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Original article

A retrospective review of enteral nutrition support practices at a tertiary pediatric hospital: A comparison of prolonged nasogastric and gastrostomy tube feeding

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SUMMARY

Background & aims: Despite the frequent use of tube-mediated enteral feeding, there is little evidence clarifying best practices pertaining to prolonged nasogastric and gastrostomy tube use in children. At the Montreal Children's Hospital, tube feeding practices are non-standardized and highly variable, with many patients remaining on protracted nasogastric feeds. We aimed to characterize enteral nutrition practices at our institution and to compare prolonged nasogastric and gastrostomy tube use, hypothesizing that earlier gastrostomy improves outcomes, particularly the development of food refusal.

Methods: In this retrospective cohort study, we reviewed the charts of children beginning long-term (>3 months) nasogastric or gastrostomy feeds at our institution between January 2007 and December 2011, with follow-up until May 2013. Patient demographics, anthropometric parameters, swallowing assessment, tube feeding duration and complications were recorded.

Results: Among 166 patients, the median total tube feeding duration was 24.9 (3.0–75.6) months and varied with underlying disease and swallowing assessment. The median duration of nasogastric tube use was 7.8 (0.7–45.3) months. Food refusal was significantly associated with nasogastric tube exposure >3 months (RR 3.3, $p < 0.001$, NNT = 3) and anthropometric outcomes were superior in gastrostomy-fed patients. Rates of aspiration pneumonia were similar in both groups. Despite more initial opposition to gastrostomy and a higher complication rate, gastrostomy users appeared more satisfied with their experience, as demonstrated by a much lower discontinuation rate than observed in the nasogastric group.

Conclusions: Prolonged nasogastric feeding is common at our institution. Its association with increased food refusal and less favorable anthropometric outcomes may warrant earlier gastrostomy placement.

1. Introduction

Malnutrition is common in children, especially in the inpatient setting, where malnutrition prevalence has been found to range from 4 to 30%, with infants and toddlers representing a particularly vulnerable subgroup [1–8]. Malnutrition is associated with substantial morbidity and mortality [9], having been shown, for example, to prolong hospitalization when moderate or severe [1]. When malnutrition is identified, the most appropriate method of nutritional support is not always immediately apparent and depends on several factors, such as anticipated duration, underlying diagnosis, patient age, anatomic considerations, gut function, feasibility and cost [10]. Enteral nutrition support (ENS), the use of dietary foods for special medical purposes, regardless of the route of administration [11], is indicated in patients with at least partial gut function, in whom oral intake is insufficient to satisfy energy and nutrient needs. It is often delivered via nasogastric (NG) or gastrostomy (GT) tube, but tubes terminating in the small bowel rather than the stomach are sometimes used as well; these include nasoduodenal (ND) or nasojejunal (NJ) tubes, and gastrojejunostomy (GJ) tubes. Both NG and GT tubes are associated with their respective advantages and drawbacks; while NG tubes are

Abbreviations: BMI, body mass index; ENS, enteral nutrition support; GJ, gastrojejunostomy; GERD, gastroesophageal reflux disease; GT, gastrostomy; MCH, Montreal Children's Hospital; ND, nasoduodenal; NG, nasogastric; NJ, nasojejunal; NNT, number needed to treat; OT, occupational therapy; SGS, short gut syndrome.

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easy to insert, they may be misplaced or become dislodged or obstructed and, while GT tubes offer greater stability, they are more invasive to place and may be associated with wound infection, leakage and gastrocutaneous fistula [10]. Both, in the long-term, may be associated with the development of oral feeding difficulties [10]. In fact, in a recent assessment of a rapid home-based tube feeding weaning program, all but one of the 39 children referred exhibited daily food refusal [12].

Gastrostomy tube placement is indicated when long-term ENS is anticipated, with the definition of *long-term* ranging from 4 to 12 weeks depending on the guideline. [10,13–16] There is little evidence comparing outcomes between prolonged NG and GT tube use in children. In adults, however, a Cochrane review addressing this question found that percutaneous gastrostomy was associated with significantly less intervention failure than NG tube (RR 0.24) with no statistically significant difference in complications [17]. At our institution, tube feeding practices are non-standardized and highly variable, with many patients remaining on protracted NG feeds, including at home. We hypothesized that earlier GT placement improves patient outcomes, particularly the development of oral feeding difficulties, as already supported by existing evidence, including the review by Avitsland et al., in which child and parent satisfaction, as well as various objective outcomes, were significantly improved after gastrostomy in a group of 58 children, 76% of whom had had a prior nasogastric tube [18].

