Risk Factors for Complications in Infants and Children with Percutaneous Endoscopic Gastrostomy Tubes

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Objective To identify risk factors associated with percutaneous endoscopic gastrostomy (PEG) tube complications in a large cohort of infants and children.

Study design We performed a chart review of 591 pediatric patients undergoing PEG tube placement between 2006 and 2010 at Boston Children's Hospital. Frequency and type of major and minor complications associated with PEG tubes in children were identified. Univariate and multivariate analyses were then conducted to determine potential risk factors for complications.

Results A total of 198 PEG-related complications (72 major and 126 minor) were noted in our cohort of 591 patients. Approximately 10.5% of patients experienced at least one major complication and 16.4% experienced at least one minor complication, with the great majority of complications occurring after discharge postplacement. Age <6 months (P = .003), American Society of Anesthesiologists class III (P = .02), and presence of a neurologic disorder (P = .05) were found to be protective against experiencing a major complication, whereas the presence of a ventriculoperitoneal shunt was confirmed to be a risk factor (P = .01) for major complications.

Conclusion Both minor and major complications are common in children after PEG tube placement, with most complications occurring several months postoperatively. Certain patient factors, including age, neurologic status, and American Society of Anesthesiologists class, may be protective, and the presence of a ventriculoperitoneal shunt may be associate with an increased risk of complications after PEG tube placement. *(J Pediatr 2015;166:1514-19)*.

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Percutaneous endoscopic gastrostomy (PEG) tube placement was developed in 1980 as a less invasive alternative to standard open surgical gastrostomy insertion.[1-5] Over the years, outcome studies have used different definitions of procedural complications related to PEG placement, and published complications rates have ranged widely, from 4% to 44%.[3,4,6-12] Our investigative team previously defined "major procedural complications" associated with PEG tubes to include any unplanned adverse event requiring additional hospitalization, surgical procedure, or interventional procedure.[13] Despite standardization of multiple periprocedural processes at our hospital over the last 20 years, our major complication rate has remained steady between 11% and 13%.[4,13] Therefore, we have postulated that recognizing risk factors for PEG complications in children may be critical to identifying opportunities for improving outcomes.[4,13]

Known risk factors for PEG tube complications in adults include procedural factors (ie, underuse of perioperative antibiotics) and patient comorbidities (ie, presence of an immune deficiency, hypoalbuminemia, older age, increasing American Society of Anesthesiologists [ASA] class).[14,15] The generalizability of these risk factors to pediatric populations undergoing PEG placement is unknown. Although several studies have suggested patient and procedural risk factors for complications of PEG placement in children, these studies have been universally limited by small sample sizes, broad definitions of complications, and rare outcomes of interest.[2-4,7,11,12]

The primary aim of the present study was to use a large cohort of pediatric patients undergoing PEG tube placement at Boston Children's Hospital between 2006 and 2010 to identify risk factors associated with major PEG complications. In particular, we investigated previously reported predictors of complications of PEG tubes in children, including neurologic and oncologic diagnoses, as well as ventriculoperitoneal (VP) shunts. We also sought to examine the elapsed time between PEG tube placement and major complications, as well as the frequency and types of complications associated with PEG tubes in children.

ASA	American Society of Anesthesiologists
GI	Gastroenterologist
PEG	Percutaneous endoscopic gastrostomy
VP	Ventriculoperitoneal

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Methods

Institutional Review Board approval was granted to complete a chart review of all patients undergoing PEG tube placement at Boston Children's Hospital between January 2006 and December 2010. We performed a query of Epic version 2008 (Informer Technologies, Shingle Springs, California) hospital electronic medical records by searching for scheduled visit type code 9709 ("Percutaneous Gastro Insert"). We also searched Epic Notes fields using the key word "PEG." These two reports were then combined for initial review. All patients who received a primary PEG tube using a pull technique were included in this analysis. Patients who underwent primary surgical gastrostomy, gastrojejunostomy, jejunostomy, or a "one-step" PEG tube placement were excluded.

