Original Article

Percutaneous Endoscopic Gastrostomy in Pediatric Patients: Experience of 201 Cases in a Tertiary-Care Hospital

Lertudomphonwanit C, MD[1], Butsriphum N, RN[1], Prabpram W, RN[1], Sumritsopak R, RN[1], Tanpowpong P, MD, MPH[1], Treepongkaruna S, MD[1]

[1] Division of Gastroenterology, Department of Pediatrics, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

Background: Percutaneous endoscopic gastrostomy (PEG) has become a common technique for children who require long-term enteral feeding. The use of PEG can improve nutritional status of patients and widely accepted by caregivers. The present study revealed outcome of PEG in 201 children age <19 years performed by pediatric gastroenterologists in a tertiary-care hospital in Thailand.

Materials and Methods: We retrospectively reviewed PEG registry of our division and medical records of pediatric patients (age <19 years) who underwent PEG at Division of Gastroenterology, Department of Pediatrics, Ramathibodi Hospital from January 2001 to December 2013.

Results: Eighty-three percent of patients were neurologically impaired. The median weight was 9 kg (IQR 5.9 to 15.3) with a minimal weight of 2.9 kg; 50% were underweight (weight for age Z-score less than -2 standard deviation) at time of PEG. Overall, rate of early post-operative complications was 20%. Most of them were minor complications albeit 1.5% were major complications. There was no mortality. At 1-year follow-up, nutritional status improved significantly. Mean weight for age Z-score was -2.13±2.1 before PEG insertion and -1.38±1.9 at 1 year later (p = 0.0001). The proportion of underweight patients decreased from 45.3% to 39.7%. Median increased weight was 38.9% (IQR 19.5 to 65.9).

Conclusion: PEG is a safe procedure for children, even in small infants, requiring long-term enteral feeding due to its favorable outcomes in terms of better nutritional status and the low rate of major complications.

Keywords: Complications, Nutritional status, Pediatric outcomes, Percutaneous endoscopic gastrostomy

J Med Assoc Thai 2019;102(Suppl.10): 130-4
Website: http://www.jmatonline.com

Percutaneous endoscopic gastrostomy (PEG) has been introduced since 1980[1] and later became a common technique for children who require long-term enteral feeding[2]. Potential benefits of PEG over nasogastric tube include less tube displacement, reduced risk of aspiration, less nasal irritation/trauma and better cosmetic appearance[3]. Compared to open gastrostomy, PEG has many advantages in terms of shorter procedure time, lower cost, smaller incision, shorter length of stay and lower incidence of postoperative complications[4]. Although PEG is considered safe and widely accepted by caregivers[5], there are potential risk of major complications such as gastro-colonic fistula and visceral organ injury[3,6]. Therefore, PEG insertion must be carried out by an experienced team with available pediatric surgeon in case of major complications. In the present study, we aim to review the outcomes of PEG in children performed at our institution, a tertiary-care hospital in Thailand, focusing on procedure-related complications, and nutritional status at 1-year follow-up.

Correspondence to:

Treepongkaruna S.

Division of Gastroenterology, Department of Pediatrics, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok 10400, Thailand.

Phone & Fax: +66-2-2011446

E-mail: suporn.tre@mahidol.ac.th, supornтr@gmail.com

Materials and Methods

We retrospectively reviewed pediatric patients (age <19 years) who underwent PEG at Division of Gastroenterology, Department of Pediatrics, Ramathibodi Hospital from January 2001 to December 2013. The data were collected from the PEG registry of our division and patients' medical records. Patient demographics, principle diagnosis, indication for PEG placement, peri- and post-operative complications and weight gain were recorded.

Indications for PEG placement were grouped into 3 categories; 1) swallowing dysfunction (documented by barium swallowing study), 2) feeding problems, such as insufficient oral intake or difficult feeding from any reason, resulting in growth impairment and 3) prophylaxis for nutritional compromised or dysphagia patients who were planned for orofacial/thoracic radiation. Patients were defined as neurologically impaired if they had significant disability (either cognitive or motor function) caused by their underlying conditions.

PEG placement was performed under general anesthesia with endotracheal intubation in an operating room

How to cite this article: Lertudomphonwanit C, Butsriphum N, Prabpram W, Sumritsopak R, Tanpowpong P, Treepongkaruna S. Percutaneous Endoscopic Gastrostomy in Pediatric Patients: Experience of 201 Cases in a Tertiary-Care Hospital. J Med Assoc Thai 2019;102(Suppl.10): 130-4.