2. Materials and methods

2.1. Study setting and participants

This single-center retrospective cohort study was conducted at the Montreal Children's Hospital (MCH), a tertiary pediatric 100-bed center affiliated with McGill University. We included all children (<18 years) beginning long-term (defined here as >3 months) tube feeding between January 1, 2007 and December 31, 2011, whether via NG/ND/NJ or GT/GJ tube, with the latter group encompassing tubes placed by all manners of insertion, including laparoscopy (by far the most common in our population), laparotomy and percutaneous endoscopic gastrostomy, with or without fundoplication. There were no exclusion criteria. Patients were identified from a registry of children enrolled in the Home Enteral Feeding Program. Data was collected from patient charts and electronic medical records, with follow-up until May 2013. Ethics approval was obtained from the institution's ethics committee prior to study commencement.

2.2. Variables and definitions

Baseline variables recorded were patient demographics (gender, date of birth, gestational age and birth weight), underlying disease (see below for classification), ENS route used, age and anthropometric parameters (weight and height) at baseline, duration of NG feeds prior to GT placement (if applicable), occupational therapy (OT) video fluoroscopic swallowing assessment (if available), presence or absence of gastroesophageal reflux disease (GERD) and patient/caregiver perception of tube feeding prior to intervention (if available). Outcomes assessed were total tube feeding duration, NG and/or GT feeding duration, ENS complications (device-related issues, aspiration pneumonia, food refusal) and anthropometric parameters at 6 months, 1 year and ENS termination or end of follow-up. When available, documentation of user/caregiver satisfaction was reviewed and compared between groups.

Patients were categorized into one of three intervention groups: *NG only*, if they did not undergo GT insertion; *GT only*, if they received no or very brief NG feeds (≤1 week while awaiting GT); or *NG followed by GT*, if they transitioned to GT after at least one week of NG feeds.

Underlying diseases were divided into the following categories: neurologic/genetic; prematurity; short gut syndrome (SGS); digestive, other than SGS (inflammatory bowel disease, dysmotility, food allergy, esophageal atresia); malignancy; upper airway anomalies; respiratory diseases; inborn errors of metabolism; renal; other (congenital diaphragmatic hernia, chylothorax, myocarditis, congenital cardiac disease, congenital hypopituitarism, immunodeficiency).

Video fluoroscopic swallowing assessment was graded on a scale from 1 to 4 as follows: 1 – normal; 2 – no aspiration, but not entirely normal (i.e. pooling, penetration.); 3 – aspiration with some, but not all, consistencies; 4 – aspiration/unsafe for oral feeding with all consistencies.

Patients were considered to have GERD at baseline if they demonstrated compatible clinical symptoms resulting in prescription of antacid treatment (H2-blockers or proton pump inhibitors) by a physician. pH probe testing was not included in the definition as it is performed infrequently at the MCH. *Food refusal* was defined fairly broadly, as either a documented clinically significant limitation in oral intake or oral hypersensitivity as per occupational therapy assessment. Early and late complications were defined as those occurring within and after 14 days of tube insertion, respectively. Major complications were defined as those necessitating a surgical intervention and minor complications as those requiring a hospital visit or causing substantial user or caregiver distress. Wound infection was defined by the requirement for oral antibiotics or drainage, and gastrocutaneous fistula by the need for surgical closure. Patients were deemed to have had aspiration pneumonia if the term *aspiration pneumonia* was documented during a hospital visit with prescription of appropriate antibiotic treatment. Patients were considered *wasted* if BMI-for-age (in patients older than 2 years) or weight-for-age (in patients younger than 2 years, or between 2 and 10 years if height was unavailable) was below the 3rd percentile according to standard cut-off values [19].

2.3. Statistical analysis

ENS durations and ages were expressed as medians with ranges. Complications were quantified as number of hospital visits per 1000 NG and GT days. BMI-for-age and weight-for-age percentiles were calculated with *AnthroPlus* (WHO, version 3.2.2, January 2011), using corrected ages for patients born prematurely (<37 weeks). ENS durations were considered both generally for the entire cohort and on a subgroup basis, according to underlying disease and video fluoroscopy swallowing assessment. Comparative statistics were calculated using the Fisher's exact test, two-proportion *Z*-test or student *t*-test as appropriate. Results were expressed as relative risks and numbers needed to treat (NNT) with 95% confidence intervals and significance was defined as $p < 0.05$.

3. Results

3.1. General findings

166 children met inclusion criteria. Of these, 49 belonged to the *NG only* group, 28 to the *GT only* group and 89 to the *NG followed by GT* group. Overall, 138 children received nasoenteric feeds (133 NG, 5 ND/NJ) and 117 children underwent enterostomy (109 GT, 8 GJ) at some point during the study period. 29 of the gastrostomies (25%) were performed with simultaneous fundoplication. No patient underwent fundoplication subsequent to gastrostomy. The precise study population composition and losses to follow-up are indicated