Corflo PEG tubes (Corpak, Wheeling, Illinois) were exclusively placed at our hospital during the study period. The procedure was performed by a gastroenterologist (GI) and a general surgeon working together in the main operating room. The GI provider was responsible for the endoscopic portions of the procedure, and the surgeon performed a percutaneous puncture and inserted the guidewire. All procedures were performed under general anesthesia. At the start of the procedure, standardized antiseptic skin preparation with Betadine was performed, and at least one intraoperative dose of a broad-spectrum antibiotic (cefazolin or comparable antibiotic) was administered. Patients were typically observed for 48 hours postoperatively before discharge and received a total of 24 hours of intravenous antibiotics (ie, cefazolin every 8 hours for a total of 3 doses) during this time. During the postoperative period, all patients underwent standardized stoma site monitoring.

In most patients, exchange of the PEG tube for a skin-level MIC-KEY button (Kimberly Clark, Dallas, Texas) was performed by the GI provider at approximately 6 months after PEG placement. This exchange typically involved removal of the PEG tube via traction pull, with confirmation of intragastric placement of the skin-level gastrostomy tube by fluoroscopy.

Patient records were reviewed for patient age, ASA class, and weight at the time of PEG tube placement, as well as the identity of the GI provider involved in PEG placement. Frequency of PEG procedures performed by individual GI providers was calculated; providers who had placed >20 PEG tubes were considered experienced. In addition, patient comorbidities were reviewed and categorized as neurologic, metabolic/genetic, cardiac, oncologic, or oropharyngeal abnormalities, as well as cystic fibrosis, or history of premature birth at <37 weeks gestation. Presence or absence of a VP shunt at the time of PEG tube placement was noted. Comorbidities were not considered mutually exclusive.

We used the following hierarchy to assign a primary indication for PEG placement: (1) aspiration, defined as having undergone a fluoroscopic modified barium swallow that demonstrated aspiration; (2) failure to thrive, defined as not meeting aspiration criteria and having a weight below the 3rd percentile or crossing of 2 percentiles on the growth curve; or (3) other feeding difficulties, defined as without aspiration or failure to thrive but with feeding immaturity, other general feeding difficulties, and/or need for supplemental medication/fluid administration.

Major complications were defined as any unplanned adverse event necessitating additional hospitalization, surgical procedures, or interventional procedures, in accordance with previously published criteria developed at Boston Children's Hospital.[4,13] Minor complications were defined as documentation of any stoma infection requiring oral antibiotics, PEG tube malfunction or dislodgement, or any other procedural complications requiring urgent medical attention (in the ambulatory gastroenterology clinic setting or the emergency department), without the subsequent need for inpatient hospitalization or surgical intervention. Vomiting, exacerbation of gastroesophageal reflux, and feeding intolerance were not considered complications of PEG tube placement, nor were granulation tissue, leakage, minor bleeding not requiring intervention, and reported stoma pain assessed and managed in ambulatory settings.

All patient records were followed from the date of PEG tube placement up to the first occurrence of one of the following events: (1) the PEG tube was permanently removed; (2) the patient expired; (3) the PEG tube was exchanged for either a skin-level device or another enteral feeding tube device (including a gastrojejunostomy tube); or (4) the PEG tube was replaced during fundoplication. If none of the foregoing events was observed, then patients were followed until the end of the study period on October 31, 2012. Major and minor complications occurring during the study period were captured in our database.

Statistical Analyses

Study design, patient population, and PEG tube outcomes were depicted on a detailed flow chart. Patient characteristics were described through summary statistics (median and IQR for quantitative variables, frequency and percentage for categorical variables). The observed number and types of major and minor complications were summarized across patients and tabulated. Six-month and 1-year cumulative incidence rates of major complications were estimated using the Kaplan-Meier method to accommodate for differences in timing of complications and censoring. Univariate and multivariate Cox proportional hazards regression models were used to identify risk factors for PEG-related major complications. All patient characteristics were considered potential risk factors in univariate Cox regression analyses. To accommodate for potential nonlinear effects of age on major complication rates, age was dichotomized into two groups: <6 months and ≥6 months. Similarly, weight was dichotomized into a binary variable: <4 kg and ≥4 kg. Any variable with a P value <.20 in the univariate Cox model was included in a multivariate Cox regression model to study the joint effects on major complication rates. A stepwise procedure