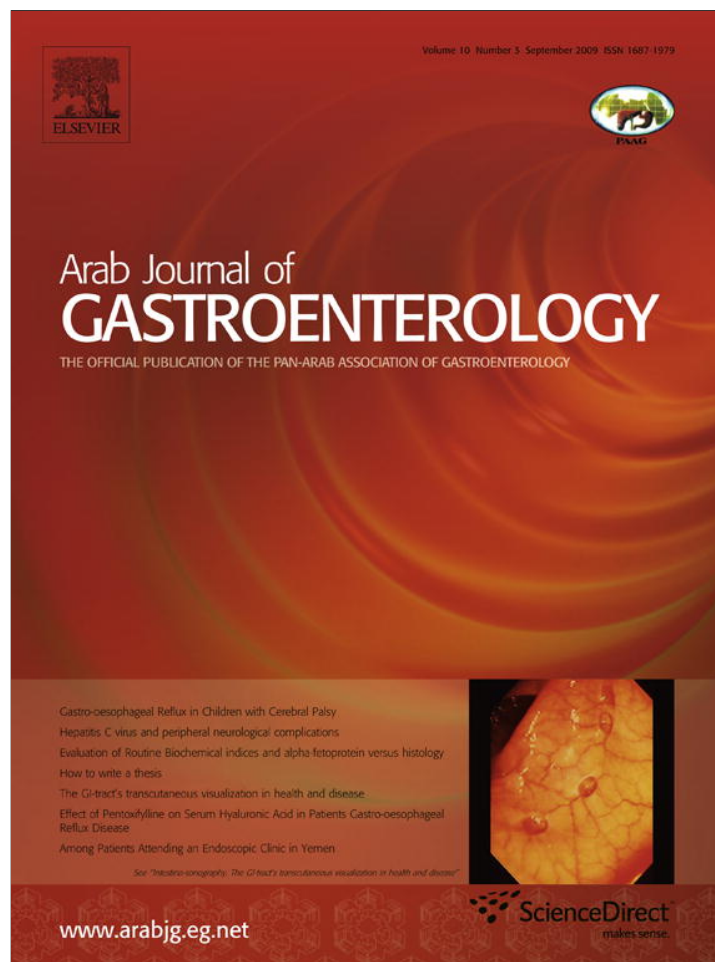


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Original Article

Gastro-oesophageal reflux in children with cerebral palsy after percutaneous endoscopic gastrostomy: Any predictors?

Omar I. Saadah *

Department of Pediatrics, Faculty of Medicine and King Abdulaziz University Hospital, King Abdulaziz University, P.O. Box 80215, Jeddah 21589, Saudi Arabia

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ABSTRACT

Background and study aims: Gastro-oesophageal reflux (GER) is common in children with cerebral palsy (CP). Such children often require percutaneous endoscopic gastrostomy (PEG) to alleviate feeding difficulty, yet GER may get worse following PEG. The aim of this study was to assess whether abnormal pH study and oesophagitis or delayed gastric emptying can predict worsening of GER after PEG.

Patients and methods: A chart review was conducted of 25 children with cerebral palsy (CP) who had PEG performed at King Abdulaziz University Hospital, Jeddah, Saudi Arabia between September 2001 and May 2007. Data collected included pre-procedure 24-h pH study, gastric emptying nuclear scan, and histopathology of the oesophageal biopsy obtained at the time of PEG placement. Clinical symptoms of GER and the need for fundoplication were also recorded.

Results: Twenty-five patients with severe CP (21 male; mean age 6.0 ± 5.3 years) were included. Thirteen (52%) had abnormal pH study. Six (24%) had delayed gastric emptying, and 10 (40%) had histological oesophagitis. Following PEG, 16 (64%) had persistent vomiting. Twelve were controlled with medical treatment. Four (16%) required fundoplication. There was no relation between abnormal pH study, delayed gastric emptying or oesophagitis and the development of persistent vomiting after PEG. There was no statistically significant difference between patients who required fundoplication and the remaining patients in either pH or gastric emptying study.

Conclusion: An abnormal pH study and oesophagitis or the presence of delayed gastric emptying before PEG placement in children with CP did not predict worsening of GER or the need for fundoplication after PEG.

