General paediatric surgical provision of percutaneous endoscopic gastrostomy in a district general hospital – a 12-year experience

T SATHESH-KUMAR, HAZEL ROLLINS, SARAH CHESLYN-CURTIS

Department of Surgery, Luton and Dunstable Hospital, Luton, UK

ABSTRACT

INTRODUCTION A small, but significant, number of children require long-term nutritional support. The aim of this study was to demonstrate the safety and efficacy of providing a percutaneous endoscopic gastrostomy (PEG) service for children in a district general hospital and to raise awareness of the suitability of the procedure to be performed on paediatric surgery lists in similar hospitals across the UK.

PATIENTS AND METHODS A multidisciplinary paediatric nutrition team was established and all children accepted for PEG insertion between 1995 and 2007 were entered onto a database prospectively and are included in this study. PEG tubes were inserted by the standard pull-through technique under general anaesthetic.

RESULTS A total of 172 procedures were performed in 76 children. The median age at first tube insertion was 3 years (range, 0.5–18 years). Length of follow-up ranged from 1 month to 12.6 years. Fifty-eight children (76%) had a neurological abnormality, the commonest being cerebral palsy. All but one procedure were performed successfully, of which 63 (37%) were new insertions, 99 change of tube, 4 changed from surgical gastrostomy and 6 from PEG to button gastrostomy. The median hospital stay was 2 days (range, 2–7 days) for new insertions and 1 day for tube changes. There were 10 (6%) early complications within 30 days, the commonest being peritubal infection (6). The 39 late complications included 16 peritubal infection/granulomata, 9 'buried bumpers', 4 worsening of gastro-oesophageal reflux disease, 2 gastrocolic fistulae, 3 gastrocutaneous fistulae and 4 tubal migration. There was no mortality.

CONCLUSIONS We have demonstrated that paediatric PEG procedures and continuing management by a supporting team can be successfully and efficiently provided in the district general hospital. It should be possible for the majority of similar hospitals to provide local access and increase the availability of PEG feeding for children.

KEYWORDS

Percutaneous endoscopic gastrostomy – PEG – Children enteral feeding – Paediatric surgery

CORRESPONDENCE TO

T Sathesh-Kumar, Department of Surgery, Luton and Dunstable Hospital, Luton LU4 0DZ, UK
E: sathesh87@yahoo.com

A small, but significant, number of children in the community have feeding difficulties and require long-term nutritional support. Percutaneous endoscopic gastrostomy (PEG) was first introduced in 1980¹ and has become the procedure of choice for long-term enteral therapy in patients who cannot maintain adequate nutrition with oral intake alone. The British Artificial Nutrition Survey (2005)² reported a steady rise in paediatric home enteral tube feeding. It is reported that 'in contrast to adults, nasogastric feeding (68%) was more common than gastrostomy (31%) in newly registered children and may reflect inadequate access for gastrostomy insertion'. Few studies report on PEG in children and those that do are from specialist paediatric units where most of these procedures are performed.

We introduced a PEG service for children in 1995. The aim was to make PEG more accessible to the local population and convenient for children and their families.

The aim of this study was to demonstrate the safety and efficacy of 12 years' experience of providing this PEG service for children in a district general hospital and to raise awareness of the suitability of the procedure to be performed on paediatric surgery lists in similar hospitals across the UK.

Patients and Methods

The study included all children who underwent PEG insertions performed between April 1995 and December 2007. A

Table 1 Underlying diagnoses in children requiring enteral feeding

Congenital neurological abnormality	
• Cerebral palsy	25
• Chromosomal abnormality	13
• Developmental delay	4
• Progressive neuro-axonal degeneration	4
• Brain malformations: microcephaly, lissencephaly	4
• Autistic spectrum disorders	2
• Muscular dystrophy and dystonia	2
• Epilepsy	2
• Encephalomalacia	1
• Metabolic abnormality	1
Acquired neurological abnormality	
• Spastic paraplegia following near-drowning or head injury	2
• Viral encephalopathy	2
Gastrointestinal abnormality	
• Food allergy, aversion, prematurity	5
• Inflammatory bowel disease	4
• Severe reflux associated with prematurity	3
• Refractory sprue – elemental diet	1
Malignancy	
• Wilms' tumour	1
Total	76

database was established to record prospectively patients' details, indication for PEG, mode of referral, procedure, complications (early, within 30 days, and late) and their management and follow-up.

