Influence of Percutaneous Endoscopic Gastrostomy on Gastroesophageal Reflux Disease in Children

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Objective To determine if gastroesophageal reflux disease (GERD) is present at long-term follow-up after percutaneous endoscopic gastrostomy (PEG), and to identify factors associated with the occurrence or aggravation of GERD after PEG placement.

Study design This prospective, observational study was conducted in our single tertiary center over a 13-year period (gastrostomy performed from 1990 to 2003 and follow-up to 2015). Every child who underwent PEG in our center (N = 368) from 1990 to 2003 was eligible. GERD was defined by clinical manifestations requiring antisecretory or prokinetic treatment, occurrence of a GERD-related complication, or the need for antireflux surgery. Outcomes among patients without antireflux surgery were also assessed. Multivariate analysis was used to identify factors aggravating GERD after PEG placement.

Results A total 326 patients (89%; 56% with a neurologic impairment) were studied with a median follow-up after 3.5 years (range, 2.0-13.5 years). After PEG placement, GERD appeared in 11% of patients and was aggravated in 25% of patients with preexisting GERD. Factors associated with GERD worsening after PEG placement were neurologic impairment and preexisting GERD. Only 53 patients (16%) required antireflux surgery, among whom 22 required surgery in the year after PEG. Neurologic impairment was the only factor significantly associated with the need for antireflux surgery.

Conclusions GERD predominantly remains clinically controlled after PEG placement. Routine antireflux surgery at the time of PEG placement is not justified. *(J Pediatr 2018;■■:■■-■■).*

Percutaneous endoscopic gastrostomy (PEG) is a standard of care for providing long-term enteral nutrition in children[1] and is frequently used long term in pediatric care.[2,3] Despite the frequent use of PEG in the pediatric population, most evaluations have focused on complications and nutritional outcomes.[4-10]

The induction or exacerbation of gastroesophageal reflux disease (GERD) by gastrostomy has long been a concern and an antireflux surgical procedure has been recommended at the time of gastrostomy placement, especially in children at risk for developing GERD or aggravation of preexisting GERD.[11,12] Many children requiring gastrostomy tube placement have a medical condition associated with high GERD prevalence, especially neurologic impairment. To date, evidence about the effectiveness of fundoplication at the time of PEG placement in neurologically impaired children is insufficient.[13,14] After our previous findings (using pH-metry before and after PEG placement) showing that GERD is not aggravated by PEG placement,[15] our center enacted a protocol of nonroutine fundoplication at the time of PEG placement.[16] Fundoplication is only performed when GERD is uncontrolled before PEG placement. Since 1999, we have collected prospective data on GERD outcomes after PEG placement in the patients who did not undergo fundoplication at the time of surgical gastrostomy placement.

The current study presents analyses of long-term outcomes from this protocol. We specifically aimed to assess the frequency, persistence, and aggravation of GERD after PEG placement, and to determine the factors associated with occurrence or exacerbation of GERD years after PEG placement.

Methods

This single-center, prospective and retrospective, population-based study was conducted over a 13-year period in the university pediatric tertiary hospital of Lille, France. During the first 9 years, we reviewed the medical records of all patients who had undergone PEG placement in our hospital. Missing data were completed by telephone contact with parents or chronic care institutions. During the second 4 years, data were collected prospectively using an ad hoc questionnaire. Data on the long-term outcomes (eg, nutrition, complications, survival) among this cohort have been published elsewhere.[17]

GERD	Gastroesophageal reflux disease
PEG	Percutaneous endoscopic gastrostomy

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We recorded patient demographics (age, sex, date of PEG placement), underlying disease, indication for PEG placement (ie, feeding difficulties—persistent food refusal, struggling, resisting during feeding, gagging and regurgitation of food, failure to thrive, gastric decompression, need for a special diet for inherited metabolic disease), nutritional status (undernutrition was defined as a Z-score [weight/height] < −2 SD), clinical signs, and treatment and evaluation of GERD including pH/impedancemetry and endoscopy. The follow-up duration has been defined by the time between PEG placement and the last visit on enteral nutrition the child was seen in our center during the study period.

