Journal of Pediatric Surgery 52 (2017) 1416–1420

Contents lists available at ScienceDirect

Journal of Pediatric Surgery

journal homepage: www.elsevier.com/locate/jpedsurg

Clinical

Comparison of operative outcomes between surgical gastrostomy and percutaneous endoscopic gastrostomy in infants

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ARTICLE INFO

Article history:
Received 2 October 2016
Received in revised form 10 January 2017
Accepted 14 January 2017

Key words:
Gastrostomy
Percutaneous endoscopic gastrostomy
Complication
Kids' Inpatient Database
Infant

ABSTRACT

Purpose: Safety profile of different gastrostomy procedures in small children has not been well studied. This study was conducted to investigate whether complication and mortality rates differ between surgical gastrostomy (G-tube) and percutaneous endoscopic gastrostomy (PEG) in infants and neonates.
Methods: In this retrospective study utilizing the Kids' Inpatient Database, all infants who underwent either G-tube or PEG as a sole procedure were identified. Variables included age, gender, race, presence of neurological impairment, prematurity, complex chronic condition, and severity of illness/risk of mortality subclasses. Postoperative complication, re-operation, and mortality rates were compared between G-tube and PEG. A subgroup of neonates was also analyzed.
Results: A total of 1456 infants were identified (G-tube n = 874, PEG n = 582). In univariate analysis, the rates of adverse outcomes were not significantly different (G-tube vs PEG complication rate was 7.3% and 6.7%, $p = 0.65$; mortality rate 1.3% and 0.7%, $p = 0.29$, respectively). Adjusted odds ratios (ORs) for complication were 1.07 (G-tube vs PEG, 95% confidence interval [CI] 0.700–1.620) for overall infants and 1.19 (95% CI 0.601–2.350) for the neonatal subgroup. Similarly, adjusted ORs for mortality did not differ significantly both in infants (OR 1.749, 95% CI 0.532–5.755) and in the neonatal subgroup (OR 2.153, 95% CI 0.566–8.165).
Conclusions: When G-tube and PEG were performed as the only procedure throughout a hospitalization in infants and neonates, the two techniques had comparable risks of postoperative complications and mortalities.
Level of evidence: Retrospective comparative study, Level III.

Gastrostomy tube placement is a common procedure in pediatric and adult populations. The most common indication in children is failure of adequate oral intake, which can result from a variety of conditions such as failure to thrive, neurological impairment, head trauma, and severe craniofacial malformations. Several technical approaches exist: open gastrostomy and minimally invasive gastrostomy, which includes percutaneous endoscopic gastrostomy (PEG), percutaneous fluoroscopic-guided gastrostomy and laparoscopic and/or laparoscopic-assisted percutaneous endoscopic gastrostomy. PEG in a pediatric population was first described in 1980 by Gauderer et al. [1] as an alternative to the open surgical gastrostomy. The use of PEG has significantly grown since the introduction of the technique. Although the indications for PEG in children have expanded since its inception, there are common and unique complications associated with PEG compared to other methods of gastrostomy, including dislodgement, migration, "buried bumper syndrome", colonic or liver injuries, as well as endoscopic complications such as esophageal tear.

Several pediatric studies have evaluated the safety of PEG with mixed results [2–25]. These studies examined the safety of PEG itself as well as PEG in comparison to other methods of gastrostomy, including open, laparoscopic, and fluoroscopic gastrostomy tube placement. To date, however, no study has compared the safety of PEG to other methods of gastrostomy tube placement, specifically among infants. Infants are a unique subpopulation, given not only their smaller frame and delicate tissues, but also in view of their feeble physiologic reserve when challenged by the physical stress of surgery or endoscopy. The type and frequency of major complications in infants may be different from those of older children or adults. Compared to older children or adults, small infants may be at increased risk of esophageal mucosal injury during PEG.

The purpose of this study was to evaluate the safety of PEG in comparison to surgical gastrostomy tube placement in infants. We hypothesized that among infants, PEG tube placement would have higher complication rates compared to surgical gastrostomy tube placement.

1. Materials and methods

This is a retrospective study utilizing the 2012 version of Kids' Inpatient Database (KID). KID is a national pediatric inpatient database

Abbreviations: PEG, percutaneous endoscopic gastrostomy; OR, odds ratio; CI, confidence interval; KID, Kids' Inpatient Database; ICD, International Classification of Diseases; CCC, complex chronic condition; APRDRG, All Patient Refined Diagnosis Related Groups; SOI, severity of illness; ROM, risk of mortality.