Selection of children for PEG feeding was decided by a multidisciplinary team comprising of paediatrician, nutrition nurse specialist, dietician and general paediatric surgeon. During selection, the risk of aspiration secondary to gastro-oesophageal reflux was assessed clinically and, in children with significant symptoms, by pH study and barium meal. Children with severe gastro-oesophageal reflux requiring fundoplication were referred to a specialist paediatric unit. A small number of children who needed tertiary level anaesthetic care and paediatric intensive care support postoperatively were referred directly to a tertiary centre.

The PEG insertions were performed on the general paediatric operating list under general anaesthetic given by a paediatric-trained anaesthetist. The PEG tube was inserted using the standard pull-through (Gauderer–Ponsky) technique.¹ An adult gastroscope (Olympus, XQ-20 until 2000, XQ-240 after 2000; Keymed, Southend, UK) was used for

children weighing > 8 kg. A flexible bronchoscope was used in smaller children. The standard tube used was 9-F (Fresenius Kabi, Runcorn, UK). Early in the study, a few 15-F tubes were used because of unfounded concerns that a smaller calibre tube would block. The children tolerated these poorly and all were replaced with 9-F tubes. Very few children and their parents/carers chose replacement with a button gastrostomy (Mickey; Vygon UK Ltd, Cirencester, UK), except the children with progressive neurological conditions who were at high risk from repeated anaesthesia.

The children remained in hospital until they were clinically stable and their parents/carers learned to manage the PEG tube. After discharge, they were followed-up by their paediatrician and continuing support was provided by members of the multidisciplinary team.

Results

In the 12-year period, 172 procedures were performed in 76 children. The median age at first tube insertion was 3 years (range, 6 months to 18 years). After 18 years of age, the care was transferred to the adult services. The male:female ratio was 1.6:1. Length of follow-up varied from 1 month to 12.6 years with a mean of 52 months (4.3 years).

The majority of children had significant co-morbidity resulting in their need for enteral nutrition (Table 1). Fifty-eight children (76%) had a neurological abnormality, the commonest being cerebral palsy ($n = 25$). Before PEG tube insertion, the majority of children had been fed by nasogastric tube alone ($n = 39$; 51%; Table 2). These methods had been used for a median of 3 years (range, 0.5–9 years).

All but one of the procedures was performed successfully (Table 3). The standard tube used was 9-F Freka for all new insertions. In three patients, 15-F Freka tubes were used initially and subsequently replaced with 9-F tubes. Six patients had 12-F Corflo tubes.

PEG tubes were changed after a median of 2 years (range, 3 months to 3 years). The main indications for changing the tube were intermittent blocking of the tube, deterioration of the tube material and accidental damage.

Table 2 Methods of feeding before PEG insertion

Nasogastric tube feeding	39
Oral feeding	21
Oral and nasogastric feeding	10
PEG inserted elsewhere	2
Operative gastrostomy placed during antireflux procedure elsewhere	4
Total	76

Table 3 Types of PEG procedure

New PEG insertions	62
Change of PEG	99
Change of operative gastrostomy to PEG	4
Change of PEG to button gastrostomy	6
Failed	1
Total	172

When tubes were replaced, a new site was used on ten occasions in nine children. This was due to recurrent infections and overgranulation at the original site in six, awkward position of an original surgical gastrostomy and a buried bumper within the abdominal wall, which was removed surgically. On two occasions in one child, the tube was changed to a different site after he was discovered to have a gastrocolic fistula.

The median hospital stay for new insertions was 2 days (range, 2–7 days) in order to train parents to use the feeding tube. Most children undergoing change of PEG tube were managed as day-cases.

Complications

Twenty-three children had 49 complications (28%) of which 10 were early procedure-related and 39 were late tube-related complications (Table 4). There were no deaths within 30 days of the procedure.

