



Analysis of risk factors contributing to morbidity from gastrojejunostomy feeding tubes in children[☆]



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ABSTRACT

Purpose: The purpose of this study was to define morbidity from gastrojejunostomy tube (GJT) placement in children. **Methods:** A retrospective single-center 5-year review of GJT placement in children was performed. Age, weight, prior surgery, indication, type of GJT, and complications (GJT replacement, wound complications, and perforation) were recorded. Logistic regression for morbidity was performed.

Results: 142 children underwent 394 GJT placements at a median age of 2.7 years (range 5 weeks–18 years). The most common indications were failure to thrive (62%) and reflux (25%). Among the 296 GJT replacements, the most common reason was tube dislodgement (30%). Risk factors for replacement, which occurred at a median interval of 12 weeks (range 2 days–2.4 years), were peristomal complaint (OR = 5.4, $p = 0.02$) and prior GJT replacement (OR = 1.8, $p = 0.03$). In all, 7 (5%) jejunal perforations occurred at a median of 3 days (range 0–21 days) from GJT placement. Patients with perforation had a median weight of 4.6 kg (range 3–11.2 kg) and age of 3.9 months (range 8 weeks–2.1 years). Lower weight ($p < 0.01$) and younger age ($p = 0.02$) predicted perforation, with those weighing less than 6 kg (OR = 51.9, $p < 0.001$) or younger than 6 months (OR = 28.6, $p < 0.01$) at highest risk.

Conclusions: GJT placement has a significant risk of recurrent dislodgement and the highest risk of perforation in children weighing less than 6 kg or younger than 6 months. Alternate feeding options should be strongly considered in this vulnerable population.

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Gastrojejunostomy tube (GJT) placement is a commonly performed procedure for providing enteral nutrition in children [1]. It is indicated for patients who require enteric feeding but have gastric feeding intolerance, such as in patients with gastroparesis, gastroesophageal reflux disease (GERD), history of aspiration, or microgastria [2,3]. Since its advent in 1984 [4,5], the GJT has become used as an alternative to fundoplication for children with GERD, and has become a means of providing postpyloric feeding for both the short- and long-term [6–8].

Despite the widespread use of feeding via GJT, a paucity of data exists regarding long-term morbidity. Retrospective studies have described complications including the need for tube replacement, peristomal granulation or leakage, recurrent GERD symptoms, intestinal perforation, and death [9–11]. The most frequent complication reported is the need for GJT replacement, which is required in more than 90% of patients in some series [6]. Indications for GJT replacement include mechanical failure (i.e. tube fracture or balloon rupture), tube obstruction/clog, or tube displacement (i.e. complete removal or jejunal extension malposition) [8]. The more serious complication of jejunal perforation

has been reported in up to 6% of cases [12]. Characterized by erosion of the jejunal extension tip through the intestinal wall in case reports, this complication has resulted in death [13,14]. The patient-related or tube-related risk factors for the development of GJT-related complications are incompletely understood.

The aims of this study were 1) to define the incidence of GJT complications and 2) to identify patient or tube-related risk factors for the need for GJT replacement or the development of intestinal perforation. Based on our clinical experience, we hypothesized that younger children would have higher rates of complications. These findings may influence tube design and patient selection and/or clinical practice approaches to decrease the morbidity associated with this procedure.

1. Methods

1.1. Study design

This is a single-center retrospective study of pediatric patients (up to 18 years of age), who underwent GJT placement between January, 2008 and December, 2013. The study was approved by the University of Michigan institutional review board (IRB no. HUM00088909). Data collected included patient age, gestational age, history of prematurity, weight, sex, history of abdominal surgery, indication for GJT placement,

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tube dimensions (length, diameter, and profile [low-profile 'button' versus tube]), interval since prior tube placement, and types of complications, including need for GJT replacement, wound complication, bowel perforation, and death within 60 days of each procedure. The time from the last GJT placement to each complication was also recorded. GJT replacement was defined as a placement of a new GJT via an existing gastrostomy tract, either in the operating room or in the interventional radiology suite. A secondary analysis was performed of cases where intestinal perforation occurred. This included an investigation of clinical presentation of the perforation, time to diagnosis after GJT placement, anatomic location of the perforation, and clinical outcome.

1.2. Inclusion criteria

Patients younger than 18 years who underwent GJT placement were included. Procedures included initial GJT placement, exchange of G-tube to a GJT, exchange of GJT to low-profile GJT, and GJT replacement. Patients with transanastomotic feeding tubes (i.e. across a gastrojejunostomy) were excluded.

1.3. Techniques

GJTs were placed via open laparotomy, endoscope-assisted, laparoscopic, and fluoroscopic-only techniques. Open, endoscopic, and laparoscopic techniques included the use of intraoperative fluoroscopy, while fluoroscopic replacement involved the use of a guidewire and fluoroscopy only. Tubes from two manufacturers were used—Kimberly-Clark, Inc. (Irving, TX) and Applied Medical Technology, Inc. (Brecksville, OH). Tube sizes were selected per surgeon discretion and GJT tip placement was distal to the third portion of the duodenum.

