Because the medication could not be changed, this patient was treated with a laparoscopic Nissen fundoplication.

DISCUSSION

Our results confirm that PEG is a minimally invasive procedure, virtually free of major complications, and that it may be performed safely with sedation instead of general anesthesia. We discuss the complications of PEG with due consideration to GER and the advantages and disadvantages of current techniques used for gastrostomy.

In our study of 81 patients, complications resulting of the mismanagement of the tube were similar to those published for other techniques,^{11,13,14} all of which remit-

Table 2. Comparison Between Percutaneous, Open (Stamm), and Laparoscopic Gastrostomies

	Percutaneous	Stamm	Laparoscopic
Surgery room	Optional	Always	Always
Only sedation	Yes	Never	Never
General anesthesia	Optional	Always	Always
Celiotomy	–	+	–
Technical difficulty	+	+	++
Duration of procedure	Minutes	Hour	Hour
Postoperative analgesia	+	+++	++
Refeeding	Hours	Days	Days
Discharge	30 h	More than 2 d	3 d ¹³
Complications	17%	28%	25%
GER	7%	39% ¹⁸	*
Peritoneal adhesions	+/-	++	+
Potential for gastric separation	+	–	–
Potential for gastrocolic fistula	++	–	+
Interferes with gastric reoperation	No	Yes	Yes
Toleration in high-risk patients	Excelent	Good	Fair
Cost	+	++	+++

*No data available.

ted readily after conservative care. A late colocutaneous fistula observed in our series merits special mention, because it probably would not have occurred with open or laparoscopic techniques. This patient had undergone several abdominal surgeries, and the radiologic study before PEG showed no bowel adhesions to the anterior gastric wall. However, we surmise that an adherence went unnoticed and that the fistula resulted from a squeeze of the colon between abdominal wall and stomach. A conservative treatment at home healed the fistula.

Peritonitis is a possible complication of PEG owing to spill of gastric content onto the peritoneal cavity,¹⁵ because the stomach is not surgically attached to the abdominal wall. This complication was conspicuously absent from our series. Most likely, this was caused by the training of the family group in the proper care of the tube.

GER was not an important complication despite the fact that the age (2.6 years) places our patients in a higher risk group.^{14,19,23} Less than 8% of the GER-free patients had a mild GER, and in no case was surgical treatment required. The figure ranks well below published values that range between 15% and 27%,^{2,3} and is similar to that of a recent study.¹⁶ We want to emphasize that the mild or moderate GER present before surgery subsided after PEG in 38% of patients, a finding already reported¹⁶ but not discussed. The gastrostomy has been suggested to have an antireflux effect; the enhanced nutritional condition improves the performance of the esophageal hiatus and diaphragmatic crura muscles.¹⁷ But we speculate that PEG has an additional antireflux effect because it produces a de facto attachment of the anterior wall of the stomach to the abdominal wall, akin to anterior gastropexia.¹⁸

In 1 patient, the preoperative GER worsened after PEG, and its surgical treatment was indicated. However, the aggravation of the reflux was not caused by PEG but by Diazepam, a drug required by the primary disease. All in all, PEG caused GER in a few cases, and in none of them was surgical treatment required.

The current gastrostomy techniques are compared in Table 2. The advantages of PEG over open or laparoscopic gastrostomies are all too obvious. Here we want to highlight only a few of them. First, operating room and general anesthesia are not mandatory for PEG. Moreover, sedation has an additional advantage in that the psychological discomfort of the child is also reduced as parents may accompany the patient. Second, in PEG, the whole procedure is quite simple and takes a very short time, reducing the invasiveness to a minimum compared with open or laparoscopic techniques that are more traumatic and considerably longer.^{14,15,19} Third, PEG reduces greatly the postoperative discomfort because the requirement of analgesics is minimal (acetaminophen), refeeding begins earlier, and patients are discharged sooner. Moreover, in our series, the last patients operated on under sedation were discharged a few hours after the procedure. Fourth, PEG is not followed by major complications, and the few that occur can be treated at home. In contrast, the antireflux procedure is associated with a higher morbidity rate, about 35%,¹⁹ even deaths have been reported,²⁰⁻²³ and GER relapses in 15 to 24% of patients.²¹⁻²³ Finally, the cost of PEG, owing to its simplicity, is significantly lower than that of open or laparoscopic techniques.^{14,15,24}

Our data substantiate that PEG is a minimally invasive procedure, the incidence of GER in the GER-free patients is low, and even a preoperative GER may remit.

Because the alternative techniques have a higher morbidity, there is no sound reason to perform systematically a prophylactic antireflux procedure along with the gastrostomy. PEG stands out as the technique of choice.

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