Table 4 Complications of gastrostomy

Early complications (within 30 days)	
Peritubal infection	6
Postoperative peritubal leak of gastric contents	1
Small bowel obstruction due to migration	1
Pyrexia of unknown origin	1
Chest infection	1
Late complications	
Peritubal infection	16
Buried bumper	9
Worsening GORD	4
Tube migration – loosening of fixation device	4
Gastrocutaneous fistula (previous surgical gastrostomy)	3
Gastrocolic fistula	2
Overgrowth of gastric mucosa	1

EARLY COMPLICATIONS

Six cases had peritubal infection and were treated with antibiotics. One 8-month-old child weighing 6 kg had peritubal leakage of gastric content due to a very thin abdominal wall, which resolved after 7 days. The only major early complication was bowel obstruction in a child due to small bowel twisting around the tube that had entered the posterior wall of the stomach. This was treated by laparotomy and it was assumed that inflation of the stomach during the procedure resulted in volvulus of the stomach causing the tube to enter through the posterior wall of the stomach. There was no case of peritonitis or haemorrhage.

LATE COMPLICATIONS

There were 39 late gastrostomy-related complications. The commonest problem was skin infection and granuloma formation around the tube that occasionally needed treatment with antibiotics.

Other problems included ‘buried bumper’ ($n = 9$), worsening of gastro-oesophageal reflux disease (GORD; $n = 4$), migration of the tube ($n = 4$), gastrocolic fistula in one patient ($n = 2$) and gastrocutaneous fistula ($n = 3$).

Figure 1 Gastrograffin study showing contrast going into the colon where the tube has migrated into the colon.

Buried bumper In nine cases, removal was difficult because the gastric mucosa had grown over the internal bumper (buried bumper). These tubes had been in for over 2 years. In all but one case, the bumper was within the gastric wall.

Gastrocolic fistula One child with severe scoliosis had a PEG tube insertion after upper abdominal operations for a ventriculoperitoneal shunt and Nissen fundoplication. He presented on two occasions with diarrhoea, 14 months after initial insertion and 17 months after replacement at a different site due to the tube migrating into the colon (Fig. 1). The tubes were cut off at the skin and the remnant was allowed to pass rectally. When the tube was replaced on the second occasion, a gastrocolic fistula was apparent. It is assumed that on both occasions the tube passed from the stomach through the colon to the skin. On this occasion, with direct vision into the colon, the tube was replaced avoiding the colon. The fistula closed spontaneously.

GORD Four children with worsening symptoms of GORD following PEG insertion were referred to a specialist paediatric unit for consideration of fundoplication. Three children had the procedure and one died of aspiration pneumonia whilst waiting for the surgery.

Failure of site closure The three cases of gastrocutaneous fistula were in children who had originally undergone surgical gastrostomy during open anti-reflux surgery. Their 12–16-F Malecot tubes had been changed to 9-F Freka tubes but the gastrostomy sites failed to heal after resiting the tube or discontinuing tube feeding and required operative closure.

Tube migration occurred in four children due to loosening of the external fixation device. They presented with sudden shortening of the PEG tube accompanied by abdominal pain and vomiting. In the first patient, a contrast study through the tube revealed that the tube had migrated through the pylorus into the duodenum. This was corrected by pulling back the tube. In the other cases, this corrective manoeuvre was performed without performing any investigations.

Outcome

During the study period, 14 children resumed oral feeding and had their gastrostomy tubes removed. Currently, 34 children have their PEG tube active. Seventeen (22%) children died of their underlying condition at a median of 24 months after PEG insertion (range, 10–56 months). Eight, all with neurodevelopmental disability, were transferred to the adult service and three children lived or moved out of the area and were lost to follow-up.