by experienced pediatric gastroenterologists. Prophylactic antibiotic, cefazolin (25 mg/kg) or alternative if patient was allergic to cephalosporin, was administered to all patients pre- and post-operative up to 24 hours. The procedure was performed with the standard "pull" technique, described elsewhere[4]. Sixteen-Fr gastrostomy tube was used for patients weighed less than 30 kg and 20-Fr gastrostomy tube for those who weighed heavier. Enteral feeding was resumed after 24 hours of procedure except some essential drugs were allowed after 6 hours. Wound dressing with sterile technique was done once daily starting from post-operative day 1 to 7. Bolster adjustment was considered according to physical examination to ensure adequate room between the external bolster and the skin (approximately 0.5 centimeter). Total admission was between 5 to 7 days; all caregivers were instructed for wound care and gastrostomy care before discharge. Complications were recorded peri- and post-operative up to 30 days after procedure, major complications defined as complications involving major organs or resulting in need for surgical intervention. Minor complications were defined as complications which did not involve major organs and not warranted for surgical intervention. Nutritional status was evaluated by weight for age Z-score and percentage of weight change at 1 year follow-up.

Results

Demographics

Two hundred and one consecutive patients underwent PEG placement during January 2001 to December 2013 were enrolled. Demographic data are summarized in Table 1. Seventy-seven patients (38.3%) were younger than 1 year; the minimal age was 1.5 months. Five patients were less than 3.5 kg and the minimal weight was 2.86 kg. Fifty percent of patients were underweight (weight for age Z-score less than -2 standard deviation) at the time of PEG. One hundred sixty-eight patients (83.6%) were neurologically impaired; 11 patients have had ventriculoperitoneal (VP) shunts. Underlying conditions and indications for PEG are listed in Table 1 and 2.

Table 1. Patient demographics

Age (years), median (IQR)	1.8 (0.6, 5.8)
Male, n (%)	111 (55.2)
Body weight (kg), median (IQR)	9 (5.9, 15.3)
Weight for age Z-score, median (IQR)	-2.1 (-3.5, -0.4)
Underlying conditions, n (%)	
Cerebral palsy	40 (20)
Seizure disorders	30 (15)
Encephalopathy (from various causes)*	28 (14)
Brain anomaly/post brain surgery	20 (10)
Muscular disorder/dystrophy	7 (3.5)
Metabolic disease/genetic syndrome**	33 (16.4)
Globally developmental delay	10 (4.9)
Chronic respiratory disease	10 (4.9)
Congenital heart disease	5 (2.4)
Malignancy	10 (5)
None	8 (3.9)

* caused by anoxic or traumatic brain injury, post viral encephalitis, central nervous system vasculitis, and adrenoleukodystrophy, etc.

** Rett syndrome, Noonan syndrome, Rubinstein-Taybi syndrome, Cornelia de Lange, maple syrup urine disease, and Menkes syndrome, etc.

Table 2. Indications for PEG

Indications	n (%)
Feeding problems	118 (59)
Swallowing dysfunction	76 (38)
Prophylaxis	7 (3)

Success rate

Overall, success rate was 99.5%. Of these, 98.5% was successful in the first attempt. Three patients (1.5%) were technically unable to have PEG placed at the first attempt. The proper site of gastric indentation could not be identified in one of the patient despite additional air insufflation and he was converted to open gastrostomy at the same time. Stomach was suspected completely under the rib cage causing this difficulty. Cause of technical difficulty in the other 2 patients was suspected from small bowel over-inflation. Then, PEG was successfully performed, thereafter, in both patients in the second attempt.

Perioperative and early post-operative complications

There was no report of serious perioperative complication such as adjacent organ injury in the present study. Forty patients (20%) experienced early post-operative complications with total of 43 events, but the majority were minor complications (Table 3). There was no mortality in the present study.

Nutritional outcome

At 1 year follow-up, data of patient's weight was available in 146 patients. Mean weight for age Z-score was -2.13$\pm$2.1 before PEG insertion and -1.38$\pm$1.9 at 1 year later (p = 0.0001). The proportion of patients with underweight (weight for age Z-score <-2SD) decreased from 45.3% before PEG insertion to 39.7% at 1-year follow-up. Median increased weight was 38.9% (IQR 19.5 to 65.9).

Discussion

PEG has become widely accepted for long-term enteral feeding in pediatric patients. The present study reported high success rate and favorable outcomes of PEG procedure in pediatric patients in terms of better nutritional status and low rate of major complications.