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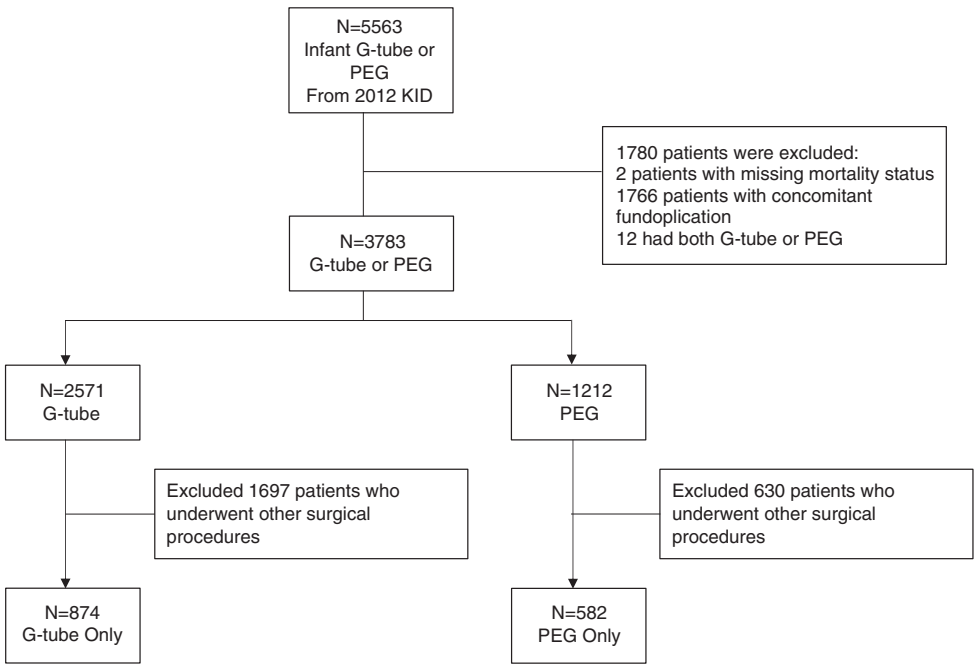
http://dx.doi.org/10.1016/j.jpedsurg.2017.01.008
0022-3468/

developed by the Healthcare Cost and Utilization Project (HCUP). The database contains discharge abstracts from pediatric (age 21 years or younger on admission) inpatient community care centers. Information contained in the discharge abstracts includes demographics, admission type, diagnostic/procedural International Classification of Diseases 9th Revision (ICD-9) codes, length of stay, disposition, payer data, and total charges. The KID 2012 database we used incorporates data from 2009 to 2012 and contains data on up to 7.5 million weighted cases. The study was approved by the institutional review board at Arrowhead Regional Medical Center.

All infants (before the first birthday) who underwent either surgical gastrostomy (G-tube, International Classification of Diseases-9 [ICD-9]: 43.19) or PEG (ICD-9: 43.11) were identified. To control for potential confounders, we excluded patients who underwent concomitant fundoplication procedure (ICD-9: 43.66 open, 43.67 laparoscopic) at the time of gastrostomy, or any other surgical procedures any time during the same admission. We also excluded those who underwent both PEG and G-tube placement during the same admission. Also those with missing mortality data were excluded from the study (Fig. 1). An exception to the exclusion criteria, the following abdominal procedures that may represent complications to gastrostomy requiring surgical intervention were included: exploratory laparotomy, reopening of recent laparotomy site, reclosure of postoperative disruption of abdominal wall, delayed closure of granulating abdominal wound, revision of gastric anastomosis or repair of stomach, incision of abdominal wall, excision or destruction of lesion or tissue of abdominal wall/peritoneal tissue, control of hemorrhage, and suture repair of stomach laceration. These events were considered "reoperations". Demographic and patient variables included age (neonate vs non-neonate), gender, race, presence of neurological impairment, prematurity (ICD-9765.21–28), complex chronic condition (CCC), 3 M™ All Patient Refined Diagnosis Related Groups (3 M™ APRDRG) severity of illness and risk of mortality subclasses. Neurological impairment was defined by grouping ICD-9 codes defined by literature [26]. CCC has been defined as "any medical condition that can be reasonably expected to last at least 12 months and to involve either several different organ systems or 1 organ system severely enough to require specialty pediatric care and probably some period of hospitalization in a tertiary care center" [27,28]. We used the latest version of the CCC system (v 2.0) which distinguishes CCC by groups of ICD-9 codes [27]. Severity of illness (SOI) and risk of mortality (ROM) are assigned by the 3 M™ APRDRG software, which incorporates the patients' primary and secondary diagnoses, identifies potential interactions between diagnoses. The APRDRG SOI measures the extent of system breakdown or organ dysfunction, whereas the ROM estimates the likelihood of dying. The 3 M™ APRDRG software has become one of the most universally used systems for SOI and ROM adjustment. In 2006, the Centers for Medicare and Medicaid Services recommended using APRDRGs as the primary predictor of resource use [29]. Both subclasses (SOI and ROM) have four levels: 1 (mild), 2 (moderate), 3 (major), and 4 (extreme), indicating increasing disease severity as well as their associated interactions.

Outcome measures evaluated were postoperative complications, reoperations, and in-hospital mortality. Complications were identified by the ICD-9 diagnostic codes for postoperative neurologic, cardiac, pulmonary, urinary, gastrointestinal, infectious, bleeding, and wound complications as well as intraoperative injury and postoperative shock. Of these complications, postoperative shock, respiratory/cardiac failure, intraoperative injury, and gastrostomy complications were further categorized as major complications, while the remainder were considered minor complications. Reoperations were identified by ICD-9 procedure codes. Univariate and multivariate analyses were performed. The subgroup of neonates was also analyzed. Forest plots were created based on the odds ratios favoring G-tube or PEG and the 95% confidence intervals. All statistical analyses were conducted using the SAS software for Windows version 9.3 (Cary, North Carolina, CA). Descriptive statistics were presented as frequencies and proportions for categorical variables. Crosstab chi-square analyses were conducted to identify variables associated with patients who experienced infectious or surgical complications, reoperations, or mortality. Baseline variables with $p < 0.1$ in univariate analysis were included in the multivariate models. Survey weight and stratum were utilized to account for sampling bias. The selection of variables was conducted in a stepwise manner. All statistical analyses were two-sided. p-Value <0.05 was considered to be statistically significant.



G-tube, Gastrostomy tube; PEG, Percutaneous Endoscopic Gastrostomy

Fig. 1. Patient selection. G-tube, gastrostomy tube; PEG, percutaneous endoscopic gastrostomy.