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Introduction

A significant proportion of children with neurological impairment have feeding difficulties due to oropharyngeal incoordination [1,2]. As a consequence, malnutrition may develop following long-term decreased oral intake [3–5]. Gastro-oesophageal reflux (GER) is also common in such children, and contributes further to feeding difficulties [6–8]. The role of delayed gastric emptying (GE) in children with cerebral palsy (CP) and its relationship to GER is less well defined [8,9]. Percutaneous endoscopic gastrostomy (PEG) has been used extensively to provide long-term enteral nutrition in neurologically impaired children with an intact gastrointestinal tract who cannot eat because of abnormalities of the swallowing mechanism [10]. This procedure is safer and easier to administer than surgical gastrostomy. However, GER often increases following the procedure and may increase the risk of aspiration. It has been suggested that fundoplication and surgical gastrostomy may be a

better option for neurologically impaired children, yet the risk of anti-reflux procedure in this population is enormous. It is difficult to predict which patients will subsequently develop GER [11].

The aim of this study was to evaluate whether an extended pH probe investigation of the oesophagus before PEG or abnormal gastric emptying were useful in predicting later complications related to GER.

Patients and methods

The charts of all CP patients who underwent PEG from September 2001 to May 2007 at King Abdulaziz University Hospital, Jeddah, Saudi Arabia, were reviewed. The results of gastric emptying investigations performed prior to the PEG were retrieved. Data from pH probe studies before placement of the PEG tube, and the number of surgical anti-reflux procedures (Nissen fundoplication) after PEG was recorded. Prior to the placement of the PEG tube our routine is to start all patients on nasogastric tube feeding for about 4 weeks and assess their tolerance. Only patients who can tolerate their feeds and protect their airway would be candidates

* Tel.: +966 2 6408203; fax: +966 2 6408353.

E-mail address: saadah@hotmail.com

for PEG insertion. Others would be referred to the surgeon for primary fundoplication and surgical gastrostomy tube.

PEG was performed by a paediatric gastroenterologist assisted by a trained specialist using a modification of the technique described by Gauderer et al. [12]. In most cases BARD PEG kits (16 or 20 F) were used. The procedure was performed in an operating room under general anaesthesia. Multiple biopsies were routinely taken from the lower oesophagus. Biopsies were sent for histopathology report. Antibiotic prophylaxis (usually amoxicillin-calvuronic acid) was given to all patients before surgery and in the immediate postoperative period. Enteral feeding was started 24 h after the procedure.

pH Study

Twenty-four-hour oesophageal pH monitoring was performed by the author before PEG placement using a 2.1-mm pH catheter with two monocrystalline antimony electrodes (Medtronic Synectics, Shoreline, MN). The pH electrodes were calibrated at 37 °C in pH 7.0 and 1.0 buffer solutions (Medtronic Synectics), before and after each study. After calibration, the catheter was placed transnasally into the oesophagus. The exact position was determined by a normogram based on crown-rump length [13] and verified by chest radiograph. Data were analysed using Esophagram software (Medtronic Synectics). For infants under 1 year old, results were considered abnormal if the reflux index (percentage of time pH below 4) was more than 10% [14]. For patients more than 1 year old, pH probe results were considered abnormal if the reflux index was more than 5% [15]. All anti-reflux and antacid medications were stopped 48 h before the study and proton pump inhibitors seven days before the study. During pH monitoring, regular oral feedings or bolus feedings were given by nasogastric tube.

Nuclear medicine gastric emptying scan

All patients underwent nuclear medicine gastric emptying scan. Patients were fasted for 4 h before the test. Patients received a dose of 99mTc-calcium phytate added to 200 ml of milk. The test meal was taken orally or administered via a nasogastric tube. Gastric half-emptying time and the percentage of the ingested meal present within the stomach at 2 h were determined from the curve of the geometric means. Delayed gastric emptying was defined as a gastric half-emptying time >50 min or a residual gastric volume at 2 h post ingestion of radionuclide of >15%.

Statistical analysis

Statistical analysis was performed using the Stata Statistical Software (Release 6.0, College Station, TX). Data were expressed as mean \pm SD or as proportions of the total group. Fisher's exact test was used for testing the association of categorical variables. The non-parametric (rank-sum) test for comparison of skewed data was performed. A *p* value <0.05 was considered significant.

