MAR Gastroenterology (2023) 3:2

Research Article

Healthcare and Socioeconomic Implications of Percutaneous Endoscopic Gastrostomy in Pediatric Patients with Neurological Swallowing Disorders

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Received: 15 October 2023

Published: 25 October 2023

DOI: https://doi.org/10.5281/zenodo.14160322

Abstract

Background: *Dysphagia refers to feeding or swallowing disorders characterized by challenges with the placement, reception, maintenance, and transmission of food and liquids from the oral cavity to the esophagus and stomach.*

Purpose: *To evaluate the socioeconomic and medical ramifications of percutaneous endoscopic gastrostomy in children suffering from neurological digestive disorders.*

Patients & methods: *This was a prospective study performed on thirty children who met the inclusion criteria that was predetermined at the Outpatient Clinic of the Pediatric Gastroenterology Unit and the Inpatient Units of the Pediatric department Faculty of Medicine, Al-Azhar University Hospitals (Al-Hussein & Sayed Galal Hospitals), in addition to referrals from other medical facilities representing patients with neurological swallowing difficulties From January 2022 to January 2024.*

Results: *Our results showed that, regarding CRP change of the studied group, 3(10.0%) had CRP decreased, 11(36.7%) had normal CRP and 16(53.3%) had CRP increased. Major Complications showed that 1(3.3%) had Buried bumper syndrome. Minor Complications showed that 12(40.0%) had Local infection, 9(30.0%) had Accidental removal, 1(3.3%) had Leakage and 1(3.3%) had Fistula formation. There was highly statistically significant decrease among prior & post treatment according to all medical outcomes except neurological examination showed no statistically significant differences between before and after treatment.*

Conclusion: *PEG had a positive medical aspect of children with neurological swallowing difficulties, a positive social effect, caregivers' satisfaction increased and a positive economic effect, the costs of medications reduced.*

Key words: *percutaneous endoscopic gastrostomy (PEG); Neurological swallowing Difficulties; Medical and socioeconomic impact.*

Introduction

Disturbances in feeding or swallowing, specifically dysphagia, encompass challenges associated with the placement, reception, maintenance, as well as transmission of food and liquids from the oral cavity to the

esophagus and stomach. Severe complications may result from untreated feeding and digestive disorders, such as malnutrition, social isolation, respiratory compromise, or aspiration pneumonia [1].

Tube feeding is an extremely prevalent enteral nutrition method for patients who are incapable of eating or drinking independently. Prior to widespread adoption, novel systems, such as PEG, necessitate more rigorous investigation than existing approaches. The potential efficacy of a PEG is highly dependent on the underlying disease and cannot be evaluated with a single result in mind [2].

Feeding & swallowing in children may be hindered by a variety of factors, such as sensorimotor function impairments, insufficient achievement of typical eating and feeding milestones and the necessary subskills associated with each, and disturbances in eating pragmatics, or the social behaviors required while eating. Children who experience such disturbances may develop malnutrition, stunted growth and development, and deteriorating health [2].

Gastrostomy is recommended for individuals who require artificial enteral nutrition for a duration exceeding two to three weeks [3].

Prolonged use of parenteral fluids and nutritional supplementation is required for children with digestive disorders, as well as congenital or acquired malformations that impede oral nourishment [4].

In infants who are incapable of orally meeting their nutritional requirements, PEG has long facilitated enteral nutrition [5].

The child's enhanced physical and mental well-being facilitated increased engagement in community activities, at times operating autonomously from the immediate family [6].

The aim of this study was to evaluate the socioeconomic and medical ramifications of percutaneous endoscopic gastrostomy in children suffering from neurological digestive disorders.

Patients and Methods

This was a prospective study performed on thirty children who met the inclusion criteria that was predetermined at the Outpatient Clinic of the Pediatric Gastroenterology Unit and the Inpatient Units of the Pediatric department Faculty of Medicine, Al-Azhar University Hospitals (Al-Hussein & Sayed Galal Hospitals), in addition to referrals from other medical facilities representing patients with neurological swallowing difficulties From January 2022 to January 2024.

