

# Gastrostomy Placement in Children: Percutaneous Endoscopic Gastrostomy or Laparoscopic Gastrostomy?

Laura Merli, MD, Erika A. De Marco, MD, Camilla Fedele, MD,  
Elena J. Mason, MD, Alessandra Taddei, PhD, Filomena V. Paradiso, MD,  
Vincenzo D. Catania, MD, and Lorenzo Nanni, MD

**Abstract:** The aim of this study is to compare the outcomes and the complications between the 2 most adopted procedures for gastrostomy placement: percutaneous endoscopic gastrostomy (PEG) and laparoscopic gastrostomy (LG) in children. We present our study on 69 patients (male: 46/female: 23): group 1 (37 patients, 54%) undergoing PEG, group 2 (32 patients, 46%) undergoing LG. A total of 5 major complications were observed all in the PEG group (13.5%), no major complication was observed in the LG group ( $P$ -value < 0.05). A total of 12 minor complications were observed: 4 occurred in the PEG group (10.8%) and 8 (25%) in the laparoscopic gastrostomy group, not statistically relevant. We suggest that the LG should be considered the preferred technique for gastrostomy placement in pediatric patients, particularly in newborns, children with significant skeletal malformations, and patients who underwent previous abdominal surgery.

**Key Words:** PEG, gastrostomy, children, complications

(*Surg Laparosc Endosc Percutan Tech* 2016;26:381–384)

According to the European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines on artificial enteral nutrition,<sup>1</sup> gastrostomy placement is indicated in all patients in need of supplementary artificial enteral nutrition for a period exceeding 2 or 3 weeks.

Indications for gastrostomy include a wide spectrum of conditions: feeding disorders (eg, neurologically impaired children), dependency on fluid and nutritional supplementation (eg, patients with metabolic or renal disorders, children with short-gut syndrome), congenital or acquired conditions in which oral intake is impeded (eg, esophageal atresia, craniofacial surgery) and, in general, patients with long-term inadequate intake (eg, stenosing tumors of the upper gastrointestinal tract, Crohn's disease, cystic fibrosis).

Aims of enteral tube feeding are to avoid further body weight loss, correct significant nutritional deficiencies, promote growth in children with intellectual disability, and improve patients' quality of life and carer satisfaction.

Various technical options have been described for gastrostomy tube placement, including: Stamm procedure, percutaneous endoscopic gastrostomy (PEG),<sup>2</sup> fluoroscopically guided percutaneous gastrostomy,<sup>3</sup> and different types of laparoscopically assisted gastrostomy (LAG).<sup>4–9</sup> Hassan and Pimpalwar<sup>10</sup> described a combined procedure in which both laparoscopy and endoscopy are used for tube placement (modified laparoendoscopic gastrostomy tube placement), the so-called video-assisted PEG. Although PEG and LAG are currently the 2 most frequently adopted procedures for gastrostomy placement, there still is no consensus as to which procedure, if any, is superior to the other.

The aim of the present study is to compare these procedures by analyzing the outcomes in 2 groups of patients, undergoing LAG and PEG, respectively. Clinical indications, anatomic presentation, operative time, time to discharge, minor and major complication rates, and number of anesthetic procedures necessary to achieve a low-profile gastrostomy button are analyzed.

## MATERIALS AND METHODS

Between January 2004 and October 2015 a total of 86 gastrostomy tube placements were performed; 15 patients were excluded from the study because they received a laparoscopic placement and 2 because patients were over 18 years old. The remaining 69 patients were analyzed retrospectively.

Data were compiled on patients' age, weight, diagnosis, neurological comorbidities, indications to surgery, operative time, complications (minor/major; intra-operative/postoperative), time to refeeding, time to total enteral feeding, time to discharge. Patients who underwent fundoplication at the same time or after gastrostomy placement were included in the analysis.

The 69 remaining patients (male: 46/female: 23) were divided into 2 groups depending on placement technique: group 1 consisted of 37 patients (54%) undergoing PEG, group 2 consisted of 32 patients (46%) undergoing laparoscopic gastrostomy (LG).

Descriptive statistics were obtained and differences between the surgical techniques (LG vs. PEG) were compared using the "t" test for the normal distribution and the Mann-Whitney test for the others. The statistical analysis of complications were obtained by using  $\chi^2$  test and we considered significant a  $P < 0.05$ .

## Operative Technique

### PEG Technique

All PEG procedures were performed under general anesthesia using a flexible Olympus gastroscope. The stomach was insufflated; the assistant—guided by

Received for publication January 1, 2016; accepted July 17, 2016.  
From the Division of Pediatric Surgery, Catholic University of the Sacred Heart, Policlinico "A. Gemelli", Rome, Italy.