Discussion

The indication for gastrostomy placement in children has changed over the years from being placed as surgical adjuncts in neonatal surgery to being adopted for optimisation of nutritional status in a wide variety of chronic diseases. The technique has similarly undergone change from a tube being placed at an operation to the percutaneous technique.⁵

Percutaneous endoscopic gastrostomy, first described by Gauderer *et al.*¹ in 1980, has revolutionised enteral feeding and now is an established technique for facilitating enteral nutrition. It is safe, quick to perform, requires a shorter hospital stay and recovery period and has a low complication rate when compared with open gastrostomy.⁴ PEG tube feeding does not have the disadvantages of long-term nasogastric feeding such as irritation of the hypopharynx, frequent dislocation and unsightly appearance and there is better compliance.⁵

As access to endoscopy is largely limited to overstretched specialist paediatric units, most children are not referred for PEG tube insertion at the right time.² The PEG service for children was introduced in 1995, with the aim of making provision available locally. A survey conducted in 1996 found that 75 patients in the area were receiving home enteral tube feeding, giving a prevalence of 261 per million.⁶ Forty-four (58%) were children and many had endured prolonged nasogastric feeding. On starting the PEG service, 12 new tubes were inserted in the first year. In the steady state, the number of new insertions per year is about six. The initial higher number was due to previously unmet local demand.

The decision to use PEG feeding requires an in-depth assessment by a multidisciplinary team of the potential benefits to the individual. Parent training begins prior to tube insertion, continues on the ward using written learning goals and continues in the home or school with support from the community nursing team.

The commonest indication for PEG in children is for nutritional supplementation in those with neurological impairment. In our series, 58 children (76%) had a neurological abnormality, the commonest being cerebral palsy. In these children, gastrostomy significantly reduces feeding time, feed-related choking episodes and frequency of chest infections.^{7,8}

Complications following gastrostomy are common with rates ranging up to 70%,⁹ which compares favourably with our overall rate of 28%. Most complications with this procedure are fairly common and their management straightforward. In a study of 130 PEG procedures,¹⁰ a major complication rate of 17.5% was reported including eight cases of peritonitis, three of haemorrhage, three of intestinal obstruction, four gastrocolic fistulae and one death. This

contrast with our experience as we had no cases of peritonitis, haemorrhage or death related to the procedure and no need to change to a surgical gastrostomy. Other paediatric series have similarly emphasised the significant risks involved with this procedure.^{11,12}

Gastrocolic fistula is an interesting complication; in our study, it occurred twice in the same child diagnosed 14 months and 17 months after PEG insertions at different sites. A similar delay in presentation has been reported^{13,14} and is postulated to be due to progressive loosening of the tube between the internal and external buttresses allowing the fistula tract to open. Our patient had previous abdominal surgery and kyphoscoliosis, both of which are considered risk factors for this problem.¹⁵

The exact incidence of 'buried bumper' syndrome is unknown and is not specific to any particular type of PEG tube.¹⁶ Buried bumpers have been implicated in the development of serious complications including gastrointestinal bleeding, perforation, peritonitis and death.¹⁷ Traditionally, the bumper is removed by open operation but different techniques (laparoscopic¹⁸, endoscopic¹⁹ and radiological²⁰ methods) have been described. In one case, the retained bumper resulted in an abscess in the abdominal wall and was removed surgically. In another patient, the bumper was successfully snared through the remaining pinhole in the gastric mucosa. Subsequently, tubes with buried bumpers have been removed successfully by passing a guide-wire through the gastrostomy tube into the stomach, snaring it endoscopically and pulling while holding the tube firmly on the wire. We found a significant reduction with this problem by routinely changing PEG tubes every 2 years.

Gastro-oesophageal reflux occurs in up to 70–75% of children with cerebral palsy. Whether antireflux surgery should be routinely performed at the time of gastrostomy is debatable. Some argue that these children should be screened for occult GORD as this will determine the need for fundoplication.²¹ Gastrostomy has been implicated in causation or exacerbation of gastro-oesophageal reflux.^{21–23}

Gastrocutaneous fistula resulting from the removal of the PEG tube usually takes 1–2 days to close spontaneously. Tubes inserted percutaneously (PEG) are less likely to develop fistula than those performed surgically.²⁴ Surgical closure should be considered when a fistula has not closed spontaneously 1 month after removal of the gastrostomy tube.²⁵

Infection around the PEG tube may be as minor as cellulitis or serious as necrotising fasciitis.⁴ It can be difficult to differentiate between true infection and erythema or granuloma around the stomal site. Our peritubal infection rate is likely to be lower than the actual infection rate as minor infection would be expected to be treated in the community. We have changed to routine antibiotic prophylaxis for the procedure though there are advocates for²⁶ and against.²⁷

Infection or persistent purulent discharge alone was not an indication for change of tube.