Inclusion criteria: Age: from 1 to 18 years, Gender: both genders will be involved, Complaint: neurological swallowing difficulties (Failure to thrive is defined as the following: a patient whose weight falls below the 3rd percentile on the CDC growth chart; recurrent aspiration pneumonia; feeding difficulty necessitating nasogastric feeding; or a patient who has previously been diagnosed with recurrent aspiration pneumonia but continues to experience feeding difficulties (frequent chocking , refusal of feeding or vomiting) and intractable convulsion).

Exclusion criteria: Severe gastroesophageal reflux, unfavorable gastrointestinal anatomy, and limited life expectancy, severe skeletal deformity kyphosis or scliosis, life threating condition as serious coagulation disorder , hemodynamic instability, sepsis , severe ascites , peritonitis and gastric outlet obstruction.

Ethical consideration

Prior to involving any individual in this investigation, written informed consent was obtained from the parenting party. Al-Azhar University's Faculty of Medicine's local Ethics Committee granted approval for the research.

Methods

All cases were divided to the following:

Full detailed History (name, age, gender, underlying neurological disease documented by pediatric neurologist), full clinical examination, general examination, local examination and measurement of body weight and length was recorded one day prior PEG tube placement & at least six months post insertion.

PEG technique

Throughout the procedure, all patients were administered either general anesthesia or intravenous sedation. The 20 Fr Standard PEG Kit with Pull Technique was a product of Cook and Boston Pull PEG Kit. The procedure was executed by means of the draw method and two physicians were required. By elevating the individual's head by 45 degrees while supine, the colon was maintained at a level below the stomach. Prior to inserting the scope, skin sterilization was conducted in order to prevent the passage of excessive air, which might have caused the colon to enlarge and cross in front of the stomach. Following sterilization, the percutaneous entrance was inserted into the epigastric region, taking into account the finger-sensitized fluctuation and the illumination of the endoscope on the skin. Following the completion of a diagnostic esophagogastroduodenoscopy, the stomach was completely distended in order to displace the liver, spleen, and colon from the site of the gastrostomy incision. Gastrostomy should be performed on the anterior wall

of the middle or lower body.

Outcomes after PEG

Number of (vomiting per day, convulsions per week, pneumonia per month, hospital admissions) and length of hospital stay (All before and after PEG insertion). Major complications and minor complications.

Laboratory investigations

CBC (Hb, WBC and PLt), CRP, Liver function tests (SGPT, SGOT and S.Albumin), Urea and creatinine and Bilirubin all were done before and after PEG insertion.

Socioeconomic impact

In order to assess the socioeconomic impact & quality of life of patients with inserted PEG tubes, an original survey was developed in which parents or caregivers responded to inquiries regarding the patient's and family's quality of life, gastrostomy management, as well as rehabilitation.

RESULTS

In our study, regarding demographic information of the group under study. The mean age of the subjects was 7.25±4.290 years. There were 17 man cases (56.7%) and 13 woman cases (43.3%) **(Table1)**.

Table 1. The study cohort was distributed in accordance with demographic data

	Number	**Percent**
Age (years)		
1 – 5	10	33.3
5 – 10	12	40.0
10 – 15	8	26.7
Mean±S.D.	7.25±4.290	
Gender		
Man	17	56.7
Woman	13	43.3

In our study regarding underlying disease of the studied group, it showed that 16(43.3%) had Cerebral palsy, 4(13.3%) had Metachromatic Leukodystrophy, 4(13.3%) had Neurodegenerative disease, 2(6.7%)

had Atonic Cerebral palsy, 2(6.7%) had Down syndrome, 1(3.3%) had Post meningitis quadriplegia and 1(3.3%) had Autism **(Table 2)**.

Table 2. Distribution of studied sample In accordance with underlying disease.

	Number	**Percent**
Cerebral palsy	19	63.3
Spastic quadriplegia	16	53.3
Atonic	2	6.7
Post meningitis quadriplegia	1	3.3
Neurodegenerative	8	26.7
Metachromatic Leukodystrophy	4	13.3
Ceroid neuronal lipofuscinosis	2	6.7
Krabbe disease	1	3.3
Adrenoleukodystrophy	1	3.3
Down syndrome	2	6.7
Autism	1	3.3
Total	30	100

In our study, 21(70.0%) had Intractable convulsions, 13(43.3%) had Frequent chocking, 11(36.7%) had Recurrent pneumonia, 10(33.3%) had Vomiting, 9(30.0%) had Failure to gain wt, 8(36.7%) had Refusal of feeding and 5(16.7%) had Replacement (**Table 3**).