PEG placement is considered a safe procedure for children of all ages and low weight should not be considered as a limiting factor[3]. Previous retrospective studies showed that medically complicated small infants, with minimal weight

Table 3. Early post-operative complications (30 days after PEG insertion) and treatment

Complications	Number of events (% of patients)	Treatments
Minor complications		
Wound infection	34 (17)	
Positive discharge culture	10	Intravenous antibiotics
Cellulitis	1	Intravenous antibiotics
Erythema of ostomy site	23	Oral antibiotic (n = 17), wound care only (n = 6)
Benign pneumoperitonium	3 (1.5)	Conservative treatment
Gastric mucosal/abdominal wall bleeding	2 (1)	Conservative treatment
Subcutaneous emphysema	1 (0.5)	Conservative treatment
Major complications		
Peritonitis	2 (1)	Surgical correction (n = 1), Conservative treatment and antibiotics (n = 1)
Infected ventriculoperitoneal shunt	1 (0.5)	Intravenous antibiotic and shunt removal

of 2.1 kg, could safely undergo PEG procedure[7,8]. In the present study, 5 patients were less than 3.5 kg at time of PEG with the minimal weight of 2.9 kg, none of them experience early post-operative complications. Success rate was 100% in this group of patients. However, it is recommended that PEG in small infants should be placed by gastroenterologists who have high experience with pediatric PEG procedure[7]. Overall successful rate in the present study was 98.5%. Failure of the procedure in 2 patients was due to air over-inflation. One of the tips for PEG insertion in the small children is to do it quickly and avoid excessive air inflation which may increase the risk of distending the small bowel or colon with air and, therefore, interposing a loop of bowel between the stomach and the anterior abdominal wall, increasing the risk of complication[4]. This tip is usually accomplished by an experienced team. PEG insertion was successfully performed in the second attempt later in both patients. In another patient, we could not identify proper gastric indentation prior to puncture a trocar. This could be due to abnormal position of stomach that was completely under the rib cage. In this situation, PEG is unlikely to be successfully placed[4]. Then a pediatric surgeon was consulted for open gastrostomy in the same session. It is important for physicians who perform PEG procedure to know limitations and be able to make rapid adjustment or terminate the procedure if necessary to avoid major complication, particularly in the situation of failure to identify a good gastric indentation[4].

The most common early complication was wound infection found in 17% of patients, similar to previous reports (2 to 25%)[9-13]. Variation of wound infection rate could be due to different definition as well as prophylactic antibiotic regimen. However, only 10 of 34 patients in the present study had significant wound discharge and one with cellulitis requiring intravenous antibiotics. Other patients were noted to have erythema at the insertion site which required only local wound care and/or oral antibiotics. Low rate of major wound infection found in the present study (5.4%) was comparable to previous reports using routine prophylactic antibiotics[9,14,15]. The use of prophylactic antibiotics to reduce perioperative stomal infection rates was recommended by the European Society of Pediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN)[3]. This recommendation was supported by meta-analysis of 10 randomized controlled trial[16] as well as a systematic review in adult population[17].

Major complications were found in only 3 patients in the present study including peritonitis (n = 2) and infected VP shunt (n = 1). Two patients had signs of peritonitis on the first day after procedure; one patient was suspected of improper position of internal and external bolsters. A sign of peritonitis was improved after adjustment of bolster position and conservative treatment. Another patient was found to have gastric leakage requiring surgical correction.

The present study showed one out of 11 patients with previously inserted VP shunt developed shunt infection 5 days after the procedure despite prophylactic antibiotic. This patient had history of repeated VP shunt infection before this episode. VP shunt was removed and intravenous antibiotic was given. The patient gradually recovered and PEG tube was functioning well. Adult studies have shown that risk of shunt infection does not increase in the patients undergoing PEG unless it is performed simultaneously at the time of admission or within 10 days apart[18-21]. It appears that shunt infection is related to some risk factors other than the PEG procedure itself. Thus, the presence of VP shunt is not a contraindication for PEG.

The present study also supports better nutritional status after PEG placement. Since majority of patients were neurologically impaired and bedridden, we used weight for age as a parameter for nutritional status outcome instead of height which could not be accurately measured. There was overall an increase in weight for age Z score at 1-year follow-up and a decrease in proportion of underweight patients. These findings were similar to previous studies[13,15].

One controversial issue is whether GERD is worsening after PEG placement. In the present study, at follow-up at 1 year, subsequent fundoplication was required

in 17 patients (8.5%) and most of them were neurological impaired patients. This group of patients is at risk of severe GERD regardless of PEG insertion. Systematic review of 8 limited methodological studies failed to show PEG as a risk factor for subsequent GERD, even in patients with neurological impairment[22]. It is recommended by the ESPGHAN that asymptomatic children do not require investigation for GERD before PEG insertion[3]. Prospective well-designed study is required to answer this controversial issue.

Conclusion

PEG is a safe procedure for children, even in small infants, requiring long-term enteral feeding due to its favorable outcomes in terms of improving nutritional status and low rate of major complications. However, the procedure should be performed by an experienced team.

What is already known on this topic?

PEG has many advantages compared to open gastrostomy. Although, the procedure is considered safe for children, there are potential risks of complications.

What this study adds?

PEG insertion can be successfully performed, even in a small infant with body weight below 3 kg and children with VP shunts, using careful technique by an experienced team.

Potential conflicts of interest

The authors declare no conflicts of interest.