1.4. Statistical analysis

Univariate logistic regression analysis was first performed to screen all analyzed variables as possible predictors of requiring GJT replacement. All nonsignificant variables were eliminated, using a cutoff of $p < 0.1$ for inclusion in multivariate analysis. Multivariate logistic regression analysis was then performed using remaining variables to identify significant predictors of GJT replacement. Analysis of risk factors for perforation was similarly performed using logistic regression. $P < 0.05$ was considered significant. Statistical analysis was performed using SPSS Statistics 19.0 (IBM Corp, Armonk, NY). Data are expressed as mean \pm standard deviation (SD), with OR = odds ratio of logistic regression models.

2. Results

2.1. Patient characteristics

A total of 142 patients were identified who underwent GJT placement during the study period, with a mean follow-up of 48 ± 58 weeks (range 1 week–5.0 years). A total of 394 GJT placements occurred among these patients, with a median age at operation of 2.7 years (range 5 weeks–18 years; Table 1A). Indications for GJT placement included failure to thrive with intolerance to gastric feeding ($n = 245$, 62%), gastroesophageal reflux ($n = 100$, 25%), aspiration ($n = 8$, 2%), and dysphagia ($n = 5$, 1%). Patient comorbidities included neurologic impairment in 45% of patients, while 18% had congenital cardiac disease, and 15% had cancer. Prior antireflux operation has been performed on 39 (27%) patients. Primary GJT placement (via a new gastrostomy) was performed in 25 patients, while 73 exchanges were performed from a prior G-tube to a GJT. Endoscope-assisted technique was used most frequently for primary placement, exchange, and replacement. Endoscope-assisted technique was used most frequently for primary placement, exchange, and replacement.

2.2. GJT replacements

Of the 394 GJT procedures during the study period, 296 (75%) were GJT replacements. Indications for GJT replacement included complete tube dislodgement (30%), jejunal extension malposition (14%), clog (13%), tube fracture (12%), and balloon rupture (10%). The median frequency of GJT replacement among all patients was 2 times per year (range 0–11 GJT replacements per year). The duration of each GJT prior to requiring replacement was 12 weeks (range 2 days–2.4 years).

Noting the high rate of GJT replacement, we then evaluated potential risk factors for requiring reoperation. Screened variables included patient age, weight, sex, history of abdominal surgery, indication for GJT placement, tube dimensions, interval since prior tube placement, and history of peristomal complaints (i.e. granulation tissue and/or leakage). On multivariate analysis, predictors of requiring GJT replacement were a history of peristomal complaint (OR = 5.4, $p = 0.02$) and history of previously requiring GJT replacement (OR = 1.8, $p = 0.03$; Table 2). The positive predictive value of requiring GJT replacement among patients with a history of peristomal complaint was 87%.

2.3. GJT-related intestinal perforations

A total of 7 GJT-related jejunal perforations occurred during the study period, reflecting 5% of patients and 1.8% of all GJT procedures. One of these patients died from subsequent sepsis. Further analysis of cases where perforation occurred revealed a potential for delayed diagnosis of up to 21 days postoperatively (median time to diagnosis 3 days). Characteristics of perforation cases are summarized in Table 1B. Of note, patients who suffered a perforation had a median weight of 4.6 kg (range 3.0–11.2 kg) with a median age of 17 weeks (range 8 weeks–2.1 years). Perforation was diagnosed early in 3 patients (either in the operating room or immediately postoperatively) via free air visible on post-placement X-ray, leading to immediate laparotomy. For the other 4 patients, delayed perforation was diagnosed with clinical decompensation leading to laparotomy. All cases of perforation occurred near the ligament of Treitz at the location of the tip of the jejunal extension of the GJT (Fig. 1).

Logistic regression analysis was then used to screen each variable as a predictor of GJT-related perforation. On univariate analysis, patient weight ($p < 0.01$) and age ($p = 0.02$) significantly predicted perforation. These were not independently significant on multivariate analysis. Scatter plot analysis was then performed to characterize the risk of GJT-related perforation by patient age and weight (Fig. 2). Patients weighing less than 6 kg (OR = 51.9, $p < 0.001$) and those younger than 6 months (OR = 28.6, $p < 0.01$) were significantly more likely to have a perforation than those above these cutoffs (Table 2). While the overall risk of perforation was 5%, those weighing less than 6 kg had a perforation risk of 13%, and those younger than 6 months had a 14% risk of perforation. Conversely, perforation occurred in 0.6% and 0.3% of children older than 6 months and weighing more than 6 kg, respectively.

3. Discussion

These findings demonstrate that, while the GJT may offer a viable route for postpyloric feeding in pediatric patients, it lacks long-term durability and confers a significant risk of perforation in younger patients. We found that 75% of patients required a return to the operating room for GJT replacement, with a median frequency of 2 replacements per year per patient. The patient factors that predicted more frequent GJT replacements included wound complications and prior GJT replacement — suggesting that certain patients were more prone to GJT trauma and subsequent peristomal granulation or leakage, with eventual tube dislodgement. Importantly, this study identified a cohort of patients — those weighing less than 6 kg or younger than 6 months — who were at substantially greater risk of suffering a GJT-related perforation.

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