# Oral Feeding Reduces Hospitalizations Compared with Gastrostomy Feeding in Infants and Children Who Aspirate

Maireade E. McSweeney, MD, MPH[1], Jessica Kerr, MPH[1], Janine Amirault, BA[1], Paul D. Mitchell, MS[2], Kara Larson, SLP[1], and Rachel Rosen, MD, MPH[1]

**Objective** To compare the frequency of hospitalization rates between patients with aspiration treated with gastrostomy vs those fed oral thickened liquids.

**Study design** A retrospective review was performed of patients with an abnormal videofluoroscopic swallow study between February 2006 and August 2013; 114 patients at Boston Children's Hospital were included. Frequency, length, and type of hospitalizations within 1 year of abnormal swallow study or gastrostomy tube (g-tube) placement were analyzed using a negative binomial regression model.

**Results** Patients fed by g-tube had a median of 2 (IQR 1, 3) admissions per year compared with patients fed orally who had a 1 (IQR 0, 1) admissions per year, $P < .0001$. Patients fed by gastrostomy were hospitalized for more days (median 24 [IQR 6, 53] days) vs patients fed orally (median 2 [IQR 1, 4] days, [$P < .001$]). Despite the potential risk of feeding patients orally, no differences in total pulmonary admissions (incidence rate ratio 1.65; 95% CI [0.70, 3.84]) between the 2 groups were found, except patients fed by g-tube had 2.58 times (95% CI [1.02, 6.49]) more urgent pulmonary admissions.

**Conclusions** Patients who underwent g-tube placement for the treatment of aspiration had 2 times as many admissions compared with patients with aspiration who were fed orally. We recommend a trial of oral feeding in all children cleared to take nectar or honey thickened liquids prior to g-tube placement. *(J Pediatr 2016;170:79-84)*.

Aspiration during swallowing is a common diagnosis in infants and children with and without developmental delay.[1-7] Management approaches have included gastrostomy tube (g-tube) feeding, g-tube feeding with concurrent antireflux surgery (fundoplication), transpyloric feeding, and oral feeding with thickening of liquids. G-tubes are frequently used in order to allow for additional enteral access in patients with aspiration, including those thought to be at risk of having respiratory complications.[8-11] Prior data have suggested that for children with neurologic disability, g-tube placement may improve respiratory outcomes, including decreased antibiotic use and respiratory related hospitalizations.[12] Conversely, additional studies have shown that once placed, g-tubes are often fraught with complications, ranging from the minor (tube leakage, skin irritation, or formation of granulation tissue formation) to the more severe (worsening gastroesophageal reflux disease, g-tube cellulitis, or g-tube dislodgement).[10,13-15] To date, there have been no studies comparing clinical outcomes in aspirating children treated with oral thickened liquids to those treated with g-tube placement.[12]

Since the development of aerodigestive centers in which patients are seen by gastroenterologists and pulmonologists together along with other subspecialties (eg, feeding therapy, otolaryngology), there has been a practice shift at many institutions away from g-tube placement and more toward continuing to feed children with aspiration orally with close combined gastroenterology, feeding team, and pulmonary follow-up. This shift has occurred in an effort to prevent feeding aversions and the complications surrounding g-tubes. Yet, there are no data comparing outcomes of these patients undergoing continued oral feeding vs g-tube placement. Before 2010, it was common practice at Boston Children's Hospital (BCH) to place g-tubes in patients who had aspiration confirmed by videofluoroscopic swallow study (VFSS). Prior data from our institution suggested that almost one-third of all patients undergoing primary percutaneous endoscopic g-tube placement had a preoperative diagnosis of aspiration.[9,16] After 2010, many children with aspiration continued to be fed orally with thickened liquids rather than by g-tube.

The primary aim of this study was to compare the frequency of hospitalizations between patients with aspiration who were treated with g-tube placement vs those who were maintained on exclusive oral thickened feedings.

| | |
|---|---|
| BCH | Boston Children's Hospital |
| g-tube | Gastrostomy tube |
| IRR | Incidence rate ratio |
| VFSS | Videofluoroscopic swallow study |

From the [1]Aerodigestive Center, Center for Motility and Functional Gastrointestinal Disorders, Division of Gastroenterology, Hepatology and Nutrition; and [2]Clinical Research Center, Boston Children's Hospital, Boston, MA

Funded by the Boston Children's Hospital Translational Research Program, the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition/AstraZeneca Grant for Diseases of the Upper Gastrointestinal Tract, and National Institutes of Health National Institute of Diabetes and Digestive and Kidney Diseases (R01 DK097112-01A1). The authors declare no conflicts of interest.



http://dx.doi.org/10.1016/j.jpeds.2015.11.028

## Methods

Institutional approval was granted to complete a retrospective chart review of patients with an abnormal VFSS at BCH between February 2006 and August 2013. Queries of hospital administrative data using Epic (v 2008; Epic Systems Corporation, Verona, Wisconsin) was performed to identify patients with a documented history of aspiration undergoing primary percutaneous endoscopic g-tube placement; additional reviews of an ambulatory BCH Aerodigestive Clinic administrative list were used to identify patients with documented aspiration treated with oral thickened feeds.