References

1. Gauderer MW, Ponsky JL, Izant RJ Jr. Gastrostomy without laparotomy: a percutaneous endoscopic technique. J Pediatr Surg 1980;15:872-5.
2. Gauderer MW. Percutaneous endoscopic gastrostomy and the evolution of contemporary long-term enteral access. Clin Nutr 2002;21:103-10.
3. Heuschkel RB, Gottrand F, Devarajan K, Poole H, Callan J, Dias JA, et al. ESPGHAN position paper on management of percutaneous endoscopic gastrostomy in children and adolescents. J Pediatr Gastroenterol Nutr 2015;60:131-41.
4. Wyllie R, Kay M. Therapeutic upper GI endoscopy. In: Gershman G, Thomson M, Ament M, editors. Practical pediatric gastrointestinal endoscopy. 2nd ed. Oxford: Blackwell Publishing; 2012. p. 94-100.
5. Sumritsopak R, Treepongkaruna S, Butsriphum N, Tanpowpong P. Percutaneous endoscopic gastrostomy in children: Caregivers' perspectives. J Pediatr Nurs 2015;30:e3-e7.
6. Kishore A. Gastrocolic fistula as a complication of percutaneous endoscopic gastrostomy (PEG): a case report and review of literature. Int Surg J 2018;5:2653-6.
7. Wilson L, Oliva-Hemker M. Percutaneous endoscopic gastrostomy in small medically complex infants. Endoscopy 2001;33:433-6.
8. Minar P, Garland J, Martinez A, Werlin S. Safety of percutaneous endoscopic gastrostomy in medically complicated infants. J Pediatr Gastroenterol Nutr 2011;53:293-5.
9. Brewster BD, Weil BR, Ladd AP. Prospective determination of percutaneous endoscopic gastrostomy complication rates in children: still a safe procedure. Surgery 2012;152:714-9.
10. Fascetti-Leon F, Gamba P, Dall'Oglio L, Pane A, de Angelis GL, Bizzarri B, et al. Complications of percutaneous endoscopic gastrostomy in children: results of an Italian multicenter observational study. Dig Liver Dis 2012;44:655-9.
11. Khattak IU, Kimber C, Kiely EM, Spitz L. Percutaneous endoscopic gastrostomy in paediatric practice: complications and outcome. J Pediatr Surg 1998;33:67-72.
12. Gauderer MW. Percutaneous endoscopic gastrostomy: a 10-year experience with 220 children. J Pediatr Surg 1991;26:288-92.
13. Viktorsdottir MB, Oskarsson K, Gunnarsdottir A, Sigurdsson L. Percutaneous endoscopic gastrostomy in children: a population-based study from iceland, 1999-2010. J Laparoendosc Adv Surg Tech A 2015;25:248-51.
14. Vervloessem D, van Leersum F, Boer D, Hop WC, Escher JC, Madern GC, et al. Percutaneous endoscopic gastrostomy (PEG) in children is not a minor procedure: risk factors for major complications. Semin Pediatr Surg 2009;18:93-7.
15. Fortunato JE, Troy AL, Cuffari C, Davis JE, Loza MJ, Oliva-Hemker M, et al. Outcome after percutaneous endoscopic gastrostomy in children and young adults. J Pediatr Gastroenterol Nutr 2010;50:390-3.
16. Jafri NS, Mahid SS, Minor KS, Idstein SR, Hornung CA, Galandiuk S. Meta-analysis: antibiotic prophylaxis to prevent peristomal infection following percutaneous endoscopic gastrostomy. Aliment Pharmacol Ther 2007;25:647-56.
17. Lipp A, Lusardi G. A systematic review of prophylactic antimicrobials in PEG placement. J Clin Nurs 2009;18:938-48.
18. Roeder BE, Said A, Reichelderfer M, Gopal DV. Placement of gastrostomy tubes in patients with ventriculoperitoneal shunts does not result in increased incidence of shunt infection or decreased survival. Dig Dis Sci 2007;52:518-22.
19. Kim JS, Park YW, Kim HK, Cho YS, Kim SS, Youn NR, et al. Is percutaneous endoscopic gastrostomy tube placement safe in patients with ventriculoperitoneal shunts? World J Gastroenterol 2009;15:3148-52.
20. Cairns A, Geraghty J, Al Rifai A, Babbs C. Percutaneous endoscopic gastrostomy and ventriculoperitoneal shunts: a dangerous combination? Dig Endosc 2009;21:228-31.

21. Taylor AL, Carroll TA, Jakubowski J, O'Reilly G. Percutaneous endoscopic gastrostomy in patients with ventriculoperitoneal shunts. Br J Surg 2001;88:724-7.

22. Noble LJ, Dalzell AM, El Matary W. The relationship between percutaneous endoscopic gastrostomy and gastro-oesophageal reflux disease in children: a systematic review. Surg Endosc 2012;26:2504-12.