The authors declare no conflicts of interest.

Reprints: Laura Merli, MD, Division of Pediatric Surgery, Largo Agostino Gemelli 8, 00168, Rome, Italy (e-mail: merlilaura@tiscali.it).

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transillumination and the indentation test—performed the gastric puncture after having incised the skin for a few millimeters. A cannula was inserted into the stomach under visual control and the assistant verified its correct positioning by air aspiration. A guide wire was passed through the cannula sheath into the stomach, grasped by the endoscopist, and drawn out through the mouth together with the gastroscope. The thread loop of the external end of the PEG tube was fastened to the guide wire and drawn down through the esophagus into the stomach and out through the puncture site until the internal fixation plate had drawn the anterior wall of the stomach against the abdominal wall.

### LG Technique

Before the procedure, the gastrostomy site is chosen and marked in the left upper abdominal quadrant, well below the costal margin to avoid decubitus.

Using an open, transumbilical access pneumoperitoneum is achieved by insufflating carbon dioxide at a rate of 1 to 3 L/min until an intra-abdominal pressure of 8 to 12 mm Hg is obtained, depending on patient age and comorbidities.

A 5-mm 30-degree telescope is placed through the umbilical port and an abdominal exploration is performed. Once the anterior gastric wall has been identified, the adequacy of the chosen gastrostomy site is evaluated to avoid developing excessive tension on gastric wall. A 3-mm grasping clamp is introduced in a trocarless modality through an additional incision made at the gastrostomy site, and the stomach is grasped along the greater curvature and put close the abdominal wall. Two transperitoneal sutures are placed through the gastric wall to fix it to the abdominal wall. A guide wire is introduced into the stomach through an 18-G cannula inserted under laparoscopic control; the passage is subsequently dilated by means of fascial dilators of increasing caliber until a caliber 2 Fr wider than the one chosen for the button is reached. The button is inserted into the gastric cavity and the balloon is filled with saline solution. The button's correct positioning is checked by infusing and aspirating saline solution under laparoscopic control.

### RESULTS

A total of 86 gastrostomy tubes were placed between January 2004 and October 2015. In total, 17 patients were excluded from the study (15 because they received a laparoscopic gastrostomy and 2 because they were over 18 y old). The remaining 69 patients (male: 46/female: 23) were analyzed in this retrospective study.

These 69 patients were divided in 2 groups. The first group, composed of 32 patients (46%, 21 male/11 female), who underwent LG, with 1 case of conversion from laparoscopic to open procedure. The second group included 37 patients (54%, 25 male/11 female) who underwent PEG.

Median age in the first group was 53 months (range, 1 to 215 mo), with a median weight of 12.8 kg (range, 3 to 30 kg); in the second group the median age was 76 months (range, 1 to 225 mo) with a median weight of 20 kg (range, 6 to 60 kg).

The 2 groups were homogenous for sex and age, but the patients who underwent LG had a lower mean weight compared with the patients who underwent PEG ( $P < 0.05$ ).

Indications to gastrostomy were in all cases malnutrition or risk of inhalation caused by acquired or congenital neurological deficit.

The mean operating time for LG procedure was 77 minutes, with a median of 60 minutes, compared with 40 minutes necessary for PEG procedure, with a median of 38 minutes ( $P < 0.05$ ).

In the LG group, the mean time to start refeeding was  $1.7 \pm 0.9$  days and the mean time to full enteral feeding (FEF) was  $10.4 \pm 10$  days.

In the PEG group, the mean time to refeeding was  $1.8 \pm 1$  days and the mean time to FEF was  $9.7 \pm 17$  days.

There were no significant differences in refeeding time and FEF time between the 2 groups.

Complications were classified into minor (peristomal erythema, decubitus, peristomal granuloma) and major (pneumoperitoneum, perforation, Buried Bumper Syndrome, gastrocolic fistula, button malfunction).

A total of 5 major complications were observed: they all occurred in the PEG group (13.5%), whereas no major complication was observed in the LG group. These data are statistically significant, being the  $P$ -value  $< 0.05$ .

A second surgical procedure was necessary in 4 of 5 patients presenting a major complication (80%).

A total of 12 minor complications were observed: 4 of them occurred in the PEG group (10.8%) and 8 (25%) in the LG group. However, this value is not statistically relevant.

All patients who underwent PEG procedure needed a second general anesthesia for the placement of a low-profile gastrostomy button.

Five of 69 patients needed fundoplication. Two of these patients were scheduled for LG and underwent fundoplication during the same procedure; the remaining 3 patients underwent PEG and needed a second procedure to perform fundoplication.

### DISCUSSION

PEG was first described by Gauderer et al<sup>2</sup> in 1980 and proposed as a valid alternative to laparoscopic gastrostomy.