Table 3. Distribution of examined sample In accordance with indications.

	Number	**Percent**
Intractable convulsions	21	70.0
Frequent chocking	13	43.3
Recurrent pneumonia	11	36.7
Vomiting	10	33.3
Failure to gain wt	9	30.0

Refusal of feeding	8	26.7
Replacement	5	16.7

In our study, major Complications showed that 1(3.3%) had Buried bumper syndrome. Minor Complications showed that 12(40.0%) had Local infection, 9(30.0%) had Accidental removal, 1(3.3%) had Leakage and 1(3.3%) had Fistula formation **(Table 4)**.

Table 4. Distribution of examined sample In accordance with complications.

	Number	**Percent**
Major Complications	1	3.3
Buried bumper syndrome	1	3.3
Death	0	0
Peritonitis	0	0
Hemorrhage	0	0
Necrotizing fasciitis	0	0
Tumor implantation	0	0
Aspiration pneumonia	0	0
Minor Complications	22	73.3
Local infection	12	40.0
Accidental removal	9	30.0
Leakage	1	3.3
Fistula formation	1	3.3
Ulcers	0	0

In our study, there was highly statistically significant decrease between before and after treatment according to all medical outcomes except neurological examination showed no statistically significant differences between before and after treatment (**Table 5**).

Table 5. Comparison between before and after treatment according to medical outcome.

	Treatment				**Test of Sig.**	**P value**
	Before		**After**			
	No.	**%**	**No.**	**%**		
General Examination						
Average	13	43.3	26	86.7	----	0.001*
Bad	17	56.7	4	13.3		
Neurological Examination						
GGD	25	83.3	22	73.3	$X^2 = 4.334$	0.363
Sitting	4	13.3	3	10.0		
Delayed social	1	3.3	1	3.3		
Crawling	0	0	3	10.0		
Sitting and crawling	0	0	1	3.3		
n. of vomiting / day						
Mean±S.D.	2.24±2.824		0.03±0.186			
n. of convulsions / week						
Mean±S.D.	10.87±14.282		0			
n. of pneumonia / month						
Mean±S.D.	0.73±1.081		0			
n. of hospitalization / month						
Mean±S.D.	1.23±1.194		0.10±0.305			
LOS / hospitalization						
No	9	30.0	28	93.3	$X^2 = 25.698$	<0.001*
1 week	15	50.0	2	6.7		
1-2 weeks	2	6.7	0	0		
2 weeks	2	6.7	0	0		
3 weeks	1	3.3	0	0		
4 weeks	1	3.3	0	0		

In our study, there was highly statistically significant increased between before and after treatment according to Hb, TLC and CRP (**Table 6**).

Table 6. Comparison between before and after treatment according to laboratory investigations.

	Treatment		**Test of Sig.**	**P value**
	Before	**After**		
Hb (gm/dL)				
Mean±S.D.	10.62±1.154	11.41±0.714		
TLC (cell/cmm)				
Mean±S.D.	9.20±1.910	11.16±2.898		
Platelet (x10^9/cmm)				
Mean±S.D.	265.60±62.994	297.63±72.082		
Albumin (g/dl)				
Mean±S.D.	4.12±0.290	4.32±0.181		
ALT (U/L)				
Mean±S.D.	24.33±8.256	28.07±9.105		
AST (U/L)				
Mean±S.D.	30.83±8.263	33.67±8.260		
Bilirubin (mg/dl)				
Mean±S.D.	0.71±0.118	0.62±0.152		
Serum urea (mg/dl)				
Mean±S.D.	18.20±3.458	19.25±3.811		
Serum creatinine (mg/dl)				
Mean±S.D.	0.69±0.169	0.72±0.148		
CRP (mg/L)				
Mean±S.D.	3.03±5.499	17.50±20.964		

In our study,CRP change of the studied group and it show that 3(10.0%) had CRP decreased, 11(36.7%) had normal CRP and 16(53.3%) had CRP increased **(Table 7)**.