Results

Twenty-five patients with severe CP (21 male; mean age 6.0 \pm 5.3 years, range 1–21) were included. The characteristics of these patients can be seen in Table 1. The baseline mean weight for age z score (WAZ) was -2.46 ± 1.6 (range -4.9 to 1.86). Nineteen (75%) patients were underweight with WAZ < -2.0 at the time of the gastrostomy tube insertion (WAZ -3.2 ± 0.77 , range -4.9 to -2). All underwent oesophageal 24-h pH probe study before PEG. The results were abnormal in 13 (52%) patients.

Table 1

Clinical characteristics of 25 patients with cerebral palsy.

	Number	Percentage
<i>Etiology of cerebral palsy</i>		
Hypoxic ischemic encephalopathy	12	(48)
Idiopathic	9	(36)
Herpes simplex encephalitis	1	(4)
Prematurity	2	(8)
Cerebral hemorrhage	1	(4)
<i>Types of cerebral palsy</i>		
Spastic quadriplegia	21	(84)
Spastic diplegia	2	(8)
Hypotonic	3	(12)
Choreoathetotic	1	(4)

Six (24%) patients had an abnormal gastric emptying scan with a half-emptying time >50 min and a residual volume >15% at 2 h. Gastric half-emptying time and percentage radionuclide remaining at 2 h were 100% concordant (Fisher's exact, *p* < 0.0001); that is, all patients with abnormal GE were detected by both criteria.

Histological oesophagitis was diagnosed in 10 of 25 (40%) patients who underwent PEG and biopsy. Abnormal pH monitoring was closely associated with presence of oesophagitis (Fisher's exact, *p* = 0.05).

Following PEG placement, patients were fed different types of formulas, with 23 fed polymeric and 2 fed elemental formulas. The mean caloric intake was 68.8 ± 38.8 kcal/kg/day. All except 2 were on bolus feeding. There was significant weight gain (*n* = 25) at 3 months and 6 months following insertion of the gastrostomy (delta WAZ 0.33 ± 0.59 , 95% CI 0.14–0.56, *p* = 0.005 and 0.64 ± 0.74 , 95% CI 0.35–0.93, *p* < 0.001, respectively). Sixteen (64%) patients had clinical reflux in the form of persistent vomiting. Twelve were controlled with medical treatment using proton pump inhibitors and domperidone. Four (16%) required fundoplication. Fundoplication was performed 5–60 months after PEG.

There was no relation between abnormal 24-h pH study, delayed gastric emptying or histological oesophagitis and the development of persistent vomiting (Table 2).

Table 2

Predictability for increased vomiting after gastrostomy tube feeding.

Parameters	Number of patients (% of abnormal)	Odds ratio	95% confidence interval	<i>p</i> Value
Gastric emptying	25 (24%)	2.33	0.36–15	0.37
GER*	25 (52%)	0.71	0.14–3.6	0.68
Esophagitis	25 (40%)	1.29	0.26–6.3	0.76

* GER, gastro-oesophageal reflux.

Table 3

Differences between Pre PEG Gastric emptying and 24-h pH robe indices in CP children according to the requirement for fundoplication.

Parameters	Fundoplication <i>n</i> = 4	No fundoplication <i>n</i> = 21	<i>p</i> Value*
<i>Gastric emptying</i>			
GE half time (minutes)	36.7 \pm 23.3	32.8 \pm 21.5	0.65
Residual volume (%)	11.2 \pm 12	9.4 \pm 12	0.69
<i>pH monitoring</i>			
Reflux episodes/24 h	33 \pm 19.5	40 \pm 27	0.5
Fractional reflux time (FRT) (%)	11.8 \pm 11.5	4.3 \pm 2.8	0.14
Total time pH < 4 (minutes)	154 \pm 150	60 \pm 40	0.1

* Non parametric rank sum test.

No statistically significant difference was seen between patients who required fundoplication and the remaining patients in either 24-h pH study or gastric emptying. (Table 3).

Discussion

Dysphagia is common in children with severe CP, and can lead to severe malnutrition [2]. In this series, nineteen (75%) patients were underweight with WAZ <−2.0 at the time of the gastrostomy tube insertion. This indicates that significant proportion of our CP patients had difficulty feeding, leading to longer mealtime durations and increased choking episodes with a risk of aspiration during feeding. This subsequently affects their nutrient intake. The introduction of gastrostomy tube feeding in children with CP has contributed to an overall improvement in nutritional status in these patients [16,17]. It has also improved quality of life, not only for the child but also the family [16]. Heine et al. [17] have reported a reduction in the feeding time, feed related choking episodes, frequency of chest infections as well as a significant alleviation of family stress after gastrostomy placement in a group of children with severe neurological impairment. The impact of PEG in the nutritional status of our patients can be seen in the significant weight gain recorded at 3 and 6 months during the follow up after PEG placement.