Following consensus that the definition of GERD is gastroesophageal reflux causing troublesome symptoms and/or complications, we a priori defined GERD when patients presented symptoms requiring a prokinetic or antisecretory treatment (H2 blockers and/or proton pump inhibitor), history of esophagitis, or antireflux surgery.[16,18,19] Worsening GERD was—also a priori—defined as the need for increased dosage or a new course of proton pump inhibitor and/or the occurrence of a GERD-related complication (ie, ulcerated esophagitis), even in patients who had previously undergone antireflux surgery.

All PEG placements were carried out by the same team of pediatric gastroenterologists, without changes to either procedure or type of device during the study period. PEG placement was performed in the operating room with the patient under general anesthesia. The standard pull technique was used[20]; 12- and 16-Fr gauge gastrostomy tube by Ansell Medical (Cergy-Pontoise, France) or 9- and 15-Fr gauge by Fresenius (Louviers, France) was used. Prophylactic perioperative parenteral antibiotic (cefamandol) was given to all patients. Tubes were replaced by a gastrostomy button 3-6 months after placement.

Statistical Analyses

Results are expressed as frequencies and percentages for categorical variables or median and ranges for numerical variables. Whether GERD factors worsened after PEG placement was investigated using bivariate analyses: χ^2 or Fisher exact test, or Student *t* test. For each outcome, variables with a *P* value of less than .2 in bivariate analysis were introduced in a multivariate logistic regression with a stepwise selection (results are expressed as ORs and CIs).

For the assessment of need for antireflux surgery, survival analysis was performed. Because death was considered as a competing event, the cumulative incidence of antireflux surgery was calculated using the Gray method[21] and the Fine and Gray method[22] was used to calculate the hazard ratio and its CI.

Statistical analyses were performed using SAS Software version 9.1 (SAS Institute, Cary, North Carolina) and the *cmprsk* package of R Software (R Corporation, Vienna, Austria) was used for survival analysis. *P* values of less than .05 were considered statistically significant.

Ethics

Because the study was purely observational from data obtained without any additional intervention or monitoring procedure, and according to French regulations on research, formal ethics committee approval was not required.[23] Nevertheless, parents and children received written information about the study and data were deidentified.

Results

A total of 368 patients (209 boys; 57%) underwent PEG during the study. Full data were available for 326 patients (89%) for long-term follow-up and were, therefore, included in current analyses. The median age at the time of PEG placement was 2.3 years (range, 1 month–25 years), 33% (n = 120) were younger than 1 year of age, 52% (n = 190) were 1-12 years of age, and 12% (n = 44) were adolescents. Fourteen patients older than 18 years of age were included in the adolescent group because they had been followed by the pediatric clinics from childhood and had neurologic impairment and severe growth retardation. Most patients (56%) who underwent PEG in our center during the study period had neurologically impairment and no difference on medium age was noted between the 2 groups (medium age, 1.6 years of age [range, 1 month-18.6 years of age] vs 1.6 years of age [range,1 month-19.4 years of age]). The underlying diseases in the study sample are listed in **Table I**.

The main indication for PEG placement was enteral nutrition owing to feeding difficulties with or without failure to thrive for 232 patients (63%). Other indications for PEG in our study population were failure to thrive without feeding difficulties for 121 patients (33%), gastric decompression for 11 patients (3%), and need for special dietary treatment in 4 patients (1%).

At the last follow-up, the PEG was still in place in 133 children (41%), had been removed in 99 (30%), and 94 children (29%) were deceased (only 2 from an early complication of the procedure, the 94 others from an evolution or complication of their underlying disease). In children still receiving enteral nutrition, the median follow-up was 3 years 6 months (range, 2 years-13 years 6 months) vs 2 years 4 months in chil-

Table I. Underlying diseases in the study sample

Underlying diseases	Patients, n (%)	Age at PEG (median (minimum-maximum), years
Neurologic impairment	208 (56)	1.6 (0.1-18.7)
Respiratory diseases	54 (14)	1.5 (0.3-18.1)
Digestive diseases	32 (9)	1.5 (0.2-15.5)
Ear nose throat diseases (ie, Robin sequence, congenital malformations)	26 (7)	1.7 (0.3-8.6)
Other (cancer, kidney, inherited metabolic diseases)	48 (13)	1.6 (0.1-19.4)

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