The majority of paediatric PEG procedures are performed in specialist paediatric units, which have long waiting lists and involve considerable travelling for families for the initial procedure and for tube changes. Most hospitals in the UK have a nutrition service with support for paediatric patients and a recent ASGBI survey²⁸ has shown that 66% of district general hospitals in England and Wales provide general paediatric surgery. Therefore, it should be feasible for the majority of these hospitals to provide local access and increased availability of PEG feeding for children.

Conclusions

This study shows that percutaneous endoscopic gastrostomy can be safely performed in children in a district general hospital. The multidisciplinary team provides a key role in the careful selection of patients, early recognition and management of complications, parent training and continuing support. Paediatric PEG procedures should be made available in similar hospitals across the UK.

References

1. Gauderer MW, Ponsky JL, Izant RJ. Gastrostomy without laparotomy: a percutaneous endoscopic technique. *J Pediatr Surg* 1980; **15**: 872–5.
2. *Annual BANS Report: Trends in Artificial Nutrition Support in the UK 2000–2003*. BAPEN 2005, ISBN 1 899467 95 5.
3. Fox VL, Abel SD, Malas S, Duggan C, Leichtner AM. Complications following percutaneous endoscopic gastrostomy and subsequent catheter replacement in children and young adults. *Gastrointest Endosc* 1997; **45**: 64–71.
4. Ljungdahl M, Sundborn M. Complication rate lower after percutaneous endoscopic gastrostomy than after surgical gastrostomy: a prospective, randomized trial. *Surg Endosc* 2006; **20**: 1248–51.
5. Hamidon BB, Abdullah SA, Zawawi MF, Sukumar N, Aminuddin A, Raymond AA. A prospective comparison of percutaneous endoscopic gastrostomy and nasogastric tube feeding in patients with acute dysphagic stroke. *Med J Malaysia* 2006; **61**: 59–66.
6. Rollins H. *The practice of home enteral tube feeding in Bedfordshire and Cambridgeshire*. MSc Professional Practice, University of Luton, 1997.
7. Schwarz SM, Corredor J, Fisher-Medina J, Cohen J, Rabinowitz S. Diagnosis and treatment of feeding disorders in children with developmental disabilities. *Pediatrics* 2001; **108**: 671–6.
8. Brant CQ, Stanich P, Ferrari Jr AP. Improvement of children's nutritional status after enteral feeding by PEG: an interim report. *Gastrointest Endosc* 1999; **50**: 183–8.
9. Meguid MM, Williams LF. The use of gastrostomy to correct malnutrition. *Surg Gynecol Obstet* 1979; **149**: 27–32.
10. Khattak IU, Kimber C, Kiely EM, Spitz L. Percutaneous endoscopic gastrostomy in pediatric practice: complications and outcome. *J Pediatr Surg* 1998; **33**: 67–72.
11. Kutiyawala MA, Hussain A, Johnstone JMS, Everson NW, Nour S. Gastrostomy complications in infants and children. *Ann R Coll Surg Engl* 1998;