Table 7. Distribution of studied sample according to CRP change.

CRP change	Number	Percent
Decreased	3	10.0
Normal	11	36.7
Increased	16	53.3
Total	30	100

In our study, Social Impact of the studied group and it show that 25(83.3%) had family's satisfaction increased, 30(100.0%) caregiver had no difficulties in finding a place to feed outside the home, 2(6.7%) had difficult to deal with the gastric while Economic effect show that the majority of patients had reduce the costs of repeatedly hospitalizing the child, reduce the costs of medications for treating the child and save parents time to work and earn money **(Table 8)**.

Table 8. Distribution of studied sample according to Social Impact.

	No		Yes	
	No.	%	No.	%
Social effect				
Has the family's satisfaction increased after the installation of the gastric tube?	5	16.7	25	83.3
Do you experience difficulties finding a place to feed outside the home?	30	100	0	0
Has the family's communication with relatives and friends increased after the installation of the gastric tube?	3	10.0	27	90.0
Did you find it difficult to deal with the gastric tube?	28	93.3	2	6.7
Does PEG feeding restrict your ability to go out?	30	100	0	0
Did the gastric tube make the child's physical rehabilitation difficult?	26	86.7	4	13.3
Did the gastric tube make the child's life difficult?	28	93.3	2	6.7
Economic effect				

Did installing a gastric tube reduce the costs of repeatedly hospitalizing the child?	5	16.7	25	83.3
Did installing a gastric tube reduce the costs of medications for treating the child?	3	10.0	27	90.0
Did inserting a gastric tube save parents time to work and earn money?	1	3.3	29	96.7

Discussion

In our study showed that the participants' ages varied from 1 to 15 years, with a mean of 7.25±4.290 years. There were 17 men cases (56.7%) and 13 women cases (43.3%) **(Table1)**.

Fernandes, et al. [5] conducted a study to evaluate the incidence of complications associated with the conventional PEG tube implantation in newborns weighing less than 5 kg in a single specialized medical facility. All eligible patients were under one year old.

Our results showed regarding underlying disease of the studied group , 19 (63%) had Cerebral palsy [16(53.3%) had Spastic quadriplegia, 2 (6.7%) Atonic and 1(3.3%) had Post meningitis quadriplegia] . 8(26.7%) had neurodegenerative disease [4(13.3%) had Metachromatic Leukodystrophy, 2(6.7%) had Ceroid neuronal lipofuscinosis , 1(3.3%) had Krabbe disease and 1(3.3%) had Adrenoleukodystrophy , 2(6.7%) with down syndrome and 1(3.3%) with autism **(Table 2)**.

Alsaggaf et al., [7] who reported that The majority of patients (77%) were diagnosed with cerebral palsy, and the vast majority of patients (97%) had severe physical and mental disabilities.Severe pseudobulbar palsy was the most prevalent indication, observed in 22 cases (73%), characterized by inadequate oral intake, recurrent choking, and/or chest infections in all patients.

Our findings showed that indications of the studied group and it show that 21(70.0%) had Intractable convulsions, 13(43.3%) had Frequent chocking, 11(36.7%) had Recurrent pneumonia, 10(33.3%) had Vomiting, 9(30.0%) had Failure to gain wt., 8(26.7%) had Refusal of feeding and 5(16.7%) had Replacement **(Table 3)**.

According to Wu et al., [8] out of the 17 patients studied, nine of them (13.4% or 9 out of 67) experienced neurological dysfunction. Additionally, two of them had gastrointestinal diseases, with one having gastric volvulus and the other having ineffective esophageal motility disorder. Furthermore, five patients had

metabolic disorders, including two with persistent hyperinsulinemic hypoglycemia of infancy, one with protein-induced hyperinsulinemic hypoglycemia, one with Niemann-Pick disease, and one with succinic semialdehyde dehydrogenase deficiency.

Indications for PEG insertion included , inability to swallow, most frequently neurologically impaired kids, Chronic illnesses with inadequate caloric intake, Unpalatable medication & Permanent enteral access & gastric decompression [9].