Abnormal GER is a common problem in neurologically impaired children [6,7]. Whether PEG aggravates GER is controversial. It has been suggested that symptomatic GER occurs frequently after PEG [18]. The need for surgical anti-reflux procedures is an indicator for worsening GER after PEG. Gauderer [19] have reported a subsequent surgical intervention for GER of 13%. Thirteen (75%) of our patients had abnormal 24-h pH study before PEG placement, but only 16% had GER symptoms of such severity that an anti-reflux procedure was performed. The correlation between oesophageal pH monitoring before PEG and the requirement for fundoplication after PEG is not clear in the paediatric literature. Six of the 10 patients reported by Grunow et al. [20] with normal pH readings before PEG had abnormal pH probe results after PEG, and only one required fundoplication. Davidson et al. [21] reported oesophageal pH monitoring on 32 patients before PEG, of whom 21 had normal and 11 had abnormal results. Seven of their patients required later fundoplication. Fundoplication was required in three of nine patients reported by Jolley et al. [22] who had normal oesophageal pH readings and underwent PEG. Our result agrees with the reported literature. Although there was a trend for patients who required fundoplication to have an abnormal mean fractional reflux index and an abnormal mean total time pH less than 4 ($p = 0.14$ and $p = 0.1$, respectively), this did not reach statistical significance, perhaps because of the small number of patients studied.

As children with CP are at great risk for reflux oesophagitis, we routinely performed oesophageal biopsy at the time of PEG insertion, even in the absence of erosions, because we consider microscopic oesophagitis as important as macroscopic oesophagitis [23]. Histological oesophagitis was diagnosed in 10 (40%) patients and correlated with the presence of abnormal pH study, but this failed to predict worsening of GER after PEG, in agreement with Heikenen and Werlin [24].

As part of the spectrum of foregut dysmotility, delayed GE has been reported to occur in more than 65% of neurologically impaired children [9,25]. However, it is difficult to compare various studies due to differences in the technique used to assess gastric emptying and the number of subjects studied. Del Giudice et al. [9] found delayed gastric emptying of liquids by scintigraphy in 12 (67%) patients with CP. This was similar to the rate reported by Alexander et al. [25] of delayed GE in 65% of 54 children studied. In our study of 25 patients with CP, we found delayed gastric emp-

tying in only 6 (24%) patients. This number is markedly lower than has been found in the aforementioned studies. This difference is possibly due to variation in the methods of assessment of GE.

Studies trying to address the relationship between GE and GER in children have been inconclusive [8,26,27]. Argon et al. [26] studied 108 patients between 3 months and 5 years of age with clinical suspicion of GER. GE scintigraphy was performed and correlated to the presence of GER diagnosed by scintigraphy. They found mild statistical correlation between the number of reflux episodes and GE half time. However, this study should be interpreted with caution since they used scintigraphy to diagnose GER, rather than 24-h pH study. Estevao Costa et al. [27] also studied thirty paediatric patients by gastric emptying scintigraphy with pathological GER diagnosed by 24-h pH study. They found that patients with delayed GE had significantly higher frequency of longer episodes in the postprandial period than did those with normal emptying. In the contrary, Spiroglou et al. [8] studied 76 children with cerebral palsy with reflux indicative symptoms investigated by 24-h pH monitoring. GE was studied using gastric scintigraphy and compared with 28 children with resistant asthma used as control for GE time. They found no relation between GER and delayed GE. Our study agrees with the finding of Spiroglou et al., as we found no significant correlation between delayed GE and the presence of preoperative GER or oesophagitis. Furthermore, we did not find delayed GE to be an important factor in worsening GER manifestation after PEG placement.

In conclusion, our data does not support the hypothesis that an abnormal 24-h pH probe study and histological oesophagitis or the presence of delayed gastric emptying before PEG placement in children with CP can predict worsening of GER or the need for fundoplication after PEG. Accordingly, the decision for anti-reflux surgery should be individualised based on clinical ground.

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