- 80:240–3.
12. Segal D, Michaud L, Guimber D, Ganga-Zandzou PS, Turck D, Gottrand F. Late-onset complications of percutaneous endoscopic gastrostomy in children. *J Pediatr Gastroenterol Nutr* 2001; **33**: 495–500.
 13. Patwardhan N, McHugh K, Drake D, Spitz L. Gastroenteric fistula complicating percutaneous endoscopic gastrostomy. *J Pediatr Surg* 2004; **39**: 561–4.
 14. Fernandes ET, Hollabaugh R, Hixon SD, Whittington G. Late presentation of gastrocolic fistula after percutaneous gastrostomy. *Gastrointest Endosc* 1988; **34**: 368–9.
 15. Gauderer MW. Percutaneous endoscopic gastrostomy: a 10-year experience with 220 children. *J Pediatr Surg* 1991; **26**: 288–92.
 16. Klein S, Heare BR, Soloway RD. The 'buried bumper syndrome': a complication of percutaneous endoscopic gastrostomy. *Am J Gastroenterol* 1990; **85**: 448–51.
 17. Anagnostopoulos GK, Kostopoulos P, Arvanitidis DM. Buried bumper syndrome with a fatal outcome, presenting early as gastrointestinal bleeding after percutaneous endoscopic gastrostomy placement. *J Postgrad Med* 2003; **49**: 325–7.
 18. Boreham B, Ammori BJ. Laparoscopic percutaneous endoscopic gastrostomy removal in a patient with buried-bumper syndrome: a new approach. *Surg Laparosc Endosc Percutan Tech* 2002; **12**: 356–8.
 19. Leung E, Chung L, Hamouda A, Nassar AH. A new endoscopic technique for the buried bumper syndrome. *Surg Endosc* 2007; **21**: 1671–3.
 20. Braden B, Brandstaetter M, Caspary WF, Seifert H. Buried bumper syndrome: treatment guided by catheter probe US. *Gastrointest Endosc* 2003; **57**: 747–51.
 21. Goldaini HA, Fernandes MI, Vincente YA, Dantas RO. Lower esophageal sphincter reacts against intraabdominal pressure in children with symptoms of gastroesophageal reflux. *Dig Dis Sci* 2002; **47**: 2544–8.
 22. Papaila JG, Vane DW, Colville C, Berend M, Mallik G, Canal D, Grosfeld JL. The effect of various types of gastrostomy on the lower esophageal sphincter. *J Pediatr Surg* 1987; **22**: 1198–202.
 23. Heine RG, Reddihough DS, Catto-Smith AG. Gastro-oesophageal reflux and feeding problems after gastrostomy in children with severe neurological impairment. *Dev Med Child Neurol* 1995; **37**: 320–9.
 24. Gordon JM, Langer JC. Gastrocutaneous fistula in children after removal of gastrostomy tube: incidence and predictive factors. *J Pediatr Surg* 1999; **34**: 1345–6.
 25. El-Rifai N, Michaud L, Mention K, Guimber D, Caldari D, Turck D *et al*. Persistence of gastrocutaneous fistula after removal of gastrostomy tubes in children: prevalence and associated factors. *Endoscopy* 2004; **36**: 700–4.
 26. Gossner L, Keymling J, Hahn EG, Ell C. Antibiotic prophylaxis in percutaneous endoscopic gastrostomy: a prospective randomised clinical trial. *Endoscopy* 1999; **31**: 119–24.
 27. Jonas SK, Neimark S, Panwalker AP. Effect of antibiotic prophylaxis in percutaneous endoscopic gastrostomy. *Am J Gastroenterol* 1985; **80**: 438–41.
 28. Pye JK. Survey of general paediatric surgery provision in England, Wales and Northern Ireland. *Ann R Coll Surg Engl* 2008; **90**: 193–7.

New online only case reports

You can access the case reports by using your College-issued Athens username and password to enter the members' area of the College website (<www.rcseng.ac.uk/members/annals/>) and following the link to the Annals.

Alternatively, if you type the following URL into the address bar of your web browser <<http://dx.doi.org/>> and then enter the DOI in the dialogue box presented on this web page, you will be taken directly to the abstract of the article.

Case report:	Duodenal polypectomy is a rare cause of acute pancreatitis
H KWAK, B DARMAS, M NUTT	doi 10.1308/147870809X401029
Case report:	Thoracic disc prolapse presenting with abdominal pain: case report and review of the literature
NIKOLAOS PAPADAKOS, HUSAM GEORGES, NAOMI SIBTAIN, CHRISTOS M TOLIAS	doi 10.1308/147870809X401038
Case report:	A case of obscure gastrointestinal bleeding in a teenager
N ABBASSI-GHADI, K BARTLAM, S RASHEED, T HOLME	doi 10.1308/147870809X450557
Case report:	Breast gangrene in an HIV-positive patient
V VENKATRAMANI, S PILLAI, S MARATHE, SA REGE, JV HARDIKAR	doi 10.1308/147870809X401056
Case report:	Attraction problems following magnet ingestion
ATIF SAEED, NAVROOP S JOHAL, ADIL ASLAM, JEFFREY BRAIN, RAY J FITZGERALD	doi 10.1308/147870809X450566