PEG tube insertion rapidly became the preferred method due to its minimally invasive nature, speed, low cost, and high patient tolerance; moreover, a significant reduction in morbidity and mortality was observed if compared with surgical gastrostomy.<sup>2</sup>

In 1998 the first reports of complications associated to PEG appear in the literature, underlining how PEG needs to be considered a major undertaking in children.<sup>11</sup>

In consideration of the more and more frequent reports of complications associated with PEG, modifications of this technique arose: the main variations aimed to position gastrostomy under direct visual control<sup>12-14</sup> and perform gastropexy.<sup>12,14,15</sup>

As new laparo-assisted or fully laparoscopic techniques developed, a comparison between these 2 approaches became necessary, and it seemed evident that complication rates associated with the laparoscopic procedure are inferior to those associated with PEG.<sup>16-20</sup> However, to this date PEG remains a common procedure and the laparoscopic approach is not considered a gold standard.

Complications are generally divided into major and minor.<sup>21</sup> The former include: pneumoperitoneum, hemorrhage, duodenal hematoma, colic injuries, liver injuries, small bowel injuries, gastric perforation, gastrocolic fistula,

peritonitis, and buried bumper syndrome<sup>22</sup>; the latter include: peristomal infections, leakage, and granuloma.

Many of the major complications have been associated to PEG; on the contrary only a few of them have been described in association to LAG, such as gastric perforation, gastrostomy dislodgment, and conversion to an open procedure.

As far as minor complications are concerned, they are equally encountered in both PEG and LAG.<sup>23</sup>

According to the literature, mortality has been reported in 0% to 2% of PEG procedures, while so far it has never been reported in association to LG; major complications have been observed in 0% to 11% of PEGs versus only 0% to 4% of LGs, whereas minor complication rates are reported equal in both procedures.<sup>18–23</sup>

The ESPEN guidelines on artificial enteral nutrition well describe the contraindications to PEG, including serious coagulation disorders, presence of interposed organs (liver, colon), severe spine anomalies, severe peritoneal carcinomatosis, severe ascites, peritonitis, anorexia nervosa, and severe psychosis.<sup>1</sup>

The laparoscopic technique was developed to obviate many of these limitations. In fact, the main advantage offered by this technique is the possibility to visualize the stomach directly and choose the best site for tube placement: this is crucial in patients with distorted anatomy due to spinal anomalies.<sup>24</sup>

The presence of peritoneal adhesions may increase the risk of injuring interposed organs during PEG. This is particularly true for patients who underwent previous abdominal surgery and for those who carry a ventricular-peritoneal shunt, in which peritoneal adhesions are often present or expected. LG may allow to access the anterior gastric wall in a safe way.

The association of gastropexy to gastrostomy is important to limit occurrence of tube dislodgement; this procedure cannot be performed during PEG and is instead feasible during laparo-assisted or fully laparoscopic procedures.

An important advantage of LG is the possibility to perform gastrostomy even in small infants (< 2 kg) who cannot undergo an operative endoscopy because of the limitations due to the endoscope's dimension.<sup>16</sup>

Direct placement of a button gastrostomy obviates the need of a second anesthesia to change the PEG tube with the button. Some authors use to remove the endoscopic tube by cutting away the external catheter and allowing the fixation plate to pass from the body by the natural route without complications in the adults; this maneuver has been associated with several complications<sup>25</sup> including subsequent ileus and need for surgery in children. For this reason the ESPEN guidelines<sup>1</sup> recommend the endoscopic removal of the tube in the children. Finally, in those patients in whom a fundoplication is needed in association with the gastrostomy placement, the laparoscopic approach allows both procedures to be accomplished during the same anesthesia.

According to the literature the present study confirms that PEG is associated to higher risk of developing major complications as opposed to LG ( $P < 0.05$ ). In addition, in our population almost all patients presenting a major complication following PEG needed a second surgical procedure.

LG is feasible in newborns weighing  $\leq 3$  kg who cannot undergo an operative endoscopy because of limitations due to the endoscope's dimension.<sup>18</sup> This is confirmed by

the difference in the median weights among the 2 groups of patients in our study.

PEG requires a second general anesthesia to place the low-profile button or to perform fundoplication, as opposed to LAG.

Laparoscopically assisted PEG can be useful, but is certainly not cost-effective as it requires 2 surgeon operators.

Considering all the aforementioned argumentations, we suggest that the LG (and particularly the U-stitch technique) should be considered the preferred technique for gastrostomy placement in pediatric patients. This approach is particularly valid in newborns, children with significant skeletal malformations, and patients who underwent previous abdominal surgery or ventricular-peritoneal shunt placement.

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