In our current study showed complications of the studied group. Major Complications show that 1(3.3%) had Buried bumper syndrome. Mainor Complications show that 12(40.0%) had Local infection, 9(30.0%) had Accidental removal, 1(3.3%) had leakage, 1(3.3%) had Fistula formation, no ulcer **(Table 4).**

The findings of our study align with those of Brewster et al., who found that out of the 92 patients with complete data, 82 (89%) did not experience any problems. No instances of procedure-related mortality, problems during surgery, peritonitis, bleeding, or organ damage were detected (95% CI, 0-3.2%). A total of 13 problems were detected in 10 cases, resulting in a complication rate of 14%. The distribution of overall problems was as outlined: There were 5 instances of dislodgment or migration seen in 5.4% of patients (95% CI, 0.8–10%). Additionally, there were 6 cases of infection in 6.5% of patients (95% CI, 1.5–11.6%), & 2 occurrences of unexpected operations in 2.2% of patients (95% CI, 0–9%). The presence of several issues in the same patient had a considerable impact on the total complication rates, and this was found in two cases. The individual experienced three persistent complications: The patient with Pierre Robin sequence necessitated a midline PEG insertion due to the presence of preexisting pacemaker wires. The patient had a (1) surgery site infection. The gastrostomy button ultimately (2) became displaced from the stomach and ended up within the abdominal wall. The patient was sent to the (3) operating room to have a procedure where the gastrostomy button was replaced with a gastrostomy tube. Additionally, central venous access was established to provide antibiotic medication. Another patient encountered displacement while receiving outpatient care and necessitated imaging assessment with contrast prior to the replacement of the tube by a physician in a clinic setting, subsequently followed by surveillance within the medical facility [10].

According to a prior investigation, the incidence of significant complications ranging from complications necessitating unanticipated endoscopic or surgical intervention, nonprophylactic antibiotic usage, or blood transfusion, to those culminating in mortality, was approximately 12.6% to 17.5% [11].

Our outcomes indicated that there was significant variance among before & after treatment according to

Hb, TLC and CRP. We investigated that CRP change of the studied group and it show that 3(10.0%) had CRP decreased, 11(36.7%) had normal CRP and 16(53.3%) had CRP increased **(Table 5)**.

Our results supported with Barbosa, et al., [12] who reported that there was statistically significant variance among before & after treatment according to CRP, the patients who died during follow-up had lower levels of hemoglobin ($p < 0.001$), greater values of leucocytes ($p = 0.005$) and higher CRP values ($p = 0.008$).

Our results showed that Social Impact of the studied group and it show that 25(83.3%) had family's satisfaction increased, 30(100.0%) caregiver had no difficulties in finding a place to feed outside the home, 2(6.7%) had difficult to deal with the gastric tube, 4(13.3%) the gastric tube make the kid's physical rehabilitation difficult and 2(6.7%) the gastric tube make the kid's life difficult,30(100.0%) PEG feeding not restrict ability to go out for caregiver , while Economic effect show that the majority of patients had reduce the costs of repeatedly hospitalizing the child, reduce the costs of medications for treating the child and save parents time to work and earn money **(Table 7)**.

Our results are consistent with Brewster et al., who reported that Complication rates associated with PEG in minors have decreased in comparison to historical PEG literature, and the data suggest a safety profile comparable to contemporary LAP-G procedures. PEG continues to be a secure and efficient technique for establishing enteral nutrition access in pediatric patients [13].

PEG provides evident advantages in terms of quality of life, as it improves nutrition and well-being. Moreover, patients may find PEG more tolerable due to its elimination of the requirement for nasal tube insertion, which reduces the likelihood of inadvertent removal followed by re-insertion. Additionally, it is correlated with improved short-term survival rates, albeit not long-term ones, given that patients often succumb to underlying ailments. This lends credence to the application of the technique [14, 15].Feeding through PEG tube effect on the family quality of life [9].

Conclusion

PEG had a positive medical aspect of children with neurological swallowing difficulties. PEG had positive impact on social aspect of children, their relative and caregivers, had no difficulties to feed outside, PEG improved the economic aspect for children, caregiver the majority of patients had reduced the costs of repeatedly hospitalizing the child, and the costs of medications for treating the child and save parents time to work and earn money.

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