All included patients had evidence of documented aspiration or penetration of thin liquids and/or nectar thick liquids via a VFSS. Any patient who had an unknown level of aspiration or aspirated all textures (thin, nectar, honey-thick, or pureed foods) were excluded. Enrolled patients were then divided into 2 groups: (1) patients who underwent g-tube placement without any preoperative documentation of an oral thickening feeding trial (g-tube group); or (2) patients who were continued on exclusive oral feeding with thickening agents (oral group). Any patients fed orally who subsequently required g-tube feedings were excluded from the primary analysis but were reanalyzed as a part of the oral group as a secondary analysis. We excluded any patients fed by g-tube who went on to require post-pyloric feedings or fundoplication because in both of these cases, not only was oropharyngeal dysphagia treated but so was gastroesophageal reflux so clarifying the treatment effect of oropharyngeal dysphagia alone would not have been possible. All patients fed orally were treated with standardized thickening recipes using either infant cereal or xanthan gum.

Our primary outcome was defined as the total number of hospitalizations within 1 year of g-tube placement (for the g-tube fed group) or within 1 year of the first abnormal VFSS (for the oral group). Secondary outcomes included total number of inpatient days, frequency of subsequent pulmonary, gastroenterology, or other types of admissions, as well as whether or not the hospitalization was elective or urgent within 1 year of their index event (either the placement of a g-tube or first abnormal VFSS). Urgent admissions were defined as any unplanned admission or admissions admitted through the emergency department. We also examined the number of patients who underwent a repeat VFSS within 1 year of their initial study (for oral group), or within 1 year of g-tube placement (for the g-tube group), as well as the frequency of normal repeat VFSS results. We also reviewed the patient characteristics of a subset of excluded patients fed orally who went on to require g-tube feedings.

Patient records were reviewed for sex, age, and weight at the time of their first abnormal VFSS. Patient comorbidities were categorized as being neurologic, cardiac, gastrointestinal, pulmonary, oropharyngeal, renal, metabolic/genetic, immunologic, or having a history of premature birth (<37 weeks gestation). Comorbidities were not considered to be mutually exclusive. Extent and type of aspiration on VFSS were also recorded for all patients.

Patient characteristics for the g-tube group were compared with the oral group using both parametric and nonparametric methods as appropriate. Pearson $\chi^2$ test was used for cross-tabulations unless any expected cell-count was <5, in which case Fisher exact test was used. Student $t$ test was used for continuous variables when normally distributed and the Wilcoxon rank-sum test otherwise.

A generalized linear model was used to adjust for subject characteristics, including neurologic, cardiac, and pulmonary comorbidities, as well as sex, age, and weight-for-age z-score. The primary and secondary outcomes, including number of hospitalization admissions as well as inpatient days among those hospitalized, were highly right-skewed, and the data were over dispersed. Therefore, a negative binomial regression provided a better fit than a Poisson regression model, based on visual inspection of the regression curve overlaid on a plot of the mean predicted probability against the observed counts and the Akaike information criterion.[17,18] Outcomes were modeled using SAS v 9.3 (SAS Institute, Cary, North Carolina). Results were expressed on a multiplicative scale as the ratio of mean outcome in the g-tube group to mean outcome in the oral group (incidence rate ratio [IRR]) with a 95% CI.[19] An additional propensity score regression analysis was performed to include a propensity score to adjust for differences in the 2 populations. All statistical tests were 2-sided with a $P$ value of <.05 considered statistically significant.

## Results

A total of 114 patients were included in the analysis, 49 patients who were exclusively fed oral thickened feeds (oral group) and 65 patients who received a g-tube (g-tube group). Differences in subject characteristics at the time of study entry are shown in **Table I**. Patients did not differ statistically by sex, ethnicity, race, or prematurity status at the time of their first abnormal VFSS, but subjects in the g-tube group were lower in weight ($P$ = .0003) and age ($P$ = .003) than those in the oral group. There was no difference in the prevalence of gastrointestinal comorbidities, but patients fed by g-tube were more likely to have cardiac, neurologic, metabolic, and renal comorbidities, and patients fed orally were more likely to have pulmonary and otolaryngology comorbidities.

Aspiration of thin liquids alone was more prevalent among patients fed orally fed vs patients fed by g-tubes (36 [73%] vs 25 [38%], respectively; $P$ < .001) on the initial VFSS. Eighty (71%) patients, 32 fed orally and 49 fed by g-tubes, underwent a repeat VFSS within a year. Of those patients who underwent repeat swallow studies, 6/32 (19%) patients fed orally vs 21/49 (43%) patients fed by g-tubes, had a subsequent normal VFSS ($P$ = .02).

Unadjusted results for total hospitalizations and inpatient days within 1 year of the first abnormal VFSS for the oral fed vs g-tube fed groups are shown in **Table II**. Median (IQR)